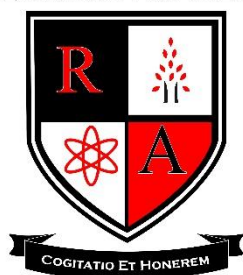




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GRADE 12

PHYSICAL SCIENCES PAPER 1

BY NAEEM MOHAMED

NAME: _____



GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION

2014

10841
PHYSICAL SCIENCES
FIRST PAPER

MARKS: 150

TIME: 3 hours

PHYSICAL SCIENCES: Page 1
1084E



10841E

X10



3

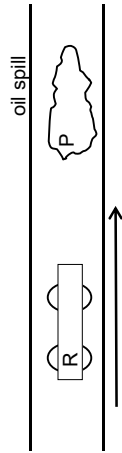
P.T.O.

PHYSICAL SCIENCES (First Paper)	10841/14	3
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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

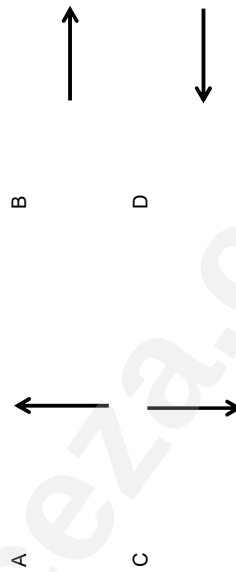
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

- 1.1 The following diagram shows a racing car R driving along a straight line to the right.



The driver of the racing car applies the brakes when the car reaches the oil spill at position P.

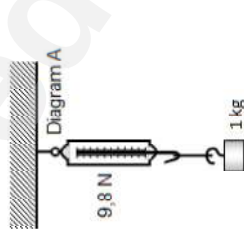
In which of the following directions will the racing car R slide?



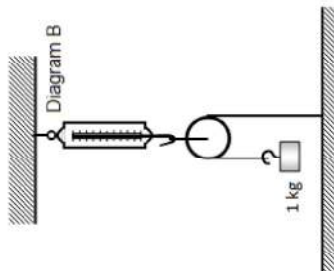
(2)

P.T.O.

- 1.2 Diagram A shows a 1 kg mass suspended by a Newton scale attached to the ceiling.



In diagram B, the same 1 kg mass is now suspended from a weightless, frictionless pulley by tying the rope to the floor.



If the reading on the scale in diagram A is 9,8 N, what will the scale read in diagram B?

- A 4,9 N
- B 9,8 N
- C 14,7 N
- D 19,6 N

(2)

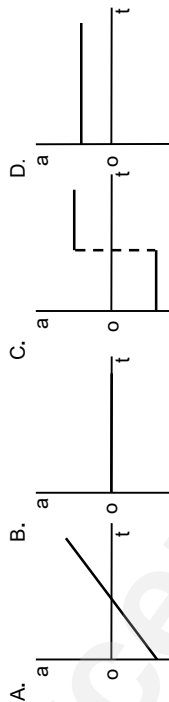
P.T.O.

- 1.3 The gravitational force between two objects is F when their centres are a distance d apart. What would the magnitude of the force be in terms of F if the mass of one object is doubled and the distance d halved?

- A $8F$
- B F
- C $\frac{1}{2}F$
- D $\frac{1}{4}F$

(2)

- 1.4 An object has a momentum p for a time of t seconds. Which ONE of the following graphs correctly shows the acceleration-time relationship for this time interval?



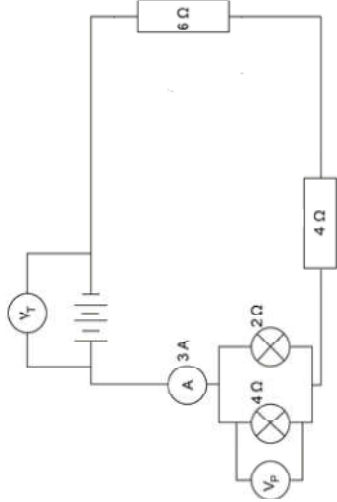
- 1.5 Which ONE of the following statements regarding the redshift of light as a result of the Doppler effect is true?

- A If a source of blue light is moving away from the observer, the light will appear violet
- B If a source of red light is moving away from the observer, the light will appear blue
- C If a source of blue light is moving away from the observer, the light will appear more green
- D If a source of red light is moving away from the observer, the light will appear more orange

(2)

P.T.O.

1.8 The circuit diagram shows two light bulbs of resistance $4\ \Omega$ and $2\ \Omega$ each connected in parallel to the circuit. The two resistors of resistance $4\ \Omega$ and $6\ \Omega$ each are connected in series to the circuit.

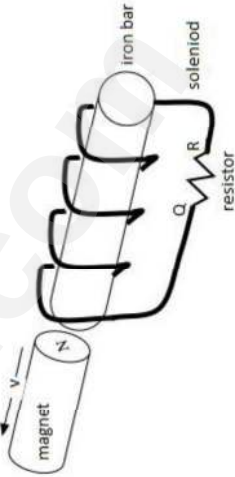


If the $2\ \Omega$ light bulb burns out what happens to the reading on V_P ?

- A Stays the same
- B Decreases
- C Increases
- D Becomes zero

(2)

1.9 The magnet in the following diagram is moving away from the solenoid. The induced current flows through the resistor in a direction from ...



- A Q to R
- B R to Q
- C Q to R and then from R to Q
- D R to Q and then from Q to R

(2)

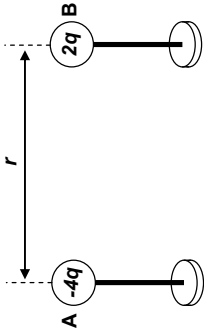
P.T.O.

1.6 Which ONE of the following combinations is correct regarding the properties of electric field lines?

Direction	Strength of field
A Positive to negative	Strongest where the lines are the most dense
B Negative to positive	Weakest where the lines are the least dense
C North to south	Strongest where the lines are the most dense
D North to south	Weakest where the lines are the least dense

(2)

1.7 Two charged spheres, A and B, are placed on insulated stands a distance r apart, as shown below. The magnitude of the electrostatic force between them is F .



The spheres are allowed to touch each other and are then moved back to their original positions. The magnitude of the electrostatic force in terms of F will now be ...

- A $8F$
- B F
- C $\frac{1}{2}F$
- D $\frac{1}{8}F$

(2)

P.T.O.

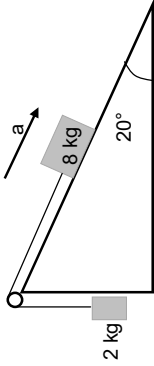
1.10 An excited electron is in energy level 3. The maximum possible emission spectrum lines that this electron can generate is ...

- A 1
- B 2
- C 3
- D 4

(2)
[20]

QUESTION 2 (Start on a new page.)

An 8 kg wooden block is attached to a 2 kg wooden block by means of a weightless inelastic string which passes over a frictionless pulley. The block accelerates down a rough plane inclined at 20° to the horizontal as shown below.

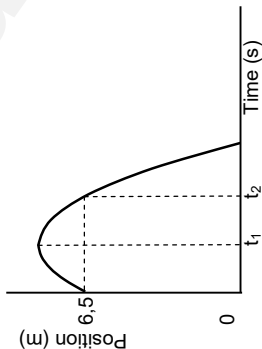


The tension in the string is 21 N.

- 2.1 Define *acceleration*. (2)
 - 2.2 Draw a labelled force diagram of all the forces acting on the 8 kg block. (3)
 - 2.3 Prove using a calculation that the magnitude of the acceleration of the system is $0,7 \text{ m}\cdot\text{s}^{-2}$. (3)
 - 2.4 Calculate the magnitude of the frictional force experienced by the 8 kg block. (4)
- [12]**

QUESTION 3 (Start on a new page.)

The position-time graph for a tennis ball thrown vertically upwards from the second floor of a school building is shown below. Ignore all effects of air friction.



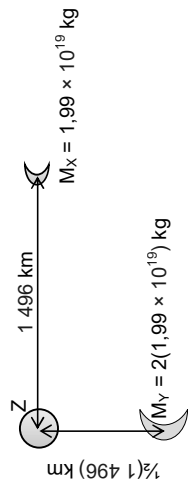
The height of the second floor is 6,5 m. The ball rises 0,9 m from the point of projection before it starts to fall to the ground.

- 3.1 Write down the magnitude and direction of the acceleration of the ball while it is moving upwards. (2)
- 3.2 Calculate the time t_1 it takes the ball to reach its maximum height. (4)
- 3.3 Calculate the initial velocity of the tennis ball the instant it is released. (4)
- 3.4 Sketch a velocity-time graph for the motion of the ball from the moment it is thrown vertically upwards till it reaches the ground. Label the axes and show all the relevant values on the graph. (4) [14]

P.T.O.

QUESTION 4 (Start on a new page.)

The diagram below shows a planet Z and its two moons X and Y at right angles to each other. The average distance between the centre of the planet and moon X is 1 496 km and the average distance between the centre of the planet and moon Y is $\frac{1}{2}(1\,496)$ km.



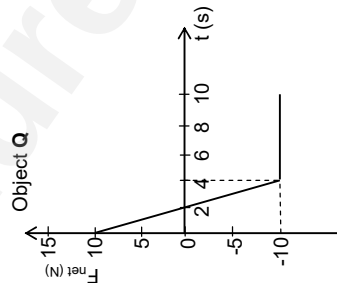
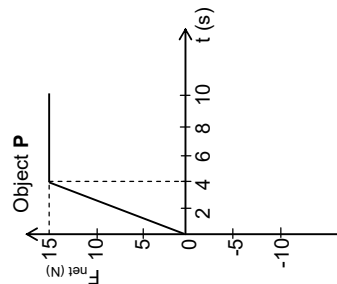
Take the mass of X as $1,99 \times 10^{19}$ kg, the mass of the planet Z as $5,98 \times 10^{24}$ kg and the mass of Y as twice the mass of X.

- 4.1 Calculate the gravitational force between moon X and planet Z. (4)
- 4.2 Write down the magnitude of the gravitational force that moon Y exerts on the planet Z. (2)
- 4.3 Calculate the magnitude of the net gravitational force of the two moons on the planet. (2) [8]

P.T.O.

QUESTION 5 (Start on a new page.)

Two identical objects **P** and **Q** with a mass of 12 kg each, are moving side by side with an initial velocity of $5,5 \text{ m}\cdot\text{s}^{-1}$ east on a horizontal surface. The following graphs show the net force experienced by each object respectively during the same time interval.

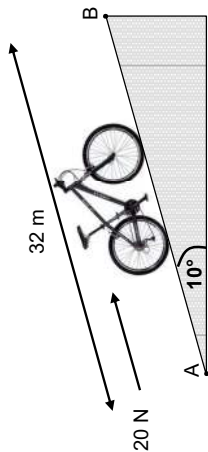


- 5.1 Calculate the total impulse experienced by object **Q** in 10 s. (3)
 - 5.2 Compare without using any calculations the total impulse for object **P** with that of object **Q**. Write down only GREATER THAN, LESS THAN or EQUAL TO. (1)
 - 5.3 Calculate the final velocity of object **Q**. (4)
- [8]

P.T.O.

QUESTION 6 (Start on a new page.)

A cyclist pushes his bicycle of mass $6,1 \text{ kg}$ up an incline with a force of 20 N . The bicycle is pushed from an initial velocity of $5 \text{ m}\cdot\text{s}^{-1}$ from point A to point B. The road is inclined at 10° to the horizontal and the distance from A to B is 32 m as shown below.



The road surface exerts a force of friction of 11 N on the bicycle tyres.

- 6.1 Calculate the work done by the cyclist on the bicycle. (3)
 - 6.2 Use the work-energy theorem and calculate the magnitude of the velocity of the bicycle at 32 m . (5)
 - 6.3 Explain why frictional forces are regarded as non-conservative forces. (2)
- [10]

P.T.O.

QUESTION 7 (Start on a new page.)

- 7.1 Keenan standing at the top of the Leaning Tower of Pisa accidentally drops his cell phone when it starts ringing at a frequency of 497×10^3 Hz. The height of the tower is 56 m.



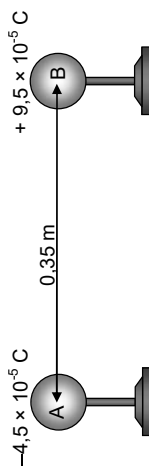
- 7.1.1 Calculate the speed of the cell phone at a height of 18 m by using the law of conservation of mechanical energy. (4)
- Nerisse standing at the bottom of the tower hears the phone ringing as it falls towards her. Ignore the effects of air friction.
- 7.1.2 Calculate the frequency of the sound observed by Nerisse when the phone is at the height of 18 m above ground. Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$. (4)
- 7.1.3 Explain in terms of wavelength and frequency of sound why Keenan who is at the top of the tower, observes a lower frequency of sound than the value calculated in QUESTION 7.1.2. (3)
- 7.1.4 How will the frequency of sound observed by Nerisse compare at a height of 18 m to that at 3 m? Write only HIGHER, LOWER or STAYS THE SAME. (1)
- 7.2 Speed cameras determine the speed of a car by measuring the signal of a radio wave reflected by the car.
- 7.2.1 Explain why the speed camera cannot measure the speed of the car accurately at the moment the car passes the camera. (1)
- 7.2.2 What is the speed of the radio wave in air? Give a reason for your answer. (2)

[15]

P.T.O.

QUESTION 8 (Start on a new page.)

The diagram below shows two spheres, A of charge $-4,5 \times 10^{-5} \text{ C}$ and B of charge $+9,5 \times 10^{-5} \text{ C}$ on insulated stands. The distance between the centres of the two spheres is 0,35 m.



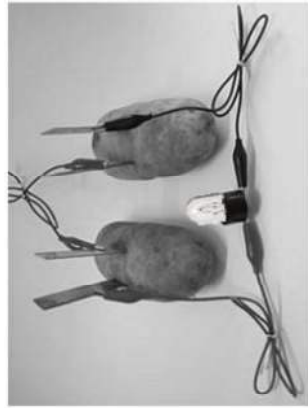
- 8.1 Draw the field pattern diagram for the net electric field present between the two charges. (3)
- 8.2 Calculate the magnitude and direction of the electrostatic force exerted by sphere B on sphere A. (4)
- 8.3 Calculate the strength of the electric field at B as a result of charge A. (4)

[11]

QUESTION 9 (Start on a new page.)

Sandle and Peter built a battery for the science fair. They used potatoes for the cells with zinc and copper plates as electrodes. Sandle and Peter were curious to find out how many potato cells connected in series would be needed to make a penlight bulb glow.

- 9.1 Write a suitable hypothesis for the investigation. (2)
- 9.2 Write down the dependent variable for the investigation. (1)



http://www.sciencebuddies.org/science-fair-projects/project_ideas/Energy_p010.shtml#procedure

Sandle and Peter started with two potatoes connected in series as shown in the picture above. They used a voltmeter directly over the outer electrodes and measured a potential difference of 1,6 V.

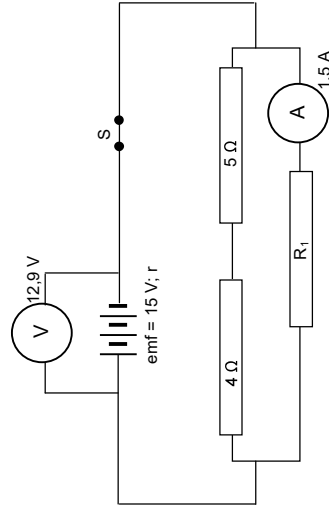
Next they connected a 1,5 V penlight bulb between the electrodes. The learners found that the bulb did not glow. When they measured the potential difference across the globe it was 0,02V.

- 9.3 What is the emf of the battery with two potato cells connected in series? (1)
- 9.4 Give a reason why the potential difference across the bulb was only 0,02V. (1)
- 9.5 The bulb has a resistance of 2 Ω. Calculate the power dissipated by the bulb even though it is not visibly glowing. (3) [8]

P.T.O.

QUESTION 10 (Start on a new page.)

The circuit diagram below shows two resistors of resistance 4 Ω and 5 Ω each connected in parallel to resistor R_1 of unknown resistance. The battery has an emf of 15 V and an unknown internal resistance.



- 10.1 State Ohm's law in words. (2)

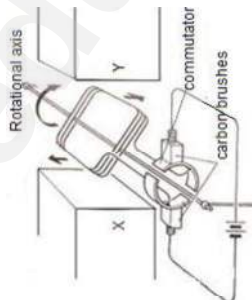
When switch S is closed, the ammeter has a reading of 1,5 A and the voltmeter has a reading of 12,9 V.

- 10.2 Calculate the resistance of resistor R_1 . (3)
- 10.3 Calculate the equivalent resistance of the parallel circuit. (3)
- 10.4 Calculate the internal resistance of the battery. (4) [12]

P.T.O.

QUESTION 11 (Start on a new page.)

- 11.1 Study the diagram of an electric **motor** given below. The coil rotates between the opposite poles X and Y of two magnets.



- 11.1.1 Is this a DC or an AC motor? Give a reason for your answer. (2)
- 11.1.2 State TWO changes that can be made to this motor to increase the rate of rotation. (2)
- 11.1.3 What is the polarity of the two magnetic poles X and Y? (2)

- 11.2 **Generators** need a source of mechanical energy to turn the coil inside a magnetic field. The picture below shows an example of a wind generator.



A wind generator has rotor blades that are 100 m in diameter. When the wind blows at maximum speed, the generator produces a maximum AC-current of 80 A in a resistor of 510 Ω .

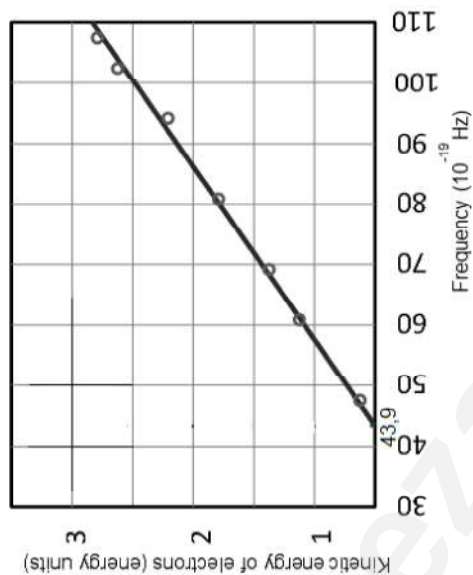
- 11.2.1 Calculate the rms potential difference across the resistor. (5)
- 11.2.2 Calculate the average power produced by the generator. (3)
- 11.2.3 Draw a sketch graph of the change in current generated by this AC-generator. Show TWO full cycles for the change in current on the graph. Indicate the appropriate values of the current on the axis. (4)

[18]

P.T.O.

QUESTION 12 (Start on a new page.)

- 12.1 The graph below shows the relation between the maximum kinetic energy for electrons emitted from the surface of a certain metal when it is illuminated with electromagnetic radiation of different frequencies.



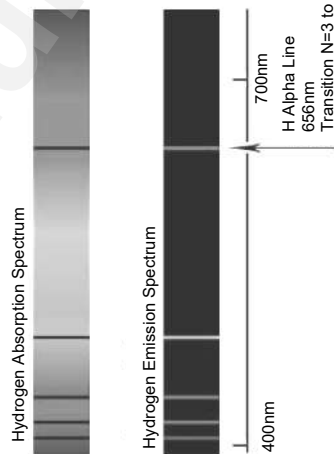
- 12.1.1 Define the work function for a specific metal. (2)
- 12.1.2 Give the magnitude of the threshold frequency of the metal as shown on the graph. (2)
- 12.1.3 Calculate the maximum velocity of an emitted electron if electromagnetic radiation with a frequency of 100×10^{15} Hz is shone onto the metal surface. (5)
- 12.1.4 The graph is described as "the best fit line". Explain what this means. (1)

P.T.O.

PHYSICAL SCIENCES (First Paper)	10841/14	20
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- 12.2 The following diagram shows different lines of the line emission spectra (coloured lines on a black background) and the absorption spectrum (black lines on a coloured background) of the hydrogen atom respectively. The lines correspond to the transition of electrons between specific energy levels.



- 12.2.1 Explain the difference between an *emission spectrum* and an *absorption spectrum*. (2)
- 12.2.2 What is the most likely colour for the H-Alpha line? Choose from RED, GREEN or VIOLET. Give a reason for your answer. (2) [14]

GRAND TOTAL: 150

**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2015**

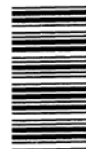
**10841
PHYSICAL SCIENCES: PHYSICS
FIRST PAPER**

**MARKS: 150
TIME: 3 hours
18 pages and
3 data sheets**

PHYSICAL SCIENCES: Paper 1
10841E



X10



QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

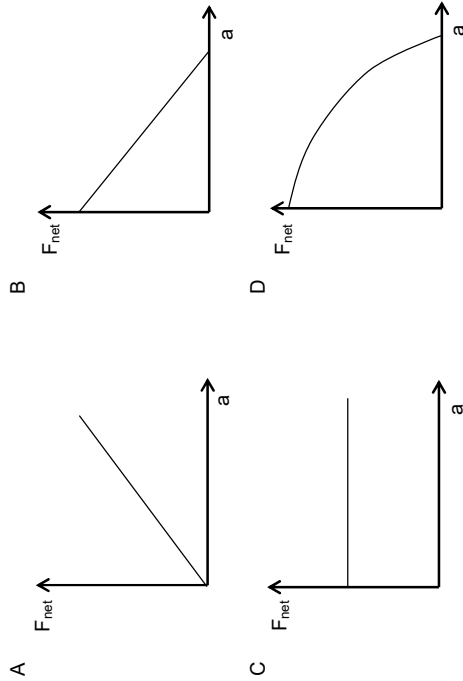
1.1 An object is free falling towards the surface of the earth.

Which ONE of the following best describes the direction of **acceleration** of the object?

- A The acceleration is $9,8 \text{ m} \cdot \text{s}^{-2}$ downward.
- B The acceleration is $9,8 \text{ m} \cdot \text{s}^{-2}$ upward.
- C The acceleration is less than $9,8 \text{ m} \cdot \text{s}^{-2}$ downward.
- D The acceleration is less than $9,8 \text{ m} \cdot \text{s}^{-2}$ upward.

1.2 A 1 kg mass has a constant acceleration.

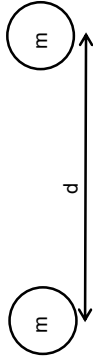
Which ONE of the following sketch graphs correctly shows the relationship between the net force, F_{net} and acceleration, a ?



(2)

P.T.O.

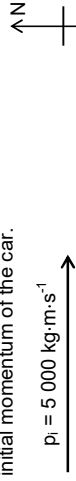
1.3 Two objects, each of mass m are placed a distance d apart as shown below. The gravitational force between them is F .



The magnitude of the force increases to $4F$ when the ...

- A distance between the objects decreased to $\frac{1}{4}d$.
- B distance between the objects decreased to $\frac{1}{2}d$.
- C mass of each object decreased to $\frac{1}{4}m$.
- D mass of each object increased to $4m$.

1.4 A car has an initial momentum of $5\,000 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ east. The vector below shows the initial momentum of the car.



This car is involved in a collision and the change in momentum of the car is represented below.



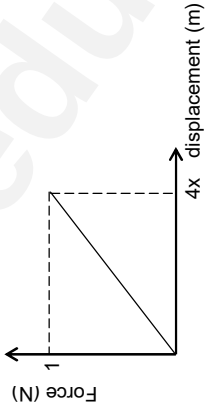
The vector representing the final momentum of the car **after** the collision is ...

- A $p_f = 3\,000 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ (vector pointing right)
- B $p_f = 3\,000 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ (vector pointing left)
- C $p_f = 8\,000 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ (vector pointing right)
- D $p_f = 8\,000 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ (vector pointing left)

(2)

P.T.O.

1.5 The graph below shows the relationship between the applied force (F) on an object and the displacement (x) of the object in the direction of the applied force.



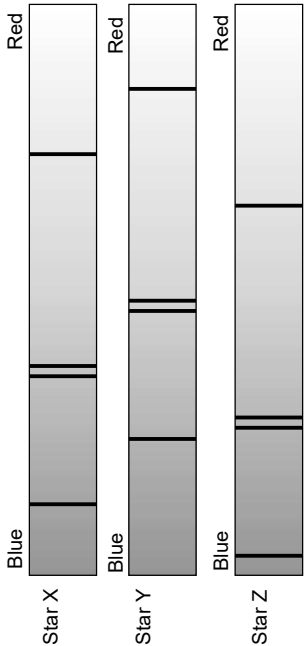
The average work in joules, done by the applied force for a displacement of $4x$ m is ...

- A $\frac{1}{2}x$
- B $2x$
- C $3x$
- D $4x$

(2)

P.T.O.

1.6 Study the following absorption spectra for three different stars as observed from earth.



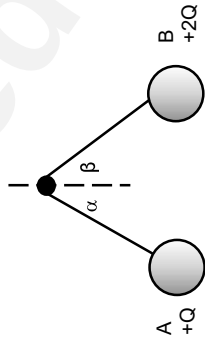
Which ONE of the following combinations correctly describes the speed of the stars relative to earth?

	Star moving away from earth at the greatest speed	Star moving towards earth at the greatest speed
A	Y	Z
B	Y	X
C	Z	Y
D	Z	X

(2)

P.T.O.

- 1.7 Sphere A, with a charge of $+Q$, and sphere B, with a charge of $+2Q$, are suspended from the same insulated point as shown in the diagram below. (The diagram is not drawn to scale.)



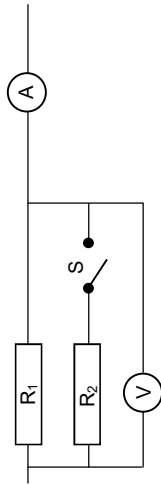
The spheres are allowed to move freely until they come to rest on their own. How will the values of the angles α and β compare to each other once the spheres come to rest?

- A $\alpha = \beta$
 B $\alpha < \beta$
 C $\alpha > \beta$
 D $\alpha = \beta = 0$

(2)

P.T.O.

- 1.8 The diagram below shows part of a circuit diagram. R_1 and R_2 are identical ohmic resistors connected in parallel. With the switch open, the ammeter reads 1 A and the voltmeter across the parallel section reads 3 V.



Switch S is closed. The reading on the ammeter and voltmeter will now be ...

	Reading on ammeter	Reading on voltmeter
A	greater than 1 A	greater than 3 V
B	less than 1 A	equal to 6 V
C	greater than 1 A	less than 3 V
D	equal to 1 A	equal to 3 V

(2)

- 1.9 Which ONE of the following phrases correctly explains how a generator works? It works ...

- A by converting electrical energy to mechanical energy.
 B by using the motor effect.
 C according to Lenz's law.
 D using electromagnetic induction.

(2)

- 1.10 When an excited electron moves from a higher energy level to a lower energy level a specific ...

- A emission line in an emission spectrum is observed.
 B absorption line in an emission spectrum is observed.
 C emission line in an absorption spectrum is observed.
 D absorption line in an absorption spectrum is observed.

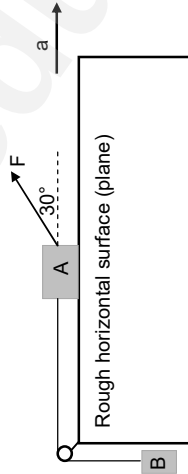
(2)
 [20]

P.T.O.

P.T.O.

QUESTION 2 (Start on a new page.)

Block A of mass 5 kg is attached to block B of unknown mass. The string joining the blocks is INELASTIC and WEIGHTLESS. The string passes over a frictionless pulley as shown below.



An applied force **F** with magnitude 15 N acts at an angle of 30° relative to the horizontal plane on block A. Block A accelerates at $2,2 \text{ m}\cdot\text{s}^{-2}$ to the right across the rough horizontal plane. The coefficient of kinetic friction between the surface of block A and the plane is 0,35.

- 1 Define Newton's Second Law in words. (2)
 - 2 Draw a labelled FREE BODY diagram of all the forces acting on block A. (5)
 - 3 Calculate the magnitude of the frictional force experienced by block A. (3)
 - 4 Calculate the mass of block B. (5)
- [15]**

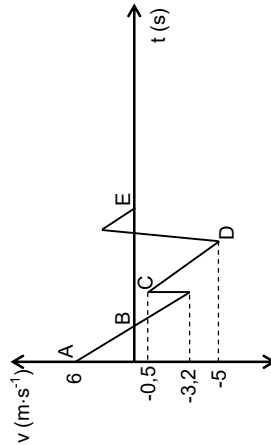
P.T.O.

QUESTION 3 (Start on a new page.)

The velocity-time sketch graph for a ball of mass 160 g, thrown vertically upwards with a velocity of $6 \text{ m}\cdot\text{s}^{-1}$ from a certain height above the ground, is shown below.

On the way down the ball crashes through a thin horizontal glass pane and then continues downward, eventually bouncing on the ground.

Ignore all effects of air friction and assume none of the broken pieces of glass sticks to the ball.



- 3.1 Write down the magnitude and direction of the acceleration of the ball when it reaches position B as indicated on the graph. (2)
 - 3.2 How many times did the ball bounce on the ground? (1)
 - 3.3 According to the graph, which direction, DOWNWARDS or UPWARDS is taken as the positive direction? (1)
 - 3.4 Calculate the distance between the pane of glass and the initial position from which the ball was thrown. (4)
 - 3.5 Draw a rough position-time graph for the motion of the ball. Show the points **A** to **E** on the graph. Do not show any displacement or time values on the graph. Take the initial position of the ball as zero. (5)
- [13]**

P.T.O.

QUESTION 4 (Start on a new page.)

Mars has an average radius of 3 390 km and a mass of $6,39 \times 10^{23}$ kg. Mars has two moons.

4.1 State Newton's Law of Universal Gravitation in words. (2)

4.2 If the gravitational force exerted by Mars on one of its moons with mass $1,08 \times 10^{16}$ kg, is $5,71 \times 10^{15}$ N, calculate the distance between the centre of this moon and the surface of Mars. (6) [8]

QUESTION 5 (Start on a new page.)

An ice-skater with a mass of 54 kg, is holding a box as part of her act. She skates with a velocity of $0,08 \text{ m}\cdot\text{s}^{-1}$ east. She throws the 1,5 kg box directly away from her with a velocity of $10,2 \text{ m}\cdot\text{s}^{-1}$ east.

5.1 State the principle of conservation of linear momentum. (2)

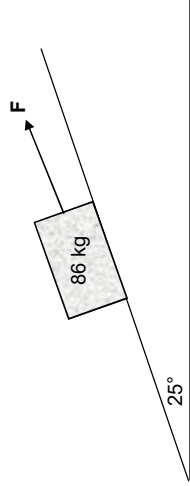
5.2 Calculate the ice-skater's velocity immediately after throwing the box away from her. (4)

5.3 Calculate the magnitude of the force exerted on the box by the ice-skater if she exerted this force for 1,2 s. (3) [9]

P.T.O.

QUESTION 6 (Start on a new page.)

A box of mass 86 kg is accelerating down a surface inclined at 25° to the horizontal.



A man applies a force **F** upwards parallel to the plane in an attempt to prevent the box from sliding down the inclined plane. In spite of the man's efforts the box is accelerating down the inclined plane.

6.1 What is a non-conservative force? (2)

6.2 The coefficient of kinetic friction (μ_k) between the box and the surface of the plane is 0,22. Prove that the magnitude of the kinetic frictional force is 168,04 N. (2)

6.3 State the work-energy theorem in words. (2)

6.4 Draw a labelled FREE BODY diagram of all the forces acting on the box. (4)

6.5 The box accelerates parallel down the inclined plane for a distance of 0,9 m at $1,54 \text{ m}\cdot\text{s}^{-2}$. Use the work-energy theorem and calculate the work done by the man on the box. (5) [15]

P.T.O.

QUESTION 7 (Start on a new page.)

While standing still near a railroad crossing, a girl hears a train horn in the distance. The horn emits a sound of frequency 430 Hz.

The speed of sound in air is taken as $335 \text{ m}\cdot\text{s}^{-1}$.

7.1 State the Doppler effect. (2)

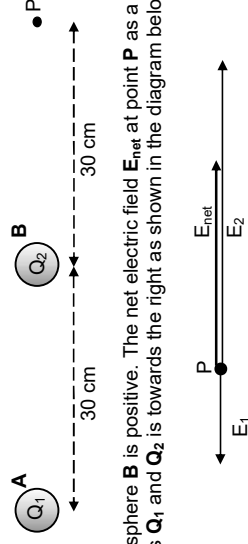
7.2 The train is moving with a constant velocity of $25 \text{ m}\cdot\text{s}^{-1}$ in a straight line towards the girl who is standing still at the crossing. Calculate the wavelength of the sound observed by the girl while the train is approaching her. (6)

7.3 Will the frequency of the sound observed by the train driver be HIGHER, LOWER or THE SAME as that emitted by the horn of the train? Give reasons for the answer. (3) [11]

QUESTION 8 (Start on a new page.)

Two identical conducting spheres **A** and **B** with charges of Q_1 and Q_2 respectively are placed in fixed positions along the same straight line as shown in the diagram below.

Spheres **A** and **B** are placed 30 cm from each other. Point **P** is positioned 30 cm to the right of sphere **B** on the same straight line.



The charge on sphere **B** is positive. The net electric field E_{net} at point **P** as a result of the two charges Q_1 and Q_2 is towards the right as shown in the diagram below.

8.1 What is the sign of the charge on sphere **A**? Give a reason for the answer. (3)

8.2 The net electric field at point **P** is $1\,600 \text{ N}\cdot\text{C}^{-1}$ to the right and the charge on sphere **B** has a magnitude of $+12 \text{ nC}$. Calculate the magnitude of the charge on sphere **A**. (7)

A proton is placed at point **P** without changing the charges and positions of spheres **A** and **B**.

8.3 Calculate the net electrostatic force experienced by the proton. (4) [15]

P.T.O.

P.T.O.

QUESTION 9 (Start on a new page.)

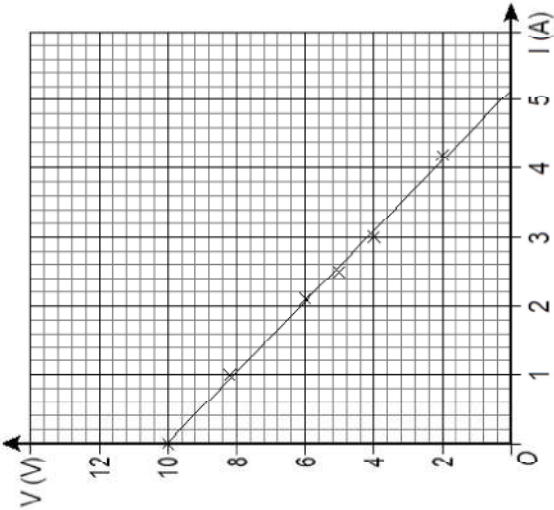
Learners investigate how a CHANGE IN THE TOTAL CURRENT of the circuit affects the INTERNAL RESISTANCE OF A CELL. Two groups of learners were given the following apparatus:

GROUP A	GROUP B
- A new AAA cell - Voltmeter - Ammeter - Rheostat - Switch - Connecting wires	- A new AAA cell with a higher internal resistance than for group A. - Voltmeter - Ammeter - Rheostat - Switch - Connecting wires

11 Write down the independent variable for the investigation. (1)

12 Refer to the apparatus provided to the learners and draw the appropriate circuit diagram required for the investigation. (3)

Group A use their readings to draw the following graph.

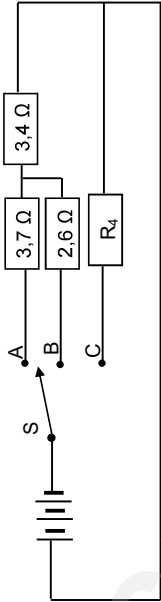


P.T.O.

- 9.3 Use the graph and determine the internal resistance of the AAA cell provided to group A. (3)
- 9.4 The AAA cell provided to group B has a higher internal resistance. How will the gradient of the graph drawn by group B compare to that of group A? Write only GREATER THAN, SMALLER THAN or THE SAME AS. (1) [8]

QUESTION 10 (Start on a new page.)

The diagram below shows the circuit for an electric blanket. It has three different resistance settings A, B and C to regulate the amount of HEAT generated by the blanket.



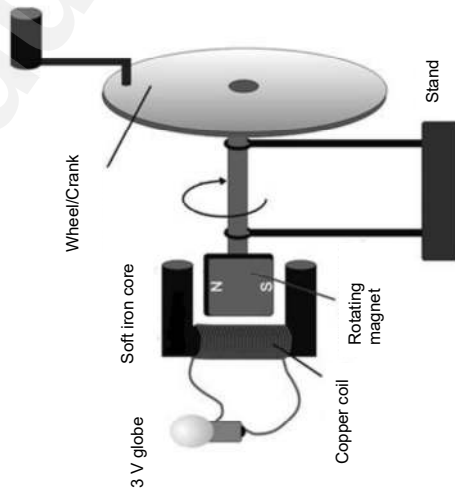
The electric blanket is connected to a battery with an emf of 20 V and an internal resistance of 1 Ω.

- 10.1 With the switch connected to position A, calculate the: (2)
- 10.1.1 Total resistance of the external circuit. (3)
- 10.1.2 Total current through the circuit. (3)
- 10.2 How does the total current change when the switch is connected to position B? Write INCREASES, DECREASES or STAYS THE SAME. Explain the answer. (3)
- 10.3 Calculate the power output of the electric blanket when the switch is connected to C given that the total current at this setting is 2,31 A. (4) [12]

P.T.O.

QUESTION 11 (Start on a new page.)

A learner built the following simple generator based on a dynamo used to power bicycle headlights. He used the generator to demonstrate that he could use mechanical energy to generate electrical energy.



- 11.1 Is this a DC or an AC generator? Give a reason for the answer. (3)
 - 11.2 How will the learner know that electrical energy is produced? (1)
 - 11.3 Explain how this generator is able to produce electrical current when there is no electrical connection between the rotating magnet and the copper coil. (3)
 - 11.4 List TWO changes that can be made to the generator to INCREASE the BRIGHTNESS of the globe. (2)
- A generator (dynamo) used to power a light on a bicycle needs an average power of 6 W and a potential difference of 12 V_{rms}.
- 11.5 Calculate the maximum current that can flow through the globe. (4)
- [13]**

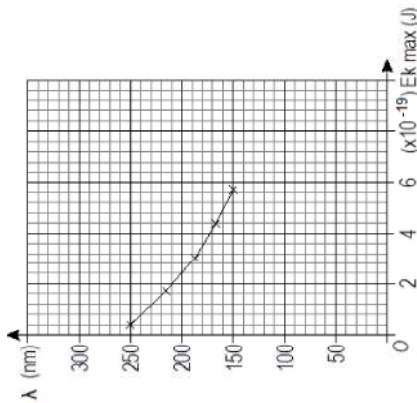
P.T.O.

