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education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)
SEPTEMBER 2023

MARKS: 150

TIME: 3 hours



12841E

X10



Stanmorephysics

This question paper consists of 15 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

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Please turn over.....

1. Write your name on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between two sub questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.



QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

- 1.1 If the distance of an object above the surface of the Earth is increased, the weight of this object ...

A increases.
B decreases.
C remains same.
D increase then suddenly decrease.

(2)

- 1.2 A constant resultant force acts on a body which is moving freely in a straight line. Which PHYSICAL QUANTITY will remain constant?

A Velocity
B Momentum
C Acceleration
D Kinetic energy

(2)

- 1.3 Which one of the following DOES NOT represent the units of a vector?

A N
B $\text{N} \cdot \text{C}^{-1}$
C $\text{C} \cdot \text{s}^{-1}$
D $\text{J} \cdot \text{m}^{-1}$

(2)

- 1.4 A car is moving on a straight, frictionless and horizontal road at **CONSTANT** velocity. When the car enters on to a rough surface **Q**, the speed decreases and the car comes to rest.

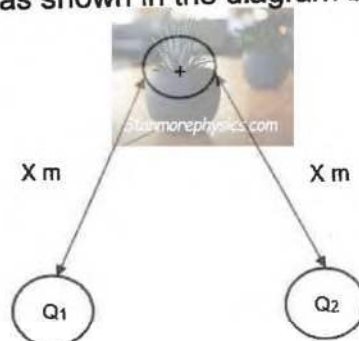
Which **ONE** of the following statements about the car, after passing point **Q** is true?

- A The kinetic energy of the car remains constant.
- B The mechanical energy of the car is conserved.
- C The potential energy of the car is converted to kinetic energy.
- D The kinetic energy of the car is used to do work against friction. (2)

- 1.5 Light of wavelength 680 nm coming from a receding distant galaxy is observed by an astronomer on the Earth. The wavelength observed by the astronomer will most likely be ...

- A 700 nm.
- B 680 nm.
- C 600 nm.
- D 630 nm. (2)

- 1.6 A positive test charge is placed in the electric field of two identical positively charged objects **Q₁** and **Q₂** as shown in the diagram below.



The net force experienced by the test charge will be:

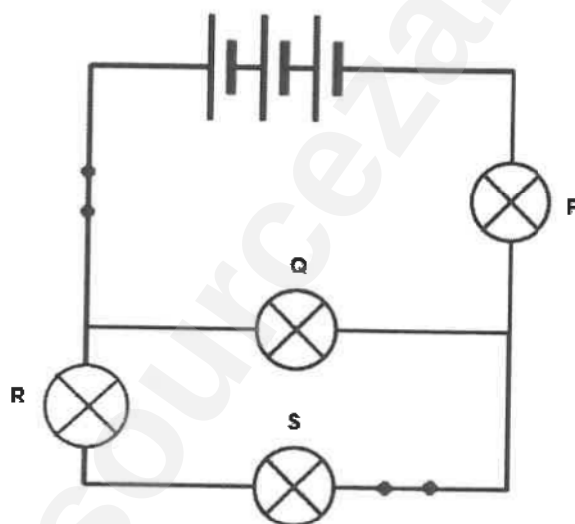
- A zero
- B upwards
- C downwards
- D to the left (2)

1.7 Power may be defined as:

- A force per unit displacement
- B energy exchange
- C rate of transfer of energy
- D product of work done and time

1.8 In the circuit shown below, the battery lights up all four identical bulbs P, Q, R and S. (2)

Which one of the statements correctly describes the comparative brightness of bulbs P, Q, R and S?



- A P and Q glow equally bright and are brighter than R and S.
- B P, R and S are of equal brightness and glow brighter than Q.
- C P and R are of equal brightness and glow brighter than Q and S.
- D P glows the brightest followed by Q and then by R and S, which are of the same brightness.

(2)



1.9 One difference between a DC generator and an AC generator is that a DC generator ...

- A generates a lower current than an AC generator.
- B has slip ring and an AC generator has split ring commutator.
- C has split ring commutator and an AC generator has slip rings.
- D generates electrical energy where the AC generator generates mechanical energy.

(2)

1.10 An absorption spectrum is the result of the ...

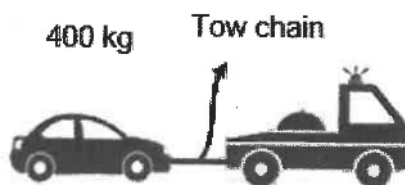
- A material's absorption of red light.
- B emission of specific frequencies of light when a gas is heated.
- C atoms of a cold, dilute gas absorbing photons of certain frequencies of white light.
- D radiation of distinct lines of different frequencies when a low-density gas is electrolysed.

(2)
[20]



QUESTION 2 (Start on a new page.)

A tow truck attempts to tow a broken down car of mass 400 kg. The coefficient of static friction is 0,60 and the coefficient of kinetic (dynamic) friction is 0,4. A tow chain connects the tow truck to the car as shown in the diagram below.

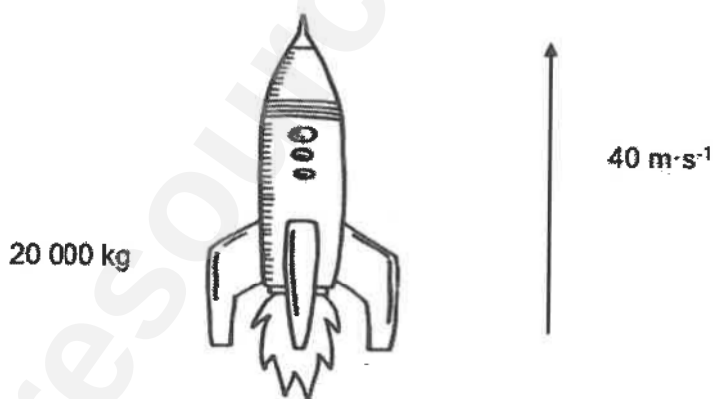


2.1 Calculate the force required to:

2.1.1 Just move the car if the rope is parallel to the road (3)

2.1.2 Keep the car moving at CONSTANT speed (2)

2.2 A rocket of mass of 20 000 kg moves vertically upwards with a uniform acceleration from rest to a velocity of $40 \text{ m}\cdot\text{s}^{-1}$ in 1,6 s. Ignore the effects of friction.



2.2.1 State Newton's Third Law of Motion in words. (2)

2.2.2 Draw a labelled free-body diagram of all the forces acting on the rocket. (2)

2.2.3 What is the magnitude and direction of the total force exerted on the rocket during first 1,6 s? (4)

2.2.4 An astronaut of mass 80 kg is carried in the space capsule. Determine the resultant force acting on him during the first 1,6 s? (2)

[15]

QUESTION 3 (Start on a new page.)

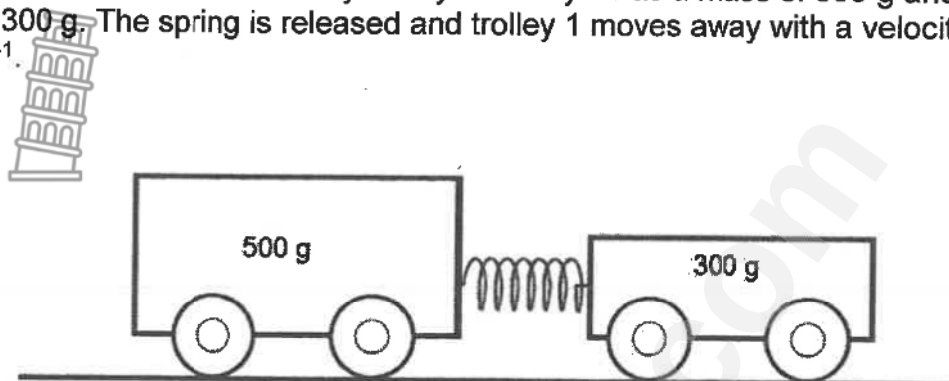
A helicopter moves vertically upwards at a constant velocity, releases a package. It takes 6 s for the package to reach the ground. The package strikes the ground with a velocity of $49,8 \text{ m}\cdot\text{s}^{-1}$. Ignore effects of air friction.