QUESTION 12 (Start on a new page.)

During the investigation of a specific type of cathode of a photoelectric cell, radiation with different wavelengths were used and the following results were obtained.

The graph below was drawn using the results.

Wavelength (nm)	Maximum kinetic energy (J)
250	$0,401 \times 10^{-19}$
215	$1,73 \times 10^{-19}$
187	$3,04 \times 10^{-19}$
167	$4,37 \times 10^{-19}$
150	$5,70 \times 10^{-19}$



- 12.1 Define the **work function** for a specific metal. (2)
 - 12.2 What is the relationship between the wavelength of the radiation and the maximum kinetic energy of the photoelectron? Explain the answer. (4)
 - 12.3 How does an increase in the intensity of the radiation affect the maximum kinetic energy of the photoelectrons? Write only INCREASES, DECREASES or STAYS THE SAME. (1)
 - 12.4 The maximum wavelength for the radiation that is able to emit electrons from this cathode is 255 nm.
Calculate the maximum velocity of a photoelectron emitted if radiation with a wavelength of 160 nm is used. (5)
- [12]**
- TOTAL: 150**

P.T.O.



GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION

2016

10841

PHYSICAL SCIENCES: PHYSICS
FIRST PAPER

TIME: 3 hours

MARKS: 150

16 pages + 3 data sheets

PHYSICAL SCIENCES: Paper 1
10841E



10841E

X10



3

PHYSICAL SCIENCES: PHYSICS
(First Paper)

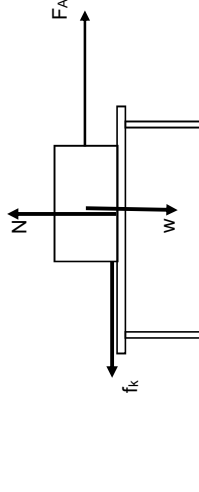
3

10841/16

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 C.

- 1.1 The diagram below shows a box being pulled by force F_A along a horizontal surface. The box slides towards the right at constant velocity.



Which ONE of the following statements about the forces acting on the box is correct?

- A N is greater than w.
- B w is greater than N.
- C F_A is greater than f_k .
- D F_A is equal to f_k .

(2)

- 1.2 The magnitude of the impulse on a ball bouncing off a wall is equal to the ...

- A net force of the ball on the wall.
- B product of the net force on the ball and the time it acts.
- C change in velocity of the ball.
- D product of the mass and the acceleration of the ball.

(2)

- 1.3 When a bus suddenly accelerates from rest, standing passengers tend to fall backwards. This observation is best explained using ...

- A Newton's first law of motion.
- B Newton's second law of motion.
- C Newton's third law of motion.
- D Newton's law of universal gravitation.

(2)

P.T.O.

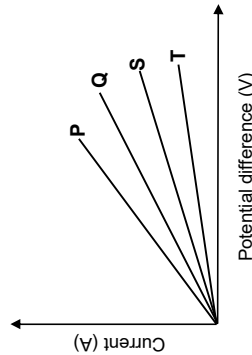
P.T.O.

1.4 Which ONE of the following will NOT increase the output current of a generator?

- A Increase the number of turns in the coil.
- B Wind the armature coil around an aluminium core.
- C Increase the speed of rotation of the armature coil.
- D Increase the strength of the magnet.

(2)

The current versus potential difference graphs below were obtained for four resistors **P, Q, S** and **T**.



The resistor with the second largest resistance is:

- A **P**
- B **Q**
- C **S**
- D **T**

(2)

A metallic surface emits photoelectrons when irradiated with green light.

When the green light is replaced by ultraviolet light, the kinetic energy (E_k) of the emitted photoelectrons will ...

- A increase.
- B decrease.
- C drop to zero.
- D remain the same.

(2)

P.T.O.

1.7 Two objects attract each other with a force of magnitude **F** when they are a distance **r** apart.

If each mass is **TRIPLED** (3 times larger), the new gravitational force that the one object exerts on the other will be:

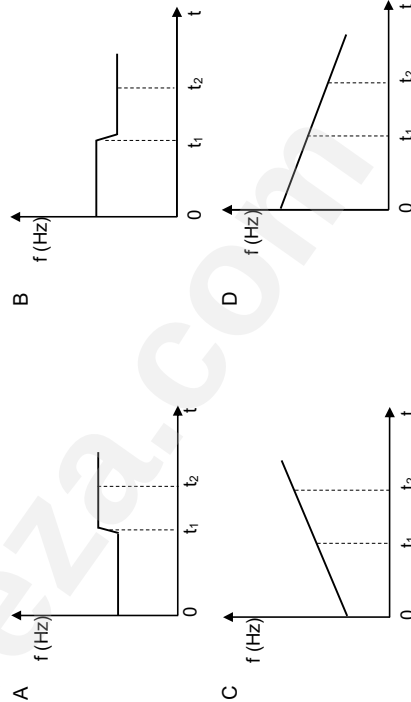
- A **9F**
- B **18F**
- C **24F**
- D **36F**

(2)

1.8 A car sounds its horn whilst travelling at constant velocity along a straight road. At time $t = 0$ the car is at position **X** as shown below. At time $t = t_1$ the car moves past a stationary listener **L**. At time $t = t_2$ the car is at position **Y**.



Which ONE of the following graphs best represents the variation of the frequency (pitch) of the horn with time as heard by the listener?



(2)

P.T.O.

- 1.9 Point **P** is situated a distance r from point charge q as shown below. The electric field at point **P** due to point charge q is found to be E .

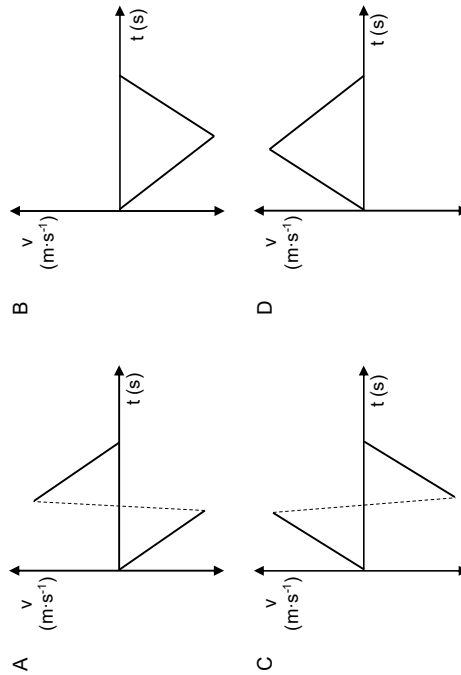


The electric field at point **Q** which is on a distance $\frac{1}{3}r$ from point charge q will be:

- A $\frac{1}{9}E$
 B $\frac{1}{3}E$
 C $3E$
 D $9E$

(2)

A ball is dropped to the ground from a certain height and bounces back to the same height. Which ONE of the following velocity versus time graphs represents the motion of the ball if downwards is taken as positive.

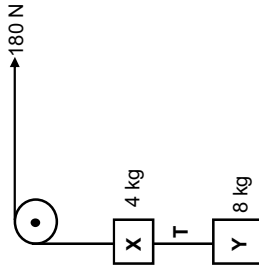


(2)
[20]

P.T.O.

QUESTION 2 (Start on a new page.)

Block **X** of mass 4 kg is connected to block **Y** of mass 8 kg by a light, inextensible string. Another light, inextensible string attached to block **X** runs over a frictionless pulley. The system is pulled by means of a constant force of 180 N as shown in the diagram below. Ignore the effects of air resistance.

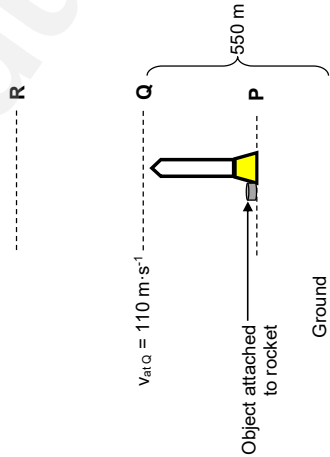


- 2.1 State Newton's second law of motion in words. (2)
 2.2 Draw a labelled free body diagram showing ALL the forces acting on object **X**. (3)
 2.3 Calculate the:
 2.3.1 tension **T** in the string connecting the two blocks. (4)
 2.3.2 magnitude of the acceleration of block **X**. (2)
 [11]

P.T.O.

QUESTION 3 (Start on a new page.)

A stationary rocket on the ground is launched vertically upwards. When it is 550 m above the ground (point **Q**), an object is released from the rocket. At this instant the velocity of the rocket is $110 \text{ m}\cdot\text{s}^{-1}$. The object reaches its **MAXIMUM** height **ABOVE** ground at point **R**. Ignore the effects of air friction.



- 3.1 Give a reason why the object keeps moving upwards after it is released from the rocket. (1)
- 3.2 What is the direction of the acceleration of the object at:
 - 3.2.1 Point **P**? (1)
 - 3.2.2 Point **R**? (1)
- 3.3 **ONLY** use **EQUATIONS OF MOTION** to calculate the time taken by the **OBJECT** to ...
 - 3.3.1 reach its maximum height after being released from the rocket at point **Q** (3)
 - 3.3.2 reach the ground after being released from the rocket at point **Q** (4)
- 3.4 Sketch the velocity versus time graph for the complete motion of the object. On the graph indicate the following:
 - Initial velocity
 - Time to reach its maximum height
 - Time when it reaches the ground

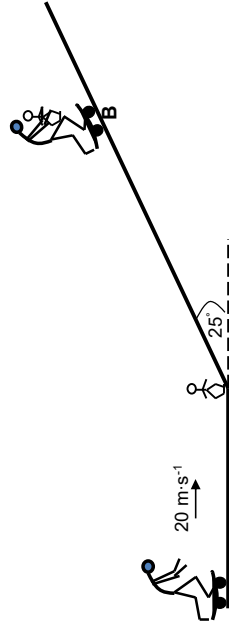
(4)
[14]

P.T.O.

QUESTION 4 (Start on a new page.)

A roller-skater approaches an inclined plane at a constant velocity of $20 \text{ m}\cdot\text{s}^{-1}$ as shown below. Just before reaching the incline, he picks up a boy standing in his way and then continues up the incline and reaches point **B**.

The total mass of the roller skater is 68 kg and that of the boy is 12 kg.



- 4.1 State the *principle of conservation of linear momentum*. (2)
- 4.2 Calculate the magnitude of the combined velocity of the roller-skater and the boy just after the boy is picked up. (4)
- 4.3 Use energy principles to calculate the distance that they will move up the incline before coming to a stop at point **B**. Ignore the effects of friction. (5)
- 4.4 How will the distance in the answer to Question 4.3 be affected if friction between the wheels of the roller-skate and the surface is **NOT** ignored?
Choose from **INCREASES**, **DECREASES** or **REMAINS THE SAME**. Give a reason for the answer. (2)
[13]

P.T.O.

QUESTION 5 (Start on a new page.)

A car of mass 700 kg moves up a rough inclined plane of 30° as shown in the diagram below.



- 5.1 What is the net work done on the car if the car moves up the inclined plane at CONSTANT velocity? (1)
 - 5.2 Draw a labelled free body diagram showing all the forces acting on the car as it moves up the inclined plane. (4)
 - 5.3 The car now starts from rest at the base of the slope and accelerates up the inclined plane. The car's engine exerts a force of 6 000 N and the coefficient of kinetic friction between the wheels of the car and surface is 0,32. (2)
 - 5.3.1 State the *work-energy theorem* in words. (2)
 - 5.3.2 Use energy principles to calculate the magnitude of the velocity of the car after moving a distance of 70 m up the incline. (8)
- [15]

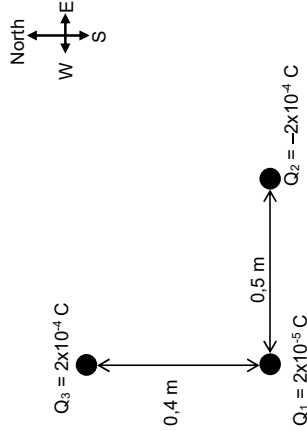
QUESTION 6 (Start on a new page.)

- 6.1 A flying bat emits sound waves at a frequency of 75 Hz. A stationary observer detects the frequency of the sound waves emitted as 73 Hz. The speed of sound in air is $340 \text{ m}\cdot\text{s}^{-1}$. (2)
- 6.1.1 State the *Doppler Effect* in words. (1)
- 6.1.2 Is the bat flying TOWARDS or AWAY from the observer? (4)
- 6.1.3 Calculate the speed at which the bat is flying. (4)
- 6.2 Briefly explain the observations that enable scientists to tell that the universe is expanding. (2)
- 6.3 State TWO applications of the Doppler Effect in medicine. [13]

P.T.O.

QUESTION 7 (Start on a new page.)

Three charges Q_1 , Q_2 and Q_3 carrying charges of $+2 \times 10^{-5} \text{ C}$, $-2 \times 10^{-4} \text{ C}$ and $+2 \times 10^{-4} \text{ C}$ respectively are positioned as shown in the diagram below.

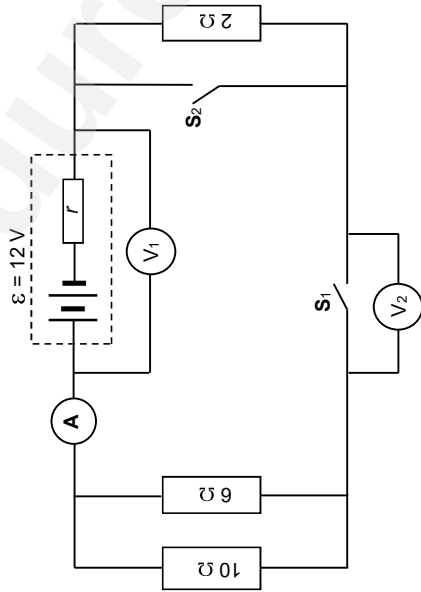


- 7.1 State *Coulomb's Law* in words. (2)
 - 7.2 Draw a diagram that shows the electrostatic forces exerted on Q_1 by Q_2 and Q_3 . (2)
 - 7.3 Calculate the net electrostatic force exerted on Q_1 by Q_2 and Q_3 . (7)
- [11]

P.T.O.

QUESTION 8 (Start on a new page.)

The battery in the circuit represented below has an emf of 12 V and an internal resistance r . Voltmeter V_1 is connected across the battery. The resistance of the connecting wires is negligible.



Switches S_1 and S_2 are both open.

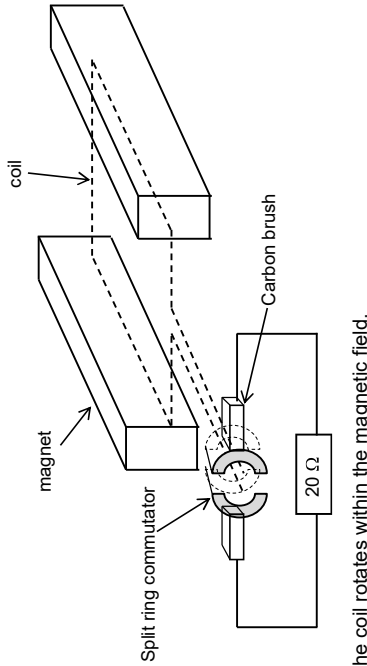
- 8.1 Write down the reading on voltmeter V_2 . (1)
- 8.2 Switch S_1 is now closed. Switch S_2 remains open. The reading on V_1 is now 10 V.
Calculate the:
 - 8.2.1 Total external resistance of the circuit. (4)
 - 8.2.2 Internal resistance of the battery. (5)
- 8.3 Both switches S_1 and S_2 are now closed.

How will the reading on the ammeter be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (3)
[13]

P.T.O.

QUESTION 9 (Start on a new page.)

The diagram below shows the essential parts of a generator.



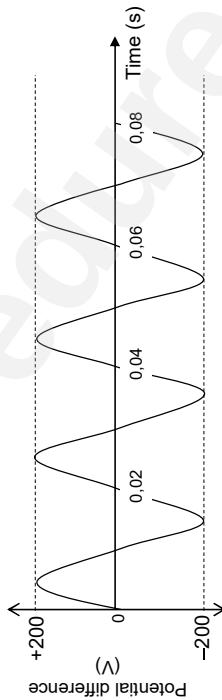
9.1 The coil rotates within the magnetic field.

Write down the type of current (**AC** or **DC**):

- 9.1.1 Induced in the coil. (1)
- 9.1.2 Passing through the $20\ \Omega$ resistor.
Give a reason for the answer. (2)
- 9.2 An AC generator is used in the commercial production of electricity.
 - 9.2.1 State ONE fundamental difference in construction between an AC generator and a DC generator. (2)
 - 9.2.2 Fully explain why AC is preferred to DC for transmission of electricity over long distances. (3)

P.T.O.

- 9.3 The diagram below shows the output of the above AC generator. A $20\ \Omega$ resistor is connected in the circuit.

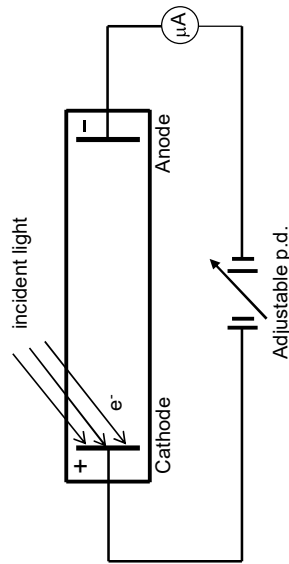


Calculate the:

- 9.3.1 Frequency of the power source. (2)
9.3.2 Average power dissipated in the resistor. (5)
[15]

QUESTION 10

Incident light of different wavelengths was shone on a metal cathode in an evacuated tube as shown in the diagram below.



It was found that light of 500 nm releases electrons with zero kinetic energy. The microammeter gives a zero reading.

- 10.1 Define the term *work function*. (2)
10.2 Calculate the work function of the metal used as cathode. (5)

P.T.O.

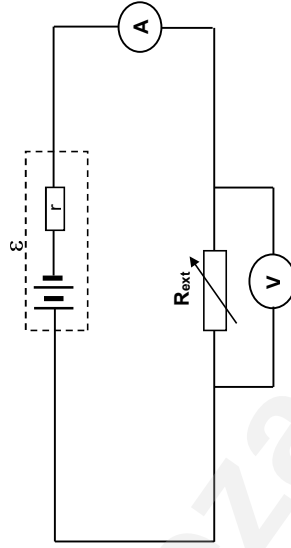
- 10.3 How will each of the following affect the reading on the micro-ammeter?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

- 10.3.1 The intensity of the light is increased. (1)
10.3.2 Light of a wavelength 550 nm is used. (1)
10.4 The metal cathode is now irradiated with light of wavelength 400 nm. (5)
Calculate the maximum kinetic energy of an emitted photo-electron. [14]

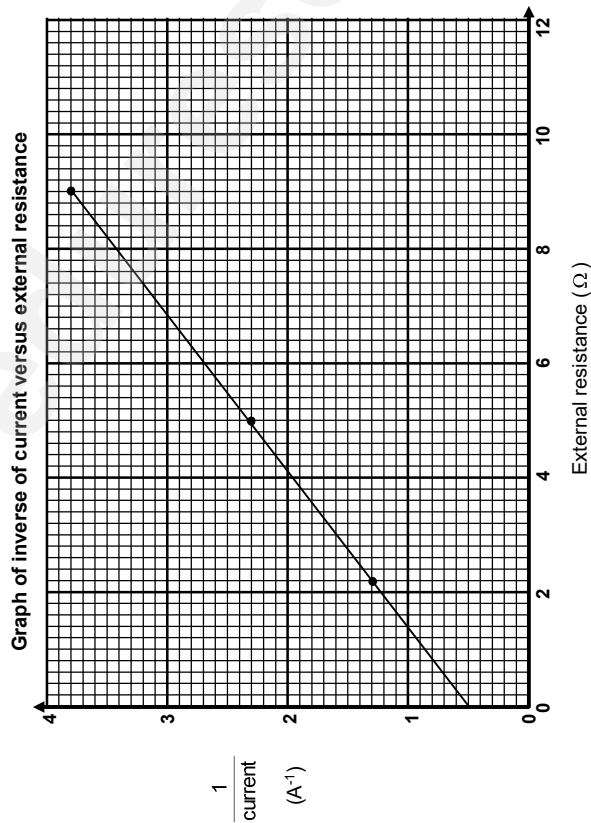
QUESTION 11 (Start on a new page.)

A learner set up the circuit shown below to measure the internal resistance of a battery.



P.T.O.

She records the readings on the voltmeter and ammeter for different resistances of the rheostat. The graph below was obtained from the results.



- 11.1 Define the term *emf*. (2)
- 11.2 Calculate the gradient of the above graph. (3)
- 11.3 What is represented by the gradient in Question 11.2? (1)
- 11.4 Use the information on the graph to calculate the:
 - 11.4.1 *Emf* of the battery (2)
 - 11.4.2 Internal resistance of the battery (3)

TOTAL: 150

P.T.O.



**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2017**

**10841
PHYSICAL SCIENCES: PHYSICS
FIRST PAPER**

TIME: 3 hours

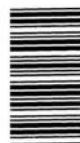
MARKS: 150

15 pages + 4 data sheets and 1 answer sheet

PHYSICAL SCIENCES: Paper 1
10841E



X10



3

P.T.O.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) of your choice next to the question number (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 D.

- 1.1 Passengers on a moving bus lean over to the right when the bus makes a sharp left turn. This is an example of ...

- Newton's first law.
- Newton's second law.
- Newton's third law.
- The Law of Universal Gravitation.

(2)

Two point charges are a distance r apart and are positioned as shown in the diagram below. An electrostatic force of magnitude F exists between the two charges.



The distance between the two charges is reduced to $\frac{1}{3}r$. The new force between the charges is ...

- F
- $3F$
- $9F$
- $\frac{1}{9}F$

(2)

A half-brick is thrown vertically upwards and caught by a builder at a height h above the ground. A full brick is also thrown vertically upwards and is caught by the same builder at the same height. Ignore all effects of friction.

Which one of the following is TRUE concerning the bricks which were thrown?

- The half-brick will take a shorter time to reach the builder.
- Both bricks have the same kinetic energy when they are thrown.
- Both bricks have the same velocity when they are thrown.
- Both bricks have the same momentum when they are thrown.

(2)

P.T.O.

- 1.4 The impulse on a ball bouncing off a wall is equal to the ...

- average force of the ball on the wall.
- change in momentum.
- rate of change in momentum.
- product of the mass and the acceleration of the ball.

(2)

- 1.5 Two spring-loaded trolleys of equal mass are "exploded" by releasing their springs simultaneously. Immediately after the explosion the trolleys move in opposite directions with equal velocity.

Which one of the following statements is correct regarding the moving apart of the trolleys?

- In an isolated system, the total momentum is conserved.
- The net force equals the product of mass and acceleration.
- Momentum equals the product of mass and velocity.
- Impulse equals the product of the net force and collision time.

(2)

- 1.6 A bird flies directly towards a speeding bus. It crashes head-on with the windscreen of the bus. Which one of the following statements is CORRECT?

- The force exerted by the bird on the windscreen is less than that exerted by the windscreen on the bird.
- The force exerted by the bird on the windscreen is greater than that exerted by the windscreen on the bird.
- The force exerted by the bird on the windscreen is equal in magnitude to the force that the windscreen exerts on the bird.
- The impulse acting on the bird is greater than the impulse acting on the windscreen.

(2)

P.T.O.

1.7 Which one of the following units is NOT equivalent to the Watt?

- A $\text{J} \cdot \text{s}^{-1}$
- B $\text{A} \cdot \text{V}^{-1}$
- C $\text{A} \cdot \text{V}$
- D $\text{A}^2 \cdot \Omega$

A model car has a motor with variable speed. Which ONE of the following modifications for the motor will NOT increase the speed of rotation of the motor?

- A Increasing the number of turns in the coil of the motor
- B Winding the armature coil around a zinc core
- C Increasing the current flowing through the coil of the motor
- D Increasing the strength of the magnet in the motor

To see an absorption spectrum, dispersed light must ...

- A come straight out of a white hot filament.
- B have passed through a gas that is substantially cooler than the source of light.
- C have passed through a gas that is substantially hotter than the source of light.
- D have passed through a gas that is at the same temperature as the source of light.

Which one of the following is TRUE concerning the photoelectric effect?

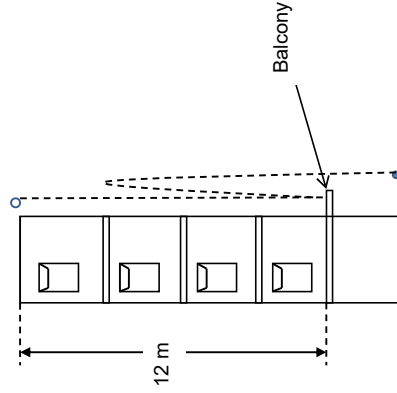
- A Light of higher frequency emits electrons with lower kinetic energies.
- B If we shine low intensity light with low energy photons on a clean metal surface long enough, electrons will eventually be emitted.
- C If we shine high intensity light with low energy photons on a clean metal surface long enough, electrons will eventually be emitted.
- D Most metals will emit electrons when ultraviolet light shines on them.

[20]

P.T.O.

QUESTION 2 (Start on a new page.)

A 120 g tennis ball is dropped from the top of a building. It bounces off a balcony 12 m below and finally falls to the ground. The diagram below shows the flight of the ball. Ignore all effects of friction as well as any horizontal motion of the ball.



2.1 Calculate the velocity with which the tennis ball strikes the balcony. (3)

2.2 The energy transformed to other forms when the ball strikes the balcony is 2 J. Calculate:

2.2.1 The kinetic energy just before the bounce (2)

2.2.2 How high the ball rises above the balcony after the bounce (5)

2.3 The ball finally strikes the ground 3,16 s after the bounce. Calculate the height of the balcony. (3)

2.4 Sketch the velocity versus time graph of the ball's entire flight. Show the following points on your sketch:

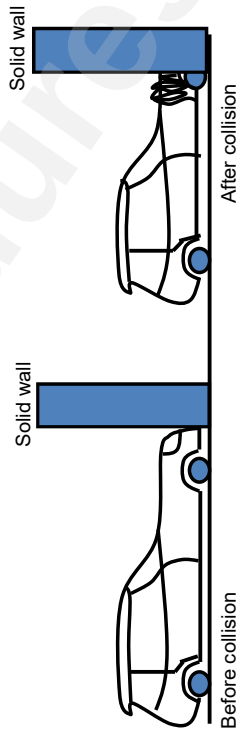
- Velocity with which the ball hits the balcony
- Time of flight of the ball to reach the balcony (Mark as t_1 only.)
- Velocity with which the ball leaves the balcony
- Time the ball reaches maximum height after bouncing off the balcony (Mark as t_2 only.)
- Total time of flight of the ball (Mark as t_3 only.)

(4)
[17]

P.T.O.

QUESTION 3 (Start on a new page.)

Most modern cars incorporate safety features that are designed to protect the driver and passengers in the event of a head-on collision. In testing one of such safety features, a car is crashed into a rigid concrete wall and its front crumples as shown in the diagram below.



The results of one such test are shown below.

Data: Car mass = 1000 kg	Speed of car at impact = $120 \text{ km} \cdot \text{h}^{-1}$
Original length of car = $d_1 = 2,8 \text{ m}$	Crushed length of car = $d_2 = 2,0 \text{ m}$

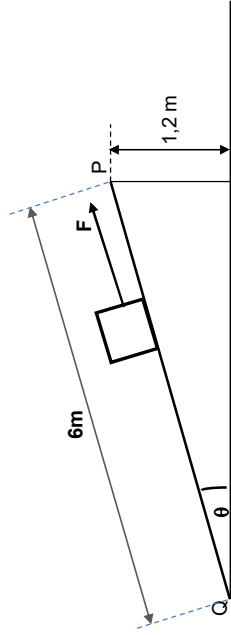
Ignore the effects of friction. Assume that there is no loss in mass as a result of the collision.

- 3.1 Draw a labelled, free-body diagram of all the forces acting on the car during impact. (3)
- 3.2 Convert $120 \text{ km} \cdot \text{h}^{-1}$ to SI units. (1)
- 3.3 State the WORK-ENERGY theorem. (2)
- 3.4 Assume that the force acting on the car is constant throughout the collision.
 - 3.4.1 Use the WORK-ENERGY theorem to calculate the nett force acting on the car during the collision. (5)
 - 3.4.2 Calculate the time taken for the car to come to rest. (4)
 - 3.4.3 Explain the purpose of a crumple zone in modern cars (3) [18]

P.T.O.

QUESTION 4 (Start on a new page.)

A 100 kg box slides down a rough inclined plane. A man applies a constant force F on the box such that it slides down the inclined plane at constant velocity.



- 4.1 Draw a labelled, free-body diagram showing all the forces acting on the box as it slides down the inclined plane. (4)
- 4.2 Write down the magnitude of the nett force acting on the box as it slides down the inclined plane. Give a reason for the answer. (2)

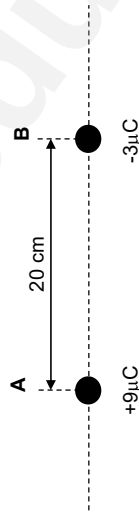
The frictional force between the box and the inclined plane is 60 N. The vertical height is 1,2 m.

- 4.3 What is a *non-conservative force*? (2)
- 4.4 Calculate the work done by the man on the box. (6)
- 4.5 Calculate the magnitude of force F exerted by the man on the box. (4) [18]

P.T.O.

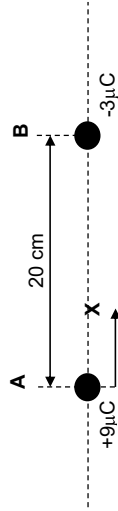
QUESTION 5 (Start on a new page.)

Two small identical metal spheres A and B carry charges of $+9\ \mu\text{C}$ and $-3\ \mu\text{C}$ respectively. They are placed 20 cm apart as shown in the diagram below.



- 5.1 What is meant by the statement, *the charge is quantised*? (1)
- 5.2 The spheres are brought into contact with each other, separated and placed at the same positions as before. (2)
- 5.2.1 Calculate the new charge on each sphere. (2)
- 5.2.2 Calculate the change in charge for each sphere and the number of electrons that are transferred. (3)
- 5.2.3 What is the direction of electron transfer between the spheres. (1)
Write only A to B or B to A.

The charged spheres A and B with original charges are now arranged as shown below. X is a point 4 cm to the right of sphere A.



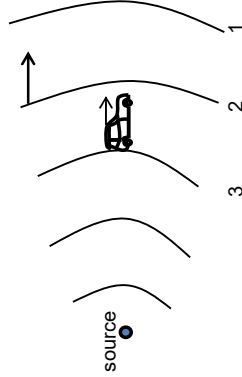
- 5.3 State *Coulomb's Law* in words. (2)
- 5.4 Calculate the electrostatic force between the two spheres. (3)
- 5.5 Calculate the magnitude of the net electric field at point X as a result of the charged spheres A and B. (4)
[16]

P.T.O.

QUESTION 6 (Start on a new page.)

Use the **ANSWER SHEET** at the end of the question paper to answer Question 6.2.

- 6.1 A fire truck has just stopped at an accident scene with its siren of frequency 380 Hz still on. The driver of an ambulance driving away from the accident scene hears the fire truck's siren as 360 Hz. This is shown in the diagram below. Take the speed of sound in air as $340\ \text{m}\cdot\text{s}^{-1}$.



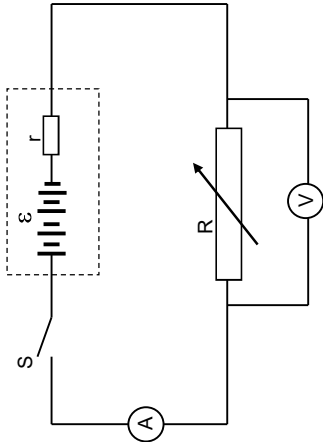
- 6.1.1 Define the *Doppler effect*. (2)
- 6.1.2 Calculate the speed of the ambulance in $\text{km}\cdot\text{h}^{-1}$. (5)
- 6.2 The wave fronts 3, 2, 1 and others shown on the diagram above, originate from the sound source.
On the **ANSWER SHEET** provided, draw the new relative positions of the wave fronts 2 and 1 as encountered by the car's driver, which would explain why the driver hears a lower frequency. Hand in the **ANSWER SHEET** with your **ANSWER BOOK**. (4)

- 6.3 Give TWO real-life examples where the Doppler effect is applied. (2)
[13]

P.T.O.

QUESTION 7 (Start on a new page.)

Learners set up a circuit, as shown below, to investigate the relationship between the potential difference across a variable resistor, R , and the current through the resistor.



7.1 In this experiment, name the ...

7.1.1 independent variable. (1)

7.1.2 dependent variable. (1)

The learners obtain a set of corresponding readings of potential difference and current. Two of the readings are shown in the table below.

Reading number	Current (A)	Potential difference (V) For external resistor
1	0,3	2,52
2	1,6	0,71

By means of a calculation, determine the internal resistance of the battery. (3)

P.T.O.

7.3 The learners now used their results to draw the following graph.



Use information from the graph to ...

7.3.1 determine emf of the battery (no calculation is necessary). (2)

7.3.2 determine current (I) when the battery is short-circuited (no calculation is necessary). (2)

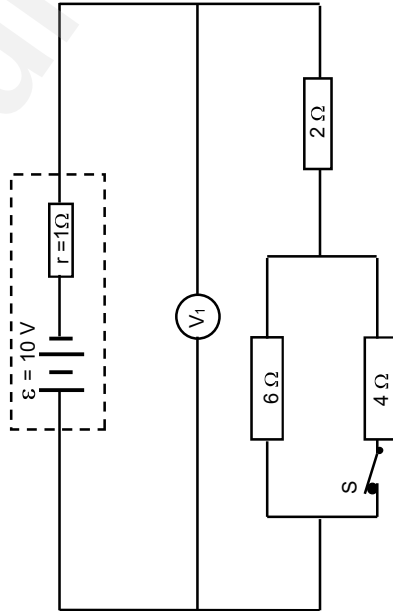
7.3.3 calculate the internal resistance of the battery. (2)

7.4 Give a reason for the slight deviation in the answers from Questions 7.2 and 7.3. (1) [12]

P.T.O.

QUESTION 8 (Start on a new page.)

A battery with an emf of 10 V and an internal resistance of $1\ \Omega$ is connected to three external resistors as shown in the circuit below.



Initially, switch S is closed.

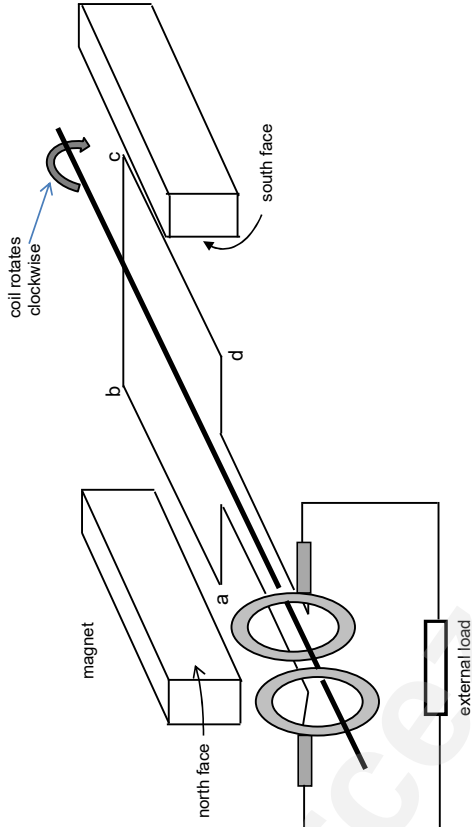
- 8.1 Calculate the current flowing in the circuit. (5)
- 8.2 Write down the reading of V_1 . (2)
- 8.3 What happens to the reading of V_1 if switch S is opened? Choose from STAYS THE SAME, INCREASES or DECREASES. Explain the answer without any calculation. (3)

[10]

P.T.O.

QUESTION 9 (Start on a new page.)

The diagram below shows the essential parts of a generator.



- 9.1 Is this an AC or DC generator? Give a reason for the answer. (2)
- 9.2 The coil **abcd** rotates clockwise within the magnetic field. Draw the shape of the voltage established across the external resistor for two cycles of the coil. Start with the coil in a horizontal position as shown. (2)
- 9.3 With the coil starting in the horizontal position as shown, what would be the direction of the induced current? Choose from **a to b** or **b to a**. (1)
- 9.4 The generator shown above delivers a maximum voltage of 6 V.
 - 9.4.1 Define the term *rms current*. (2)
 - 9.4.2 Calculate the rms current of this generator. (4)
 - 9.4.3 Calculate the average power dissipated at the external load. (3)

[14]

P.T.O.

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION

2018

10841
PHYSICAL SCIENCES: PHYSICS
PAPER 1

TIME: 3 hours

MARKS: 150

15 pages + 4 data sheets

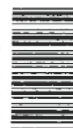
PHYSICAL SCIENCES: Paper 1

1084E



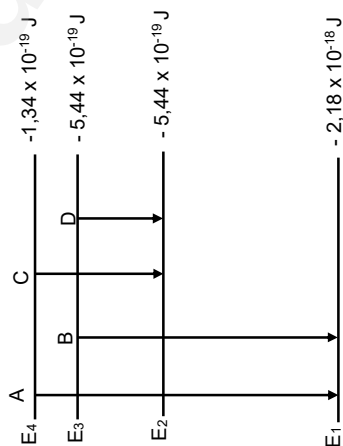
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X10



QUESTION 10 (Start on a new page.)

The diagram below shows electron transitions between energy levels of an atom.