- 3.1 Define the term *free fall*. (2)
- 3.2 Why does the package rise before falling to the ground? (1)
- 3.3 If the time taken for the package to reach the maximum height is 0,8 s, calculate the velocity of the helicopter. (3)
- 3.4 Calculate the height of the package above the ground at the moment it is released from the helicopter. (3)
- 3.5 Draw a velocity-time graph that represents the motion of the package until it reaches the ground.
Indicate the initial velocity, final velocity and times for entire motion on the graph. (3)
- 3.6 Use the graph, drawn for question 3.5, to determine the maximum height reached by the package above its point of release. (2)
- 3.7 After releasing the package, the helicopter continue to move vertically upwards with the same constant velocity. Calculate how much higher the helicopter moves, from the time it releases the package until the time that the package reaches the ground. (2)
- [16]**



QUESTION 4 (Start on a new page.)

Two trolleys are placed on a frictionless track in a Physics laboratory. A compressed spring is placed between the two stationary trolleys. Trolley 1 has a mass of 500 g and trolley 2 has a mass of 300 g. The spring is released and trolley 1 moves away with a velocity of $2,4 \text{ m} \cdot \text{s}^{-1}$.



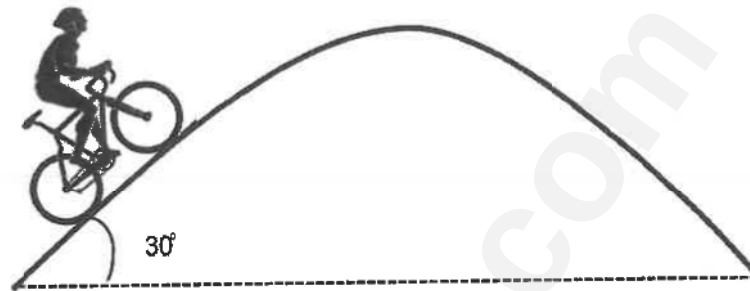
- 4.1 State the law of *conservation of momentum*. (2)
- 4.2 Calculate the velocity of trolley 2 after the spring is released. (3)
- 4.3 If the release of the spring takes 0,12 s. Calculate the force which the spring exerts on each of the trolleys. (3)
- 4.4 Describe how the acceleration of the trolleys would be affected if the masses of the trolleys were doubled.

Choose from INCREASE, DECREASE OR REMAINS THE SAME.
Explain your answer.

(2)
[10]

QUESTION 5 (Start on a new page.)

A cyclist cycles up to the top of a hill with a length of 50 m at a **CONSTANT** velocity. The force of kinetic friction that the bike encounters is 55 N. The combined mass of the cyclist and the bicycle is 70 kg. The slope forms an angle of 30° with the horizontal.

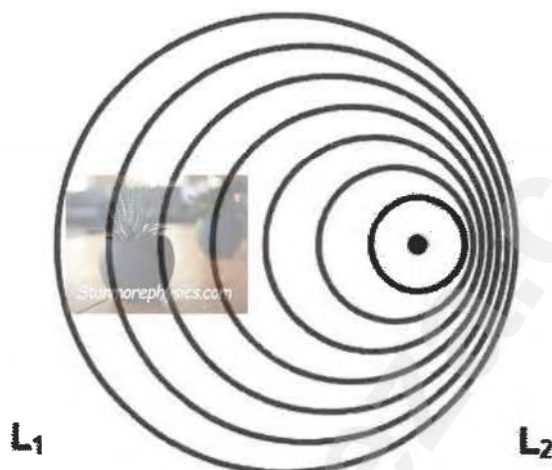


- 5.1 Draw a labelled free-body diagram to show all the forces acting on the bicycle when the cyclist pedals up the slope. (4)
 - 5.2 When the bicycle is going up the slope, calculate work done by the:
 - 5.2.1 Force of friction (3)
 - 5.2.2 Gravitational force (3)
 - 5.2.3 Applied force (4)
 - 5.3 Determine magnitude of the applied force (2)
- [16]**



QUESTION 6 (Start on a new page)

- 6.1 Diagram below represents sound waves which are emitted by the siren of a police car. The speed of the police car is $100 \text{ km} \cdot \text{h}^{-1}$ and frequency of sound waves emitted is 800 Hz . The points L_1 and L_2 represents the stationary listeners standing on the road.

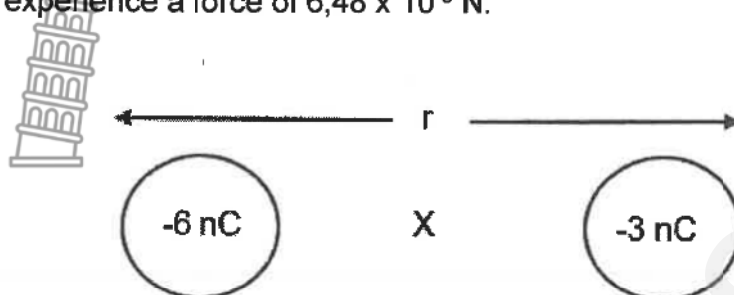


- 6.1.1 State the *Doppler effect* in words. (2)
- 6.1.2 What is the name of the instrument used to measure the rate of blood flow in the arteries of a human being? (1)
- 6.1.3 Will the frequency of the sound heard by listener L_1 be greater or less than 800 Hz ? Explain the answer. (3)
- 6.1.4 Calculate the frequency of sound heard by the listener L_1 . (4)
- 6.2 Galaxy A is 1 500 million and Galaxy B 5 000 million light years away from Earth. Light from which galaxy will have greater red shift? Explain your answer. (3)
- [13]**



QUESTION 7 (Start on a new page.)

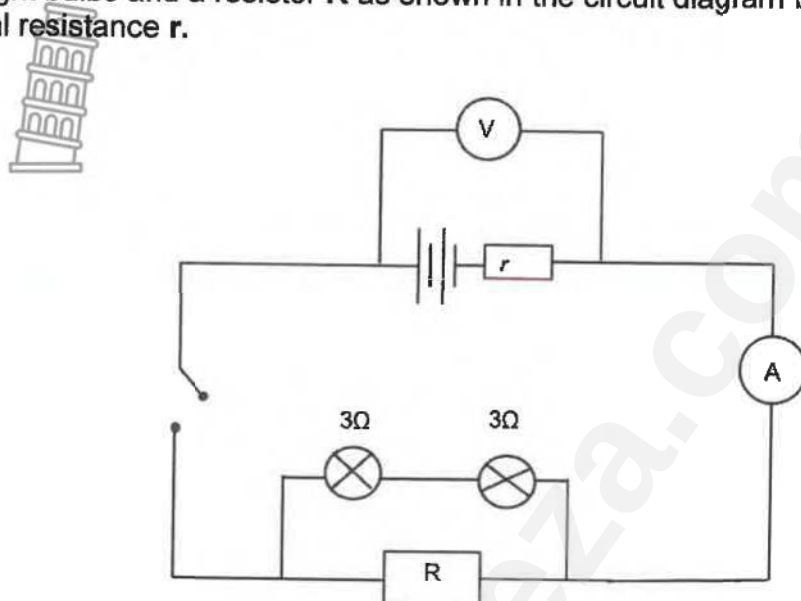
Two dust particles are floating in the air. One dust particle carries a charge of -6 nC and other carries a charge of -3 nC . When they are a certain distance r from each other, they experience a force of $6,48 \times 10^{-3} \text{ N}$.