- 10.1 A photon of light is released when an electron moves from the E_3 state to the E_1 state. Calculate the frequency of this photon. (5)
- 10.2 How many different photons can be produced when excited electrons move from the E_3 state to the E_1 state? (1)
- 10.3 10.3.1 Define the *work function* of a metal. (2)
- 10.3.2 The photon in Question 10.1 is incident on a metal surface. The work function of the metal is $2 \times 10^{-19} \text{ J}$. Calculate the maximum velocity of the ejected electron. (4)

[12]

TOTAL: 150

END

P.T.O.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) of your choice next to the question number (1.1 – 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Which one of the following physical quantities is equal to the product of net force and change in time?

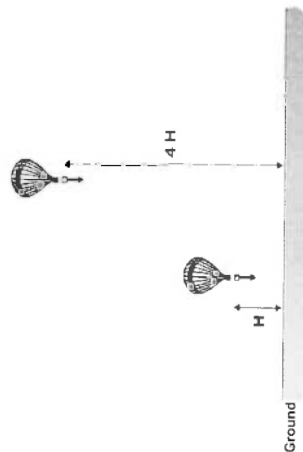
- A Power
- B Impulse
- C Energy
- D Work

1.2 A full brick of mass m and a half brick of mass $\frac{1}{2}m$ fall freely from the 10th floor of a building. Ignore the effects of air resistance.

When the bricks are 4 m above the ground, they have the same ...

- A kinetic energy.
- B potential energy.
- C acceleration.
- D momentum.

1.3 A package is dropped from a hot air balloon from two different heights. In the first instance the height of the balloon from the ground is H and it takes t seconds for the package to reach the ground. In the second instance the package is dropped from a height of $4H$.



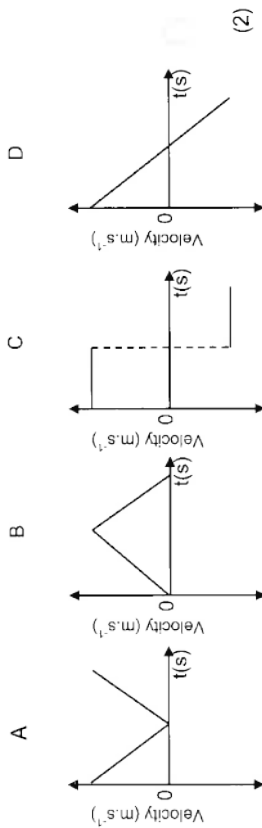
The time for the package, dropped from the height of $4H$, to reach the ground compared to the time t of the package dropped from H is:

- A t
- B $2t$
- C $4t$
- D $16t$

(2)
P.T.O.

1.4 A ball is rolled up a smooth, inclined plane. The ball stops briefly at some point on its way up and rolls back to the point where it was first released.

Which one of the following velocity-time graphs best shows the motion of the ball?



1.5 A passenger in a car that is moving at constant velocity at night observes that there is a car behind them through its lights and sound. If the passenger hears a higher frequency than that emitted by the engine of the car behind them then the car behind them is ...

- A moving at the same speed as theirs.
- B moving faster than theirs.
- C moving slower than theirs.
- D stationary with its lights on and engine at a constant high rev.

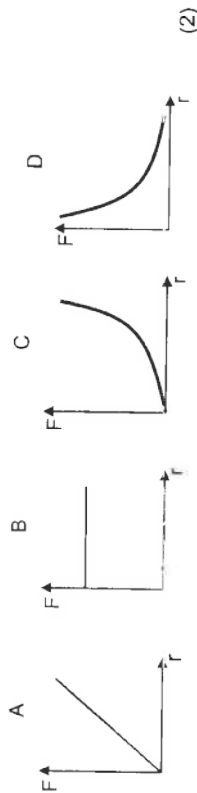
(2)

- 1.6 Two small, oppositely charged spheres on an insulated surface are held a distance r apart as shown in the diagram.

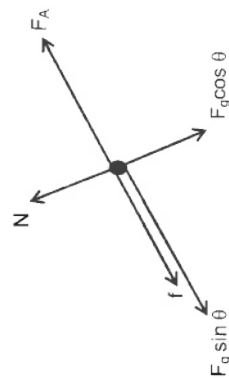


When the spheres are released simultaneously, they roll towards each other due to the electrostatic force of attraction.

Which ONE of the following graphs represents the magnitude of the force experienced by each sphere as a function of the distance r between their centres?



- 1.7 The free-body diagram below shows all the forces acting on an object that is moving up an inclined plane. All the forces are drawn to scale.



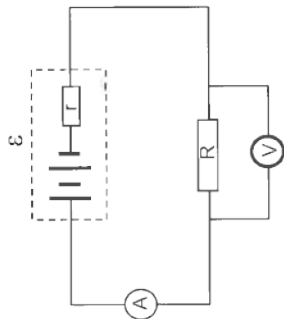
The kinetic energy of the object

- A increases.
B decreases.
C is zero.
D remains the same.

(2)

P.T.O.

- 1.8 A battery with an emf $\mathcal{E}$ and an internal resistance r is connected to a resistor R as shown in the diagram below.



A second resistor with the same resistance as R is connected in parallel with R . How will the voltmeter and ammeter readings change when the second resistor is added to the circuit?

	Voltmeter reading	Ammeter reading
A	Increases	Increases
B	Decreases	Increases
C	Increases	Stays the same
D	Stays the same	Decreases

(2)

P.T.O.

- 1.9 An experiment was carried out to study the effect of a magnetic field on a current carrying conductor **Y**, placed within a magnetic field. **X** and **Z** are poles of magnets.

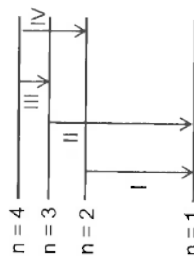


When a current flows through **Y**, the conductor moves downwards as shown by the arrow. Which one of the following combinations, regarding the **polarities** of the magnets and the direction of the current is correct?

	Polarity X	Polarity Z	Current direction in Y
A	South	North	Out of the page
B	North	North	Into the page
C	North	South	Out of the page
D	North	South	Into the page

(2)

- 1.10 Electron transitions occur in an atom as shown in the diagram. In each transition photons are emitted.



The emitted photons are all capable of releasing photoelectrons from a certain metal, which photon will release electrons with the lowest kinetic energy?

- A I
B II
C III
D IV

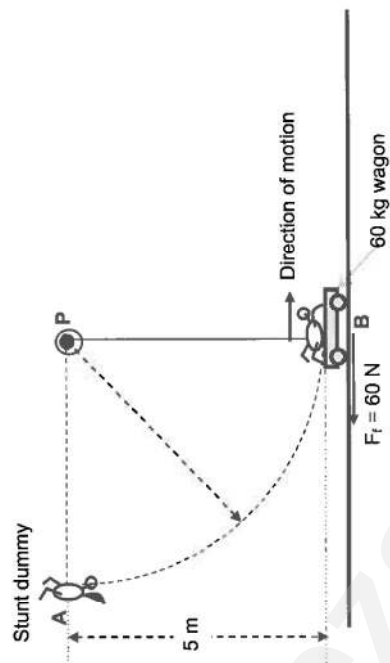
(2)
[20]

P.T.O.

QUESTION 2 (Start on a new page.)

A 50 kg stunt dummy is attached to one end of a 5 m inelastic light rope. The other end is attached to a fixed point **P** that is 5 m vertically above a stationary wagon. The dummy is then pulled upward to point **A** such that the rope is fully stretched and held horizontally as shown in the diagram below. When released, the dummy swings downwards along the dotted path. On reaching the stationary wagon, the stunt dummy detaches from the rope, falls flat on the wagon and sticks to it. The wagon has a mass of 60 kg.

The wagon and the stunt dummy move as one unit towards the right.



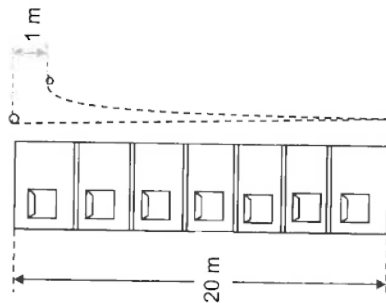
- 2.1 State the *law of conservation of mechanical energy*. (2)
- 2.2 Calculate the magnitude of the velocity of the stunt dummy when it reaches its lowest point **B**. (4)
- As the dummy and the wagon move as one unit towards the right, a constant frictional force of 60 N acts on the wheels of the wagon as shown.
- 2.3 State the *principle of conservation of linear momentum*. (2)
- 2.4 Calculate the ...
- 2.4.1 initial velocity of the dummy and wagon soon after the dummy lands on the wagon. (3)
- 2.4.2 impulse provided to the dummy. (2)
- 2.4.3 distance moved by the dummy-and-wagon combination before coming to rest. (4)

[17]

P.T.O.

QUESTION 3 (Start on a new page.)

1. A tennis ball is thrown with a velocity of 10 m s^{-1} vertically downwards from the top of a 20 m high building. The ball bounces off the ground, reaching a height which is 1 m below the point from which it was projected. Ignore air resistance and any lateral movement of the ball.

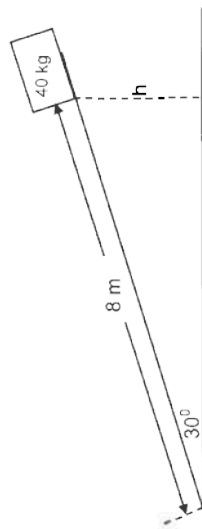


- 3.1 Explain free fall. (2)
- 3.2 Calculate the magnitude of the velocity with which the ball strikes the ground. (3)
- 3.3 Calculate the time that it takes the ball to reach the ground after it was thrown. (3)
- 3.4 Calculate the magnitude of the velocity with which the ball leaves the ground after the bounce. (3)
- 3.5 Is the collision of the ball with the ground elastic or inelastic? Give a reason for your answer. (2)
- 3.6 Sketch the velocity-time graph of the ball's flight from the moment it was thrown to the maximum height after the bounce. Your sketch must show values at the following points: (6)
- Velocity when ball was thrown
 - Velocity just before it bounced off the ground
 - Velocity just after the bounce
 - Time after launch at which it bounced on the ground
- [19]

P.T.O.

QUESTION 4 (Start on a new page.)

A 40 kg box slides from rest down a rough slope of length 8 m. It starts the downward slide from a height h above the horizontal. The slope makes an angle of 30° with the horizontal. While sliding, the box experiences a constant acceleration of 2 m s^{-2} .

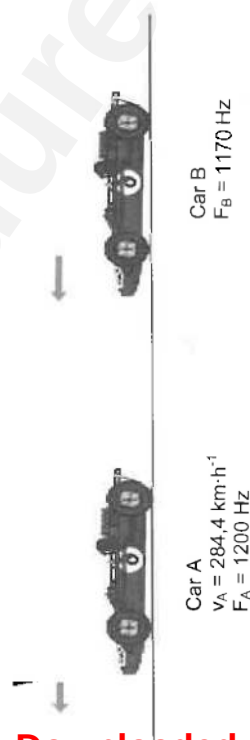


- 4.1 State the Work-Energy theorem in words. (2)
- 4.2 Draw a free-body diagram that shows ALL the forces acting on the box as it slides down the slope. (3)
- 4.3 Calculate the following: (5)
- 4.3.1 The kinetic energy of the box as it reaches the bottom of the slope (4)
- 4.3.2 The work done on the box by the gravitational force (4)
- 4.3.3 The work done on the box by the frictional force using the work-energy theorem (4)
- 4.3.4 The magnitude of the frictional force acting on the box (3)
- [21]

P.T.O.

QUESTION 5 (Start on a new page.)

Two racing cars approach the finishing line as shown on the diagram below. Car **A** approaches the finishing line at a speed of $284,4 \text{ km} \cdot \text{h}^{-1}$. The engine of car **A** produces a sound with a frequency of 1200 Hz . Assume the speed of sound in air is $340 \text{ m} \cdot \text{s}^{-1}$.



- 5.1 State the Doppler effect. (2)
- 5.2 For car **A**, what frequency of the engine sound will a man at the finishing line hear? (5)
- 5.3 A second racing car, **B**, produces a sound with a frequency of 1170 Hz which is heard by a man at the finishing line as 1600 Hz .
What is the speed of car **B**? (4)
- 5.4 An ambulance races towards an accident scene with its siren blaring and its red lights flashing.
Explain why there is a noticeable change in the siren's frequency as the ambulance approaches an observer but there is no noticeable change in the colour of the red light. (4)

[15]

P.T.O.

QUESTION 6 (Start on a new page.)

Learners are provided with apparatus as shown in the diagram below to investigate the relationship between current (I) flowing through a resistor and the potential difference (V) across the resistor.



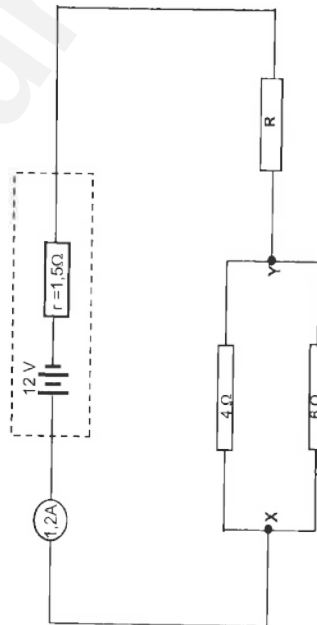
- 6.1 Write down the investigative question. (2)
- 6.2 Draw a circuit diagram to show how the learners must connect all the apparatus for a successful investigation. (3)
- 6.3 Identify:
 - 6.3.1 The independent variable (1)
 - 6.3.2 The dependent variable (1)
 - 6.3.3 The variable that must be controlled (1)
- 6.4 Explain how you would go about controlling the variable mentioned in Question 6.3.3. (1)
- 6.5 The learners recorded the following readings of results of the investigation: At start, the voltmeter (V) reads $0,00$ when ammeter (A) reads $0,00$; when A is $0,29$, V is 1 ; when A is $0,6$, V is 2 ; A is $0,9$ when V is 3 ; when A is $1,22$, V is 4 ; A is $1,48$ when V is 5 .
 - 6.5.1 Rewrite these results in a suitable table. (3)
 - 6.5.2 Draw a fully-labelled graph of the results. (4)
 - 6.5.3 Draw a suitable conclusion for this investigation. (2)
 - 6.5.4 What physical quantity does the gradient of the graph represent? (1)

[19]

P.T.O.

QUESTION 7 (Start on a new page.)

In the circuit diagram below the potential difference across the terminals of a battery is 12 V when the current flowing is 1,2 A. The battery has an internal resistance of 1,5 Ω . The resistance of the ammeter and connecting wires can be ignored.

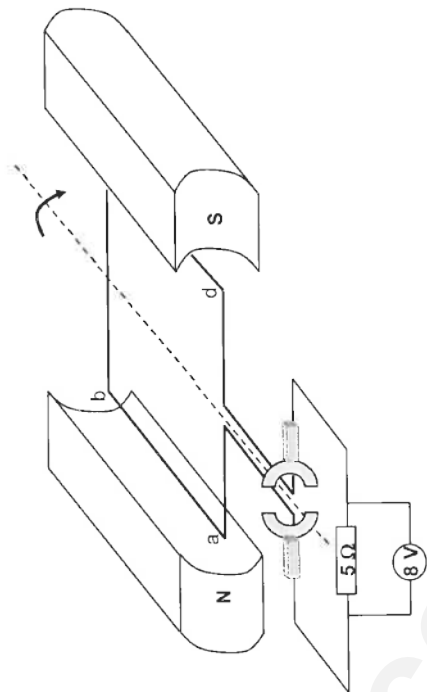


- 7.1 Calculate the resistance of the external resistors in the circuit. (3)
- 7.2 Calculate the resistance of resistor R. (4)
- 7.3 Determine the emf of the battery. (3)
- 7.4 A resistor of resistance 2 Ω is connected between the points X and Y.
How will this affect the ammeter reading? Answer by writing only **INCREASE**, **DECREASE** or **REMAIN THE SAME**. (1)
- 7.5 Explain your answer to Question 7.4. (2) [13]

P.T.O.

QUESTION 8 (Start on a new page.)

The diagram below shows a type of generator. The coil rotates clockwise.

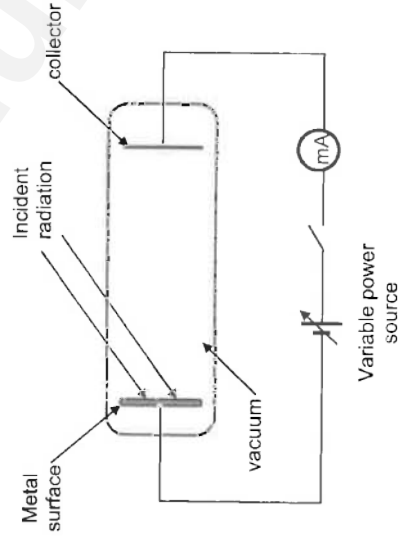


- 8.1 Name this type of generator (AC or DC). (1)
- 8.2 Give a reason for your answer to Question 8.1. (1)
- 8.3 For the position of the coil as shown, in which direction will the current flow? (Simply state **a to b** or **b to a**.) (1)
- 8.4 Define the term *rms current*. (2)
- 8.5 If the voltmeter shows a maximum voltage output of 8 V across the 5 Ω resistor, calculate the **rms** current output of the generator. (4)
- 8.6 Starting with the coil in the horizontal position as shown: (1)
- 8.6.1 Draw a sketch graph of the output voltage for **one cycle** of the coil. (3)
- 8.6.2 Would the generator output current graph differ from the output voltage graph? (Simply state **YES** or **NO**.) (1)
- 8.6.3 Explain your answer to Question 8.6.2. (2) [15]

P.T.O.

QUESTION 9 (Start on a new page.)

The circuit shown below was used to investigate the photoelectric effect. Orange light with a wavelength of 600 nm incident on the metal surface ejected electrons from the metal surface. The ejected electrons had zero kinetic energy.



- 9.1 Briefly describe what the **photoelectric effect** is. (2)
- 2 Define work function (W_0) of a metal. (2)
- 9.3 Calculate the work function of the metal. (4)
- 9.4 The orange light is then replaced by a faint blue light. Will the milliammeter detect a photocurrent? (Answer **YES** or **NO**.) (1)
- 9.5 Explain your answer to Question 9.4. (2)

[11]

TOTAL: 150

**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2019**

**10841
PHYSICAL SCIENCES: PHYSICS
PAPER 1**

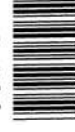
**TIME: 3 hours
MARKS: 150
19 pages + 3 information sheets**

PHYSICAL SCIENCES: Paper 1



10841E

X10



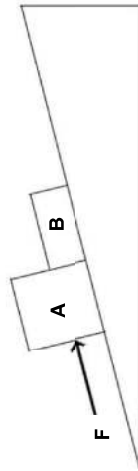
END

P.T.O.

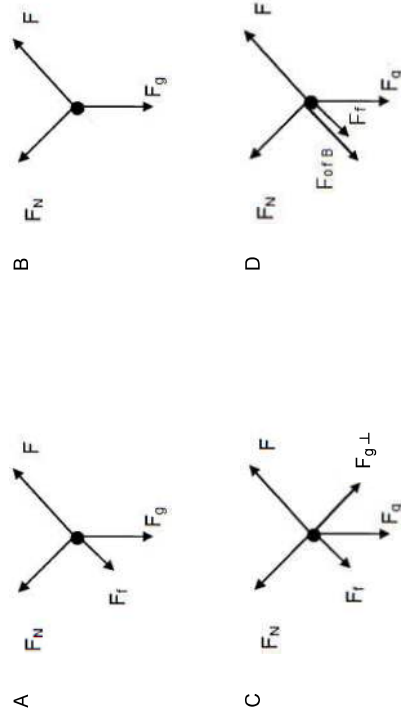
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

- 1.1 A learner is sitting on a chair. According to Newton's *Third Law of Motion*, the reaction force to the learner's weight, w is the force of the ...
 A learner on the chair.
 B chair on the learner.
 C earth on the learner.
 D learner on the earth.
- 1.2 Two objects, **A** and **B**, are in contact with each other on an inclined plane. A horizontal force, F , is applied parallel to the incline, and pushes on the objects as shown in the diagram below.



The magnitude of kinetic frictional force acting on the objects cannot be ignored. Which ONE of the following is the correct free body diagram for block **A**?



(2)

P.T.O.

- 1.3 Trolley **T**, mass $3m$, moving to the right with a speed v collides head-on with trolley **R**, mass m , moving to the left with speed v . Immediately after the collision, trolley **R** moves to the right with a speed $2v$ and trolley **T** is at rest. Refer to the diagram below.

Ignore the effects of friction.



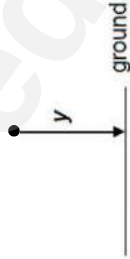
Which of the following combinations is CORRECT?

	MECHANICAL ENERGY	MOMENTUM
A	Conserved	Conserved
B	Conserved	Not conserved
C	Not conserved	Not conserved
D	Not conserved	Conserved

(2)

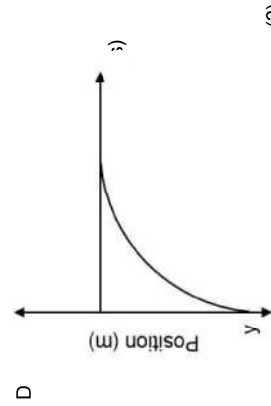
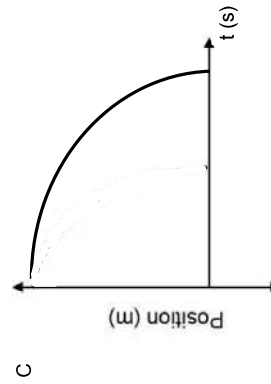
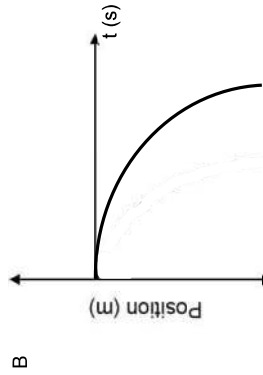
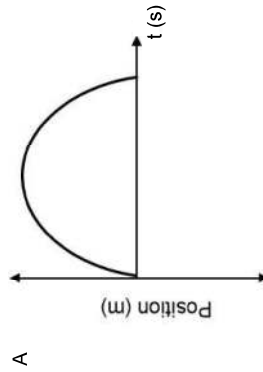
P.T.O.

- 1.4 A small stone is dropped from a height y above the ground as shown in the diagram below. It strikes the ground after time t .



Take UPWARDS AS THE POSITIVE. Ignore the effects of air resistance.

Which of the following diagrams shows the correct position-time graph for the motion of the stone?

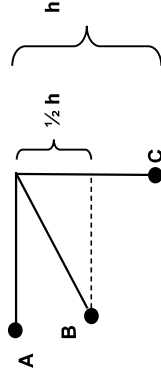


(2)

P.T.O.

- 1.5 A pendulum bob is raised to position **A** at a height h above the lowest point of its swing, **C**. It is released from point **A**, and swings through points **B** with speed v_B and **C** with speed v_C .

Ignore frictional effects.



What is the relationship between the speed v_B and speed v_C ?

A $v_B = \frac{v_C}{\sqrt{2}}$

B $v_B = \sqrt{0,5} v_C$

C $v_B = 0,5 v_C$

D $v_B = \frac{\sqrt{2}}{v_C}$

(2)

- 1.6 An astronomer views the line spectrum from a star. Which of the following describes the effect of the Doppler shift on the line spectrum if the star is moving *towards* earth?

The line spectrum ...

A appears dimmer.

B appears larger.

C is shifted towards the red end of the spectrum.

D is shifted towards the blue end of the spectrum.

(2)

P.T.O.

- 1.7 Point charges Q_1 , Q_2 and Q_3 are arranged at the corners of a right-angled triangle, as shown in the diagram below. The charges on Q_1 , Q_2 and Q_3 are unknown. The distance between Q_1 and Q_3 is r . The distance between Q_2 and Q_3 is also r . Charge Q_3 experiences a resultant electrostatic force to the **WEST**.

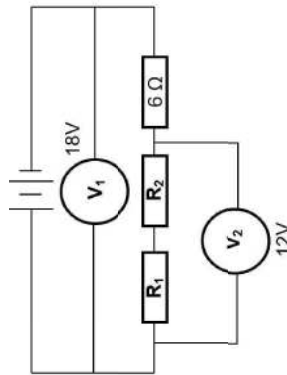


Which of the following combinations of charges could be possible for charges Q_1 , Q_2 and Q_3 ?

	Q_1	Q_2	Q_3
A	NEGATIVE	POSITIVE	POSITIVE
B	POSITIVE	POSITIVE	POSITIVE
C	NEGATIVE	NEGATIVE	NEGATIVE
D	POSITIVE	NEGATIVE	POSITIVE

(2)

In the circuit diagram below three resistors, R_1 , R_2 and a $6\ \Omega$ are connected in series. $R_1 = R_2$ and the internal resistance of the cell and connecting wires may be ignored. V_1 reads 18V and V_2 reads 12V.



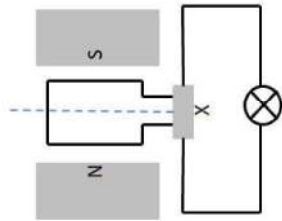
Which of the following is the possible values for R_1 and R_2 ?

- A $4\ \Omega$
B $6\ \Omega$
C $12\ \Omega$
D $18\ \Omega$

(2)

P.T.O.

- 1.9 The diagram below is a simplified version of an electric generator connected to a light bulb. Component X is either a split ring or slip rings.



Which of the following options for this generator is correct?

	Energy conversion taking place	Type of current generated	Component X
A	mechanical to electrical	slip ring	AC
B	mechanical to electrical	split ring	AC
C	electrical to mechanical	slip ring	DC
D	electrical to mechanical	split ring	DC

(2)

- 1.10 The diagram below shows some principle lines, P, Q, R and S in the line emission spectrum of helium with corresponding wavelengths in nm.



Which ONE of the spectral lines represents the *lowest energy* change of an electron within a helium atom?

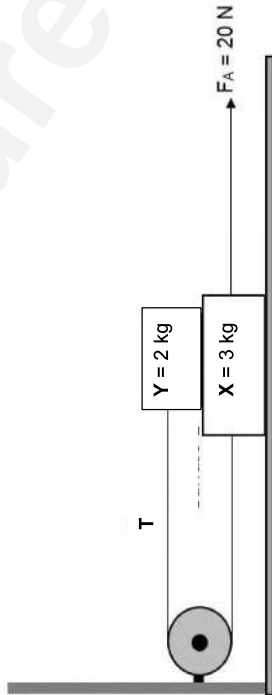
- A P
B Q
C R
D S

(2)
[20]

P.T.O.

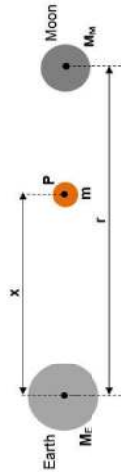
QUESTION 2 (Start on a new page.)

- 2.1 A horizontal force F_A of magnitude 20 N is applied to block X, mass 3 kg on a table. Block Y, mass 2 kg, is resting on block X. The two blocks are joined by a thin inextensible string of negligible mass which runs over a frictionless pulley, fixed to the wall. Block X experiences a kinetic frictional force of 1,2 N with the surface of the table. There is no friction between block X and block Y. The tension in the string is T when block X accelerates to the right.



- 2.1.1 State Newton's Second Law of Motion in words. (2)
 2.1.2 Draw a labelled, free-body diagram showing ALL the forces acting on block X. (6)
 2.1.3 Calculate the magnitude of the tension T in the string. (6)

A learner wants to calculate the distance between the Earth (mass $M_E = 5,97 \times 10^{24}$ kg) and the Moon (mass $M_M = 7,35 \times 10^{22}$ kg) where the net gravitational force is zero. To achieve this, the learner placed a third mass 'm' at point 'P' as shown in the diagram below. The distance between the centres of the Earth and the Moon is 'r'.



- 2.2.1 State Newton's Law of Universal Gravitation in words. (2)
 2.2.2 Use the law of gravitation to show that r and x are related by the following equation:

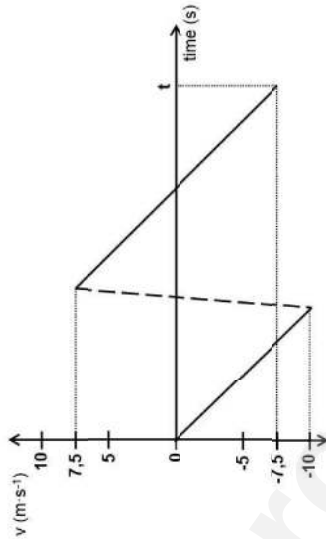
$$r^2 - 2rx + 0,988x^2 = 0 \quad (4) \quad [20]$$

P.T.O.

QUESTION 3 (Start on a new page.)

A ball of mass 0,2 kg is dropped vertically from the top of a building to a concrete floor below. The ball bounces off the floor. The velocity versus time graph below shows the motion of the ball. Ignore the effects of air friction.

DOWNWARD MOTION IS TAKEN AS NEGATIVE.



- 3.1 Explain the term *free fall*. (2)
 Use the graph to answer the following questions.
 3.2 Write down the number of times the ball hits the floor. (1)
 3.3 Calculate the height:
 3.3.1 From which the ball was dropped (4)
 3.3.2 Reached by the ball after the first bounce (3)
 3.4 Determine the magnitude of the displacement of the ball from the moment it was dropped until time t . (1) [11]

P.T.O.

QUESTION 4 (Start on a new page.)

The table below shows how the momentum of a single train coach **A** changes with time just before and just after a head-on collision with another coach **B**.

$p \text{ (kg} \cdot \text{m} \cdot \text{s}^{-1}) \text{ of coach A}$	30 000	30 000	14 000	14 000
time (s)	20	20,1	20,2	20,3

Coach **B** has a mass of 9 000 kg and was initially travelling at $1,5 \text{ m} \cdot \text{s}^{-1}$ west. You may assume that the net external force acting on the system is zero.

1 Write down a word / term for the underlined words above.

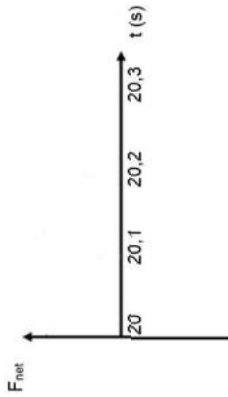
2 Use the information in the table to answer the following questions.

3 Calculate the magnitude of the:

4.2.1 Net average force acting on engine coach **A** during the collision

4.2.2 Velocity of coach **B** just after collision

5 Redraw the net force vs time graph below in your answer book and complete the graph for coach **A**. The time values are on the graph.



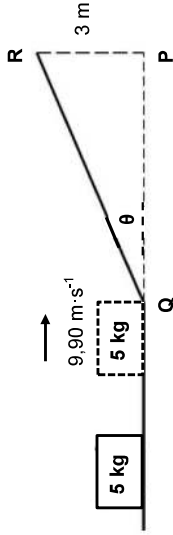
(3)
[12]

P.T.O.

QUESTION 5 (Start on a new page.)

5.1 In an experiment, a rough inclined plane **QR** has been constructed to stop a moving 5 kg block. The block reaches point **Q** with a speed $9,90 \text{ m} \cdot \text{s}^{-1}$. The block comes to a stop at point **R** which is 3 m above level **QP**.

The frictional force between the surface **QR** and the block is 18 N.



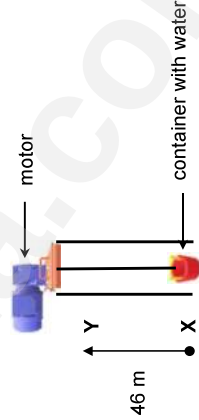
5.1.1 Define a *non-conservative force*.

(2)

5.1.2 Use energy principles and calculate the angle θ of slope **QR**.

(7)

5.2 A motor is used to lift a container of water up a vertical shaft with a steel cable. The total mass of the container and the water is 987 kg. The container is lifted from rest from point **X** and passes point **Y** at a height 46 m. At point **Y** the container has a speed of $0,9 \text{ m} \cdot \text{s}^{-1}$. You may ignore frictional effects and the mass of the steel cable.



5.2.1 State the *work-energy theorem* in words.

(2)

5.2.2 Use the work-energy theorem to calculate the work done by the motor in lifting the container from point **X** to **Y**.

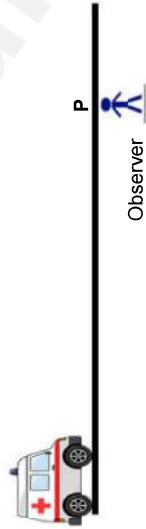
(4)
[15]

P.T.O.

P.T.O.

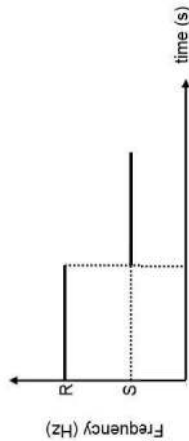
QUESTION 6 (Start on a new page.)

An ambulance is travelling at a constant speed along a straight horizontal road with its siren emitting a sound of frequency 800 Hz. A stationary observer standing at point **P** next to the road, hears the siren frequency of 910 Hz as the ambulance approaches. The ambulance passes point **P** and continues at the same speed. Take the speed of sound in air to be $340 \text{ m}\cdot\text{s}^{-1}$.



- 6.1 State the *Doppler effect*. (2)
 6.2 Calculate the speed of the ambulance. (5)

A detector at point **P** measures the siren's frequency and the results are shown in the graph below.

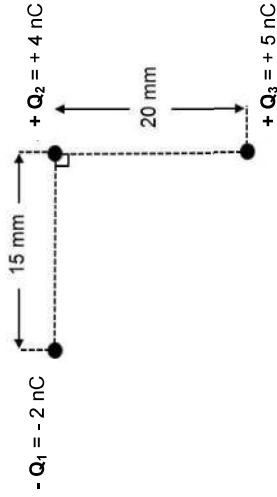


- 6.3.1 Write down frequency **R**. (1)
 6.3.2 Calculate the value of **S** on the graph. (4)
 6.4 What frequency will the observer hear when the ambulance is at point **P**? (1) [13]

P.T.O.

QUESTION 7 (Start on a new page.)

- 7.1 Point charges $-Q_1$, $+Q_2$ and $+Q_3$ are arranged at the corners of a right-angled triangle, as shown in the diagram below.



- 7.1.1 State *Coulomb's law* in words. (2)
 7.1.2 Draw a force diagram to show the forces acting on charge $+Q_2$ due to charge $-Q_1$ and $+Q_3$. (2)
 7.1.3 Calculate the magnitude of the net force acting on Q_2 due to Q_1 and Q_3 if $Q_1 = -2 \text{ nC}$, $Q_2 = +4 \text{ nC}$ and $Q_3 = +5 \text{ nC}$. (5)
 7.2 A -2 nC charge is 15 mm to the left of a $+4 \text{ nC}$ charge as shown in the diagram below. Point **P** is 10 mm to the right of the $+4 \text{ nC}$ charge.

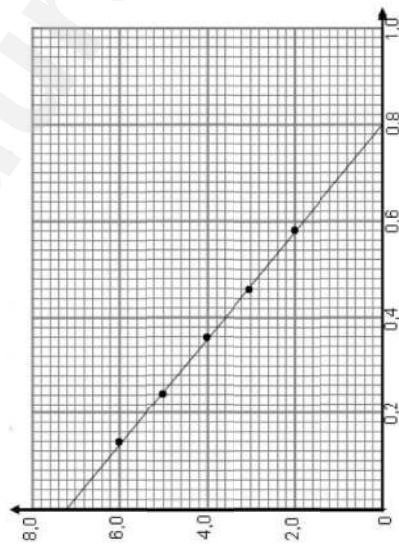


- Calculate the net electric field at point **P**. (5) [14]

P.T.O.

QUESTION 8 (Start on a new page.)

A group of learners conduct an experiment to determine the emf ($\mathcal{E}$) and internal resistance (r) of a battery. The data obtained from the experiment is used to plot points on graph paper and draw a line of best fit. The graph of one of the learners is given below. The x and y axes have not been labelled.

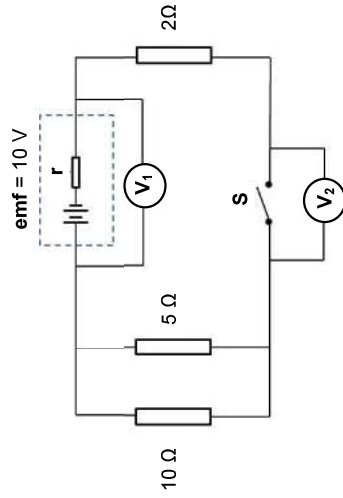


- 8.1 Explain the term *internal resistance*. (1)
 - 8.2 Write down ONE factor which must be kept constant during this experiment. (1)
 - 8.3 Using the graph:
Provide a label for the y-axis. (1)
 - 8.4 Write down the quantity represented by the gradient? (1)
 - 8.5 Write down the emf of the battery. (1)
 - 8.6 Calculate the internal resistance of the battery. (4)
 - 8.7 Determine the value of V_{int} when the graph reaches 0.8 on the x-axis. (1)
- [10]

P.T.O.

QUESTION 9 (Start on a new page.)

9. A circuit is connected as shown below. The battery has an **emf** of 10 V and an unknown internal resistance r . A voltmeter V_1 is connected across the battery and another voltmeter V_2 is connected across the switch S . The connecting wires have negligible internal resistance.



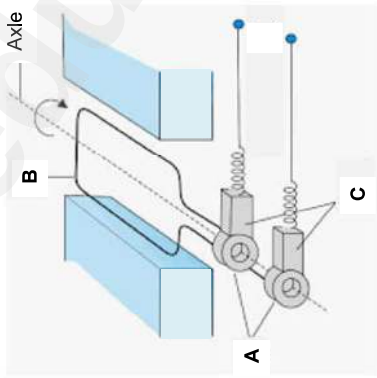
Switch S is initially open.

- 9.1 Write down the reading on voltmeter V_2 . (1)
 - Switch S is now **closed**. The reading on voltmeter V_1 is 8 V.
 - 9.2 What is the reading on V_2 ? (1)
 - 9.3 Calculate the total external resistance of the circuit. (3)
 - 9.4 Calculate the internal resistance, r , of the battery. (5)
 - 9.5 How will the reading on the voltmeter V_1 be affected if the 5 Ω resistor was removed? (Choose from: INCREASES, DECREASES or STAYS THE SAME.) (1)
 - 9.6 Explain your answer to Question 9.5. (3)
- [14]

P.T.O.

QUESTION 10 (Start on a new page.)

The diagram below shows an AC generator. The main components are labelled A, B and C.



10.1 Write down the name of the components labelled:

10.1.1 A

(1)

10.1.2 B

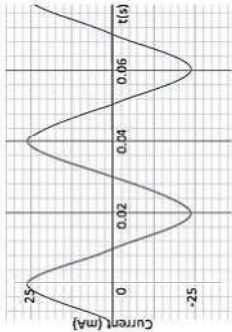
(1)

10.2 Write down the function of component C.

(1)

P.T.O.

The graph below represents the output current vs time for an AC generator.



Use the graph above to answer the following questions.

10.3 At what position was the coil relative to the magnetic field of the generator for the current output to be a maximum?
(Choose from: PERPENDICULAR or PARALLEL.)

(1)

10.4 Calculate the rms current (I_{rms}) for this generator.

(3)

10.5 Calculate the average power dissipated by a $100\ \Omega$ resistor connected across the terminals of the generator.

(3)

[10]

P.T.O.

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2020

10841
PHYSICAL SCIENCES: PHYSICS
PAPER 1

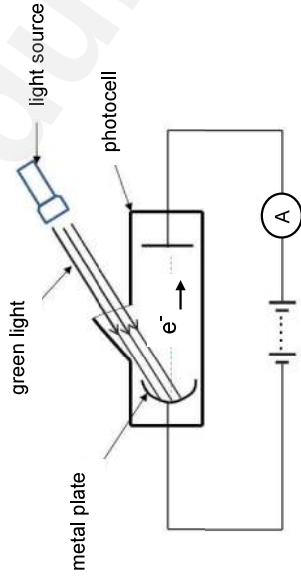
TIME: 3 hours

MARKS: 150

17 pages + 3 data sheets and an answer sheet

QUESTION 11 (Start on a new page.)

In an investigation, the metal plate of a photocell, shown below, is irradiated with green, blue and violet light.



The results of the investigation are shown in the table below.

Colour	Wavelength (nm)	Reading on ammeter
green	560	No
blue	500	Yes
violet	430	Yes

- 11.1 Define the *work function* of a metal. (2)
- 11.2 Explain why no current is registered when green light is used. (2)
- 11.3 What effect will increasing the **intensity** of light have on the reading of the ammeter when blue light is used? (Choose from INCREASES, DECREASES or STAYS THE SAME.) (1)
- 11.4 Explain your answer to Question 11.3. (2)
- 11.5 Calculate the energy of a photon of blue light. (4)

[11]

TOTAL: 150

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

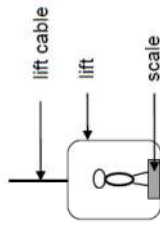
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) of your choice next to the question number (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Which of Newton's laws is associated with being a conservative force?

- A First law
- B Third Law
- C Second Law
- D Law of Universal Gravitation

(2)

A person stands on a bathroom scale that is fixed to the floor of a lift, as shown in the diagram below.



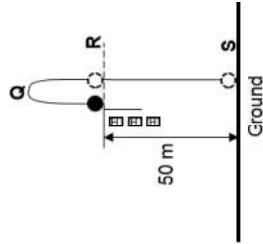
The reading on the scale is zero when the lift moves ...

- A if the lift cable is broken.
- B upwards with increasing speed.
- C upwards at constant speed.
- D downwards at constant speed.

(2)

P.T.O.

1.3 In the diagram below, a ball is thrown vertically upwards from the top of a building of height 50 m. The path of the ball is labelled, **Q**, **R** and **S** as shown in the diagram.



Study the three statements below.

The change in position of the ball at:

- (i) **Q** is 50 m
- (ii) **R** is zero
- (iii) **S** is 50 m

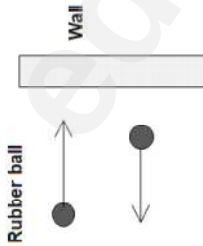
Which ONE of the following statements is true?

- A (i) and (iii)
- B (i) only
- C (i) and (ii)
- D (ii) and (iii)

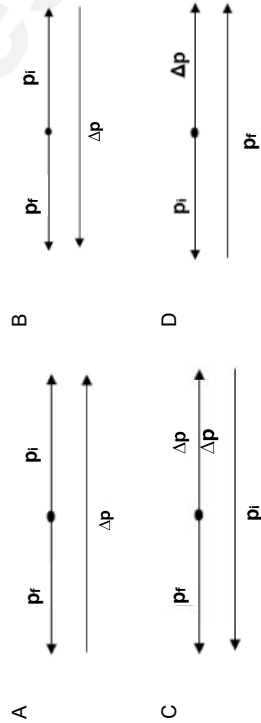
(2)

P.T.O.

- 1.4 In the diagram below, a rubber ball is thrown towards a wall and bounces back.



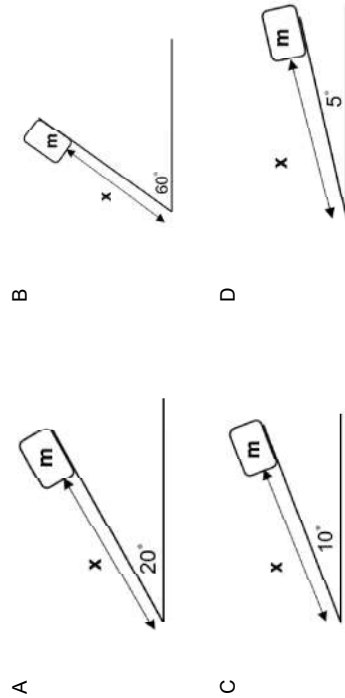
Which ONE of the diagrams below represents the correctly labelled momentum vectors for the rubber ball?



(2)

Block m moves down the slope for a distance x in all the diagrams below. The magnitude of m and x are the same in each diagram. None of the diagrams are drawn to scale. Ignore all effects of friction.

In which ONE of the diagrams below will W_{net} be the greatest?



(2)

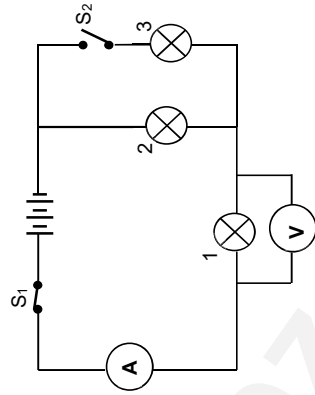
P.T.O.

- 1.6 When a DC electric current flows through a single current-carrying conductor, the right-hand rule helps us to determine the ...

- A force on the conductor.
B field on the conductor.
C direction of induced emf.
D direction of the electric field around the conductor.

(2)

- 1.7 In the circuit below, the battery has negligible internal resistance. Bulbs 1, 2 and 3 are identical. Switch S_1 is closed and switch S_2 is open.



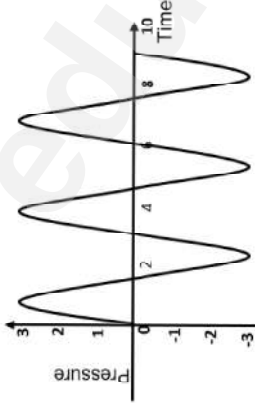
Which ONE of the following is true concerning the ammeter and the voltmeter readings when switch S_2 is closed?

	Ammeter reading A	Voltmeter reading V
A	Decreases	Increases
B	Increases	Increases
C	Decreases	Decreases
D	Increases	Decreases

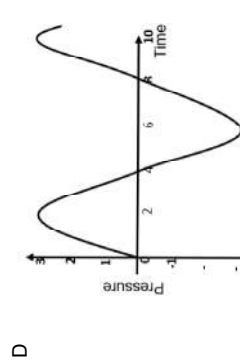
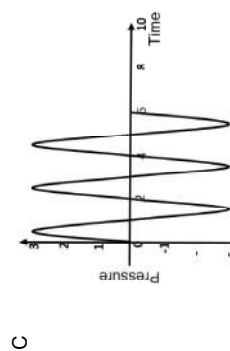
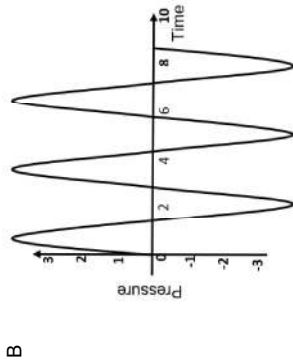
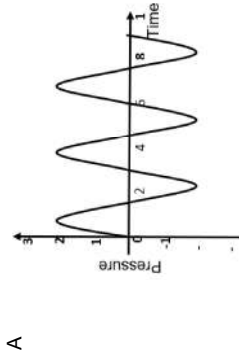
(2)

P.T.O.

- 1.8 The pressure vs time graph for a stationary source, relative to the observer, is shown below.



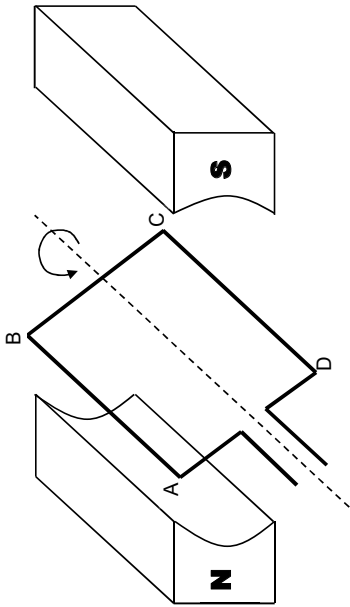
Which of the following sound waves best represents the sound wave if the source is moving towards the observer?



(2)

P.T.O.

- 1.9 A rectangular wire loop ABCD is rotated between two poles of a magnet as shown below.



Which of the following is true concerning the induced emf and induced current in the coil when the loop is at the position shown in the diagram above? The loop is being rotated anti-clockwise.

	Induced emf	Induced current
A	Increasing	Decreasing
B	Increasing	Increasing
C	Decreasing	Decreasing
D	Decreasing	Increasing

(2)

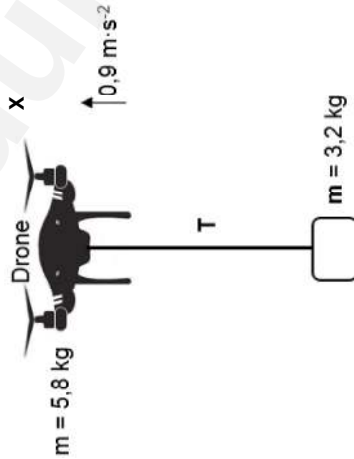
- 1.10 When light of a certain frequency is shone on a metal surface, no electrons are ejected from the surface. Which of the following changes may result in electrons being ejected from the metal surface?

- A Use a metal with a larger work function.
- B Increase the surface area of the metal.
- C Increase the intensity of the light.
- D Use light with a much higher frequency.

(2)
[20]

QUESTION 2 (Start on a new page.)

In the diagram below a drone, with a mass $5,8 \text{ kg}$, is used to lift a mass. $m = 3,2 \text{ kg}$ by using an inextensible cable of negligible mass. The tension in the cable is T , and the drone accelerates vertically upwards at $0,9 \text{ m}\cdot\text{s}^{-2}$. The lifting force of the drone is 180 N . The frictional force f experienced by the drone and the mass m , as they move upwards, is the same.

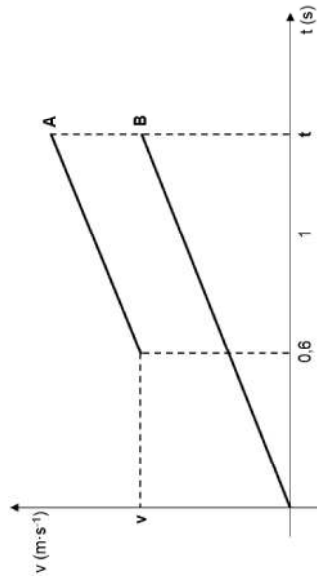


- 2.1 State Newton's Second Law of Motion in words. (2)
- 2.2 Draw a fully-labelled, free-body diagram for the mass m . (3)
- 2.3 Calculate the magnitude of the frictional force experienced by the drone and m . (7)
- 2.4 Calculate the tension in the cable. (2)
- 2.5 The drone reaches its maximum constant speed of $19,7 \text{ m}\cdot\text{s}^{-1}$ after it has passed point X . The lifting force does not change. (3)
- 2.6 Calculate the power of the motors of the drone. [17]

P.T.O.

QUESTION 3 Start on a new page.)

The two velocity-time graphs below, are for two objects **A** and **B** falling vertically towards the ground. Both objects start from a height of 8 m and strike the ground at the same time t . Ignore the effects of friction.

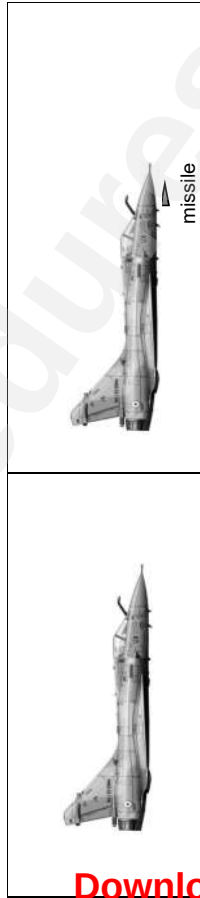


- 3.1 Explain the term *projectile*. (2)
- 3.2 Which ONE of the objects, **A** or **B**, was projected (thrown) downwards? Choose from **A** or **B**. (1)
 - 3.2.1 (1)
 - 3.2.2 Give a reason for your answer to QUESTION 3.2.1. (4)
- 3.3 Calculate the following values on the graph. (4)
 - 3.3.1 Time t (4)
 - 3.3.2 Velocity v of object **A** (4)
- 3.4 How does the area under graph **A** compare with that of graph **B**? Choose from: SAME AS, GREATER, LESS THAN. (2)
 - 3.4.1 Give a reason for your answer. (2)
- 3.5 Write the magnitude and direction of the vector represented by the gradient. (2) [16]

P.T.O.

QUESTION 4 (Start on a new page.)

In the diagram below, a fighter jet is flying in a straight line at a constant speed of $275 \text{ m} \cdot \text{s}^{-1}$. The pilot fires a missile forward so that the missile leaves the jet with a speed of $700 \text{ m} \cdot \text{s}^{-1}$. The mass of the jet is $5\,000 \text{ kg}$ and that of the missile is 50 kg .



- 1 Define *impulse* in words. (2)
- 2 The missile takes a time of $1,5 \text{ s}$ to reach the speed of $700 \text{ m} \cdot \text{s}^{-1}$ from rest. Use the impulse-momentum theorem to calculate the magnitude of the net force on the missile. (4)
- 3 Treat the system as an isolated system and calculate the velocity of the fighter jet immediately after the missile has been fired. (5)
- 4 Explain why the system must be treated as an isolated system to calculate the speed of the jet after the missile has been fired. (2)

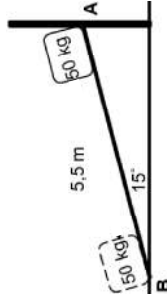
[13]

P.T.O.

QUESTION 5 (Start on a new page.)

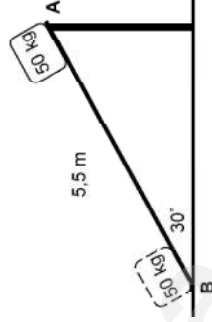
In Diagram 1 below, a slide of length **AB** equal to $5,5 \text{ m}$ is inclined at an angle of 15° . In a test, a 50 kg mass, travels the length of **AB** at **CONSTANT** speed. The kinetic friction of the slide is unknown.

Diagram 1



In Diagram 2 below the inclined angle of the same slide of length $5,5 \text{ m}$ is increased to 30° . The mass of 50 kg starts from rest at **A** and slides down the slide to point **B**.

Diagram 2



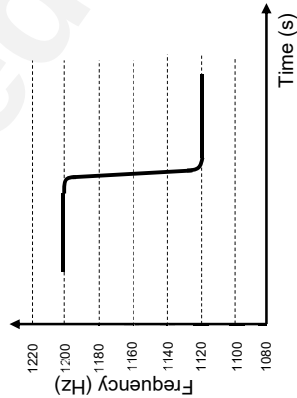
The kinetic coefficient of friction for the slope in Diagram 1 and Diagram 2 are identical.

- 5.1 State the *work-energy theorem* in words. (2)
- 5.2 Use energy principles to calculate the ... (6)
- 5.2.1 Kinetic coefficient of the surface. (5)
- 5.2.2 speed of the mass at point **B** in Diagram 2. [13]

P.T.O.

QUESTION 6 (Start on a new page.)

A racing car approaches a data capturing centre at a racetrack. The motion-monitoring machine produces a frequency versus time trace as shown below.



- 1 State the *Doppler effect* in words. (2)
- 2 Write down the frequency detected by the machine as the race car ... (1)
 - 6.2.1 approaches the data centre. (1)
 - 6.2.2 moves away from the data centre. (5)
- 3 Calculate the speed of the race car if the frequency produced by the motion-monitoring machine is 1 160 Hz. (2)

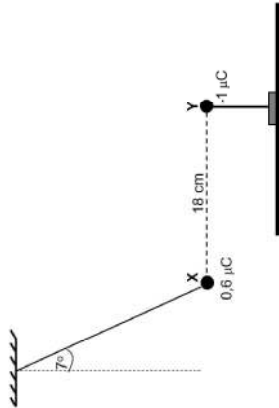
Take the speed of sound in air as $340 \text{ m} \cdot \text{s}^{-1}$.
- 4 Doctors use the Doppler flow meter for diagnostic purposes on patients who have blocked arteries. (1)
 - 6.4.1 State what is measured in a human using the Doppler flow meter. (2)
 - 6.4.2 Explain how the Doppler effect works in the answer to QUESTION 6.4.1. (1)
- 5 While studying the stars through a telescope it is noticed that a red colour is observed behind the stars. (1)
 - 6.5.1 What is this phenomenon called? (2)
 - 6.5.2 Should the people on earth be worried about this occurrence? (2)

Give a reason for your answer by referring to the motion of the star. [15]

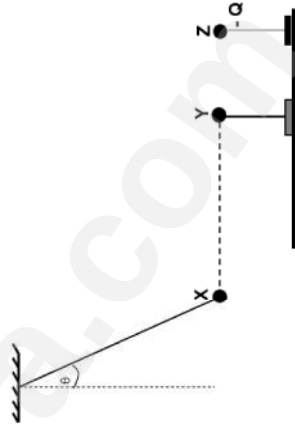
P.T.O.

QUESTION 7 (Start on a new page.)

Ball **X** carries a charge of $+0.6 \mu\text{C}$ and is suspended from the ceiling with an inelastic thread as shown below. Another ball, **Y**, on an insulated stand, carries a charge of $-1 \mu\text{C}$ and is brought to a distance of 18 cm from ball **X**. Ball **X** moves towards ball **Y** due to electrostatic attraction so that it suspends at an angle of 7° from the vertical and remains in equilibrium.



- 7.1 State *Coulomb's law* in words. (2)
- 7.2 Draw a labelled, free-body diagram showing ALL the forces acting on ball **X**. (3)
- 7.3 Calculate the magnitude of the tension in the string. (4)
- 7.4 A third small ball **Z**, on an insulated stand, is placed to the right of **Y**, but not touching **Y**, as shown below. Ball **Z** carries a negative charge.

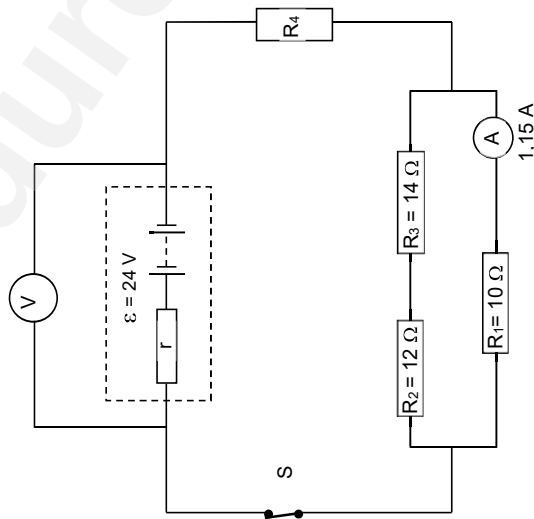


- 7.4.1 What effect will the charge on ball **Z** have on the angle of inclination of **X**? State only: INCREASE, STAY THE SAME, DECREASE. (1)
 - 7.4.2 Explain the answer to QUESTION 7.4.1. (2)
 - 7.4.3 Explain why balls **Y** and **Z** must be placed on insulated stands. (2)
- [14]

P.T.O.

QUESTION 8 (Start on a new page.)

The circuit below consists of a battery with an emf of 24 V and an unknown internal resistance, r . Three ohmic resistors R_1 , R_2 , and R_3 have resistances as shown in the diagram. Resistance of R_4 is not known. When switch S is closed, the reading on voltmeter V is 21,5 V whilst the ammeter reads 1,15 A.

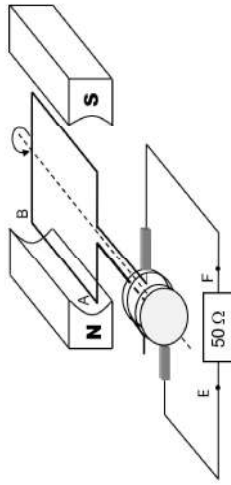


- 8.1 Explain the term *ohmic resistor*. (2)
- 8.2 Calculate the following: (4)
- 8.2.1 Magnitude of the current through resistor R_2 (4)
- 8.2.2 Resistance of resistor R_4 (4)
- 8.2.3 Internal resistance of the battery (3)
- 8.3 By referring to energy transfer in the battery, explain why the reading on voltmeter V decreases when switch S is closed. (2)
- [15]

P.T.O.

QUESTION 9 (Start on a new page.)

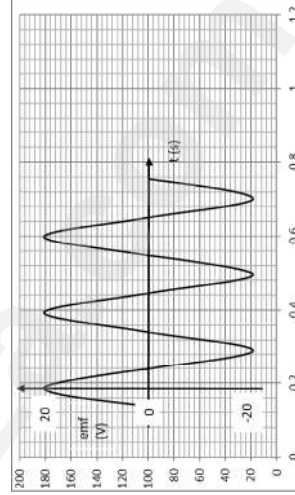
The diagram below shows a generator with copper coils being rotated between poles of permanent magnets.



9.1 State ...

- 9.1.1 the direction of the induced current in the left side of the coil marked AB. State only (A to B, or B to A). (1)
- 9.1.2 the name of the law that relates the induced emf to the rate of change of magnetic flux in the coil. (1)
- 9.1.3 what should be done to change this generator to a DC generator. (2)

9.2 The shape of the emf of this generator between the points **E** and **F** is shown below. The peak emf output is 20 V as shown in the graph.



- 9.2.1 The above output is reproduced for you on the ANSWER SHEET attached to the question paper. On the same set of axes, draw the output emf if the speed of the coil is halved. (2)
- 9.2.2 Explain the change, if any, on the emf graph. (2)
- 9.3 Calculate the average power of this generator. (5)
- [13]

P.T.O.

QUESTION 10 (Start on a new page.)

An experiment was conducted to demonstrate the photoelectric effect. Light of a certain frequency was shone onto a metal surface of a photocell and the corresponding maximum kinetic energy of the released electrons was measured. This was repeated for several other frequencies while still using the same metal. The results are recorded in the table below.

Frequency of photons ($\times 10^{14}$ Hz)	Maximum kinetic Energy $E_{k(max)}$ ($\times 10^{-19}$ J)
5,49	0,72
6,91	1,63
7,41	1,92
8,23	2,53
9,61	3,39
11,83	4,83

- 10.1 Define the term *photoelectric effect*. (2)
- 10.2 Formulate an investigative question for this investigation. (2)
- 10.3 Identify the ...
- 10.3.1 independent variable. (1)
- 10.3.2 controlled variable. (1)
- 10.4 Use the information given in the table above and draw a graph of maximum kinetic energy ($E_{k(max)}$) versus frequency on the attached ANSWER SHEET. (4)
- 10.5 Use the graph to determine the ...
- 10.5.1 threshold frequency of the metal in the photoelectric cell. (1)
- 10.5.2 work function of the metal used as the cathode in the photocell. (3)

TOTAL: 150

END



PREPARATORY EXAMINATION/ VOORBEREIDENDE EKSAMEN

2014

MEMORANDUM

SUBJECT/VAK:	PHYSICAL SCIENCES: PHYSICS (P1)/ FISIESE WETenskAPPE: FISIKA (V1) (10841)
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QUESTION 2/VRAAG 2

- 2.1 Acceleration is the rate ✓ of change in velocity / ✓
Versnelling is die tempo ✓ van verandering in snelheid ✓
- Acceleration is the change in velocity ✓ per unit time / ✓
Versnelling is die verandering in snelheid ✓ per eenheid tyd ✓

(2)

2.2 Accepted Labels/Aanvaarde benoemings

- w F_g/F_w /force of Earth on block/weight/49 N/mg/gravitational force
 F_g/F_w /krag van Aarde op blok/gewig/49 N/mg/gravitasiekrag
- N F_N /normal
 F_N /normaal
- f Friction/ F_f
Wrywing/ F_f



Note/Nota
One mark for correct arrow and label.
If any other forces shown max. $\frac{2}{5}$

Een punt vir die korrekte pyl en benaming
Indien enige ander krag getoon word maks. $\frac{2}{5}$

(3)

- 2.3 **OPTION 1/OPSIE 1**
Upward positive:
Opwaarts positief:
For/Vir 2 kg

$$F_{\text{net}} = ma \checkmark$$

$$T - F_g = ma$$

$$21 - 19,6 = 2a \checkmark$$

$$a = 0,7 \text{ m} \cdot \text{s}^{-2}$$

- OPTION 2/OPSIE 2**
Upward negative:
Opwaarts negatief:
For/Vir 2 kg

$$F_{\text{net}} = ma \checkmark$$

$$F_g - T = ma$$

$$19,6 - 21 = 2a \checkmark$$

$$a = -0,7 \text{ m} \cdot \text{s}^{-2}$$

$$\therefore a = 0,7 \text{ m} \cdot \text{s}^{-2}$$

(3)

2

10841/14

GAUTENG DEPARTMENT OF EDUCATION/
GAUTENGSE DEPARTEMENT VAN ONDERWYS
PREPARATORY EXAMINATION/
VOORBEREIDENDE EKSAMEN

PHYSICAL SCIENCES: PHYSICS (P1)/
FISIESE WETenskAPPE: FISIKA (V1)

MEMORANDUM

QUESTION 1/VRAAG 1

- | | | |
|------|------|-----|
| 1.1 | B ✓✓ | (2) |
| 1.2 | D ✓✓ | (2) |
| 1.3 | B ✓✓ | (2) |
| 1.4 | B ✓✓ | (2) |
| 1.5 | C ✓✓ | (2) |
| 1.6 | A ✓✓ | (2) |
| 1.7 | D ✓✓ | (2) |
| 1.8 | C ✓✓ | (2) |
| 1.9 | A ✓✓ | (2) |
| 1.10 | C ✓✓ | (2) |

[20]

10841/14

- 2.4 **OPTION 1/OPSIE 1**
Parallel down positive:
Parallel af positief:
For/Vir 5 kg

$$F_{\text{net}} = ma$$

$$F_g \sin \theta - T - f = ma \checkmark$$

$$78,4 \sin 20^\circ - 21 - f = 8(0,7) \checkmark$$

$$f = 0,21 \text{ N} \checkmark$$

- OPTION 2/OPSIE 2**
Parallel down negative:
Parallel af negatief:
For/Vir 5 kg

$$F_{\text{net}} = ma$$

$$-F_g \sin \theta + T + f = ma \checkmark$$

$$-78,4 \sin 20^\circ + 21 + f = 8(-0,7) \checkmark$$

$$f = -0,21 \text{ N}$$

$$\therefore f = 0,21 \text{ N}$$

Note/Nota
Any one of the
two answers.
Enige een van die
twee antwoorde

(4)

[11]

QUESTION 3/VRAAG 3

- 3.1 $9,8 \text{ m} \cdot \text{s}^{-2}$ ✓ downward/to the centre of the earth / ✓
 $9,8 \text{ m} \cdot \text{s}^{-2}$ ✓ afwaarts / na die middelpunt van die aarde ✓

(2)

- 3.2 **OPTION 1 / OPSIE 1**
 Downward positive:
 Afwaarts positief:
 From t_1 to t_2 / Vanaf t_1 na t_2

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$0,9 = 0 + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

- OPTION 3 / OPSIE 3**
 Downward positive:
 Afwaarts positief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = v_i^2 + 2(9,8)(-0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = -4,2 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a\Delta t \checkmark$$

$$0 = -4,2 + (9,8)\Delta t \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

- OPTION 2 / OPSIE 2**
 Downward negative:
 Afwaarts negatief:
 From t_1 to t_2 / Vanaf t_1 na t_2

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-0,9 = 0 + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

- OPTION 4 / OPSIE 4**
 Downward negative:
 Afwaarts negatief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = v_i^2 + 2(-9,8)(0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

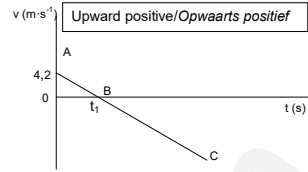
$$\therefore v_i = 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a\Delta t \checkmark$$

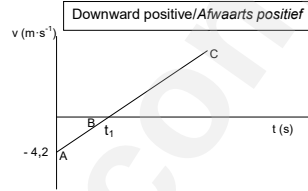
$$0 = 4,2 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

4

3.4 POSITIVE MARKING FROM QUESTION 3.2 AND 3.3
 POSITIEWE NASIEN VANAF VRAAG 3.2 EN 3.3

Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Straight line, crossing x-axis Reguitlyn, kruis die x-as	✓
AB is shorter than BC AB is korter as BC	✓
$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$	✓
$t_1 = 0,43 \text{ s}$	✓



Note/Nota
 if no/incorrect labels on axis: max. $\frac{3}{4}$
 as geen/verkeerde benamings vir
 asse dan: maks. $\frac{3}{4}$

(4)
 [14]

6

- OPTION 5 / OPSIE 5**
 Downward positive:
 Afwaarts positief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = v_i^2 + 2(9,8)(-0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = -4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$$

$$-0,9 = \frac{-4,2 + 0}{2} \Delta t \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

- OPTION 6 / OPSIE 6**
 Downward negative:
 Afwaarts negatief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = v_i^2 + 2(-9,8)(0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$$

$$0,9 = \frac{4,2 + 0}{2} \Delta t \checkmark$$

$$\Delta t = 0,43 \text{ s} \checkmark$$

(4)

3.3 POSITIVE MARKING FROM QUESTION 3.2
 POSITIEWE NASIEN VANAF VRAAG 3.2

- OPTION 1 / OPSIE 1**
 Downward positive:
 Afwaarts positief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = v_i^2 + 2(9,8)(-0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = -4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = -4,2 \text{ m} \cdot \text{s}^{-1} \text{ upward/opwaarts}$$

- OPTION 1 / OPSIE 1**
 Downward negative:
 Afwaarts negatief:
 From 0 to t_1 / Vanaf 0 na t_1

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = v_i^2 + 2(-9,8)(0,9) \checkmark$$

$$v_i = \pm 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = 4,2 \text{ m} \cdot \text{s}^{-1} \text{ upward/opwaarts}$$

- OPTION 3 / OPSIE 3**
 Downward positive:
 Afwaarts positief:
 From 0 to t_2 / Vanaf 0 na t_2

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$0,9 = v_i (0,43) + \frac{1}{2} (9,8) (0,43)^2 \checkmark$$

$$v_i = -4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = -4,2 \text{ m} \cdot \text{s}^{-1} \text{ upward/opwaarts}$$

- OPTION 4 / OPSIE 4**
 Downward negative:
 Afwaarts negatief:
 From 0 to t_2 / Vanaf 0 na t_2

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-0,9 = v_i (0,43) + \frac{1}{2} (9,8) (0,43)^2 \checkmark$$

$$v_i = 4,2 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_i = 4,2 \text{ m} \cdot \text{s}^{-1} \text{ upward/opwaarts}$$

(4)

QUESTION 4/VRAAG 4

4.1 $F_g = \frac{Gm_1m_2}{d^2} \checkmark$

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(1,99 \times 10^{19})}{(1,496 \times 10^8)^2} \checkmark$$

$$F_g = 3,52 \times 10^{21} \text{ N attractive / aantrekkend} \checkmark$$

OR/OF

$$F_g = 3,55 \times 10^{21} \text{ N towards X / na X}$$

(4)

4.2 $(3,55 \times 10^{21}) \times 8 = 2,84 \times 10^{22} \text{ N towards moon Y / na maan Y} \checkmark \checkmark$

(2)

4.3 $F_{\text{net}} = F_{\text{MX}}^2 + F_{\text{MY}}^2 \checkmark$

$$F_{\text{net}} = (3,55 \times 10^{21})^2 + (2,84 \times 10^{22})^2 \checkmark$$

$$F_{\text{net}} = 2,86 \times 10^{22} \text{ N} \checkmark$$

(2)

[8]



QUESTION 5/VRAAG 5

- 5.1 Impulse = area between graph and x-axis
 Impuls = oppervlakte tussen grafiek en x-as
 Impulse = $\frac{1}{2}bh + \frac{1}{2}bh + lb \checkmark$
 Impulse = $\frac{1}{2}(2)(10) + \frac{1}{2}(2)(-10) + (6)(-10) \checkmark$
 Impulse = $-60 \text{ N} \cdot \text{s} \checkmark$

$\therefore \text{Impulse} = 60 \text{ N} \cdot \text{s} \text{ in oppositedirection/west}$
 $\therefore \text{Impuls} = 60 \text{ N} \cdot \text{s} \text{ in teenoorgestelde rigting/wes}$

(3)

- 5.2 Greater than / Groter as ✓

(1)

- 5.3 **OPTION 1 / OPSIE 1**
 East positive:
 Oos positief:

$$\text{Impulse} = mv_i - mv_f \checkmark$$

$$-60 = (12)v_i - (12)(5,5) \checkmark$$

$$v_i = 0,5 \text{ m} \cdot \text{s}^{-1} \text{ east / oos} \checkmark$$

- OPTION 2 / OPSIE 2**
 West positive:
 Wes positief:

$$\text{Impulse} = mv_i - mv_f \checkmark$$

$$-60 = (12)v_i - (12)(5,5) \checkmark$$

$$v_i = 0,5 \text{ m} \cdot \text{s}^{-1} \text{ east / oos} \checkmark$$

(4)

[8]

QUESTION 6/VRAAG 6

6.1 $W = F\Delta x \cos \theta$ ✓
 $W = (20)(32) \cos 10^\circ$ ✓
 $W = 630,28 \text{ J}$ ✓

6.2 OPTION 1 / OPSIE 1

$$F_{\text{net}} = F - F_G \sin \theta - f$$

$$F_{\text{net}} = 20 - 59,78 \sin 10^\circ - 11$$

$$F_{\text{net}} = -1,38 \text{ N}$$

$$F_{\text{net}} = 1,38 \text{ N backwards/agteruit}$$

$$W_{\text{net}} = \Delta E_K$$

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$(1,38)(32) \cos 180^\circ = \frac{1}{2} (6,1)(v_f^2 - 5^2)$$

$$v_f^2 = 10,51$$

$$v_f = 3,24 \text{ m} \cdot \text{s}^{-1}$$

Notes/Aantekeninge:

If "net" left out for F_{net} : Max. $\frac{2}{5}$

As "net" uitgelaat is

vir F_{net} : Maks. $\frac{2}{5}$

(3)

(5)

OPTION 2 / OPSIE 2

$$W_{\text{net}} = \Delta E_K$$

$$F\Delta x \cos \theta + f\Delta x \cos \theta + F_G \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$(20)(32) \cos 0^\circ + (11)(32) \cos 180^\circ + (59,78)(32) \cos 10^\circ = \frac{1}{2} (6,1)v_f^2 - \frac{1}{2} (6,1)(5^2)$$

$$v_f^2 = 10,51$$

$$v_f = 3,24 \text{ m} \cdot \text{s}^{-1}$$

OPTION 3 / OPSIE 3

$$W_{\text{net}} = \Delta E_K$$

$$F\Delta x \cos \theta + f\Delta x \cos \theta + F_G \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$(20)(32) \cos 0^\circ + (11)(32) \cos 180^\circ + (59,78 \sin 10^\circ)(32) \cos 180^\circ = \frac{1}{2} (6,1)v_f^2 - \frac{1}{2} (6,1)(5^2)$$

$$v_f^2 = 10,51$$

$$v_f = 3,24 \text{ m} \cdot \text{s}^{-1}$$

- 6.3 The net work done by the non-conservative force / frictional force depends on the path the object travelled ✓ / Die netto arbeid verrig deur 'n nie-konservatiewe krag / wrywingskrag is onafhanklik van die roete geneem ✓ / OR/OF

The mechanical energy is not constant ✓ for a non-conservative force / Die meganiese energie is nie konstant ✓ vir 'n nie-konservatiewe krag nie

(2)

8

11

QUESTION 7/VRAAG 7

7.1.1 $\Sigma E_{\text{in 56m}} = \Sigma E_{\text{in 10m}}$

$$(E_P + E_K)_{56\text{m}} = (E_P + E_K)_{10\text{m}}$$

$$mgh + 0 = mgh + \frac{1}{2}mv^2$$

$$9,8(56) = 9,8(18) + \frac{1}{2}v^2$$

$$v = 27,29 \text{ m} \cdot \text{s}^{-1}$$

(4)

7.1.2 POSITIVE MARKING FROM QUESTION 7.1
POSITIEWE NASIEN VANAF VRAAG 7.1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$$

OR/OF

$$f_L = \frac{v}{v - v_s} f_s$$

$$f_L = \left(\frac{340}{340 - 27,29} \right) 497 \times 10^3$$

$$f_L = 5,4 \times 10^5 \text{ Hz}$$

Notes:

• Any other Doppler formula, e.g.

$$f_L = \frac{v + v_L}{v - v_s} f_s - \text{Maks. } \frac{3}{4} \text{ for calculation}$$

• Marking rule 1.5: No penalisation if zero substitutions are omitted.

Aantekeninge:

• Enige ander Dopplerformule, bv.

$$f_L = \frac{v + v_L}{v - v_s} f_s - \text{Maks. } \frac{3}{4} \text{ vir berekening}$$

• Nasienreël 1.5: Geen punte word verbeur indien nul substitusies weggelaat word nie.