- 7.1 Write down the name of the force that exists between these two particles and state the effect they have on each other. (2)
- 7.2 Suggest ONE way in which the particles could have acquired their charge. (1)
- 7.3 Draw the electric field pattern, which exists between the two particles. (2)
- 7.4 Calculate the distance r between the particles. (4)
- 7.5 Calculate the magnitude and direction of net electric field at a point X which is exactly halfway between the particles, when they are at distance r apart. (5)
- [14]**

QUESTION 8 (Start on a new page.)

Two 9 V batteries are connected in a circuit with an ammeter, a switch, a voltmeter, two $3\ \Omega$ light bulbs and a resistor **R** as shown in the circuit diagram below. The battery has an internal resistance **r**.



- 8.1 When the switch is open, what will the reading be on the:
- 8.1.1 Voltmeter (1)
- 8.1.2 Ammeter (1)
- 8.2 When the switch is closed, voltmeter reading drops by 0,72 V and ammeter reads 7,2 A.
- 8.2.1 Explain why the voltmeter reading drops. (3)
- 8.2.2 Calculate the internal resistance **r** of the battery. (3)
- 8.2.3 Calculate the resistance of the resistor **R** (5)
- 8.3 If the resistor **R** is removed from the circuit, would the power dissipated in the light bulbs INCREASE, DECREASE or REMAINS SAME. Explain your answer without calculations. (3)
- [16]**

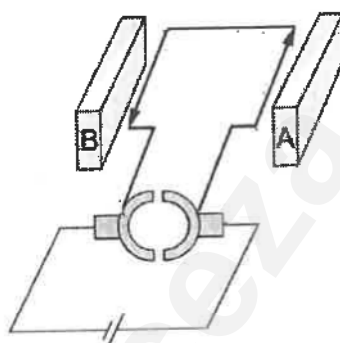
QUESTION 9 (Start on a new page.)

A company that manufactures electrical appliances has produced a new cordless electric drill, which is operated by a 9 V battery.

9.1 State the principle on which an electric motor works. (2)

9.2 Does the drill have a direct or alternating current motor? (1)

The diagram below shows a simplified version of structure of a motor. The coil is placed between the opposite poles of two magnets.



9.3 Name the structure that ensures the coil rotates in one direction only. (1)

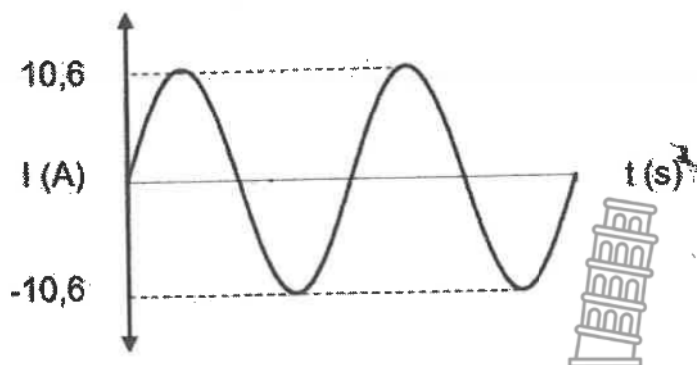
9.4 If the current is flowing in the coil as indicated in the diagram, the coil is undergoing anticlockwise rotation.