(4)

- 7.1.3 The phone is moving away from Keenan who is stationary, the phone is increasing the distance between each wavefront and therefore the wavelength increases. This causes the frequency to decrease since $f \propto \frac{1}{\lambda}$ for the same speed of sound. Die selfoon beweeg weg van Keenan af, die foon vergroot dus die grootte van die afstand tussen die golf fronte en die golflengte vergroet. Dit veroorsaak dat die frekwensie afneem aangesien $f \propto \frac{1}{\lambda}$ vir dieselfde spoed van klank.

(3)

- 7.1.4 HIGHER; ✓ / HOËR ✓

(1)

- 7.2 7.2.1 The observed frequency is the same as the original frequency of the source. The car is moving perpendicular to the camera. Die waargenome frekwensie is dieselfde as die oorspronklike frekwensie van die bron. Die motor beweeg loodreg ten opsigte van die kamera.

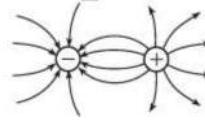
(1)

- 7.2.2 $3 \times 10^8 \text{ m} \cdot \text{s}^{-1}$ ✓
 It is an electromagnetic wave. ✓ / Dit is 'n elektromagnetiese golf. ✓

Downloaded from eduresourceza.com

QUESTION 8/VRAAG 8

8.1



Criteria for sketch Kriteria vir skets	Marks Punte
Correct shape as shown. Korrekke vorm soos getoon	✓
Direction from positive to negative. Rigting van positief na negatief.	✓
Field lines start on spheres and do not cross. Veldlyne begin op elke sfeer en kruis nie.	✓

(3)

8.2

$$F_{\text{B on A}} = \frac{kQ_A Q_B}{r^2}$$

$$F_{\text{B on A}} = \frac{(9 \times 10^9)(4,5 \times 10^{-5})(9,5 \times 10^{-5})}{(0,35)^2}$$

$$F_{\text{B on A}} = 314,08 \text{ N to the right / na regs}$$

(4)

8.3

POSITIVE MARKING FROM QUESTION 8.2
POSITIEWE NASIEN VANAF VRAAG 8.2

Option 1/Opsie 1

$$E_A = \frac{kQ_A}{r^2}$$

$$E_A = \frac{(9 \times 10^9)(4,5 \times 10^{-5})}{(0,35)^2}$$

$$E_A = 3,31 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the right / na regs}$$

Option 2/Opsie 2

$$E_A = \frac{F_{\text{A on B}}}{q_B}$$

$$E_A = \frac{314,08}{9,5 \times 10^{-5}}$$

$$E_A = 3,31 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the right / na regs}$$

(3)
[10]

QUESTION 9 / VRAAG 9

9.1

Criteria for hypothesis / Kriteria vir hipotese:	Mark/ Punt
The dependent and independent variables are stated. Die afhanklike en onafhanklike veranderlikes is genoem.	✓
Makes a statement about the relationship between dependent and independent variables. Maak 'n stelling oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes.	✓

Independent variable/Onafhanklike veranderlike:
Amount of potato cells / Aantal aartappelselle

Dependent variable/Afhanklike veranderlike:

Bulb glows or not / Gloeilampie gloei of nie

Or/of

Current (strength) / Stroom (sterkte)

Examples/Voorbeelde:

More potato cells will increase the brightness of the bulb / Meer aartappelselle sal die helderheid van die gloeilampie laat toeneem.

More potato cells will increase the current through the bulb / Meer aartappelselle sal die grootte van die stroom deur die gloeilampie laat toeneem.

Notes/

Aantekeninge:

A statement that does not contain a relationship: Max ½
 'n Stelling wat geen verwantskap bevat nie: Maks. ½

Example/

Voorbeeld:

Three potato cells are needed to make penlight bulb glow. ½
 Drie aartappelselle is nodig om die gloeilampie te laat gloei. ½

(2)

9.2

Dependent variable/Afhanklike veranderlike:

Bulb glows or not / Gloeilampie gloei of nie

Or/of

Current (strength) / Stroom (sterkte)

(1)

9.3

1,6 V

(1)

9.4

The battery has an internal resistance / Die battery het 'n interne weerstand

(1)

9.5

$$P = \frac{V^2}{R}$$

$$P = \frac{(0,02)^2}{2}$$

$$P = 2 \times 10^{-4} \text{ W}$$

(3)
[8]

QUESTION 10/VRAAG 10

- 10.1 The potential difference is directly proportional to the current ✓ through the resistor if the temperature stays the same. ✓
Die potensiaalverskil is direk eweredig aan die stroomsterkte ✓ deur die resistor, mits die temperatuur konstant bly ✓ vir die resistor. (2)

10.2 $R_1 = \frac{V}{I}$ ✓
 $R_1 = \frac{129}{15}$ ✓
 $R_1 = 8,6 \Omega$ ✓ (3)

10.3 **POSITIVE MARKING FROM QUESTION 11.2**
POSITIEWE NASIEN VAN VRAAG 11.2

$\frac{1}{R_{\text{tot}}} = \frac{1}{R_1} + \frac{1}{R_{\text{series}}}$ ✓
 $\frac{1}{R_{\text{tot}}} = \frac{1}{8,6} + \frac{1}{(4+5)}$ ✓
 $\frac{1}{R_{\text{tot}}} = \frac{88}{387}$ ✓
 $R_{\text{tot}} = 4,4 \Omega$ ✓ (3)

10.4 **POSITIVE MARKING FROM QUESTION 11.3**
POSITIEWE NASIEN VAN VRAAG 11.3

Option 1/Opsie 1:

$I_{\text{total}} = \frac{V}{R_{\text{total}}}$ ✓
 $I_{\text{total}} = \frac{129}{4,4}$ ✓
 $I_{\text{total}} = 2,93 \text{ A}$ ✓
 $r = \frac{V_{\text{lost}}}{I}$ ✓
 $r = \frac{15 - 129}{2,93}$ ✓
 $r = 0,72 \Omega$ ✓

Option 2/Opsie 2:

$I_{\text{total}} = \frac{V}{R_{\text{total}}}$ ✓
 $I_{\text{total}} = \frac{129}{4,4}$ ✓
 $I_{\text{total}} = 2,93 \text{ A}$ ✓
 $\epsilon = IR + Ir$ ✓
 $15 = (2,93)(4,4) + (2,93)r$ ✓
 $r = 0,72 \Omega$ ✓

13

11.2 11.2.1 Option 1/Opsie 1:

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ ✓
 $I_{\text{rms}} = \frac{80}{\sqrt{2}}$ ✓
 $I_{\text{rms}} = 56,57 \text{ A}$ ✓
 $V_{\text{rms}} = I_{\text{rms}} R$ ✓
 $V_{\text{rms}} = (56,57)(510)$ ✓
 $V_{\text{rms}} = 2,89 \times 10^4 \text{ V}$ ✓

Option 2/Opsie 2:

$V_{\text{rms}} = I_{\text{rms}} R$ ✓
 $V_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} R$ ✓
 $V_{\text{rms}} = \left(\frac{80}{\sqrt{2}}\right)(510)$ ✓
 $V_{\text{rms}} = 2,89 \times 10^4 \text{ V}$ ✓

(5)

11.2.2 Option 1/Opsie 1:

$P_{\text{ave}} = I_{\text{rms}}^2 R$ ✓
 $P_{\text{ave}} = (56,57)^2 (510)$ ✓
 $P_{\text{ave}} = 1,63 \times 10^6 \text{ W}$ ✓

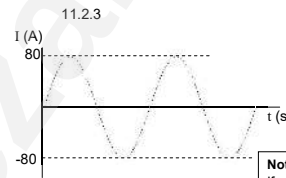
Option 2/Opsie 2:

$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ ✓
 $P_{\text{ave}} = \frac{(2,89 \times 10^4)^2}{510}$ ✓
 $P_{\text{ave}} = 1,63 \times 10^6 \text{ W}$ ✓

(3)

Option 3/Opsie 3:

$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ ✓
 $P_{\text{ave}} = (2,89 \times 10^4)(56,57)$ ✓
 $P_{\text{ave}} = 1,63 \times 10^6 \text{ W}$ ✓



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Sinus or cosines graph Sinus of kosinus grafiek	✓
Two cycles Twee siklusse	✓
Max and min I-values indicated Maks en min I-waardes getoon	✓

Note/Nota
 if no/incorrect labels on y-axis: max. $\frac{2}{3}$
 as geen/verkeerde benamings vir y-as
 dan: maks. $\frac{2}{3}$

(4) [18]

15

Option 3/Opsie 3:

$I_{\text{series}} = \frac{V}{R_{\text{series}}}$ ✓
 $I_{\text{series}} = \frac{129}{9}$ ✓
 $I_{\text{series}} = 1,43 \text{ A}$ ✓
 $I_{\text{total}} = 1,5 + 1,43$ ✓
 $I_{\text{total}} = 2,93 \text{ A}$ ✓
 $r = \frac{V_{\text{lost}}}{I}$ ✓
 $r = \frac{15 - 129}{2,93}$ ✓
 $r = 0,72 \Omega$ ✓

Option 4/Opsie 4:

$I_{\text{series}} = \frac{V}{R_{\text{series}}}$ ✓
 $I_{\text{series}} = \frac{129}{9}$ ✓
 $I_{\text{series}} = 1,43 \text{ A}$ ✓
 $I_{\text{total}} = 1,5 + 1,43$ ✓
 $I_{\text{total}} = 2,93 \text{ A}$ ✓
 $\epsilon = IR + Ir$ ✓
 $15 = (2,93)(4,4) + (2,93)r$ ✓
 $r = 0,72 \Omega$ ✓

(4) [12]

QUESTION 11/VRAAG 11

- 11.1 11.1.1 DC: ✓ It is powered by a DC-source ✓
 GS: ✓ Dit word aangedryf deur 'n GS-bron ✓ (2)
- 11.1.2
- Increase the emf of the source
 - Increase the amount or turns on the coil
 - Increase the strength of the magnet ✓✓ [any two]
- Verhoog die emk van die bron
- Vermeerder die aantal windings op die spoel
- Gebruik 'n sterker magneet ✓✓ [enige twee] (2)
- 11.1.3 X: South pole / Suidpool ✓
 Y: North pole / Noordpool ✓ (2)

QUESTION 12/VRAAG 12

- 12.1 12.1.1 Workfunction is the minimum energy of a photon ✓ needed to set an electron free from the surface of a metal ✓ /
Werkfunksie is die minimum energie wat 'n foton ✓ moet hê om 'n elektron vry te stel uit die oppervlak van 'n metaal. (2)

12.1.2 $43,9 \times 10^{-19} \text{ Hz}$ ✓✓ (2)

12.1.3 **POSITIVE MARKING FROM QUESTION 13.1.2**
POSITIEWE NASIEN VAN VRAAG 13.1.2

Option 1/Opsie 1:

$E = W_0 + E_K$ ✓
 $hf = hf_0 + \frac{1}{2}mv^2$ ✓ Any one/Enige een
 $(6,63 \times 10^{-34})(100 \times 10^{-19}) = (6,63 \times 10^{-34})(43,9 \times 10^{-19}) + \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓
 $v^2 = 8,17 \times 10^{-21}$ ✓
 $v = 9,04 \times 10^{-11} \text{ m} \cdot \text{s}^{-1}$ ✓

Option 2/Opsie 2:

$E = hf$ ✓
 $E = (6,63 \times 10^{-34})(100 \times 10^{-19})$ ✓
 $E = 6,63 \times 10^{-51} \text{ J}$ ✓
 $W_0 = hf_0$ ✓
 $W_0 = (6,63 \times 10^{-34})(43,9 \times 10^{-19})$ ✓
 $W_0 = 2,91 \times 10^{-51} \text{ J}$ ✓
 $E_K = \frac{1}{2}mv^2$ ✓
 $E - W_0 = \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓
 $6,63 \times 10^{-51} - 2,91 \times 10^{-51} = \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓
 $v^2 = 8,17 \times 10^{-21}$ ✓
 $v = 9,04 \times 10^{-11} \text{ m} \cdot \text{s}^{-1}$ ✓ (5)

- 12.1.4 The data points are not connected directly, an average straight line connecting most of the points are drawn ✓ /
Die data punte is nie direk verbind nie, 'n gemiddelde reguitlyn wat deur so veel as moontlik punte gaan word geteken. ✓ (1)

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION – 2015

PHYSICAL SCIENCES: PHYSICS/
FISIESE WETENSAPPE: FISIKA
(First Paper/Eerste Vraestel)

- 12.2 12.2.1 Emission spectra occurs when a light source gives off light✓ and absorption spectra occurs when white light is observed through a cold gas✓ /
Emissiespektra vorm as 'n ligbron lig afgee✓ tenwyl absorpsiespektra vorm as die wit lig waargeneem word deur 'n koue gas. ✓ (2)

- 12.2.2 RED ✓ it has the longest wavelength of all the visible colours✓ /
ROOI ✓ Dit het die langste golflengte van al die sigbare kleure. ✓ (2)

[125]

150

MEMORANDUM

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
1.2 A ✓✓ (2)
1.3 B ✓✓ (2)
1.4 A ✓✓ (2)
1.5 B ✓✓ (2)
1.6 C ✓✓ (2)
1.7 A ✓✓ (2)
1.8 C ✓✓ (2)
1.9 D ✓✓ (2)
1.10 A ✓✓ (2)

[20]

17

2



PREPARATORY EXAMINATION
2015
MEMORANDUM

SUBJECT: PHYSICAL SCIENCES: PHYSICS P1 (10841)
FISIESE WETENSAPPE: FISIKA V1 (10841)

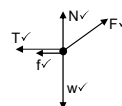
10841/15

QUESTION 2/VRAAG 2

- 2.1 The net force acting on an object is equal to the rate of change in the momentum of the object. ✓✓
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum vir die voorwerp. ✓✓
OR/OF
When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass of the object. / ✓
Wanneer 'n resultante/netto krag op 'n voorwerp inwerk sal die voorwerp in die rigting van die krag versnel met 'n versnelling direk eweredig aan die krag ✓ en omgekeerd eweredig aan die massa. ✓ (2)

2.2 Accepted Labels/Aanvaarde benoemings

w	F_g/F_w /force of Earth on block/weight/49 N/mg/gravitational force F_g/F_w /krag van Aarde op blok/gewig/49 N/mg/gravitasiekrag
N	F_N /normal F_N /normaal
f	Friction/ F_f Wrywing/ F_f
T	Tension/Force in string/ F_T Spanning/Trekkrag (van die tou)/ F_T
F	F_{app} /15 N F_{toeg} /15 N



Note/Nota
One mark for correct arrow and label.
If any other forces shown max. ½

Een punt vir die korrekte pyl en benaming
Indien enige ander krag getoon word maks. ½

(5)

2.3

$$f_k = \mu_k N \checkmark$$

$$f_k = (0,35)(49 - 15 \sin 30^\circ) \checkmark$$

$$f_k = 14,53 \text{ N} \checkmark$$

(3)

2.4 OPTION 1/OPSIE 1

Right positive:
Regs positief:
For/Vir 5 kg

$$\begin{aligned} F_{\text{net}} &= ma \quad \checkmark \\ F \cos 0 - T - f &= m(2,2) \\ 15 \cos 30^\circ - T - 14,53 &= 5(2,2) \quad \checkmark \\ T &= 14,53 - 15 \cos 30^\circ + 11 \\ T &= 12,54 \text{ N} \end{aligned}$$

Upward positive:
Opwaarts positief:
For/Vir B

$$\begin{aligned} F_{\text{net}} &= ma \\ 12,54 - F_G &= m(2,2) \\ 12,54 - 9,8m &= m(2,2) \quad \checkmark \\ 12,54 &= 12m \\ m &= 1,05 \text{ kg} \quad \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

Upward positive:
Opwaarts positief:
For/Vir B

$$\begin{aligned} F_{\text{net}} &= ma \quad \checkmark \\ T - F_G &= m(2,2) \quad \checkmark \\ T - 9,8m &= m(2,2) \\ T &= 12m \quad (\text{A}) \end{aligned}$$

Parallel down positive:
Ewewydig af positief:
For/Vir 5 kg

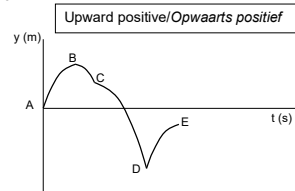
$$\begin{aligned} F_{\text{net}} &= ma \\ F \cos 0 - T - f &= m(2,2) \\ 15 \cos 30^\circ - T - 14,53 &= 5(2,2) \quad \checkmark \\ T &= 14,85 - 15 \cos 30^\circ + 11 \\ T &= 12,54 \text{ N} \quad (\text{B}) \end{aligned}$$

Set/stel (A) = (B)

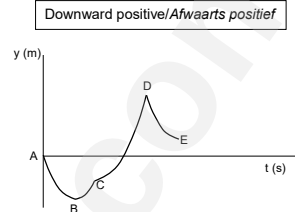
$$\begin{aligned} 12m &= 12,54 \\ m &= 1,05 \text{ kg} \quad \checkmark \end{aligned}$$

(5)
[15]

3.5



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Parabolic shape from A to C	✓
Paraboliese vorm van A tot C	✓
Shape from C to D	✓
Vorm van C tot D	✓
Shape from D to E	✓
Vorm van D tot E	✓
Combination of negative parabola	✓
Kombinasie van negatiewe parabole	✓
A starts at zero	✓
A begin vanaf nul	✓



Note/Nota
if no/incorrect labels on axis: max. 4
as geen/verkeerde benamings vir asse dan: maks. 4

(5)
[13]

4

6

QUESTION 3/VRAAG 3

- 3.1 $9,8 \text{ m}\cdot\text{s}^{-2}$ ✓ downward/to the centre of the earth ✓
 $9,8 \text{ m}\cdot\text{s}^{-2}$ ✓ afwaarts / na die middelpunt van die aarde ✓

- 3.2 Once/one time ✓
Een keer ✓

- 3.3 Upward ✓
Opwaarts ✓

- 3.4 **OPTION 1/ OPSIE 1**
Upward positive:
Opwaarts positief:

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\ -3,2^2 &= 6^2 + 2(-9,8)\Delta y \quad \checkmark \\ \Delta y &= 1,31 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 3 / OPSIE 3
Upward positive:
Opwaarts positief:

$$\begin{aligned} v_f &= v_i + a\Delta t \\ -3,2 &= 6 + (-9,8)\Delta t \quad \checkmark \\ \Delta t &= 0,94 \text{ s} \\ \Delta y &= \frac{v_f + v_i}{2} \Delta t \quad \checkmark \\ \Delta y &= \frac{-3,2 + 6}{2} (0,94) \quad \checkmark \\ \Delta y &= 1,31 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 2 / OPSIE 2
Upward positive:
Opwaarts positief:
From t_1 to t_2 / Vanaf t_1 na t_2

$$\begin{aligned} v_f &= v_i + a\Delta t \\ -3,2 &= 6 + (-9,8)\Delta t \quad \checkmark \\ \Delta t &= 0,94 \text{ s} \\ \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark \\ \Delta y &= (6)(0,94) + \frac{1}{2} (-9,8)(0,94)^2 \quad \checkmark \\ \Delta y &= 1,31 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 4 / OPSIE 4
Upward negative:
Opwaarts negatief:

All the options 1 to 3 with all the applicable signs changed. Maximum ¾
Al die opsies 1 tot 3 met die toepaslike tekens omgekeerd. Maksimum ¾

(4)

QUESTION 4/VRAAG 4

- 4.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres ✓
Elke voorwerp in die heelal trek elke ander voorwerp aan met 'n krag wat direk eweredig is aan die produk van hul massas ✓ en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. ✓

$$\begin{aligned} 4.2 \quad F_G &= \frac{Gm_1m_2}{d^2} \quad \checkmark \\ 5,71 \times 10^{15} &= \frac{(6,67 \times 10^{-11})(6,39 \times 10^{23})(1,08 \times 10^{18})}{d^2} \\ d^2 &= 8,06 \times 10^{13} \\ d &= 8,98 \times 10^6 \text{ m} \quad \checkmark \\ \therefore h &= 8,98 \times 10^6 - 3390 \times 10^3 \\ h &= 5,59 \times 10^6 \text{ m} \quad \checkmark \end{aligned}$$

(6)
[8]

QUESTION 5/VRAAG 5

- 5.1 The total linear momentum of a closed system remains constant (is conserved). ✓
Die totale lineêre momentum in 'n geslote stelsel bly konstant (bly behoue). ✓ ✓
OR/OF
In a closed/isolated system the total momentum before collision is equal to the total momentum after collision. ✓ ✓
In 'n geslote/geïsoleerde sisteem is die totale momentum voor 'n botsing gelyk aan die totale momentum na 'n botsing. ✓ ✓

5.2 **OPTION 1/ OPSIE 1**
East positive:
Oos positief:

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \quad \checkmark \\ m_{1+2}v_i &= m_1v_{1f} + m_2v_{2f} \\ (54 + 15)(0,08) &= 54v_{1f} + 15(10,2) \quad \checkmark \\ v_{1f} &= -0,2 \text{ m}\cdot\text{s}^{-1} \\ v_{1f} &= 0,2 \text{ m}\cdot\text{s}^{-1} \text{ west/wes} \quad \checkmark \end{aligned}$$

OPTION 2/ OPSIE 2
West positive:

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \quad \checkmark \\ m_{1+2}v_i &= m_1v_{1f} + m_2v_{2f} \\ (54 + 15)(-0,08) &= 54v_{1f} + 15(-10,2) \quad \checkmark \\ v_{1f} &= 0,2 \text{ m}\cdot\text{s}^{-1} \text{ west/wes} \quad \checkmark \end{aligned}$$

(4)

5.3 OPTION 1 / OPSIE 1

East positive:
Oos positief:

$$F_{\text{net}} \Delta t = mv_f - mv_i \quad \checkmark$$

$$F_{\text{net}}(1,2) = (15)(10,2) - (15)(0,08) \quad \checkmark$$

$$F_{\text{net}} = 1265 \text{ N east / oos} \quad \checkmark$$

OPTION 2 / OPSIE 2

West positive:
Wes positief:

$$F_{\text{net}} \Delta t = mv_f - mv_i \quad \checkmark$$

$$F_{\text{net}}(1,2) = (15)(-10,2) - (15)(-0,08) \quad \checkmark$$

$$F_{\text{net}} = -12,65 \text{ N}$$

$$\therefore F_{\text{net}} = 12,65 \text{ N east / oos} \quad \checkmark$$

OPTION 3 / OPSIE 3

East positive:
Oos positief:

$$v_f = v_i + a \Delta t$$

$$10,2 = 0,08 + a(12)$$

$$a = 8,43 \text{ m} \cdot \text{s}^{-2}$$

$$F_{\text{net}} = ma \quad \checkmark$$

$$F_{\text{net}} = 15(8,43) \quad \checkmark$$

$$F_{\text{net}} = 1265 \text{ N east / oos} \quad \checkmark$$

OPTION 3 / OPSIE 3

West positive:
Wes positief:

$$v_f = v_i + a \Delta t$$

$$-10,2 = -0,08 + a(12)$$

$$a = -8,43 \text{ m} \cdot \text{s}^{-2}$$

$$F_{\text{net}} = ma \quad \checkmark$$

$$F_{\text{net}} = 15(-8,43) \quad \checkmark$$

$$F_{\text{net}} = -12,65 \text{ N}$$

$$F_{\text{net}} = 1265 \text{ N east / oos} \quad \checkmark$$

(3)
[9]

8

6.5 OPTION 1 / OPSIE 1

Parallel to the plane down is positive
Ewewydig aan die vlak af is positief

$$v_f^2 = v_i^2 + 2a \Delta x$$

$$v_f^2 - v_i^2 = 2(1,54)(0,9) \quad \checkmark$$

$$v_f^2 - v_i^2 = 2,772$$

$$W_{\text{net}} = \Delta E_k \quad \checkmark$$

$$W_{\text{man}} + W_{\text{grav}} + W_f = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$W_{\text{man}} + (86 \times 9,8) \sin 25^\circ (0,9) \cos 0^\circ + 168,04(0,9) \cos 180^\circ = \frac{1}{2} (86)(2,772) \quad \checkmark$$

$$W_{\text{man}} + 320,56 - 151,236 = 119,196$$

$$W_{\text{man}} = -50,13 \text{ J} \quad \checkmark$$

OPTION 2 / OPSIE 2

Parallel to the plane up is positive
Ewewydig aan die vlak op is positief

$$v_f^2 = v_i^2 + 2a \Delta x$$

$$v_f^2 - v_i^2 = 2(-1,54)(-0,9) \quad \checkmark$$

$$v_f^2 - v_i^2 = 2,772$$

$$W_{\text{net}} = \Delta E_k \quad \checkmark$$

$$W_{\text{man}} + W_{\text{grav}} + W_f = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$W_{\text{man}} + (86 \times 9,8) \sin 25^\circ (0,9) \cos 0^\circ + 168,04(0,9) \cos 180^\circ = \frac{1}{2} (86)(2,772) \quad \checkmark$$

$$W_{\text{man}} + 320,56 - 151,236 = 119,196$$

$$W_{\text{man}} = -50,13 \text{ J} \quad \checkmark$$

OPTION 3 / OPSIE 3

Parallel to the plane up is positive
Ewewydig aan die vlak op is positief

$$F_{\text{net}} = ma$$

$$F_{\text{man}} - F_g \sin \theta + f = ma$$

$$F_{\text{man}} - (86 \times 9,8) \sin 25^\circ + 168,04 = 86(-1,54) \quad \checkmark$$

$$F_{\text{man}} = 356,18 - 168,04 - 132,44$$

$$F_{\text{man}} = 55,7 \text{ N}$$

$$W_{\text{man}} = F_{\text{man}} \Delta x \cos \theta \quad \checkmark$$

$$W_{\text{man}} = (55,7)(0,9) \cos 180^\circ \quad \checkmark$$

$$W_{\text{man}} = -50,13 \text{ J} \quad \checkmark$$

10

QUESTION 6/VRAAG 6

- 6.1 A force for which the net work done in any closed path is dependent on the path the object travelled. $\checkmark \checkmark$

OR/OF

'n Krag waarvoor die netto arbeid verrig langs enige geslote pad onafhanklik is van die roete geneem $\checkmark \checkmark$

OR/OF

The net work done by the non-conservative force / frictional force depends on the path the object travelled $\checkmark \checkmark$
Die netto arbeid verrig deur 'n nie-konserwatiewe krag / wrywingskrag is onafhanklik van die roete geneem $\checkmark \checkmark$

OR/OF

The mechanical energy is not constant $\checkmark \checkmark$ for a non-conservative force / Die meganiese energie is nie konstant $\checkmark \checkmark$ vir 'n nie-konserwatiewe krag nie

(2)

- 6.2 $f_k = \mu_k N$
 $f_k = \mu_k F_{g1}$ } Any one/enige een $\checkmark$
 $f_k = 0,22 \times (86 \times 9,8) \times \cos 25^\circ \quad \checkmark$
 $f_k = 168,04 \text{ N}$

(2)

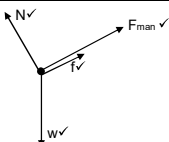
- 6.3 The net/total work done $\checkmark$ on an object is equal to the change in the object's kinetic energy. $\checkmark$ OR The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.

Die netto/totalte arbeid $\checkmark$ wat op 'n voorwerp verrig word, is gelyk aan die verandering in die kinetiese energie van die voorwerp. $\checkmark$ OF Die arbeid verrig op 'n voorwerp deur 'n resultante/netto krag is gelyk aan die verandering in die kinetiese energie van die voorwerp.

(2)

6.4 Accepted Labels/Aanvaarde benoemings

w	F_g/F_w force of Earth on block/weight/842,8 N/mg/gravitational force F_g/F_w krag van Aarde op blok/gewig/842,8 N/mg/gravitasiekrag
N	F_N /normal F_N /normaal
f	Friction/ F_f Wrywing/ F_r
F	F_{app} /15 N F_{toeg} /15 N

(5)
[15]

QUESTION 7/VRAAG 7

- 7.1 The change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓ ✓

Die verandering in die frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede het relatief tot die medium van voortplanting. ✓ ✓

(2)

7.2 OPTION 1 / OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s$$

$$f_L = \left(\frac{335}{335 - 25} \right) \checkmark 430 \checkmark$$

$$f_L = 464,68 \text{ Hz}$$

$$\lambda = \frac{v}{f} \checkmark$$

$$\lambda = \frac{335}{464,68} \checkmark$$

$$\lambda = 0,72 \text{ m} \checkmark$$

OPTION 2 / OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s$$

$$\frac{v}{\lambda_L} \checkmark = \left(\frac{335}{335 - 25} \right) \checkmark 430 \checkmark$$

$$\frac{335 \checkmark}{\lambda_L} = \left(\frac{335}{335 - 25} \right) 430$$

$$\lambda_L = 0,72 \text{ m} \checkmark$$

(6)

- 7.3 THE SAME; ✓ The relative velocity of the train driver and the train is zero ✓. There will therefore not be an observed change ✓ in the frequency heard by the driver.

DIESELFDE ✓ Die relatiewe snelheid van die treindrywer ten opsigte van die trein is nul. ✓ Daar sal dus nie 'n verandering in die waargenome frekwensie ✓ soos gehoor deur die treindrywer wees nie.

(3)
[11]

12

14

QUESTION 8/VRAAG 8

- 8.1 Negative OR – ✓ The direction of E_1 on the diagram is to the left ✓ which is opposite to that of E_2 which indicates the field for a positive charge. ✓

Negatief of – ✓ Die rigting van E_1 in die diagram is na links ✓ wat in die teenoorgestelde rigting is as E_2 wat die veld vir 'n positiewe lading is. ✓

(3)

8.2 POSITIVE MARKING FROM QUESTION 8.1

POSITIEWE NASIEN VANAF VRAAG 8.1

Option 1/Opsie 1

$$E_{\text{net}} = E_2 - E_1 \quad \left. \begin{array}{l} \therefore E_1 = E_2 + E_{\text{net}} \end{array} \right\} \text{Any one/enige een} \checkmark$$

$$\frac{kQ_1}{r^2} = \frac{kQ_2}{r^2} + E_{\text{net}}$$

$$\frac{(9 \times 10^9) Q_1}{(0,6)^2} = \frac{(9 \times 10^9)(12 \times 10^{-9})}{(0,3)^2} + 1600 \checkmark$$

$$2,5 \times 10^{10} Q_1 = 1200 + 1600$$

$$Q_1 = 1,12 \times 10^{-7} \text{ C} \checkmark$$

8.3 Option 2/Opsie 2

$$E_2 = \frac{kQ_2}{r^2} \checkmark$$

$$E_2 = \frac{(9 \times 10^9)(12 \times 10^{-9})}{(0,3)^2} \checkmark$$

$$E_2 = 1200 \text{ N} \cdot \text{C}^{-1} \text{ to the right / na regs}$$

$$E_{\text{net}} = E_2 - E_1 \quad \left. \begin{array}{l} \therefore E_1 = E_2 + E_{\text{net}} \end{array} \right\} \text{Any one/enige een} \checkmark$$

$$E_1 = 1200 + 1600 \checkmark$$

$$E_1 = 2000 \text{ N} \cdot \text{C}^{-1} \text{ to the left / na links}$$

$$E_1 = \frac{kQ_1}{r^2}$$

$$2000 = \frac{(9 \times 10^9) Q_1}{(0,6)^2} \checkmark$$

$$Q_1 = 1,12 \times 10^{-7} \text{ C} \checkmark$$

(7)

8.3

$$E = \frac{F}{Q} \checkmark$$

$$F = (1,6 \times 10^{-19}) \checkmark (1600) \checkmark$$

$$F = 2,56 \times 10^{-16} \text{ N to the right / na regs} \checkmark$$

(4)
[15]

QUESTION 9 / VRAAG 9

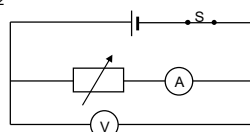
9.1 Independent variable/Onafhanklike veranderlike:

Total current in the circuit ✓

Totale stroom (sterkte) in die stroombaan ✓

(1)

9.2



Cell; switch rheostat correctly drawn and placed in series	✓
Sel, skakelaar en reostaat korrek geteken en in serie met mekaar.	✓
Ammeter in series with rheostat.	✓
Ammeter in series with the rheostat.	✓
Voltmeter in parallel with the rheostat and ammeter or cell.	✓
Voltmeter in parallel met die reostaat en die ammeter of sel.	✓

(3)

9.3

$$\text{gradient} = \frac{\Delta y}{\Delta x}$$

$$\text{gradient} = \frac{10 - 8}{0 - 1} \checkmark$$

$$\text{gradient} = -2$$

$$\therefore r = 2 \Omega \checkmark$$

Accept any legitimate coordinates taken from the graph
Aanvaar antwoorde enige geldige koördinate afgelees vanaf die grafiek

(3)

9.4

GREATER THAN; ✓

GROTER AS ✓

(1)
[8]

QUESTION 10/VRAAG 10

- 10.1.1 $R_T = R_1 + R_2$ ✓
 $R_T = 3,7 + 3,4$ ✓
 $R_T = 7,1 \Omega$ ✓ (2)
- 10.1.2 $\epsilon = IR + Ir$ ✓
 $20 = I(7,1 + 1)$ ✓
 $I = 2,47 \text{ A}$ ✓ (3)
- 10.2 INCREASES; ✓ When the total resistance decreases ✓; the total current increases when emf and internal resistance stay the same. ✓
 NEEM TOE: ✓ Wanneer die totale weerstand afneem ✓ sal die totale stroom toeneem as die EMK en die interne weerstand dieselfde bly. ✓ (3)
- 10.3 **Option 1/Opsie 1:** **Option 2/Opsie 2:**
- $\epsilon = IR + Ir$ $\epsilon = IR + Ir$
 $20 = (2,31)R_4 + (2,31)(1)$ $20 = (2,31)R_4 + (2,31)(1)$ ✓
 $R_4 = 7,66 \Omega$ $R_4 = 7,66 \Omega$
- $V = IR$ $P = I^2 R$ ✓
 $V = (2,31)(7,66)$ $P = 2,31^2(7,66)$ ✓
 $V = 17,69 \text{ V}$ $P = 40,87 \text{ W}$ ✓
- $P = \frac{V^2}{R}$ ✓
 $P = \frac{17,69^2}{7,66}$ ✓
 $P = 40,86 \text{ W}$ ✓
- Accept answers between
 Aanvaar antwoorde tussen
 40,86 W en 40,88 W
- (4)
[12]

16

QUESTION 12/VRAAG 12

- 12.1 Workfunction is the minimum energy of a photon ✓ needed to set an electron free ✓ from the surface of a metal ✓ /
 Werksfunksie is die minimum energie wat 'n foton ✓ moet hê om 'n elektron vry te stel ✓ uit die oppervlak van 'n metaal. ✓ (2)
- 12.2 The wavelength is then inversely proportional to the maximum kinetic energy ✓
 $(\lambda \propto \frac{1}{E_{k \text{ max}}})$ ✓
Wavelength is inversely proportional to the frequency $(\lambda \propto \frac{1}{f})$ ✓ of the radiation. ✓
 The frequency is directly proportional to the maximum kinetic energy $(f \propto E_{k \text{ max}})$. ✓
if the cathode remains the same. ✓
Die golflengte is omgekeerd eweredig aan die maksimum kinetiese energie ✓
 $(\lambda \propto \frac{1}{E_{k \text{ max}}})$ ✓
Die golflengte is omgekeerd eweredig aan die frekwensie ✓ $(\lambda \propto \frac{1}{f})$ van die straling.
Die frekwensie is direk eweredig aan die maksimum kinetiese energie ✓ $(f \propto E_{k \text{ max}})$
mits die katode dieselfde bly. ✓ (4)
- 12.3 STAYS THE SAME
 BLY DIESELFDE (1)

18

QUESTION 11/VRAAG 11

- 11.1 AC; ✓ The magnetic field changes continuously ✓ which causes the current through the globe to alternate direction. ✓
 WS: ✓ Die magneetveld word kontinu omgekeer ✓ wat veroorsaak dat die stroom deur die gloeilamp van rigting verander. ✓ (3)
- 11.2 The globe will light up/glow/burn. ✓
 Die gloeilamp sal brand/ gloei. ✓ (1)
- 11.3 The strength of the magnetic field/magnetic flux linking with the copper coil changes continuously. ✓ This causes an induced emf in the copper coil. ✓ A current is able to flow through the globe because the coil is part of that circuit. ✓
 Die sterkte van die magneetveld/magnetiese fluks wat met die koperspoel skakel verander voortdurend. ✓ Dit veroorsaak 'n geïnduseerde EMK in die koperspoel. ✓
 'n Stroom kan deur die gloeilamp vloei omdat die spoel deel vorm van daardie stroombaan. ✓ (3)
- 11.4
 - Increase the speed/tempo at which the wheel/crank is turned.
 - Increase the number or turns on the coil
 - Use a stronger magnet ✓✓ [any two]
 - Verhoog die tempo waarteen die wiel/kruk gedraai word.
 - Vermeerder die aantal windings op die spoel
 - Gebruik 'n sterker magneet ✓✓ [enige twee] (2)
- 11.5 **Option 1/Opsie 1:** **Option 2/Opsie 2:**
- $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ ✓ $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ ✓
 $6 = (12) I_{\text{rms}}$ ✓ $6 = \frac{(12)^2}{R}$ ✓
 $I_{\text{rms}} = 0,5 \text{ A}$ $R = 24 \Omega$
- $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ ✓ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
 $0,5 = \frac{I_{\text{max}}}{\sqrt{2}}$ $12 = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
 $I_{\text{max}} = 0,707 \text{ A}$ $V_{\text{max}} = 16,97 \text{ V}$
- $I_{\text{max}} = \frac{V_{\text{max}}}{R}$
 $I_{\text{max}} = \frac{16,97}{24}$
 $I_{\text{max}} = 0,707 \text{ A}$ ✓ (4)
[13]

17

12.4 Option 1/Opsie 1:

$$E = W_0 + E_K$$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \frac{1}{2} m v_{\text{max}}^2$$

Any one/Enige een

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{160 \times 10^{-9}} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{255 \times 10^{-9}} + \frac{1}{2} (9,11 \times 10^{-31}) v_{\text{max}}^2$$

$$1,24 \times 10^{-18} = 7,8 \times 10^{-19} + 4,555 \times 10^{-31} v_{\text{max}}^2$$

$$v_{\text{max}}^2 = 1,009 \times 10^{12}$$

$$v_{\text{max}} = 1,01 \times 10^6 \text{ m} \cdot \text{s}^{-1}$$

Option 2/Opsie 2:

$$E = \frac{hc}{\lambda}$$

$$E = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{160 \times 10^{-9}}$$

$$E = 1,24 \times 10^{-18} \text{ J}$$

$$W_0 = hf_0$$

$$W_0 = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{255 \times 10^{-9}}$$

$$W_0 = 7,8 \times 10^{-19} \text{ J}$$

$$E_K = \frac{1}{2} m v^2$$

$$E - W_0 = \frac{1}{2} (9,11 \times 10^{-31}) v_{\text{max}}^2$$

$$1,24 \times 10^{-18} - 7,8 \times 10^{-19} = \frac{1}{2} (9,11 \times 10^{-31}) v_{\text{max}}^2$$

$$v_{\text{max}}^2 = 1,009 \times 10^{12}$$

$$v_{\text{max}} = 1,01 \times 10^6 \text{ m} \cdot \text{s}^{-1}$$

(5)
[12]

GRAND TOTAL/GROOTTOTAAL: 150

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PREPARATORY EXAMINATION /
VOORBEREIDENDE EKSAMEN
2016
MEMORANDUM

PHYSICAL SCIENCES: PHYSICS FIRST PAPER /
FISIESE WETENSAPPE: FISIKA EERSTE VRAESTEL(10841)

14 pages / bladsye

2.2

180 N/F/F_{applied} / applied force ✓
180 N/F/F_{toegepaste} / toegepaste krag ✓

T/Force of Y on X ✓
T/Krag Y op X ✓

Weight/mg/w/F_g / 39,2 N ✓
Gewig/mg/w/F_g / 39,2 N ✓

Notes/Aantekeninge:

- Correct arrow and label for EACH force for one mark. / Korrekte pyle en benoeming vir ELKE krag vir een punt.
- Comparative lengths of arrows are not required. / Vergelykende lengte van pyle nie vereiste nie.

(3)

2.3 2.3.1 For block X / Vir blok X:

$F_{net} = ma$ ✓
 $180 - w - T = ma$ ✓
 $180 - (4)(9,8) - T = 4a$ ✓
 $140,8 - T = 4a$ (i)

For block Y / Vir blok Y:

$F_{net} = ma$ ✓
 $T - w = ma$ ✓
 $T - (8)(9,8) = 8a$ ✓
 $-78,4 + T = 8a$ (ii)

$281,6 - 2T = 8a$ ✓
 $-78,4 + T = 8a$ ✓
 $360 - 3T = 0$ ✓
 $T = 120 \text{ N}$ ✓
 $T = 120 \text{ N upwards / opwaarts}$ ✓

Note/Aantekeninge:

- If the system approach is used to first calculate acceleration and then acceleration is substituted to obtain T:

Max. $\frac{2}{4}$

- Indien die stelsel benader word om eerstens versnelling te bereken en dan die versnelling gebruik om T te bereken.

Maks $\frac{2}{4}$

(4)

2.3.2 POSITIVE MARKING FROM QUESTION 2.3.1 / POSITIEWE NASIEN VAN VRAAG 2.3.1

OPTION / OPSIE 1	OPTION / OPSIE 2
$-78,4 + T = 8a$ ✓ $-78,4 + 120 = 8a$ ✓ $a = 5,2 \text{ m}\cdot\text{s}^{-2}$ ✓	$140,8 - T = 4a$ ✓ $140,8 - 120 = 4a$ ✓ $a = 5,2 \text{ m}\cdot\text{s}^{-2}$ ✓
OPTION / OPSIE 3	
$281,6 - 2T = 8a$ ✓ $281,6 + 220 = 8a$ ✓ $a = 5,2 \text{ m}\cdot\text{s}^{-2}$ ✓	

(2)
[11]

3

10841/16

GAUTENG DEPARTMENT OF EDUCATION /
GAUTENGSE DEPARTEMENT VAN ONDERWYS
PREPARATORY EXAMINATION / VOORBEREIDENDE EKSAMEN

PHYSICAL SCIENCES: PHYSICS /
FISIESE WETENSAPPE: FISIKA
(First Paper / Eerste Vraestel)

MEMORANDUM

QUESTION 1 / VRAAG 1

- 1.1 D ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 A ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 C ✓✓ (2)
- 1.6 A ✓✓ (2)
- 1.7 A ✓✓ (2)
- 1.8 B ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]

QUESTION 2 / VRAAG 2

- 2.1 When a resultant/net force acts on an object, the object accelerates in the direction of the (net) force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n resultante /netto krag op 'n voorwerp uitgeoefen word, versnel die voorwerp in die rigting van die (netto) krag met 'n versnelling direk eweredig aan die grootte van die krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓ (2)

QUESTION 3 / VRAAG 3

- 3.1 The object had an upward velocity when it was released. ✓ / Die voorwerp het 'n opwaartse snelheid toe dit losgelaat is.
- OR/ OF
- The object continues with its state of motion in a straight line. / Die voorwerp beweeg voort in dieselfde rigting van beweging in 'n reguit lyn.
- OR/ OF
- The object has inertia. / Die voorwerp het inersie. (1)
- 3.2 3.2.1 Upwards / opwaarts ✓ (1)
- 3.2.2 Downwards / afwaarts ✓ (1)
- 3.3 3.3.1
- | Upward positive / opwaarts positief | Downward positive / afwaarts positief |
|--|---|
| $v_f = v_i + a \Delta t$ ✓
$0 = 110 - 9,8 \Delta t$ ✓
$\Delta t = 11,22 \text{ s}$ ✓ | $v_f = v_i + a \Delta t$ ✓
$0 = -110 + 9,8 \Delta t$ ✓
$\Delta t = 11,22 \text{ s}$ ✓ |
- (3)

3.3.2 OPTION 1 / OPSIE 1

Upward positive / opwaarts positief	Upward negative / opwaarts negatief
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ $-550 = 110 \Delta t + \frac{1}{2} (-9,8) \Delta t^2$ ✓ $4,9 \Delta t^2 - 110 \Delta t - 550 = 0$ ✓ $\Delta t = \frac{-(-110) \pm \sqrt{(-110)^2 - 4(4,9)(-550)}}{2(4,9)}$ ✓ $\Delta t = 26,66 \text{ s or } -4,21 \text{ s}$ ✓ $\Delta t = 26,66 \text{ s}$ ✓	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ $550 = -110 \Delta t + \frac{1}{2} (9,8) \Delta t^2$ ✓ $4,9 \Delta t^2 - 110 \Delta t - 550 = 0$ ✓ $\Delta t = 26,66 \text{ s or } -4,21 \text{ s}$ ✓ $\Delta t = 26,66 \text{ s}$ ✓

OPTION 2 / OPSIE 2
POSITIVE MARKING FROM QUESTION 3.3.1 /
POSITIEWE NASIEN VAN VRAAG 3.3.1.

Time / Tyd (point / punt Q to R): 11,22 s Time / Tyd (point / punt R to Q): 11,22 s Time / Tyd (point / punt Q to ground):	Time / Tyd (point / punt Q to R): 11,22 s Time / Tyd (point / punt R to Q): 11,22 s Time / Tyd (point / punt Q to ground):
Upward positive / opwaarts positief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-550 \checkmark = (-110) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $4,9 \Delta t^2 + 110 \Delta t - 550 = 0$ $\Delta t = \frac{-110 \pm \sqrt{(110)^2 - 4(4,9)(-550)}}{2(4,9)}$ $\Delta t = 4,21 \text{ s}$ Total time / Totale tyd $= 11,22 + 11,22 + 4,21$ $= 26,65 \text{ s} \checkmark$	Upward negative / opwaarts negatief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $550 \checkmark = (110) \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $4,9 \Delta t^2 + 110 \Delta t - 550 = 0$ $\Delta t = \frac{-110 \pm \sqrt{(110)^2 - 4(4,9)(-550)}}{2(4,9)}$ $\Delta t = 4,21 \text{ s}$ Total time / Totale tyd $= 11,22 + 11,22 + 4,21$ $= 26,65 \text{ s} \checkmark$

OPTION 3 / OPSIE 3
POSITIVE MARKING FROM QUESTION 3.3.1 /
POSITIEWE NASIEN VAN VRAAG 3.3.1.

Upward positive / Opwaarts positief Height reached above point Q \ Hoogte bereik bo punt Q: $v_f^2 = v_i^2 + 2a\Delta y_2$ $(0)^2 = (110)^2 + 2(-9,8)\Delta y_2$ $\therefore \Delta y_2 = 617,35 \text{ m}$ Displacement from point R to ground / Verplasing van punt R na grond: $\Delta y = 550 + 617,35 = 1\ 167,35 \text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-1\ 167,35 \checkmark = (0) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $\Delta t = 15,435 \text{ s}$ Total time / Totale tyd $= 11,22 + 15,435$ $= 26,66 \text{ s} \checkmark$	Upward negative / Opwaarts negatief Height reached above point Q / Hoogte bereik bo punt Q: $v_f^2 = v_i^2 + 2a\Delta y_2$ $(0)^2 = (-110)^2 + 2(9,8)\Delta y_2$ $\therefore \Delta y_2 = 617,35 \text{ m}$ Displacement from point R to ground / Verplasing van punt R na grond: $\Delta y = 550 + 617,35 = 1\ 167,35 \text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $1\ 167,35 \checkmark = (0) \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $\Delta t = 15,435 \text{ s}$ Total time / Totale tyd $= 11,22 + 15,435$ $= 26,66 \text{ s} \checkmark$
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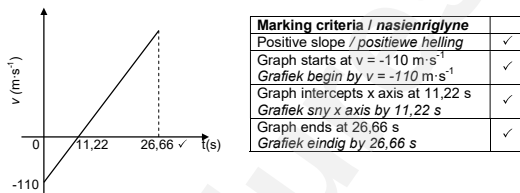
(4)

5

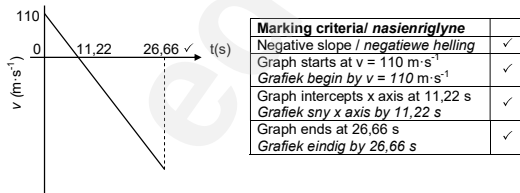
7

3.4 POSITIVE MARKING FROM QUESTION 3.3 / POSITIEWE NASIEN VAN VRAAG 3.3.

Downward as positive / afwaarts as positief:



Upward as positive / opwaarts as positief:



(4)

[14]

QUESTION 4 / VRAAG 4

- 4.1 The total (linear) momentum of a closed system remains constant/is conserved. ✓✓
(2 marks or zero)

Die totale (liniêre) momentum van 'n geslote sisteem bly konstant/bly behoue. ✓✓
(2 punte of niks)

(2)

- 4.2 $\Sigma p_i = \Sigma p_f \checkmark$
 $m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_c \checkmark$
 $(68 \times 20) \checkmark + (12 \times 0) = (68 + 12) v_c \checkmark$
 $\therefore v_c = 17 \text{ m}\cdot\text{s}^{-1} \checkmark$

(4)

4.3 POSITIVE MARKING FROM QUESTION 4.2 /
POSITIEWE NASIEN VAN VRAAG 4.2.

OPTION 1 / OPSIE 1

$$(E_p + E_k)_i = (E_p + E_k)_f \checkmark$$

$$(mgh + \frac{1}{2}mv_c^2)_i = (mgh + \frac{1}{2}mv_c^2)_f \checkmark$$

$$0 + \frac{1}{2}(80)(17)^2 \checkmark = (80)(9,8)h + 0 \checkmark$$

$$\therefore h = 14,75 \text{ m}$$

Distance up the incline, d/ Afstand opwaarts teen skuinsvlak

$$\sin \theta = \frac{h}{\Delta x}$$

$$\sin 25^\circ = \frac{14,75}{\Delta x} \checkmark$$

$$\therefore \Delta x = 34,89 \text{ m} \checkmark$$

OPTION 2 / OPSIE 2

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$W_w = E_{kf} - E_{ki} \checkmark$$

$$mgs \sin 25^\circ \cos 180^\circ = \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$(80)(9,8) \sin 25^\circ \cos 180^\circ \checkmark = \frac{1}{2} (80)(0^2 - 17^2) \checkmark$$

$$\Delta x = 34,89 \text{ m} \checkmark$$

(5)

- 4.4 Decreases / verminder ✓

Friction is a non-conservative force/ opposes motion/removes kinetic energy from the system. ✓

Wrywing is 'n nie-konserwatiewe krag /opponeer beweging / verwyder kinetiese energie van die sisteem. ✓

(2)

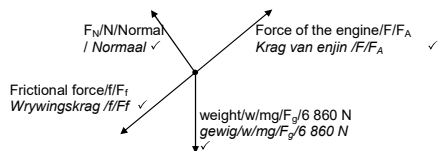
[13]

QUESTION 5 / VRAAG 5

- 5.1 Zero/0 (J) ✓

(1)

- 5.2



(4)

- 5.3 5.3.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓ **(2 marks or zero.)**

Die netto/totale werk verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. ✓✓ **(2 punte or niks.)**

(2)

5.3.2 Marking guidelines / nasienriglyne

- Formula / Formule: $W_{\text{net}} = \Delta E_k$ or $W_{\text{net}} = \Delta E_p + \Delta E_k \checkmark$
- Formula / Formule: $W = F \Delta x \cos \theta \checkmark$
- Substitution to calculate / Vervanging in formule $f = \mu_k mg \cos 30^\circ \checkmark$
- Substitute to calculate / Vervanging om te bereken: $W_f \checkmark$
- Substitute to calculate / Vervanging om te bereken: W_w OR $\Delta E_p \checkmark$
- Substitute to calculate / Vervanging om te bereken: $W_F \checkmark$
- Substitute to calculate / Vervanging om te bereken: $\Delta E_k \checkmark$
- Final answer / Finale antwoord: $11,59 \text{ m}\cdot\text{s}^{-1} \checkmark$

OPTION 1 / OPSIE 1:

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$W_N + W_f + W_w + W_F = \Delta E_k$$

$$0 + f \Delta x \cos 180^\circ + w \Delta x \cos 180^\circ + F \Delta x \cos 0^\circ \checkmark = E_{kf} - E_{ki}$$

$$\mu_k mg \cos 30^\circ \Delta x \cos 180^\circ + mg \Delta x \sin 30^\circ \cos 180^\circ + F \Delta x \cos 0^\circ \checkmark = \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$0,32(700)(9,8) \cos 30^\circ \checkmark (70) \cos 180^\circ \checkmark + (700)(9,8) \sin 30^\circ (70) \cos 180^\circ \checkmark + (6000)(70) \cos 0^\circ \checkmark =$$

$$\frac{1}{2} (700)(v_f^2 - 0) \checkmark$$

$$-1,33 \times 10^5 - 2,4 \times 10^5 + 4,2 \times 10^5 = 350 v_f^2 \checkmark$$

$$v_f = 11,59 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2 / OPSIE 2:

$$W_{\text{nc}} = \Delta E_p + \Delta E_k \checkmark$$

$$W_f + W_F = mg \Delta h + \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$f \Delta x \cos 180^\circ + F \Delta x \cos 0^\circ \checkmark = mg \Delta h + \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$0,32(700)(9,8) \cos 30^\circ \checkmark (70) \cos 180^\circ \checkmark + (6000)(70) \cos 0^\circ \checkmark =$$

$$(700)(9,8)(70 \sin 30^\circ - 0) \checkmark + \frac{1}{2} (700)(v_f^2 - 0) \checkmark$$

$$v_f = 11,59 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(8)

[15]

QUESTION 6 / VRAAG 6

- 6.1 6.1.1 It is the apparent change in frequency of a source when there is relative motion between the source and the observer. ✓✓
Dit is die skynbare verandering in frekwensie van 'n bron wanneer daar 'n relatiewe verandering in beweging tussen die bron en die waarnemer is. ✓✓ (2)
- 6.1.2 Away / Weg ✓ (1)
- 6.1.3 $f_L = \frac{v \pm v_s}{v \pm v_o} f_s$ ✓
 $73 = \frac{340}{340 + v_s} 75$ ✓
 $v_s = 9,32 \text{ m} \cdot \text{s}^{-1}$ ✓ (4)
- 6.2 • The absorption spectrum observed for elements on a distant star compared to spectrum of elements on the earth or sun. ✓
 • Absorption lines in spectrum from star shifted to red end of the spectrum/ red shifted. ✓
 • Wavelengths in the absorption spectrum lines have increased. ✓
 • According to the Doppler effect the star is thus moving away from the earth. ✓
 • The absorptionspektrum waargeneem vir elemente van 'n verregeleë ster in vergeliking met die spektrum van elemente nader aan die aarde of die son. ✓
 • Absorpsielinje in die spektrum van ster verskuif na die rooi kant van die spektrum/ rooiverskuiwing. ✓
 • Golflengte in die absorpsiespektrumlynne vermeerder. ✓
 • Volgens die Doppler effek beweeg die ster dus verder van die aarde. ✓ (4)
- 6.3 Ultrasound scans / ultraklankskandering ✓
 Measuring rate of flow of blood (Blood-flow meter) / Meting van die tempo waarteen bloed vloei (bloedvloeiometer) ✓ (2)

[13]

9

QUESTION 8 / VRAAG 8

- 8.1 12 V ✓ (1)
- 8.2 8.2.1
- | OPTION 1 / OPSIE 1 | OPTION 2 / OPSIE 2 |
|--|--|
| $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓
$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{10}$ ✓
$R_p = 3,75 \Omega$ ✓
$R_{\text{external/ekstern}} = 3,75 + 2 = 5,75 \Omega$ ✓ | $R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓
$= \frac{(6)(10)}{6 + 10}$ ✓
$R_p = 3,75 \Omega$ ✓
$R_{\text{external/ekstern}} = 3,75 + 2 = 5,75 \Omega$ ✓ |
- 8.2.2 POSITIVE MARKING FROM QUESTION 8.2.1 / POSITIEWE NASIEN VAN VRAAG 8.2.1
- | OPTION 1 / OPSIE 1 | OPTION 2 / OPSIE 2 |
|--|---|
| $V_1 = IR_{\text{ext/ekstern}}$ ✓
$\therefore I = \frac{10}{5,75}$ ✓
$= 1,74 \text{ A}$ ✓
$\mathcal{E} = IR_{\text{ext/ekstern}} + Ir$ ✓
$12 = (1,74)(5,75) + 1,74r$ ✓
$\therefore r = 1,15 \Omega$ ✓ | $V_1 = IR_{\text{ext/ekstern}}$ ✓
$\therefore I = \frac{10}{5,75}$ ✓
$= 1,74 \text{ A}$ ✓
$V_{\text{lost/verlore}} = Ir$ ✓
$12 - 10 = 1,74r$ ✓
$r = 1,15 \Omega$ ✓ |
- 8.4 Increases / Verhoog ✓
 Closing S_2 effectively cuts off the 2Ω resistor / is a short circuit. / Sluit van S_2 sny die 2Ω weerstand effektief af / vorm 'n kortsluiting ✓
 Total resistance decreases / Totale weerstand verminder. ✓ (3)

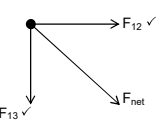
[13]

QUESTION 9 / VRAAG 9

- 9.1 9.1.1 AC Alternating current / WS Wisselstroom ✓ (1)
- 9.1.2 DC / GS (Gelykstroom) ✓
 Due to the presence of the split ring commutator, current always exits through the one brush and then leaves through the other brush. ✓
Agv die teenwoordigheid van die splitringkommutator, is daar altyd stroom wat deur een borsel beweeg en dan deur die ander borsel. ✓ (2)
- 9.2 9.2.1 AC generator has slip rings ✓ whilst a DC generator has a split ring commutator. ✓
WS generator het slipringe, terwyl die GS generator splitringkommutator het. ✓ (2)

11

QUESTION 7 / VRAAG 7

- 7.1 The force of attraction that two charges at rest exert on each other is directly proportional to the product of the two charges ✓ and inversely proportional to the square of the distance between their centres. ✓
Die aantrekkingskrag wat twee ladinge in rus op mekaar uitoefen, is direk eweredig aan die produk van die twee ladinge ✓ en omgekeerd eweredig aan die vierkant van die afstand tussen die middelpunte. ✓ (2)
- 7.2  (2)
- 7.3 $F_{12} = \frac{kQ_1 Q_2}{r_{12}^2}$ ✓
 $= \frac{(9 \times 10^9)(2 \times 10^{-5})(2 \times 10^{-4})}{(0,5)^2}$ ✓
 $= 144 \text{ N, to the right / na regs}$ ✓
 $F_{13} = \frac{kQ_1 Q_3}{r_{13}^2}$ ✓
 $= \frac{(9 \times 10^9)(2 \times 10^{-5})(2 \times 10^{-4})}{(0,4)^2}$ ✓
 $= 225 \text{ N, downwards/afwaarts}$ ✓
 $F_{\text{net}} = \sqrt{(225)^2 + (144)^2}$ ✓
 $= 267,13 \text{ N}$ ✓
 $\tan \theta = \frac{225}{144} \therefore \theta = 57,38^\circ$ ✓
 $F_{\text{net}} = 267,13 \text{ N, } \angle 147,38^\circ / 57,38^\circ \text{ S} / 57,38^\circ \text{ south of east / suid van oos}$ ✓ (7)

[11]

- 9.2.2 An AC voltage can be stepped up, / 'n WS stroom kan verhoging ondergaan, ✓
 Increase in voltage and decrease in current. / Verhoging in potensiaalverskil en verlagings in stroom. ✓
 Loss in power $P = I^2 R$ decreases. / Verlies aan drywing $P = I^2 R$ verminder ✓ (3)
- 9.3 9.3.1
- | OPTION 1 / OPSIE 1 | OPTION 2 / OPSIE 2 |
|--|---|
| $f = \frac{1}{T}$ ✓
$= \frac{1}{0,02}$ ✓
$= 50 \text{ Hz}$ ✓ | $f = \frac{\text{cycles / siklusse}}{\text{time / tyd}}$ ✓
$= \frac{3,5}{0,07}$ ✓
$= 50 \text{ Hz}$ ✓ |
- 9.3.2
- | OPTION 1 / OPSIE 1 | OPTION 2 / OPSIE 2 |
|---|---|
| $I_{\text{max}} = \frac{V_{\text{max}}}{R}$ ✓
$= \frac{200}{20}$ ✓
$= 10 \text{ A}$ ✓
$P_{\text{ave}} = \frac{1}{2} (V_{\text{max}} I_{\text{max}})$ ✓
$= \frac{1}{2} (200 \times 10)$ ✓
$= 1000 \text{ W (1 kW)}$ ✓ | $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
$= \frac{200}{\sqrt{2}}$ ✓
$= 141,42 \text{ V}$ ✓
$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$ ✓
$= \frac{141,42}{20}$ ✓
$= 7,07 \text{ A}$ ✓
$P_{\text{ave}} = I_{\text{rms}}^2 R$ ✓
$= (7,07)^2 20$ ✓
$= 999,70 \text{ W}$ ✓
OR
$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ ✓
$= (141,42)(7,07)$ ✓
$= 999,84 \text{ W}$ ✓
Accept range / Aanvaar:
999,70 to 1000 W |
- OPTION 3 / OPSIE 3
- | |
|--|
| $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
$= \frac{200}{\sqrt{2}}$ ✓
$= 141,42 \text{ V}$ ✓
$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ ✓
$= \frac{(141,42)^2}{20}$ ✓
$= 999,98 \text{ W}$ ✓ |
|--|

[15]

QUESTION 10 / VRAAG 10

- 10.1 Minimum energy required to release (photo) electrons from a metal surface. ✓✓
 Minimum energie nodig om (foto) elektrone uit 'n metaaloppervlak vry te stel. ✓✓ (2)

OPTION 1 / OPSIE 1 $W_0 = hf$ ✓ $= \frac{hc}{\lambda}$ ✓ $= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{500 \times 10^{-9}}$ ✓ $= 3,978 \times 10^{-19} \text{ J}$ ✓	OPTION 2 / OPSIE 2 $f = \frac{c}{\lambda}$ ✓ $= \frac{3 \times 10^8}{500 \times 10^{-9}}$ ✓ $= 6 \times 10^{14} \text{ Hz}$ $W_0 = hf$ ✓ $= (6,63 \times 10^{-34})(6 \times 10^{14})$ ✓ $= 3,98 \times 10^{-19} \text{ J}$ ✓
--	---

- 10.3 10.3.1 Remains the same / Bly dieselfde ✓ (1)
 10.3.2 Remains the same / Bly dieselfde ✓ (1)
 10.4 POSITIVE MARKING FROM QUESTION 10.2 / POSITIEWE NASIEN VAN VRAAG 10.2.

OPTION 1 / OPSIE 1 $E = W_0 + E_{k(\max)}$ ✓ $\frac{hc}{\lambda} = W_0 + E_{k(\max)}$ ✓ $\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{400 \times 10^{-9}} = 3,978 \times 10^{-19} + E_{k(\max)}$ ✓ $E_{k(\max)} = 9,95 \times 10^{-20} \text{ J}$ ✓ Range / aanvaar: $9,93 \times 10^{-20} \text{ J to } 9,95 \times 10^{-20} \text{ J}$	OPTION 2 / OPSIE 2 $f = \frac{c}{\lambda}$ ✓ $= \frac{3 \times 10^8}{400 \times 10^{-9}}$ ✓ $= 7,5 \times 10^{14} \text{ Hz}$ $E = hf$ ✓ $= (6,63 \times 10^{-34})(7,5 \times 10^{14})$ ✓ $= 4,97 \times 10^{-19} \text{ J}$ $E = W_0 + E_{k(\max)}$ ✓ $4,97 \times 10^{-19} = 3,98 \times 10^{-19} + E_{k(\max)}$ ✓ $E_{k(\max)} = 9,93 \times 10^{-20} \text{ J}$ ✓
--	---

[14]

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN
2017
MARKING GUIDELINES /
NASIEN RIGLYNE

PHYSICAL SCIENCES: CHEMISTRY (SECOND PAPER) (10842)
FISIESE WETENSAPPE: CHEMIE (TWEDE VRAESTEL) (10842)

12 pages / bladsye

13

QUESTION 11 / VRAAG 11

- 11.1 The energy transferred to / work done on ✓ each coulomb (of charge) / per C charge ✓ passing through the battery.
 Die lading oorgedra / arbeid verrig op ✓ elke coulomb (lading) / per C lading ✓ wat deur die battery beweeg. (2)

- 11.2 Gradient / helling = $\frac{3,8 - 0,5}{9 - 0}$ ✓
 $= 0,37 \text{ (V}^{-1}\text{)}$ ✓
Note / Aantekening:
 • Accept any correct values from graph to calculate the gradient.
 • Aanvaar enige korrekte waarde vanaf grafiek om helling te bereken. (3)

- 11.3 $\frac{1}{\text{emf}}$ ✓ (1)

- 11.4 11.4.1 POSITIVE MARKING FROM QUESTION 11.2 / POSITIEWE NASIEN VAN VRAAG 11.2

OPTION 1 / OPSIE 1 $\frac{1}{\text{emf}} = 0,37$ ✓ $\varepsilon (\text{emf}) = 2,70 \text{ V}$ ✓ Range/Aanvaar: $2,67 - 2,70 \text{ V}$	OPTION 2 / OPSIE 2 $\text{emf} = 2(0) + 2r$ $\text{emf} = 0,26(9) + 0,26r$ $0 = -2,34 + 1,74r$ $r = 1,34 \Omega$ $\varepsilon = 2(0) + 2r$ $= 2(1,34)$ $= 2,67 \text{ V}$
---	---

(2)

- 11.4.2 POSITIVE MARKING FROM QUESTION 11.2 AND 11.3.1 / POSITIEWE NASIEN VAN VRAAG 11.2 EN 11.3.1

OPTION 1 / OPSIE 1 $\text{Emf} = I(R + r)$ $y = mx + c: \frac{1}{I} = \frac{1}{\text{emf}}R + \frac{r}{\text{emf}}$ $y \text{ intercept/afsnit} = \frac{r}{\text{emf}}$ $0,5 = \frac{r}{2,70}$ ✓ $R = 1,35 \Omega$ ✓ Range / aanvaar: $1,34 - 1,35 \Omega$	OPTION 2 / OPSIE 2 Any two equation using values from the graph / Enige twee vergelykings waar waardes van grafiek gebruik is: $\text{emf} = 2(0) + 2r$ ✓ $\text{emf} = 0,26(9) + 0,26r$ ✓ $0 = -2,34 + 1,74r$ $r = 1,34 \Omega$ ✓
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(3)
[11]

GRAND TOTAL / GROOTTOTAAL: 150

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PHYSICAL SCIENCES: CHEMISTRY /
FISIESE WETENSAPPE: CHEMIE
(Second Paper)(Tweede Vraestel)

MEMORANDUM

QUESTION 1: MULTIPLE-CHOICE QUESTIONS
VRAAG 1: MEERVOUDIGEKEUSE VRAE

- | | | | |
|------|---|----|-----|
| 1.1 | C | ✓✓ | (2) |
| 1.2 | B | ✓✓ | (2) |
| 1.3 | C | ✓✓ | (2) |
| 1.4 | A | ✓✓ | (2) |
| 1.5 | D | ✓✓ | (2) |
| 1.6 | A | ✓✓ | (2) |
| 1.7 | C | ✓✓ | (2) |
| 1.8 | B | ✓✓ | (2) |
| 1.9 | C | ✓✓ | (2) |
| 1.10 | A | ✓✓ | (2) |

[20]

QUESTION / VRAAG 2

- 2.1 A series of organic compounds that can be described by the same general formula ✓✓
OR
 A series of organic compounds in which one member differs from the next with a CH₂ group. (2 ✓✓ or nil)
h Reeks organise verbindings wat beskryf kan word deur dieselfde algemene formule.
OF
h Reeks organise verbindings waarin een lid verskil van die volgende met 'n CH₂ groep. (2 ✓✓ of nul) (2)
- 2.2 2.2.1 B: Esters ✓ (1)
- 2.2.2 C: Aldehydes ✓ Aldehyde (1)
- 2.3 C_nH_{2n} ✓ (1)
- 2.4 Pentanoic acid ✓ Pentanoësuur (2)
- 2.5 2.5.1 HIGHER THAN ✓ HOER AS (1)
- 2.5.2 Negative marking from Q2.5.1 to Q 2.5.2 / *Negatiewe nasien vanaf V2.5.1 tot 2.5.2*
 (Next member is hexanoic acid.) / *(Volgende lid is heksanoësuur.)*

Structure / Struktuur

Because hexanoic acid has a larger surface area / longer chain length / increasing molecular mass than pentanoic acid, this causes more intermolecular forces ✓

Aangesien heksanoësuur 'n groter kontakoppervlakte het / langer ketting / toename in molekulêre massa as pentanoësuur, sal dit tot meer intermolekulêre kragte lei.

Intermolecular forces / Intermolekulêre kragte

More intermolecular forces / induced dipole forces / London forces / dispersion forces / and hydrogen bond between the hydroxyl group of neighbouring molecules in hexanoic acid ✓
 Meer intermolekulêre kragte / geïnduseerde dipoolkragte / Londonkragte / dispersiekragte / en waterstofbinding tussen die hidroksielgroepe of naburige molekule in heksanoësuur

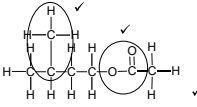
Energy / Energie

More energy needed to overcome / break intermolecular forces in hexanoic acid. ✓ (Therefore a higher boiling point in next member of homologous series.)
 Meer energie benodig om intermolekulêre kragte te oorkom / breek in heksanoësuur. (Daarom 'n hoër kookpunt in die volgende homologe reeks.)

OR / OF

3

QUESTION / VRAAG 3

- 3.1 3.1.1  (3-methylbutyl ethanoate and H₂O)
 (3-metielbutieleetanaaat en water) (3)
- Marking guideline / Nasienglyne:**
- Water molecule not required / watermolekule nie nodig nie
 - Ester functional group correct ✓ / korrekte funksionele groep vir ester
 - Methyl side chain correct ✓ / metielketting korrek
 - Whole structure correct / hele struktuur korrek 3/3
- 3.1.2 To smell the ester ✓ / Om die ester te ruik
 (The smell of the ester is masked by the smell of the carboxylic acid. Esters are fairly insoluble in water and form a thin layer on the water surface. Esters are volatile. The excess acid and alcohol both dissolve in water and are less volatile and the smell is less pronounced.)
(Die reuk van die ester word gemasker deur die reuk van die karskasielsuur. Esters is redelik oplosbaar in water en vorm 'n dun laag op die water oppervlakte. Esters is vlugtig. Die oormaat suur en alkohol los beide op in water en is minder vlugtig en die reuk is minder opvallend.) (1)
- 3.1.3 Any TWO safety precautions: / Enige TWEE veiligheidsmaatreëls:
- Sulphuric acid is corrosive. Use safety equipment e.g. goggles, gloves, glass ware. ✓
Swawelsuur is vretend. Gebruik veiligheidsklere, bv. Veiligheidsbrille, handskoene, glassware.
 - Do not use a pipette to suck up the acid. ✓
Moet nie 'n pipet gebruik om die suur op te suig nie.
 - Because heat is involved and alcohols are flammable, a water bath is needed in which to place the test tube. ✓
Omdat hitte betrokke is en alkohole is vlambaar, word 'n waterbad benodig om die proefbuis in te plaas. (2)
- 3.2 3.2.1 hexan-2-ol ✓✓ heksan-2-ol (2)
- 3.2.2 Addition reaction/hydration ✓ / addisiereaksie / hidrasie (1)
- 3.2.3 Any TWO: / Enige TWEE:
- Excess water / Small amount of acid as catalyst (sulphuric or phosphoric) / Mild heat ✓ mark each
- Oormaat water / klein hoeveelheid van die suur as katalisator (swawelsuur of fosforsuur) / matige hitte ✓ een punt elk.* (2)

5

Structure / Struktuur

Because pentanoic acid has a smaller surface area / shorter chain length / lower molecular mass than hexanoic acid, this causes less intermolecular forces ✓

Omdat pentanoësuur 'n kleiner oppervlakte het / korter kettinglengte / laer molekulêre massa as heksanoësuur, veroorsaak dit minder intermolekulêre kragte.

Intermolecular forces / Intermolekulêre kragte

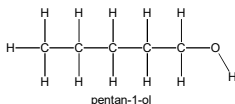
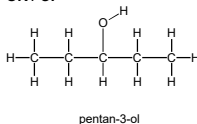
Lower intermolecular forces / induced dipole forces / London forces / dispersion forces / and hydrogen bond between the hydroxyl group of neighbouring molecules in pentanoic acid ✓
 Minder intermolekulêre kragte / geïnduseerde dipoolkragte / Londonkragte / dispersiekragte / en waterstofbinding tussen die hidroksielgroepe van naburige molekule in pentanoësuur.

Energy / Energie

Less energy needed to overcome/break intermolecular forces in pentanoic acid than in hexanoic acid. ✓
 Minder energie word benodig om die intermolekulêre kragte te oorkom / breek in pentanoësuur as in heksanoësuur. (3)

- 2.6 2.6.1 Same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain. ✓✓
Dieselfde molekulêre formule maar verskillende posisies van die syketting, substituentte of funksionele groepe op die moederketting. (2)

2.6.2

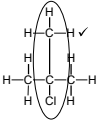
**OR / OF**2.6.3 (Positive marking from 2.6.2) / *(Positiewe nasien vanaf 2.6.2)*

Pentan-1-ol ✓✓

OR / OF

Pentan-3-ol ✓✓

[17]

- 3.3 3.3.1  ✓ whole structure / hele struktuur (2)
- 3.3.2 2-chloro-2-methylpropane ✓ and water ✓
2-chloro-2-metielpropan en water (3)
- 3.4 3.4.1 High temperature ✓ / Hoë temperatuur
 High pressure ✓ / Hoë druk (2)
- 3.4.2 Ethene ✓ / eteen (1)
- 3.4.3 Dehydration ✓ / dehidrasie (1)
- 3.4.4 A polymer formed when monomers (usually containing a double bond) combine through an addition reaction. ✓✓
'n Polimeer vorm wanneer monomere (gewoonlik met 'n dubbelbinding) kombineer deur 'n addisiereaksie. (2)
- 3.4.5 Polythene ✓ / politeen of polietileen (1)

[23]

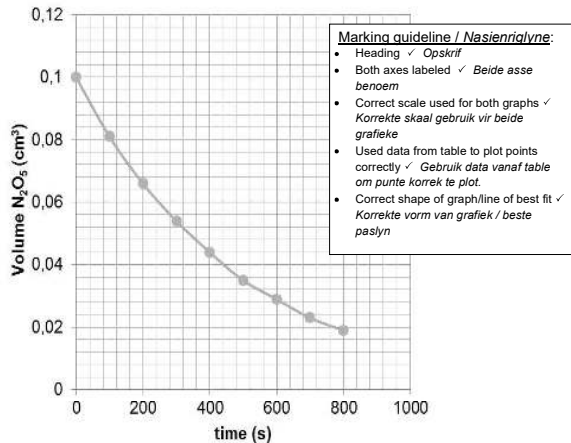
QUESTION / VRAAG 4

- 4.1 4.1.1 10 kJ ✓ (1)
- 4.1.2 -20 kJ ✓ (1)
- 4.2 4.2.1 The particles with sufficient kinetic energy for a reaction to take place. ✓
Die deeltjies met genoegsame kinetiese energie vir 'n reaksie om plaas te vind. (1)
- 4.2.2 B ✓ (1)
- 4.2.3 Increasing temperature increases the rate of reaction. ✓ Molecules must collide with sufficient energy for bonds to break. ✓ and a reaction to occur (activation energy). When the temperature is increased, more particles have enough energy for more effective collisions to take place ✓ and more particles have energy greater than the activation energy. ✓
Vermeerdering van die temperatuur verhoog die tempo van die reaksie. Molekule moet bots met genoegsame energie vir die bindings om te breek en 'n reaksie om plaas te vind (aktiveringsenergie). Wanneer die temperatuur verhoog, het meer deeltjies genoeg energie vir meer effektiewe botsings om plaas te vind en meer deeltjies het energie groter as die aktiveringsenergie.

Increase in energy increases kinetic energy. As the kinetic energy of the particles increase, more particles have sufficient activation energy, the chances of colliding with correct orientation increases, more effective collisions per unit time takes place.