Is the magnetic field direction from B to A or from A to B? (1)

9.5 Peter has an electric drill, which operates from an alternating current supply.

The drill has the following markings on it: 240 V, 1800 W, 50 Hz

The current passing through the drill while operating is represented in the graph below:



9.5.1 The current passing through the drill changes within every cycle. How long does it take to complete a cycle? (1)

- 9.5.2 Calculate the **rms** current the drill draws when operating. (3)
- 9.5.3 What is the resistance of the drill? (4)
- 9.6 Small electric motors are used in remote controlled toy cars.
- 9.6.1 Write down two modifications that can be made to increase toy car's speed. (2)
- 9.6.2 As the motor turns, the wheels of the car rotates in one direction, moving it forwards.
- Write down TWO modifications to the motor that could make the car to move in reverse direction. (2)
- [17]**

QUESTION 10 (Start on a new page.)

A scientist was investigating certain material for possible use in a solar cell. Firstly the scientist uses a source of blue light with wavelength 460 nm to produce photo electrons. The kinetic energy of photo electron is $1,6 \times 10^{-19}$ J. The scientist then carries an experiment to find out whether light of other wavelengths also emits electrons from the material. He used red light with wavelength 700 nm in this experiment.

- 10.1 What type of energy conversion is taking place in a solar cell? (2)
- 10.2 What is the aim of his investigation? (2)
- 10.3 Show by calculation whether red light will be able to emit electrons from the material? (7)
- 10.4 Is the material used in this investigation suitable for making solar cells? Explain your answer. (2)
- [13]**

TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
 PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
 VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant <i>Universele gravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Speed of light in a vacuum <i>Spoe van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant <i>Coulomb se konstante</i>	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Charge on electron <i>Lading op elektron</i>	e	$1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$
Mass of the Earth <i>Massa van die Aarde</i>	M_E	$5,98 \times 10^{24} \text{ kg}$
Radius of the Earth <i>Radius van die Aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

MOTION/BEWEGING

$v_f = v_i + a \Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ or/of $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ or/of $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$

FORCE/KRAG

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or/of $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or/of $g = G \frac{M}{r^2}$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = F \Delta x \cos \theta$	$U = mgh$ or/of $E_p = mgh$
$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{ave}} = F v_{\text{ave}}$ / $P_{\text{gemid}} = F v_{\text{gemid}}$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_0 + E_{k(\text{max})}$ or/of $E = W_0 + K_{\text{max}}$ where/waar	
$E = hf$ and/en $W_0 = hf_0$ and/en $E_{k(\text{max})} = \frac{1}{2} mv_{\text{max}}^2$ or/of $K_{\text{max}} = \frac{1}{2} mv_{\text{max}}^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

$R = \frac{V}{I}$	emf ($\mathcal{E}$) = $I(R + r)$ emk ($\mathcal{E}$) = $I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/WISSELSTROOM

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ / $I_{\text{wgk}} = \frac{I_{\text{maks}}}{\sqrt{2}}$	$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ / $P_{\text{gemiddeld}} = V_{\text{wgk}} I_{\text{wgk}}$
$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ /	$P_{\text{ave}} = I_{\text{rms}}^2 R$ / $P_{\text{gemiddeld}} = I_{\text{wgk}}^2 R$
$V_{\text{wgk}} = \frac{V_{\text{maks}}}{\sqrt{2}}$	$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ / $P_{\text{gemiddeld}} = \frac{V_{\text{wgk}}^2}{R}$



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NATIONAL SENIOR CERTIFICATE NASIONALE SENIOR SERTIFIKAAT

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

SEPTEMBER 2023

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 13 pages and a cognitive table/
Hierdie nasienriglyne bestaan uit 13 bladsye en 'n kognitiewe tabel.**