Toename in energie verhoog die kinetiese energie. Indien die kinetiese energie van die deeltjies verhoog, is daar meer deeltjies met genoegsame aktiveringsenergie, die kans vir botsings met korrekte oriëntasie verhoog, meer effektiewe botsings per eenheid tyd vind plaas.

- 4.3 4.3.1 Graph of time of reaction taking place vs Volume of N_2O_5
Grafiek van tyd van reaksie wat plaasvind teenoor Volume van N_2O_5 (5)



- 4.3.2 The change in concentration of reactants or products per unit time. ✓
Die verandering in konsentrasie van reaktante of produkte per eenheid tyd. (2)

4.3.3 Rate of reaction (*Reaksietempo*) = $\frac{\text{volume } \text{N}_2\text{O}_5 \text{ used}}{\Delta t}$ ✓

$$= \frac{0,06}{240} \checkmark = 2,5 \times 10^{-4} \text{ mol} \cdot \text{dm}^{-3} \cdot \text{s}^{-1} \checkmark$$
 (Allow for a range $2,4 - 2,6 \times 10^{-4}$ – see learner's graphs)
 (Laat toe vir 'n reeks van $2,4 - 2,6 \times 10^{-4}$ - sien leerder se grafiek) (3)

7

9

QUESTION / VRAAG 5

- 5.1 When the rate of the forward reaction is equal to the rate of the reverse reaction. ✓
 Or
 When both reactants and products continue to form at the same time.
 Wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie
 Of
 Wanneer beide reaktante en produkte aanhou vorm op dieselfde tyd. (2)

	$4\text{AO}_2(\text{g})$	$2\text{A}_2\text{O}_3(\text{g}) +$	$\text{O}_2(\text{g})$	
Molar ratio Molêre verhouding	4	2	1	
Initial concentration Aanvanklike konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)	0 (given)	2,0 (given)	1,0 (given)	
Change in concentration Verandering in konsentrasie ($\text{mol} \cdot \text{dm}^{-3}$)	+4x	-2x	-x	Use ratio 4:2:1 ✓ Gebruik verhouding
Equilibrium concentration Konsentrasie by ewewig ($\text{mol} \cdot \text{dm}^{-3}$)	4x	2,0-2x	1,0-x	n at equilibrium ✓ n by ewewig

At equilibrium, AO_2 is 10% decomposed. / By ewewig, AO_2 word 10% ontbind.
 $\therefore [\text{AO}_2]_{\text{eq}} = 10\% \text{ of } 2,0 \checkmark$ Use 10% decomposition / Gebruik 10% ontbinding

$$\therefore 2,0 - 2x = \frac{10}{100} \times 2,0$$

$$x = 0,9 \text{ mol} \cdot \text{dm}^{-3}$$

OR / OF

$$[\text{O}_2] = 10\% \text{ of } 1$$

$$\therefore 1 - x = \frac{10}{100} \times 1$$

$$x = 0,9 \text{ mol} \cdot \text{dm}^{-3}$$

Therefore at equilibrium: / Dus by ewewig:

$$[\text{AO}_2] = 4(0,9) = 3,6 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$[\text{A}_2\text{O}_3] = 2,0 - 2(0,9) = 0,20 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$[\text{O}_2] = 1,0 - 0,9 = 0,10 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

Positive marking from x
Positiewe nasien vanaf x

(6)

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- 5.3 5.3.1 COLOURLESS ✓ KLEURLOOS (1)

- 5.3.2 (Negative marking from 5.3.1) / (Negatiewe nasien vanaf 5.3.1)

Decreasing the volume will increase the pressure.
 Reaction will reduce the stress on the system by favouring the reaction that will reduce the pressure, i.e. less number of moles ✓

Reaction will favour the forward reaction / production of $\text{A}_2\text{O}_3(\text{g}) + \text{O}_2(\text{g})$ / decomposition of $\text{AO}_2(\text{g})$ ✓
More product / colourless gases will reduce the intensity of the mixture's reddish-brown colour ✓

Vermindering van volume sal die druk verhoog.
 Reaksie sal die versteuring teenwerk om die sisteem deur die reaksie te bevoordeel wat die druk sal verminder, dit is minder aantal mol.

Die reaksie sal die voorwaartse reaksie bevoordeel / produksie van $\text{A}_2\text{O}_3(\text{g}) + \text{O}_2(\text{g})$ / ontbinding van $\text{AO}_2(\text{g})$
 Meer produkte / kleurlose gasses al die intensiteit van diemengsel se rooi-bruin kleur verminder. (3)

[12]

QUESTION / VRAAG 6

- 6.1 An acid is a substance that donates a proton. ✓
 Or
 An acid is a proton donor.
 'n Suur is 'n stof wat 'n proton skenk.
 Of
 'n Suur is 'n protionskenker. (2)
- 6.2 HPO_4^{2-} ✓ (1)
- 6.3 6.3.1 Bromothymol blue. ✓ / broomtimblou (1)
- 6.3.2 Strong acid + strong base ✓ pH range is between 6 and 7.6 ✓
 Sterk suur + sterk basis pH reeks is tussen 6 en 7,6 (2)
- 6.3.3 OPTION / OPSIE 1
 $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$
 $\frac{(0,1)(15) \checkmark}{c_b (20) \checkmark} = \frac{1}{2} \checkmark$
 $c_b = 0,15 \text{ mol} \cdot \text{dm}^{-3} \checkmark$
- OPTION / OPSIE 2
 $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$
 $\frac{(0,1)(\frac{15}{1000}) \checkmark}{c_b (\frac{20}{1000}) \checkmark} = \frac{1}{2} \checkmark$
 $c_b = 0,15 \text{ mol} \cdot \text{dm}^{-3} \checkmark$ (5)

6.3.4 Option / Opsie 1

$$\text{pOH} = -\log [\text{OH}^-] \checkmark$$

$$\text{pOH} = -\log (0,15) \checkmark$$

$$\text{pOH} = -(-0,82)$$

$$\text{pOH} = 0,82$$

$$\text{pH} + \text{pOH} = 14 \checkmark$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 0,82 \checkmark$$

$$\text{pH} = 13,18 \checkmark$$

The pH of a 0,15 M solution of potassium hydroxide is 13,18.
 Die pH van 'n 0,15 M oplossing van kaliumhidroksies is 13,18. (5)

6.4 6.4.1 Hydrolysis ✓ Hidroliese

6.4.2 SMALLER THAN 7 ✓ KLEINER AS 7

6.4.3 Hydrolysis of the salt of a strong acid and a weak base ✓ results in an acidic solution.
 Hidroliese van die sout van 'n sterk suur en 'n swak basis eindig in 'n suur oplossing. (1)

[19]

QUESTION / VRAAG 7

- 7.1 Copper ✓ / Koper (1)
- 7.2 The negative terminal ✓ / Die negatiewe terminal (1)
- 7.3 Reduced ✓ / gereduseer (1)
- 7.4 $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s}) \checkmark$ (1)
- 7.5 Electrons must be constantly supplied by the negative terminal ✓ of the battery/power source and cannot alternate between terminals. ✓ If AC is used no plating will occur ✓ / Plating will continuously occur on both.
 Elektrone moet constant toegevoeg word tot die negatiewe terminaal van die battery / kragbron en kan nie wissel tussen terminale nie. Indien WS gebruik word sal geen platering plaasvind nie / platering sal plaasvind op beide gelyktydig. (3)

[7]

QUESTION / VRAAG 8

- 8.1 8.1.1 $\text{Ag(s)} \mid \text{Ag}^+(\text{aq}) (1 \text{ mol-dm}^{-3}) \parallel \text{Co}^{3+}(\text{aq}) (1 \text{ mol-dm}^{-3}) \mid \text{Co}^{2+}(\text{aq}) (1 \text{ mol-dm}^{-3})$
(Do not penalise if phases and standard conditions are omitted.)
(Moet nie penaliseer indien fases en standaardtoestande uitgelaat is nie) (3)
- 8.1.2 $\text{Co}^{3+}(\text{aq}) \checkmark$ (1)
- 8.1.3 $\text{Co}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Co}^{2+}(\text{aq}) \checkmark$ (1)
- Marking guidelines / Nasienriglyne:
 $\text{Co}^{2+}(\text{aq}) \leftarrow \text{Co}^{3+}(\text{aq}) + \text{e}^-$ 1/1
 If double arrow, no marks
 Indien dubbel pyle, geen punte.
- 8.2 8.2.1 To determine the standard electrode potential of another half-cell. $\checkmark$
Om die standard electrode potensiaal van 'n ander halfsel te bereken. (1)
- 8.2.2 Platinum (Pt) $\checkmark$ (1)
- 8.2.3 Complete the circuit / allow ions to move / maintain electrical neutrality / keep the electrolytes separate. $\checkmark$
Voltooi die stroombaan / laat ione toe om te vloei / handhaaf elektriese neutraliteit / hou die elektroliete apart. (1)
- 8.2.4 Metal M is chromium (Cr). $\checkmark \checkmark$ Metaal M is chroom (Cr) (2)
- 8.2.5 $2\text{Cr} + 6\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{H}_2$ $\checkmark$ reactants; $\checkmark$ products; $\checkmark$ balancing
Reaktante produkte balansering (3)
- 8.2.6 DECREASE $\checkmark$ / VERMINDER
An increase in $[\text{Cr}^{3+}]$ will affect the equilibrium to the left, decreasing the concentration of products and increasing the concentration of reactants. This will result in a decrease in V_{cell} . $\checkmark$
'n Toename in $[\text{Cr}^{3+}]$ sal die ewewig na links affekteer, vermindering van die konsentrasie van produkte en vermeerdering van die konsentrasie van die reaktante. Dit veroorsaak 'n afname in V_{sel} . (2)
- 8.2.7 0 V $\checkmark$ (1)
- 8.2.8 H_2 is flammable $\checkmark$, H^+ (or H_3O^+) is an acid which is corrosive. $\checkmark$
 H_2 is vlambaar, H^+ (of H_3O^+) is 'n suur wat vretend is. (2)

[18]

11



PREPARATORY EXAMINATION 2018 MARKING GUIDELINES

PHYSICAL SCIENCES: PHYSICS (PAPER 1) (10841)

13 pages

QUESTION 9 / VRAAG 9

- 9.1 9.1.1 $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
 $\checkmark$ reactants $\checkmark$ products $\checkmark$ balancing
Reaktante produkte balansering (3)
- 9.1.2 Catalytic Oxidation of Ammonia $\checkmark$ / Katalitiese oksidasie van ammoniak (1)
- 9.1.3 HNO_3 $\checkmark$ (1)
- 9.2 9.2.1 $(\text{NH}_4)_2\text{SO}_4$ / ammoniumsulphate $\checkmark$ / ammoniumsulfaat (1)
- 9.2.2 NH_4NO_3 / ammoniumnitrate $\checkmark$ / ammoniumnitraat (1)
- 9.3 Any TWO. ONE $\checkmark$ each: Enige TWEE. EEN punt elk:
 - Nitrogen saturation of soil leads to washing away of other nutrients needed in the soil, into the rivers and dams.
 - Washing of top soil into lakes / rivers / dams causes it to become acidic.
 - Build up of nitrates in rivers (eutrophication) causes algae bloom that depletes oxygen causing aquatic life to die.
 - Build up of nitrates in drinking water can cause death of infants due to hemoglobin deficiency.
 - Ground water can become acidic.
 - Promotes growth of alien plants in dams and rivers.
 - Water poisoning / blue baby syndrome / nitrates potentially carcinogenic
 - stikstof versadiging van grond lei tot die weg wassery van ander nutriënt benodig in die grond na die riviere en damme.
 - was van bo-grond na die mere / riviere / damme veroorsaak dat dit suur word.
 - opbou van nitrate in riviere (eutrofikasie) veroorsaak dat alge groei wat suurstof neem uit die water en diere en plante in water laat sterf.
 - grondwater word suur.
 - bevorder groei van uitheemse plante in damme en riviere.
 - water vergiftiging / blou baba sindroom / nitrate potensiaal karsinogenies (2)
- 9.4 9.4.1 The N : P : K gives the proportion / ratio of nitrogen, phosphorus and potassium in a fertilizer. $\checkmark$
Die N : P : K verhouding gee die verhouding van stikstof, fosfor en kalium in die kunsmis. (1)
- 9.4.2 4 : 5 : 8 $\checkmark$ (1)
- 9.4.3 Lower N. $\checkmark$ This is to prevent too much leaf growth, at the cost of fruit growth. $\checkmark$
Laer N. Dit is om te voorkom dat te veel blare groei ten koste van vrugte. (2)
- 9.4.4 Fertilizer D (Kunsmis D) $8/17 \times 25 = 11,77\% \checkmark$
Fertilizer E (Kunsmis E) $9/27 \times 20 = 6,67\% \checkmark$
Thus Fertilizer D $\checkmark$ (If only fertilizer D given as answer 1/3)
Dus Kunsmis D (Indien slegs kunsmis D gegee as antwoord 1/3) (3)

TOTAL / TOTAAL: 150

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12

GAUTENG DEPARTMENT OF EDUCATION PREPARATORY EXAMINATION – 2018

PHYSICAL SCIENCES: PHYSICS (Paper 1)

MARKING GUIDELINES

QUESTION 1

- 1.1 B $\checkmark \checkmark$
 1.2 C $\checkmark \checkmark$
 1.3 B $\checkmark \checkmark$
 1.4 D $\checkmark \checkmark$
 1.5 B $\checkmark \checkmark$
 1.6 D $\checkmark \checkmark$
 1.7 B $\checkmark \checkmark$
 1.8 B $\checkmark \checkmark$
 1.9 D $\checkmark \checkmark$
 1.10 C $\checkmark \checkmark$

[20]

QUESTION 2

- 2.1 The total mechanical energy (sum of the potential energy and kinetic energy) in a system remains constant as long as the only forces acting are conservative forces. $\checkmark \checkmark$ (2)
- 2.2 At point A $E_{\text{mech}} = E_p + E_k \checkmark$
 $= mgh + 0$
 $= 50 \times 9,8 \times 5 \checkmark$
 $= 2\,450 \text{ J}$
 At point B $E_{\text{mech}} = E_p + E_k$
 $2\,450 = 0 + \frac{1}{2}mv^2 \checkmark$
 $v_i = 9,899 \text{ m}\cdot\text{s}^{-1} \checkmark$ (4)
- 2.3 The total linear momentum of a closed system remains constant (is conserved). $\checkmark \checkmark$ (2)

POSITIVE MARKING FROM 2.2

2

$$\begin{aligned}
 m_d v_{d_i} + m_w v_{w_i} &= (m_d + m_w) v_c \\
 50 \times 9,899 + 0 &= (50 + 60) v_c \\
 v_c &= 4,4995 \\
 v_c &= 4,50 \text{ m}\cdot\text{s}^{-1} \quad (3)
 \end{aligned}$$

$$\begin{aligned}
 \text{Impulse, } \Delta p &= m_d \Delta v \\
 &= 50 \times (9,899 - 4,4995) \\
 &= 269,98 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1} \quad (2)
 \end{aligned}$$

$$\begin{aligned}
 W_{\text{net}} = \Delta E_k &= F_{\text{net}} \Delta x \cos \theta \\
 E_{k_f} - E_{k_i} &= F_{\text{net}} \Delta x \cos \theta \\
 0 - \frac{1}{2} \times 110 \times 4,50^2 &= 60 \times \Delta x \cos 180^\circ \quad (3)
 \end{aligned}$$

"free fall" is the motion of a body when the only force acting on the body is gravity/pull due to gravity/its weight. ✓✓

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 v_f &= (10^2 + (2 \times 9,8 \times 20)) \\
 &= 22,181 \text{ m}\cdot\text{s}^{-1} \quad (3)
 \end{aligned}$$

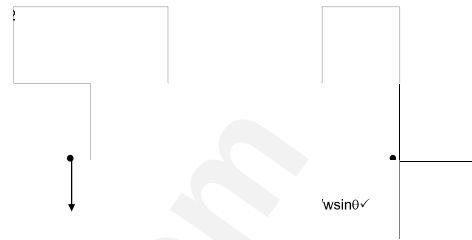
$$\begin{aligned}
 v_f &= v_i + a\Delta t \\
 \Delta t &= \frac{22,181 - 10}{9,8} \\
 &= 1,243 \text{ s} \quad (3)
 \end{aligned}$$

Ball rises 19 m ✓ after the bounce hence

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 0^2 &= v_i^2 + 2(-9,8)(-19) \\
 v_i &= 19,298 \text{ m}\cdot\text{s}^{-1} \quad (3)
 \end{aligned}$$

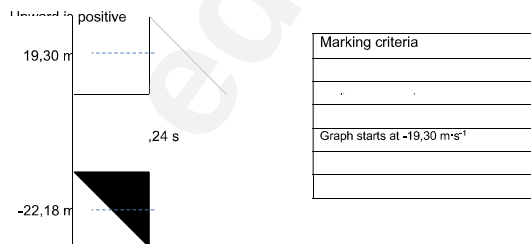
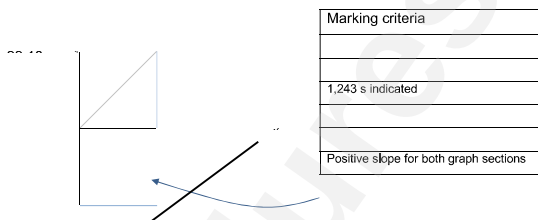
The decrease in the magnitudes of the velocities, hence the loss in kinetic energy shows that the collision between the ball and the ground is inelastic and energy is lost through sound and heat ✓

The net/total work done on an object is equal to the change in the object's kinetic energy ✓✓ (OR the work done on an object by a resultant/ net force is equal to the change in the object's kinetic energy) (2)



(3)

Down is positive



(6)

4.3.1

$$\begin{aligned}
 v_f &= 0^2 + 2 \times 2 \times 8 \\
 &= 5,657 \text{ m}\cdot\text{s}^{-1} \\
 E_k &= \frac{1}{2} m v^2 \\
 &= 0,5 \times 40 \times 5,657^2 \\
 &= 640,03 \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 \Delta t &= 0 \times \Delta t + 0,5 \times 2 \times \Delta t \\
 \Delta t &= 2,828 \\
 v_f &= v_i + a \Delta t \\
 &= 0 + 2 \times 2,838 \\
 &= 5,657 \text{ m}\cdot\text{s}^{-1} \\
 E_k &= \frac{1}{2} m v^2 \\
 &= 0,5 \times 40 \times 5,657^2 \\
 &= 640,03 \text{ J}
 \end{aligned}$$

(5)

4.3.2

OPTION 1

$$\begin{aligned}
 &= (mg \sin \theta) \Delta x \cos \theta \\
 &= 40 \times 9,8 \times \sin 30^\circ \times 8 \times \cos 0^\circ \\
 &= 1568 \text{ J}
 \end{aligned}$$

OPTION 2

$$\begin{aligned}
 E_p &= mgh \\
 &= 40 \times 9,8 \times 4 \\
 &= 1568 \text{ J}
 \end{aligned}$$

(4)

POSITIVE MARKING FROM 4.3.1 & 4.3.2

$$\begin{aligned}
 4.3.3 \quad W_{\text{net}} &= \Delta E_k \\
 W_g + W_f &= E_{k_f} - E_{k_i} \\
 1568 + W_f &= 640,03 - 0 \\
 \therefore W_f &= -927,97 \text{ J}
 \end{aligned}$$

(4)

$$\begin{aligned}
 4.3.4 \quad W_f &= F_f \Delta x \cos \theta \\
 927,97 &= F_f \times 8 \cos 180^\circ \\
 F_f &= -115,996 \text{ N} \\
 &= 115,996 \text{ N}
 \end{aligned}$$

(3)

QUESTION 5

The Doppler effect is the change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

(2)

For car A: $f_L = \left(\frac{v + v_L}{v} \right) f_s$ ✓ $v_s = 79 \text{ m} \cdot \text{s}^{-1}$ ✓

$$= \left(\frac{340 + 1600}{340} \right) 1200 \text{ ✓}$$

$$= 1563,218 \text{ Hz. ✓}$$

(5)

For car B: $f_L = \left(\frac{v - v_L}{v} \right) f_s$

$$1600 \text{ ✓} = \left(\frac{340 - 1600}{340} \right) 1170 \text{ ✓}$$

With sound

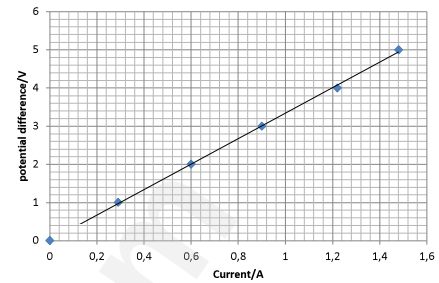
- The velocity of sound in air is comparable with speed of the ambulance. ✓ The change in frequency will therefore be significant hence a noticeable change. ✓

With light

The change in frequency is not significant because the speed of light is much greater than the speed of the ambulance. ✓

[15]

Graph of voltage vs current for a fixed resistor



Marking criteria

Axes labelled ✓

Scales on both axes correct ✓

At least 3 plots correct ✓

Straight line ✓ passing through the origin

(4)

- i The current through the resistor is directly proportional to the potential difference across the resistor if the temperature of the resistor is kept constant. ✓✓

(2)

resistor. ✓

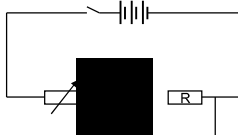
- If I vs V is plotted, then gradient represents the reciprocal of the resistance of the resistor.

(1)

QUESTION 6

What is the relationship between the potential difference across a resistor and the current through the resistor? ✓✓

(2)



Marking criteria	

6.3.1 potential difference (V) ✓

(1)

6.5.1

potential difference/V ✓	1	2	3	4	5

$$R_{\text{ext}} = \frac{V}{I} \quad (V = \text{terminal pd})$$

$$= \frac{12}{4} \text{ ✓}$$

$$= 3 \text{ } \Omega \text{ ✓}$$

(3)

Option 1

Option 2

$$R_{\text{eff}} = \frac{V}{I} \text{ ✓}$$

$$= \frac{12}{5} \text{ ✓}$$

$$R = R_T - R_{\text{eff}} \text{ ✓}$$

$$= 10 - 2,4$$

$$= 7,6 \text{ } \Omega \text{ ✓}$$

$$= \frac{4 \times 6}{4 + 6}$$

$$R_{\text{eff}} = \frac{4 \times 6}{4 + 6}$$

$$= 2,4 \text{ } \Omega$$

$$I_{\text{eff}} = R_{\text{eff}} I$$

$$= 2,4 \times 1,2$$

$$= 2,88 \text{ } \Omega$$

$$I_R = 12 \text{ } \Omega \text{ } \underline{2,88}$$

$$= 9,12$$

$$R = \frac{12}{9,12}$$

$$= 1,315 \text{ } \Omega$$

$$= 7,6 \text{ } \Omega$$

Option 3

$$\mathcal{E} = I(R_{\text{ext}} + r) \text{ ✓}$$

$$= 1,2 (2,4 + R \text{ } 1,5) \text{ ✓}$$

$$13,8 = 1,2R + 4,68 \text{ ✓}$$

(4)

7.3 Option 1

$$V_r = Ir = 1,2 \times 1,5 = 1,8 \text{ V} \checkmark$$

$$\therefore \text{emf} = V_r + V_r$$

$$= 12 + 1,8 \checkmark$$

$$= 13,8 \text{ V} \checkmark$$

Option 2

$$V_{II} = IR_{II} = (1,2)(2,4) = 2,88 \text{ V} \checkmark$$

$$V_R = IR = (1,2)(7,6) = 9,12 \text{ V} \checkmark$$

$$V_r = 1,8 \text{ V}$$

$$\text{emf} = V_{II} + V_R + V_r$$

$$= 2,88 + 9,12 + 1,88$$

$$= 13,8 \text{ V} \checkmark$$

(max = 3 marks)

7.4 Increase ✓

- 7.5
- Total resistance decreases ✓
 - Current increases ✓

(3)

(1)

(2)

[13]

QUESTION 9

- 9.1 The photoelectric effect is a phenomenon whereby electrons are ejected ✓ from a metal surface when light (EM radiation) with a frequency equal to or greater than the threshold frequency of the metal is shone on it. ✓ (2)

- 9.2 Work function is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓ (2)

9.3 $E = hf_0 = h \frac{c}{\lambda_0} \checkmark$

$$= 6,63 \times 10^{-34} \times \frac{3 \times 10^8}{600 \times 10^{-9}} \checkmark$$

$$= 3,315 \times 10^{-19} \text{ J} \checkmark$$

(4)

- 9.4 Yes ✓

(1)

- 9.5 Frequency of blue light is much higher than that of orange light ✓ making blue light photons carry more than sufficient energy to eject photoelectrons from the metal surface ✓

OR

Since W_0 is constant the additional energy is transferred to the photoelectrons as kinetic energy. Therefore the ammeter will register a reading.

(2)

[11]

TOTAL: 150

11

13

QUESTION 8

- 8.1 DC (generator) ✓ (1)

- 8.2 split ring commutator ✓ (1)

- 8.3 a to b ✓ (1)

- 8.4 rms current is that a.c. current that would have the same effect as its dc equivalent ✓✓ OR ($I_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$) (2)

8.5 $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} = \frac{8}{\sqrt{2}} = 5,657 \text{ V} \checkmark$

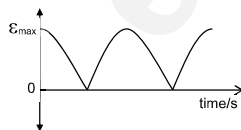
$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$$

$$= \frac{5,657}{5} \checkmark$$

$$= 1,131 \text{ A} \checkmark$$

(4)

8.6.1



Marking guideline

- Starts max ✓
- All quarters positive ✓
- 1 cycle ✓

(3)

- 8.6.2 No ✓

(1)

- 8.6.3 induced emf drives current through the conductors ✓ such that emf and current are in phase, ✓ therefore shape of graphs is the same.

(2)

[15]



**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION
2019**

**10841
PHYSICAL SCIENCES: PHYSICS
PAPER 1**

TIME: 3 hours

MARKS: 150

19 pages + 3 information sheets

GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION

PHYSICAL SCIENCES: PHYSICS
(Paper 1)

TIME: 3 hours

MARKS: 150

INSTRUCTIONS AND INFORMATION

- Write your name in the appropriate space on the ANSWER BOOK.
- This question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
- Start the answer to each question on a NEW page.
- Number the answers correctly according to the numbering system used in this question paper.
- Leave ONE line open between sub-questions, for example, between Question 2.1 AND Question 2.2.
- You may use a non-programmable calculator.
- You may use appropriate mathematical instruments.
- You are advised to use the attached DATA SHEETS.
- Show ALL formulae and substitutions in ALL calculations.
- Round-off your final numerical answers to a minimum of TWO decimal places.
- Give brief discussions, et cetera where required.
- Write neatly and legibly.

P.T.O.

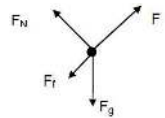
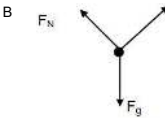
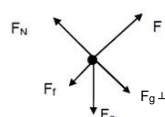
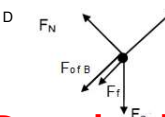
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

- A learner is sitting on a chair. According to Newton's *Third Law of Motion*, the reaction force to the learner's weight, w is the force of the ...
 - learner on the chair.
 - chair on the learner.
 - earth on the learner.
 - learner on the earth.
- Two objects, **A** and **B**, are in contact with each other on an inclined plane. A horizontal force, F , is applied parallel to the incline, and pushes on the objects as shown in the diagram below.
 

The magnitude of kinetic frictional force acting on the objects cannot be ignored.

Which ONE of the following is the correct free body diagram for block **A**?

- 
- 
- 
- 

(2)

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P.T.O.

- Trolley **T**, mass $3m$, moving to the right with a speed v collides head-on with trolley **R**, mass m , moving to the left with speed v . Immediately after the collision, trolley **R** moves to the right with a speed $2v$ and trolley **T** is at rest. Refer to the diagram below.

Ignore the effects of friction.



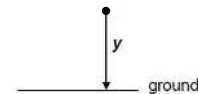
Which of the following combinations is CORRECT?

	MECHANICAL ENERGY	MOMENTUM
A	Conserved	Conserved
B	Conserved	Not conserved
C	Not conserved	Not conserved
D	Not conserved	Conserved

(2)

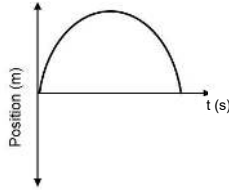
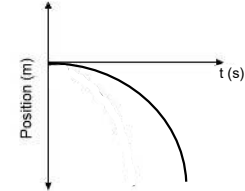
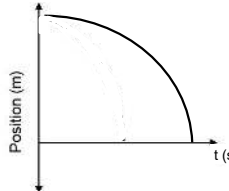
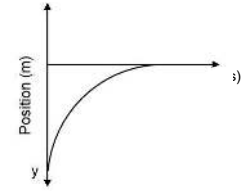
P.T.O.

- A small stone is dropped from a height y above the ground as shown in the diagram below. It strikes the ground after time t .



Take UPWARDS AS THE POSITIVE. Ignore the effects of air resistance.

Which of the following diagrams shows the correct position-time graph for the motion of the stone?

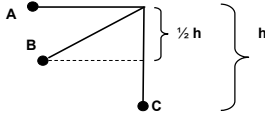
- 
- 
- 
- 

(2)

P.T.O.

- 1.5 A pendulum bob is raised to position **A** at a height **h** above the lowest point of its swing, **C**. It is released from point **A**, and swings through points **B** with speed **v_B** and **C** with speed **v_C**.

Ignore frictional effects.



What is the relationship between the speed **v_B** and speed **v_C**?

- A $v_B = \frac{v_C}{\sqrt{2}}$
 B $v_B = \sqrt{0,5} v_C$
 C $v_B = 0,5 v_C$
 D $v_B = \frac{\sqrt{2}}{v_C}$

(2)

- 1.6 An astronomer views the line spectrum from a star. Which of the following describes the effect of the Doppler shift on the line spectrum if the star is moving *towards* earth?

The line spectrum ...

- A appears dimmer.
 B appears larger.
 C is shifted towards the red end of the spectrum.
 D is shifted towards the blue end of the spectrum.

(2)

P.T.O.

- 1.7 Point charges **Q₁**, **Q₂** and **Q₃** are arranged at the corners of a right-angled triangle, as shown in the diagram below. The charges on **Q₁**, **Q₂** and **Q₃** are unknown. The distance between **Q₁** and **Q₃** is **r**. The distance between **Q₂** and **Q₃** is also **r**. Charge **Q₃** experiences a resultant electrostatic force to the **WEST**.

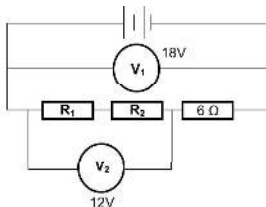


Which of the following combinations of charges could be possible for charges **Q₁**, **Q₂** and **Q₃**?

	Q₁	Q₂	Q₃
A	NEGATIVE	POSITIVE	POSITIVE
B	POSITIVE	POSITIVE	POSITIVE
C	NEGATIVE	NEGATIVE	NEGATIVE
D	POSITIVE	NEGATIVE	POSITIVE

(2)

- 1.8 In the circuit diagram below three resistors, **R₁**, **R₂** and a 6 Ω are connected in series. **R₁** = **R₂** and the internal resistance of the cell and connecting wires may be ignored. **V₁** reads 18V and **V₂** reads 12V.



Which of the following is the possible values for **R₁** and **R₂**?

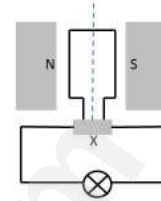
- A 4 Ω
 B 6 Ω
 C 12 Ω
 D 18 Ω

(2)

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P.T.O.

- 1.9 The diagram below is a simplified version of an electric generator connected to a light bulb. Component **X** is either a split ring or slip rings.



Which of the following options for this generator is correct?

	Energy conversion taking place	Type of current generated	Component X
A	mechanical to electrical	slip ring	AC
B	mechanical to electrical	split ring	AC
C	electrical to mechanical	slip ring	DC
D	electrical to mechanical	split ring	DC

(2)

- 1.10 The diagram below shows some principle lines, **P**, **Q**, **R** and **S** in the line emission spectrum of helium with corresponding wavelengths in nm.



Which ONE of the spectral lines represents the *lowest energy* change of an electron within a helium atom?

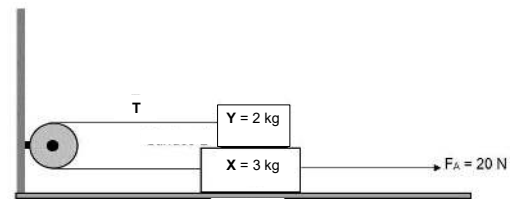
- A **P**
 B **Q**
 C **R**
 D **S**

(2)
[20]

P.T.O.

QUESTION 2 (Start on a new page.)

- 2.1 A horizontal force **F_A** of magnitude 20 N is applied to block **X**, mass 3 kg on a table. Block **Y**, mass 2 kg, is resting on block **X**. The two blocks are joined by a thin inextensible string of negligible mass which runs over a frictionless pulley, fixed to the wall. Block **X** experiences a kinetic frictional force of 1,2 N with the surface of the table. There is no friction between block **X** and block **Y**. The tension in the string is **T** when block **X** accelerates to the right.

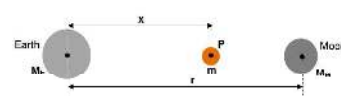


2.1.1 State Newton's *Second Law of Motion* in words. (2)

2.1.2 Draw a labelled, free-body diagram showing ALL the forces acting on block **X**. (6)

2.1.3 Calculate the magnitude of the tension **T** in the string. (6)

- 2.2 A learner wants to calculate the distance between the Earth (mass **M_E** = 5,97 × 10²⁴ kg) and the Moon (mass **M_M** = 7,35 × 10²² kg) where the net gravitational force is zero. To achieve this, the learner placed a third mass '**m**' at point '**P**' as shown in the diagram below. The distance between the centres of the Earth and the Moon is '**r**'.



2.2.1 State Newton's *Law of Universal Gravitation* in words. (2)

2.2.2 Use the law of gravitation to show that **r** and **x** are related by the following equation:

$$r^2 - 2rx + 0,988x^2 = 0$$

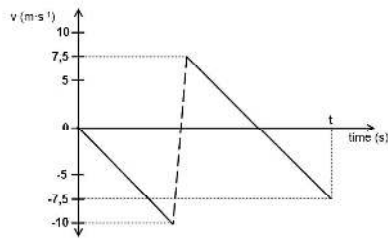
(4)
[20]

P.T.O.

QUESTION 3 (Start on a new page.)

A ball of mass 0,2 kg is dropped vertically from the top of a building to a concrete floor below. The ball bounces off the floor. The velocity versus time graph below shows the motion of the ball. Ignore the effects of air friction.

DOWNWARD MOTION IS TAKEN AS NEGATIVE.



- 3.1 Explain the term *free fall*. (2)

Use the graph to answer the following questions.

- 3.2 Write down the number of times the ball hits the floor. (1)
- 3.3 Calculate the height: (4)
- 3.3.1 From which the ball was dropped (4)
- 3.3.2 Reached by the ball after the first bounce (3)
- 3.4 Determine the magnitude of the displacement of the ball from the moment it was dropped until time t . (1)

[11]

P.T.O.

QUESTION 4 (Start on a new page.)

The table below shows how the momentum of a single train coach **A** changes with time just before and just after a head-on collision with another coach **B**.

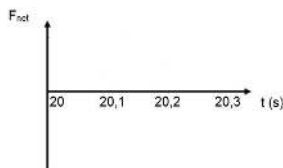
p (kg·m·s ⁻¹) of coach A	30 000	30 000	14 000	14 000
time (s)	20	20,1	20,2	20,3

Coach **B** has a mass of 9 000 kg and was initially travelling at 1,5 m·s⁻¹ west. You may assume that the net external force acting on the system is zero.

- 4.1 Write down a word / term for the underlined words above. (1)

Use the information in the table to answer the following questions.

- 4.2 Calculate the magnitude of the: (4)
- 4.2.1 Net average force acting on engine coach **A** during the collision (4)
- 4.2.2 Velocity of coach **B** just after collision (4)
- 4.3 Redraw the net force vs time graph below in your answer book and complete the graph for coach **A**. The time values are on the graph. (3)

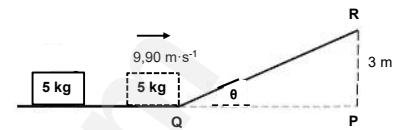


[12]

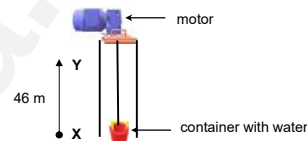
QUESTION 5 (Start on a new page.)

- 5.1 In an experiment, a rough inclined plane **QR** has been constructed to stop a moving 5 kg block. The block reaches point **Q** with a speed 9,90 m·s⁻¹. The block comes to a stop at point **R** which is 3 m above level **QP**.

The frictional force between the surface **QR** and the block is 18 N.



- 5.1.1 Define a *non-conservative force*. (2)
- 5.1.2 Use energy principles and calculate the angle θ of slope **QR**. (7)
- 5.2 A motor is used to lift a container of water up a vertical shaft with a steel cable. The total mass of the container and the water is 987 kg. The container is lifted from rest from point **X** and passes point **Y** at a height 46 m. At point **Y** the container has a speed of 0,9 m·s⁻¹. You may ignore frictional effects and the mass of the steel cable.

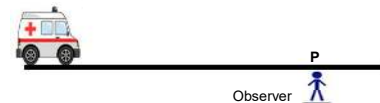


- 5.2.1 State the *work-energy theorem* in words. (2)
- 5.2.2 Use the work-energy theorem to calculate the work done by the motor in lifting the container from point **X** to **Y**. (4)

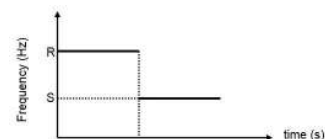
P.T.O.

QUESTION 6 (Start on a new page.)

An ambulance is travelling at a constant speed along a straight horizontal road with its siren emitting a sound of frequency 800 Hz. A stationary observer standing at point **P** next to the road, hears the siren frequency of 910 Hz as the ambulance approaches. The ambulance passes point **P** and continues at the same speed. Take the speed of sound in air to be 340 m·s⁻¹.



- 6.1 State the *Doppler effect*. (2)
- 6.2 Calculate the speed of the ambulance. (5)
- 6.3 A detector at point **P** measures the siren's frequency and the results are shown in the graph below.

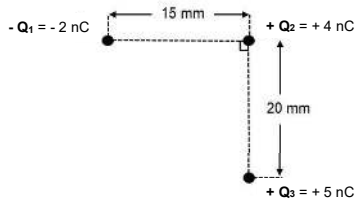


- 6.3.1 Write down frequency **R**. (1)
- 6.3.2 Calculate the value of **S** on the graph. (4)
- 6.4 What frequency will the observer hear when the ambulance is at point **P**? (1)

P.T.O.

QUESTION 7 (Start on a new page.)

- 7.1 Point charges $-Q_1$, $+Q_2$ and $+Q_3$ are arranged at the corners of a right-angled triangle, as shown in the diagram below.



- 7.1.1 State *Coulomb's law* in words. (2)
- 7.1.2 Draw a force diagram to show the forces acting on charge $+Q_2$ due to charge $-Q_1$ and $+Q_3$. (2)
- 7.1.3 Calculate the magnitude of the net force acting on Q_2 due to Q_1 and Q_3 if $Q_1 = -2 \text{ nC}$, $Q_2 = +4 \text{ nC}$ and $Q_3 = +5 \text{ nC}$. (5)
- 7.2 A -2 nC charge is 15 mm to the left of a $+4 \text{ nC}$ charge as shown in the diagram below. Point P is 10 mm to the right of the $+4 \text{ nC}$ charge.



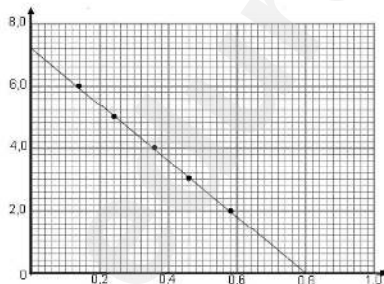
Calculate the net electric field at point P .

(5)
[14]

P.T.O.

QUESTION 8 (Start on a new page.)

A group of learners conduct an experiment to determine the emf (ϵ) and internal resistance (r) of a battery. The data obtained from the experiment is used to plot points on graph paper and draw a line of best fit. The graph of one of the learners is given below. The x and y axes have not been labelled.



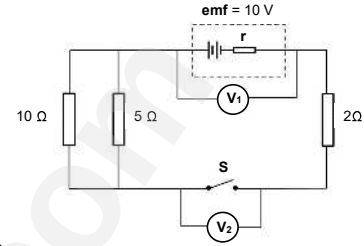
- 8.1 Explain the term *internal resistance*. (1)
- 8.2 Write down ONE factor which must be kept constant during this experiment. (1)
- Using the graph:
- 8.3 Provide a label for the y-axis. (1)
- 8.4 Write down the quantity represented by the gradient? (1)
- 8.5 Write down the emf of the battery. (1)
- 8.6 Calculate the internal resistance of the battery. (4)
- 8.7 Determine the value of V_{int} when the graph reaches 0,8 on the x-axis. (1)

[10]

P.T.O.

QUESTION 9 (Start on a new page.)

9. A circuit is connected as shown below. The battery has an emf of 10 V and an unknown internal resistance r . A voltmeter V_1 is connected across the battery and another voltmeter V_2 is connected across the switch S . The connecting wires have negligible internal resistance.



Switch S is initially open.

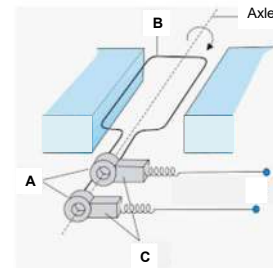
- 9.1 Write down the reading on voltmeter V_2 . (1)
- Switch S is now closed. The reading on voltmeter V_1 is 8 V .
- 9.2 What is the reading on V_2 ? (1)
- 9.3 Calculate the total external resistance of the circuit. (3)
- 9.4 Calculate the internal resistance, r , of the battery. (5)
- 9.5 How will the reading on the voltmeter V_1 be affected if the 5Ω resistor was removed? (Choose from: INCREASES, DECREASES or STAYS THE SAME.) (1)
- 9.6 Explain your answer to Question 9.5. (3)

[14]

P.T.O.

QUESTION 10 (Start on a new page.)

The diagram below shows an AC generator. The main components are labelled A , B and C .

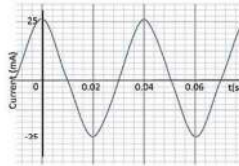


- 10.1 Write down the name of the components labelled:
- 10.1.1 A (1)
- 10.1.2 B (1)
- 10.2 Write down the function of component C . (1)

P.T.O.

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

The graph below represents the output current vs time for an AC generator.



Use the graph above to answer the following questions.

- 10.3 At what position was the coil relative to the magnetic field of the generator for the current output to be a maximum?
(Choose from: PERPENDICULAR or PARALLEL.) (1)
- 10.4 Calculate the rms current (I_{rms}) for this generator. (3)
- 10.5 Calculate the average power dissipated by a 100Ω resistor connected across the terminals of the generator. (3)
- [10]

TABLE 1: PHYSICAL CONSTANTS

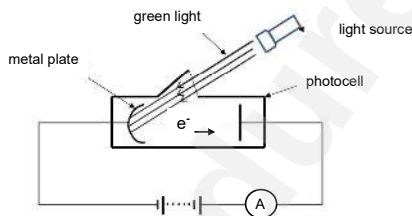
NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8 \text{ m} \cdot \text{s}^{-2}$
Universal gravitational constant	G	$6,67 \times 10^{-11} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Planck's constant	h	$6,63 \times 10^{-34} \text{ J} \cdot \text{s}$
Coulomb's constant	k	$9,0 \times 10^9 \text{ N} \cdot \text{m}^2 \cdot \text{C}^{-2}$
Charge on electron	e	$1,6 \times 10^{-19} \text{ C}$
Electron mass	m_e	$9,11 \times 10^{-31} \text{ kg}$
Mass of the earth	M_E	$5,98 \times 10^{24} \text{ kg}$
Radius of the earth	R_E	$6,38 \times 10^6 \text{ m}$

P.T.O.

P.T.O.

QUESTION 11 (Start on a new page.)

In an investigation, the metal plate of a photocell, shown below, is irradiated with green, blue and violet light.



The results of the investigation are shown in the table below.

Colour	Wavelength (nm)	Reading on ammeter
green	560	No
blue	500	Yes
violet	430	Yes

- 11.1 Define the *work function* of a metal. (2)
- 11.2 Explain why no current is registered when green light is used. (2)
- 11.3 What effect will increasing the **intensity** of light have on the reading of the ammeter when blue light is used? (Choose from INCREASES, DECREASES or STAYS THE SAME.) (1)
- 11.4 Explain your answer to Question 11.3. (2)
- 11.5 Calculate the energy of a photon of blue light. (4)
- [11]

TOTAL: 150

TABLE 2: FORMULAE

MOTION

$v_f = v_i + a \Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ or $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ or $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$

FORCE

$F_{\text{net}} = ma$	$p = mv$
$f_{\text{friction}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$	$w = mg$
$\Delta p = mv_f - mv_i$	$g = \frac{GM}{d^2}$ or $g = \frac{GM}{r^2}$
$F = G \frac{m_1 m_2}{d^2}$ or $F = G \frac{m_1 m_2}{r^2}$	

WORK, ENERGY AND POWER

$W = F \Delta x \cos \theta$	$U = mgh$ or $E_p = mgh$
$K = \frac{1}{2} mv^2$ or $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or $W_{\text{net}} = \Delta E_k$
$W_{\text{nc}} = \Delta K + \Delta U$ or $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$\Delta K = K_f - K_i$ or $\Delta E_k = E_{kf} - E_{ki}$
$P_{\text{ave}} = F v_{\text{ave}}$ / $P_{\text{gen}} = F v_{\text{gen}}$	$P = \frac{W}{\Delta t}$

WAVES, SOUND AND LIGHT

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_S} f_s$ or $f_L = \frac{v \pm v_L}{v \pm v_B} f_b$	$E = hf$ or $E = h \frac{c}{\lambda}$
$E = W_o + E_{k(\text{max})}$ or $E = W_o + K_{\text{max}}$ where	
$E = hf$ and $W_o = hf_o$ and $E_{k(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$ or $K_{\text{max}} = \frac{1}{2} mv_{\text{max}}^2$	

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS

$R = \frac{V}{I}$	$\text{emf } (\mathcal{E}) = I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$\text{emk } (\mathcal{E}) = I(R + r)$ $q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ / $I_{\text{w.gk}} = \frac{I_{\text{maks}}}{\sqrt{2}}$	$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ / $P_{\text{gem}} = V_{\text{w.gk}} I_{\text{w.gk}}$
$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ / $V_{\text{w.gk}} = \frac{V_{\text{maks}}}{\sqrt{2}}$	$P_{\text{ave}} = I_{\text{rms}}^2 R$ / $P_{\text{gem}} = I_{\text{w.gk}}^2 R$
	$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ / $P_{\text{gem}} = \frac{V_{\text{w.gk}}^2}{R}$

END

QUESTION / VRAAG 1

- 1.1 D ✓✓
1.2 A ✓✓
1.3 D ✓✓
1.4 B ✓✓
1.5 B ✓✓
1.6 D ✓✓
1.7 B ✓✓
1.8 C ✓✓
1.9 B ✓✓
1.10 D ✓✓

[20]

QUESTION / VRAAG 2

- 2.1 When a net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n netto krag op 'n voorwerp inwerk sal die voorwerp in die rigting van die krag versnel en die versnelling sal direk eweredig wees aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

The net (or resultant) force acting on an object is equal to the rate of change of momentum of the object in the direction of the net force. ✓✓

Die netto (of resultante) krag wat inwerk op 'n voorwerp is gelyk aan die tempo van die verandering van momentum van die voorwerp in die rigting van die netto krag.

(2)

2.2



Accepted labels/Aanvaarde benoemings	
w	F_g /Weight/mg/gravitational force F_z /Gewig/mg/gravitasiekrag
f	F_{friction} /Friction/fk F_{wrysing} /Wrysing/fz
T	F_{normal} /Normal force F_n /Normaal/Normalalkrag
	Deduct 1 mark for any additional force. / Trek een punt af vir enige ekstra krag. Mark is given for both arrow and label / Punt word toegeken vir beide 'n pyl en byskrif

(3)

2



PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

2020

MARKING GUIDELINES /
NASIENRIGGLYNE

PHYSICAL SCIENCES: PHYSICS (PAPER 1) (10841)
FISIESE WETENSKAPPE: FISIKA (VRAESTEL 1) (10841)

15 pages / bladsye

10841/20

- 2.3 For drone / Vir hommeluig
 $F_{\text{net}} = ma$ ✓
 $F_{\text{net}} = T - f - F_g = ma$
 $180 - T - f - (5.8)(9.8) = (5.8)(0.9)$ ✓
 $T = -f + 117.94 \dots (1)$
- For m / Vir m
 $F_{\text{net}} = ma$
 $T - f - F_g = ma$
 $T - f - (3.2)(9.8) = (3.2)(0.9)$ ✓
 $T = f + 34.24 \dots (2)$
- $-f + 117.94 = f + 34.24$ ✓
 $-2f = -83.67$
Magnitude / Grootte $2f = 83.7 \text{ N}$ ✓

(7)

Marking guidelines / Nasienrigglyne	
✓	Formula for $F_{\text{net}} = ma$ Formule vir $F_{\text{net}} = ma$
✓	Substitution left side for drone Invangang linkerkant vir hommeluig
✓	Substitution right side for drone with $ma = (5.8)(0.9)$ Invangang regterkant vir hommeluig met $ma = (5.8)(0.9)$
✓	Substitution left side for m Invangang linkerkant vir m
✓	Substitution right side for m with $ma = (3.2)(0.9)$ Invangang regterkant vir m met $ma = (3.2)(0.9)$
✓	Equate 1 and 2 Stel 1 en 2 gelyk aan mekaar
✓	Final answer and unit Finale antwoord en eenheid

- 2.4 Positive marking from 2.3 / Positiewe nasien vanaf 2.3

$$T = -(41.85) + 117.94 \quad \text{or / of} \quad T = f + 34.24$$

$$= 76.09 \text{ N} \quad \quad \quad = 41.85 + 34.24$$

$$= 76.09 \text{ N} \quad \quad \quad = 76.09 \text{ N} \quad \quad \quad$$

(2)

- 2.5 $P = Fv$ ✓
 $= (180)(19.7)$ ✓
 $= 3546 \text{ W}$ ✓

(3)
[17]

QUESTION / VRAAG 3

- 3.1 A moving object upon which the only force acting is the force of gravity. ✓✓
in Bewegende voorwerp waarop slegs gravitasiekrag inwerk. (2)
- 3.2.1 A ✓ (1)
- 3.2.2 The initial velocity is not zero. ✓
Die beginsnelheid (aanvanklike snelheid) is nie nul nie. (1)
- 3.3.1 **OPTION 1 / OPSIE 1**
 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $8 \checkmark = 0 + \frac{1}{2} (9,8) (\Delta t)^2$ ✓
 $\Delta t = 1,28 \text{ s}$ ✓
- Because the graph is given the learners should take down as positive only. The graph determines the direction of the ball and down is positive in the graph.
- OPTION 2 / OPSIE 2**
 $v_f^2 = v_i^2 + 2a\Delta y$
 $= 0 + 2(9,8)(8)$ ✓
 $v_f = 12,52 \text{ m} \cdot \text{s}^{-1}$
 $v_f = v_i + a\Delta t$ ✓
 $12,52 = 0 + 9,8\Delta t$ ✓
 $t = 1,278 \text{ s}$ ✓ (4)
- 3.3.2 Positive marking from 3.3.1 / *Positiewe nasien vanaf 3.3.1:*
OPTION 1 / OPSIE 1 (Downwards as positive) / *Afwaarts as positief*
 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $8 \checkmark = v_i (1,28 - 0,6) + \frac{1}{2} (9,8) (1,28 - 0,6)^2$ ✓
 $v_i = 8,43 \text{ m} \cdot \text{s}^{-1}$ downwards / *afwaarts* ✓
- OPTION 2 / OPSIE 2** (Downwards as positive) / *Afwaarts as positief*
 $v_f^2 = v_i^2 + 2a\Delta y$
 $v_f^2 = (0)^2 + 2(9,8)(8)$ ✓
 $v_f = 12,52 \text{ m} \cdot \text{s}^{-1}$
 $v_f = v_i + a\Delta t$ ✓
 $12,52 = v_i + (9,8)(1,28 - 0,6)$ ✓
 $v_i = 8,34 \text{ m} \cdot \text{s}^{-1}$ downwards / *afwaarts* ✓ (4)
- 3.4 Same as ✓. They fall from the same height / change in position is the same for A and B. ✓
Dieselfde as. ✓ Beide balle val van dieselfde hoogte / verandering in posisie is dieselfde vir beide A en B. ✓
OR / OF
 Area under the graph indicates the total displacement. It was the same height (2)

4

QUESTION / VRAAG 5

- 5.1 The work done on an object by a net force is equal to the change in the object's kinetic energy. ✓✓ **OR**
 The net work done on an object is equal to the change in kinetic energy of the object.
Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. OF
Die netto arbeid verrig op die voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp. (2)
- 5.2.1 **OPTION 1 / OPSIE 1**
 For diagram 1:
 $W_{\text{net}} = \Delta K + \Delta U$ ✓
 $f_{k1} \Delta x \cos \theta = (0 - 0) \checkmark + 0 - mgh_1$
 $f_{k1} (5,5) \cos 180^\circ = -50(9,8)(5,5 \sin 15^\circ)$ ✓
 $f_{k1} = 126,821 \text{ N}$
 $f_{k1} = \mu_k N$
 $126,821 = \mu_k (50)(9,8) \cos 15^\circ$ ✓
 $\mu_k = 0,26$ ✓
- Marking guideline:**
 ✓ energy formula used
 ✓ change in $E_k = 0$
 ✓ substitution for work done by w or mgh
 ✓ substitution for work done by f
 ✓ substitution for N force equating to vertical component of w
 ✓ answer with NO unit
- Nasiennriglyne:**
 ✓ energie formule gebruik
 ✓ verandering in $E_k = 0$
 ✓ invervanging vir arbeid verrig deur w of mgh
 ✓ invervanging vir arbeid verrig deur f
 ✓ invervanging vir N krag gelyk gestel aan vertikale komponent van w
 ✓ antwoord met GEEN eenheid
- OPTION 2 / OPSIE 2**
 Diagram 1
 $W_{\text{net}} = \Delta E_k$ ✓
 $W_{\text{g(paralel)}} + W_f = 0 \checkmark (\Delta E_k = 0)$
 $0 = (m \sin \theta) \Delta x \cos \theta + f_{k1} \Delta x \cos \theta$
 $0 = (50)(9,8)(\sin 15^\circ)(5,5)(\cos 0^\circ) \checkmark + (f_{k1})(5,5) \cos 180^\circ$ ✓
 $f_{k1} = 126,88 \text{ N}$
 $f_{k1} = \mu_k N$
 $126,88 = \mu_k (50)(9,8)(\cos 15^\circ)$ ✓
 $\mu_k = 0,27$ ✓
- OPTION 3 / OPSIE 3**
 Diagram 1
 $W_{\text{net}} = \Delta E_k$ ✓
 $W_{\text{g(paralel)}} + W_f = 0 \checkmark (\Delta E_k = 0)$
 $0 = (m \sin \theta) \Delta x \cos \theta + f_{k1} \Delta x \cos \theta$
 $0 = (50)(9,8)(\sin 15^\circ)(5,5)(\cos 0^\circ) \checkmark + (\mu_k)(50 \times 9,8 \cos 15^\circ)(5,5) \cos 180^\circ$ ✓
 $\mu_k = 0,27$ ✓ (6)
- 5.2.2 **OPTION 1 / OPSIE 1**
 Diagram 2
 $f_{c2}(\text{at } 9-30) = 0,27(50)(9,8 \cos 30^\circ)$
 $= 114,58 \text{ N}$
- $W_{\text{net}} = \Delta E_k$ ✓
 $W_{F_g} + W_{f_{k2}} = \Delta E_k$
 $(m \sin \theta) \Delta x \cos \theta + f_{k2} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$
 $(50)(9,8)(\sin 30^\circ)(5,5) \cos 0^\circ \checkmark + (114,58)(5,5)(\cos 180^\circ) \checkmark = \frac{1}{2} (50)(v_f^2) - (0)$ ✓
 $v_f = 5,35 \text{ m} \cdot \text{s}^{-1}$ ✓
- OPTION 2 / OPSIE 2**
 For diagram 2:
 $W_{\text{net}} = \Delta K + \Delta U$ ✓
 $F_{k2} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - 0 + 0 - mgh_2$
 $[0,26(50)(9,8)](5,5) \cos 180^\circ \checkmark = \frac{1}{2} (50) v_f^2 \checkmark - 50(9,8)(5,5) \sin 30^\circ$ ✓
 $v_f = 5,44 \text{ m} \cdot \text{s}^{-1}$ ✓
- OPTION 3 / OPSIE 3**
 Diagram 1
 $W_{\text{net}} = \Delta K + \Delta U$
 $f_{k1} \Delta x \cos \theta = 0 - 0 + 0 - mgh_1$
 $\mu_k N \Delta x \cos \theta = -mgh_1$
 $\mu_k = \frac{-mgh_1}{N \Delta x \cos \theta}$ (1)
- Diagram 2
 $W_{\text{net}} = \Delta K + \Delta U$
 $f_{k2} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - 0 + 0 - mgh_2$
 $\mu_k N \Delta x \cos \theta = \frac{1}{2} m v_f^2 - mgh_2$
 $\mu_k = \frac{\frac{1}{2} m v_f^2 - mgh_2}{N \Delta x \cos \theta}$ (2)
 $(1) = (2)$
 $\frac{-mgh_1}{N \Delta x \cos \theta} = \frac{\frac{1}{2} m v_f^2 - mgh_2}{N \Delta x \cos \theta}$
 $\frac{-gh_1}{N_1} = \frac{\frac{1}{2} v_f^2 - gh_2}{N_2}$
 $\frac{-9,8(5,5 \sin 15^\circ)}{(50)(9,8) \cos 15^\circ} = \frac{\frac{1}{2} v_f^2 - (9,8)(5,5 \sin 30^\circ)}{(50)(9,8) \cos 30^\circ}$
 $v_f = 5,30 \text{ m} \cdot \text{s}^{-1}$
- Marking guideline:**
 ✓ energy formula
 ✓ substitution of $\mu_k N$ for new f_k
 ✓ substitution for final E_k in diagram 2
 ✓ substitution W_{F_g} and W_{k2} in diagram 2
 ✓ answer with correct unit
- Nasiennriglyne:**
 ✓ energie formule
 ✓ invervanging van $\mu_k N$ vir nuwe f_k
 ✓ invervanging vir finale E_k in diagram 2
 ✓ invervanging W_{F_g} en W_{k2} in diagram 2
 ✓ antwoord met korrekte eenheid

6

for both the objects.

Die oppervlakte onder die grafiek dui die totale verplasing aan. Dit was dieselfde hoogte vir beide die voorwerpe.

- 3.5 $9,8 \text{ m} \cdot \text{s}^{-2}$ ✓ downwards / *afwaarts* ✓ (2)
[16]
- QUESTION / VRAAG 4**
- 4.1 It is the product of the net force acting on an object and the time that the net force acts on the object. ✓✓
Dit is die produk van die netto krag wat inwerk op die voorwerp en die tyd waarin die netto krag op die voorwerp inwerk. (2)
- 4.2 $F_{\text{net}} \Delta t = \Delta p$
 $F_{\text{net}} \Delta t = m \Delta v$ ✓ any one of the equations
 $F_{\text{net}} (1,5) \checkmark = 50(700 - 0) \checkmark$
 $F_{\text{net}} = 23\,333,33 \text{ N}$ ✓ (4)
- 4.3 $\sum p \text{ before} = \sum p \text{ after}$ ✓
 $(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$
 $(5\,000 + 50)(275) \checkmark = 5\,000 v_{1f} + (50)(700) \checkmark$
 $v_{1f} = 270,75 \text{ m} \cdot \text{s}^{-1}$ ✓
 in original direction of motion of missile / ✓
in oorspronklike rigting van beweging van missiel (5)
- 4.4 Momentum is only conserved ✓ in a closed/isolated system. ✓
Momentum bly slegs behoue ✓ in 'n geslote sisteem. ✓ (2)
[13]

QUESTION / VRAAG 6

- 6.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Dit is die waarneembare verandering in frekwensie (of toonhoogte) van die klank deur die luisteraar waargeneem as gevolg van die beweging van die klankbron en die luisteraar relatief tot mekaar en die voortplanting van die klank.

- 6.2.1 1 200 Hz ✓

- 6.2.2 1 120 Hz ✓

- 6.3 **OPTION 1 / OPSIE 1**
Towards the source / na die bron

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \quad \checkmark$$

$$1200 \checkmark = \frac{340 + v_L}{340 - 0} \cdot 1160 \checkmark$$

$$v = 11,72 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

- OPTION 2 / OPSIE 2**
Away from the source / weg van die bron

$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \quad \checkmark$$

$$1120 \checkmark = \frac{340 - v_L}{340 + 0} \cdot 1160 \checkmark$$

$$v = 11,72 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

- 6.4.1 velocity / speed of blood ✓ or rate of flow of blood in arteries

snelheid / spoed van die bloed / of tempo van vloei van bloed in are.

- 6.4.2 Waves from the Doppler meter bounce off moving blood cells and are detected with a different frequency. ✓ The meter uses the changed frequency to calculate the velocity ✓ of the blood.

OR
Veins and arteries let blood flow in opposite directions. The Doppler flow meter detects the change in frequency of the flowing blood and shows the data on the monitors for doctors to interpret.

Golwe van die Doppler meter weerkaats terug vanaf die bewegende bloedselle en word waargeneem as 'n sekere frekwensie. Die meter gebruik die verandering in frekwensie om die spoed van die bloed te bereken.

OR
Are en slagare laat bloed in teenoorgestelde rigtings vloei. Die Doppler vloei-meter neem die verandering in die frekwensie van die vloeiende bloed waar en toon dit op die monitors aan vir die dokters om te interpreteer.

8

7.3

OPTION 1 / OPSIE 1

$$F_E = \frac{(kQ_1Q_2)}{r^2} \quad \checkmark$$

$$= \frac{(9 \times 10^9)(0,6 \times 10^{-6})(1 \times 10^{-6})}{(0,18)^2} \quad \checkmark$$

$$= 0,1667 \text{ N}$$

$$\frac{F_E}{\sin 7^\circ} = \frac{T}{\sin 90} \quad \checkmark$$

$$T = \frac{(0,1667 \sin 90)}{\sin 7^\circ} \quad \checkmark$$

$$= 1,367 \text{ N} \quad \checkmark$$

OPTION 2 / OPSIE 2

$$F_E = \frac{(kQ_1Q_2)}{r^2} \quad \checkmark = \frac{(T \cos 83^\circ)}{(T \sin 7^\circ)} \quad \checkmark$$

$$T = \frac{(9 \times 10^9)(0,6 \times 10^{-6})(1 \times 10^{-6})}{(0,18^2)(\cos 83^\circ)} \quad \checkmark$$

$$= 1,367 \text{ N} \quad \checkmark$$

OPTION 3 / OPSIE 3

$$F_E = \frac{(kQ_1Q_2)}{r^2} \quad \checkmark$$

$$= \frac{(9 \times 10^9)(0,6 \times 10^{-6})(1 \times 10^{-6})}{0,18^2} \quad \checkmark$$

$$= 0,1667 \text{ N}$$

$$\tan 7^\circ = \frac{T_x}{T_y} = \frac{0,1667}{T_y} \quad \checkmark$$

$$T_y = 1,358$$

$$T = \sqrt{T_x^2 + T_y^2}$$

$$= \sqrt{0,1667^2 + 1,358^2}$$

$$= 1,368 \text{ N} \quad \checkmark$$

OPTION 4 / OPSIE 4

Horizontal components

$$F_{\text{net}} = 0$$

$$F_{\text{el Yon x}} = T_x \quad \checkmark$$

$$\frac{kQ_1Q_2}{r^2} = T \cos 83^\circ$$

$$\frac{(9 \times 10^9)(0,6 \times 10^{-6})(1 \times 10^{-6})}{(18 \times 10^{-2})^2} \quad \checkmark = T \cos 83^\circ \quad \checkmark$$

$$T = 1,37 \text{ N} \quad \checkmark$$

(4)

10

- 6.5.1 Red shift / Doppler shift for light
Rooiverskuiwings / Doppler verskuiwing vir lig ✓

(1)

- 6.5.2 No. ✓
The star has a red colour due to the red shift. The star is moving away from the Earth. ✓

Nee. ✓
Die ster het 'n rooi kleur as gevolg van die rooiverskuiwing. Die ster is besig om weg te beweeg van die aarde af. ✓

(2)

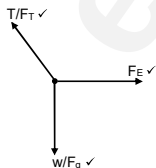
[15]

QUESTION / VRAAG 7

- 7.1 The magnitude of the electrostatic force exerted by a point charge on another point charge is directly proportional to the product of the two charges ✓ and inversely proportional to the square of the distance between the charges. ✓

Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk van die twee ladinge en omgekeerd eweredig aan die kwadraat van die afstand tussen die twee ladinge.

7.2



Accepted labels <i>Aanvaarbare benoemings</i>	
W	$F_g / F_w / \text{mg} / \text{weight} / \text{gravitational force}$ $F_g / F_w / \text{mg} / \text{gewicht} / \text{gravitasiekrag}$
T	$F_T / \text{tension}$ $F_T / \text{spanning} / \text{spankrag}$
F_E	$F_c / F_o / \text{Coulombic force} / \text{Electrostatic force}$ $F_c / F_o / \text{Coulomb krag} / \text{elektrostatiese krag}$

(3)

- 7.4.1 Increase ✓

Vermeerder

(1)

- 7.4.2 The net field at X increases, ✓ resulting in an increase on the force attracting X to Y and Z hence the angle increases. ✓

Die netto veld by X verhoog, dit veroorsaak 'n toename in die aantrekkingskrag van X na Y en Z en daarom vergroot die hoek.

(2)

- 7.4.3 The insulated stands prevent the negative charges ✓ from flowing to the earth and discharging the balls. ✓

Die geïsoleerde staanders voorkom dat die negatiewe ladinge na die aarde vloei en die balle ontlaa.

(2)

[14]

QUESTION / VRAAG 8

- 8.1 A resistor which obeys Ohm's law at constant temperature. ✓✓

OR

A resistor for which the ratio V/I is a constant at constant temperature.

'n Weerstand wat die wet van Ohm gehoorsaam by konstante temperatuur.

OR

'n Weerstand waarvan die verhouding V/I 'n konstante is by konstante temperatuur.

(2)

- 8.2.1 **OPTION 1 /**

For R_1 :
 $V = IR \quad \checkmark$
 $= (1,15)(10) \quad \checkmark$
 $= 11,5 \text{ V}$
 But as in a parallel circuit the potential difference stays the same the voltmeter reading over both R_2 and R_3 is also 11,5 V
 So for the two in series (R_2 and R_3):
 $V = IR$
 $11,5 = I(12+14) \quad \checkmark$
 $I = 0,44 \text{ A} \quad \checkmark$

OPTION 2 / OPSIE 2

RATIO of $R_1 : R_2 + R_3 \quad \checkmark$

$$10 : 26 \quad \checkmark$$

RATIO of $I_1 : I_{2,3} \quad \checkmark$

$$26 : 10 \quad \checkmark$$

$$1,15 : 0,44 \quad \checkmark$$

$$I_{2,3} = 0,44 \text{ A} \quad \checkmark$$

(4)

OPSIE 1

Vir R_1 :

$$V = IR \quad \checkmark$$

$$= (1,15)(10) \quad \checkmark$$

$$= 11,5 \text{ V}$$

Soos in 'n parallel stroombaan sal die potensiaalverskil dieselfde bly vir die voltmeterlesing oor beide R_2

en R_3 en is dus ook 11,5 V.

Dus vir die twee in serie (R_2 en R_3):

$$V = IR$$

$$11,5 = I(12 + 14) \quad \checkmark$$

$$I = 0,44 \text{ A} \quad \checkmark$$

8.2.2 Positive marking from 8.2.1
OPTION 1 / OPSIE 1

$$I_{\text{circuit/stroombaan}} = 1,15 + 0,442 \quad \checkmark$$

$$= 1,592 \text{ A}$$

$$R_s = \frac{V_{\text{rd}}}{I_{\text{circuit}}} \quad \checkmark$$

$$= \frac{21,5 - 11,5}{1,59} \quad \checkmark$$

$$= 6,281 \Omega \quad \checkmark$$

OPTION 2 / OPSIE 2

$$I_{\text{total}} = 1,15 + 0,44 = 1,592 \text{ A} \quad \checkmark$$

Whole Circuit:

$$V_{\text{tot}} = I_{\text{t}} R_{\text{t}} \quad \checkmark$$

$$21,5 = 1,59 \times R_{\text{t}} \quad \checkmark$$

$$R_{\text{t}} = 13,51 \Omega \quad \checkmark$$

$$R_{\text{t}} = R_p + R \quad \checkmark$$

$$\frac{1}{R_p} = \frac{1}{R_2 + R_3} + \frac{1}{R_1} \quad \checkmark$$

$$= \frac{1}{12 + 14} + \frac{1}{10} \quad \checkmark$$

$$R_p = 7,22 \Omega \quad \checkmark$$

$$R_{\text{t}} = R_p + R \quad \checkmark$$

$$13,51 = 7,22 + R \quad \checkmark$$

$$R = 6,285 \Omega \quad \checkmark$$

(4)

8.2.3 Positive marking from 8.2.2
OPTION 1 / OPSIE 1

$$\text{Emf} = I(R + r) \quad \checkmark$$

$$24 = 1,592(13,51 + r) \quad \checkmark$$

$$r = 1,57 \Omega \quad \checkmark$$

OPTION 2 / OPSIE 2

$$r = \frac{V_{\text{lost volts}}}{I_{\text{circuit}}} \quad \checkmark$$

$$= \frac{24 - 21,5}{1,59} \quad \checkmark$$

$$= 1,570 \Omega \quad \checkmark$$

(3)

8.3 When current flows through the battery, electrical energy is converted to heat energy $\checkmark$ due to the battery's internal resistance. $\checkmark$ This explains the lower potential difference.

Wanneer stroom vloei deur die battery word elektriese energie omsgeskakel na hitte energie as gevolg van die battery se interne weerstand.

(2)

[15]

QUESTION / VRAAG 9

9.1.1 B to A $\checkmark$

(1)

9.1.2 Faraday's law (of electromagnetic induction) $\checkmark$

Faraday se wet (van elektromagnetiese induksie)

(1)

9.1.3 Remove the slipring $\checkmark$ and replace it with a splitring. $\checkmark$

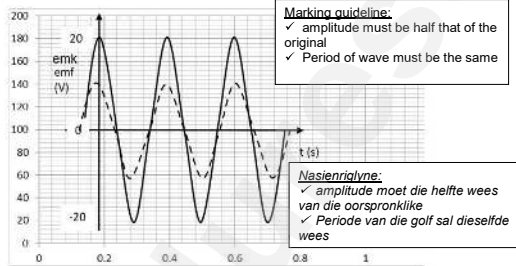
Verwyder die sleepkring en vervang dit met 'n spleetkring.

(2)

12

14

9.2.1



(2)

9.2.2 From Faraday's Law, induced emf is directly proportional to the rate of change of magnetic flux. $\checkmark \checkmark$ hence halving speed halves the rate, hence V_{max} is halved

Vanuit Faraday se wet, die geïnduseerde emk is direk eweredig aan die tempo van verandering van die magnetiese vloedkoppeling, die halvering van die spoed sal die tempo halveer dus sal V_{maks} halveer word.

(2)

9.3 OPTION 1 / OPSIE 1

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \quad \checkmark$$

$$= \frac{20}{\sqrt{2}} \quad \checkmark$$

$$= 14,142 \text{ V} \quad \checkmark$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \quad \checkmark$$

$$= \frac{14,142}{50} \quad \checkmark$$

$$= 0,283 \text{ A} \quad \checkmark$$

$$P_{\text{ave}} = I_{\text{rms}} V_{\text{rms}} \quad \checkmark$$

$$= 0,283 \times 14,142 \quad \checkmark$$

$$= 4,002 \text{ W} \quad \checkmark$$

OPTION 2 / OPSIE 2

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \quad \checkmark$$

$$= \frac{20}{\sqrt{2}} \quad \checkmark$$

$$= 14,142 \text{ V} \quad \checkmark$$

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \quad \checkmark$$

$$= \frac{14,142^2}{50} \quad \checkmark$$

$$= 4,002 \text{ W} \quad \checkmark$$

(5)

[13]

QUESTION / VRAAG 10

10.1

It is a phenomenon in which electrons are emitted from a metal surface when light of a suitable frequency is shone on the metal surface. $\checkmark \checkmark$

Dit is die verskynsel waar die elektrone vrygestel word vanuit die metaal se oppervlakte wanneer lig van 'n geskikte frekwensie op die metaal oppervlakte geskyn word.

(2)

10.2

Example:

What is the relationship between the frequency of light incident on the photocell and the maximum kinetic energy of the corresponding ejected photoelectrons?

Voorbeeld:

Wat is die verhouding tussen die frekwensie van die invallende lig op die fotosel en die maksimum kinetiese energie van die ooreenstemmende vrygestelde elektrone?

Marking criteria	Marks
The independent and dependent variables are stated	$\checkmark$
It must be a question about the relationship between the independent and dependent variables.	$\checkmark$

Nasienglyne	Punte
Die onafhanklike en afhanklike veranderlikes is gestel	$\checkmark$
Dit moet 'n vraag wees oor die verhouding tussen die onafhanklike en afhanklike veranderlikes.	$\checkmark$

(2)

10.3.1

frequency of photons $\checkmark$ or frequency of incident light

frekwensie van die fotone of frekwensie van invallende lig

(1)

10.3.2

use the same metal $\checkmark$

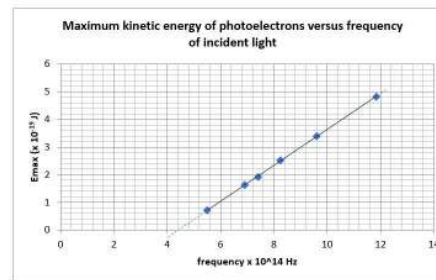
gebruik dieselfde metaal

(1)

10.4

Mark positive from 10.3.1

(4)



10.5.1

 $4,2 \times 10^{14} \text{ Hz}$ to $4,4 \times 10^{14} \text{ Hz}$ $\checkmark$

Mark positive from 10.3 and 10.4

(1)

10.5.2

OPTION 1 By extrapolation from graph

OPSIE 1 Deur ekstrapolering van grafiek

$$W_0 = hf_0 \quad \checkmark$$

$$= 6,63 \times 10^{-34} \times 4,4 \times 10^{14} \quad \checkmark$$

$$= 2,917 \times 10^{-19} \text{ J} \quad \checkmark$$

OPTION 2 Using any point on graph.

OPSIE 2 Gebruik enige punt op grafiek.

$$hf = W_0 + E_k \quad \checkmark$$

$$6,63 \times 10^{-34} \times 5,4 \times 10^{14} = W_0 + 0,72 \times 10^{-19} \quad \checkmark$$

$$W_0 = 2,919 \times 10^{-19} \text{ J} \quad \checkmark$$

OPTION 3

OPSIE 3

$$hf = W_0 + E_k \quad \checkmark$$

$$6,63 \times 10^{-34} \times 6,91 \times 10^{14} = W_0 + 1,63 \times 10^{-19} \quad \checkmark$$

$$W_0 = 2,951 \times 10^{-19} \text{ J} \quad \checkmark$$

OPTION 4

OPSIE 4

$$hf = W_0 + E_k \quad \checkmark$$

$$6,63 \times 10^{-34} \times 7,41 \times 10^{14} = W_0 + 1,92 \times 10^{-19} \quad \checkmark$$

$$W_0 = 2,993 \times 10^{-19} \text{ J} \quad \checkmark$$

Marking guidelines:

 $\checkmark$ Formula $\checkmark$ Substitution $\checkmark$ Answer with unit

Nasienglyne:

 $\checkmark$ Formule $\checkmark$ Invervanging $\checkmark$ Antwoord met eenheid

(3)

[15]

150