QUESTION 1/VRAAG 1

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



QUESTION 2/VRAAG 2

2.1.1

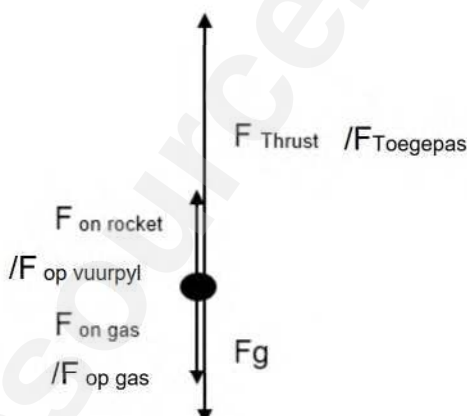
$F_s = \mu_s F_g$ $F_s = \mu_s N$ $= (0,6)(400)(9,8) \checkmark$ $F_s = 2352 \text{ N} \checkmark$	any one ✓	(3)
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2.1.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2	(2)
$F_f = \mu_k F_g$ $= \mu_k N$ $= (0,4)(400)(9,8) \checkmark$ $= 1568 \text{ N} \checkmark$	$F_{\text{net}} = ma$ $F_A - f_k = 400 \times 0$ $F_A - 0,4 \times 400 \times 9,8 = 0 \checkmark$ $F_A = 1568 \text{ N} \checkmark$	

2.2.1 When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓✓
 Wanneer voorwerp A 'n krag op voorwerp B uitoefen, sal voorwerp B gelyktydig 'n krag van gelyke grootte en in die teenoorgestelde rigting op voorwerp A uitoefen. (2)

2.2.2



$F_{\text{Thrust}}/F_{\text{Applied by gas}}/F_{\text{Toegepas}}$	✓
$F_g/mg/\text{weight}/\text{gravitational force}/w/\text{gravitasiekrag}$	✓
$F_{\text{on rocket}}/F_{\text{op vuurpyl}}$	
$F_{\text{on gas}}/F_{\text{op gas}}$	

Accept any of the 2 forces/Aanvaar enige 2 kragte (2)

2.2.3

$v_f = v_i + a\Delta t \checkmark$ $40 = 0 + (a)(1,6) \checkmark$ $a = 25 \text{ m} \cdot \text{s}^{-2}$ $F_{\text{Total}}/Totaal = w + ma$ $= (20\,000)(9,8) + (20\,000)(25) \checkmark$ $= 696\,000 \text{ N} \checkmark$	(4)
--	-----

2.2.4

$F_{\text{net}} = ma - w$ $= (80)(25) - (80)(9,8) \checkmark$ $= 1216 \text{ N} \checkmark$	(2)
---	-----

[15]

QUESTION 3/VRAAG 3

- 3.1 Motion during which the only force acting on an object is the force of gravity. ✓✓
Beweging waar die enigste krag wat op die voorwerp inwerk gravitasiekrag is. (2 or/of 0) (2)

- 3.2 It has an initial velocity as it is rising with the helicopter. ✓
Dit het 'n aanvanklike snelheid soos dit saam met die helikopter opwaarts beweeg.
OR/OF
Package has same initial velocity of that of the helicopter. ✓
Dit het 'n aanvanklike snelheid dieselfde as die helikopter.

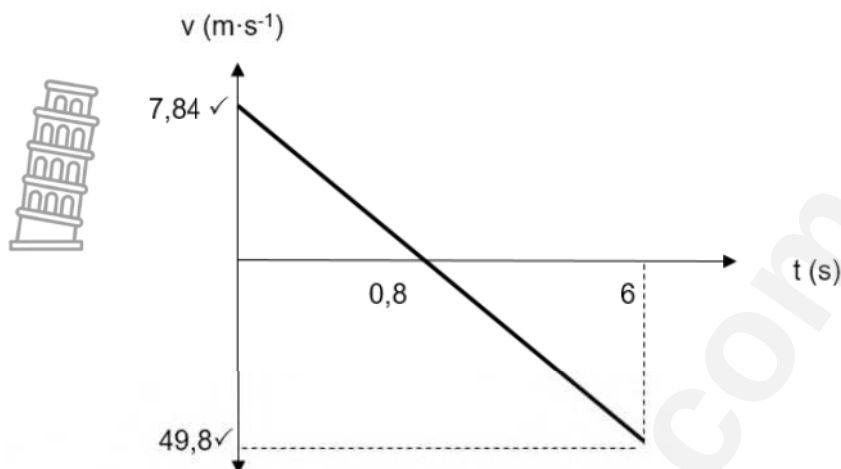
Accept explanation based on Newton's first law
Aanvaar verduideliking gebaseer op Newton se eerste wet (1)

- 3.3 Consider upward motion of the package/Beskou opwaartse beweging van die pakkie:
 $v_f = v_i + a\Delta t$ ✓
 $0 = v_i + (-9,8)(0,8)$ ✓
 $v_i = 7,84 \text{ m}\cdot\text{s}^{-1}$ upwards/opwaarts ✓
Initial velocity of the package is same as the velocity of helicopter.
Die aanvanklike snelheid van die pakkie is dieselfde as die snelheid van die helikopter. (3)

- 3.4
 $v_f^2 = v_i^2 + 2a\Delta y$ ✓
 $(-49,8)^2 = (7,84)^2 + (2)(-9,8) \Delta y$ ✓
 $\Delta y = -123,4 \text{ m}$
 $= 123,4 \text{ m above the ground/bo die grond}$ ✓ (3)



3.5 **POSITIVE MARKING FROM QUESTION 3.3**
POSITIEWE NASIEN VANAF 3.3



Marking criteria/Nasienkriteria

Labelling/Benoem 7,84 and/en 49,8 on the graph/op die grafiek ✓✓

Labelling/Benoem 0,8 s and/en 6 s on the graph/op die grafiek ✓

(3)

- 3.6 Height reached = area under the graph/
Hoogte = oppervlak onder die grafiek
 Height/Hoogte = $\frac{1}{2}bh$
 $= \frac{1}{2}(0,8)(7,84)$ ✓
 $= 3,14 \text{ m}$ ✓

(2)

- 3.7 $\Delta y = v_i \Delta t$
 $= (7,84)(6)$ ✓
 $= 47,04 \text{ m}$ ✓

(2)

[16]

QUESTION 4/VRAAG 4

- 4.1 The total linear momentum of a closed system remains constant
 (is conserved). ✓✓

(2)

Die totale lineêre momentum in 'n geslote sisteem bly konstant.

(2 or/of 0)

- 4.2 $\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}}$
 $m_1 v_i + m_2 v_i = m_1 v_f + m_2 v_f$ } any one/enige een ✓
 $0 \checkmark = (0,5)(-2,4) + (0,3)(v_f)$ ✓
 $v_f = 4 \text{ m}\cdot\text{s}^{-1}$ towards right/na regs ✓

(3)



4.3

Marking criteria/Nasienkriteria

Formula ✓

Substitution to calculate F_{net} ✓

Final answer ✓

OPTION 1/OPSIE 1

$$\left. \begin{aligned} F_{\text{net}} \Delta t &= \Delta P \\ F_{\text{net}} \Delta t &= m(v_f - v_i) \end{aligned} \right\} \begin{array}{l} \text{any one } \checkmark \\ \text{enige een} \end{array}$$

$$F_{\text{net}} = \frac{(0,5)(-2,4) - (0,5)(0)}{0,12} \checkmark$$

$$F_{\text{net}} = -10 \text{ N } \checkmark$$

= 10 N against the trolley/
teen die trollie

OPTION 2/OPSIE 2

$$\left. \begin{aligned} F_{\text{net}} \Delta t &= \Delta P \\ F_{\text{net}} \Delta t &= m(v_f - v_i) \end{aligned} \right\} \begin{array}{l} \text{any one } \checkmark \\ \text{enige een} \end{array}$$

$$F_{\text{net}} = \frac{(0,3)(4) - (0,3)(0)}{0,12} \checkmark$$

$$F_{\text{net}} = 10 \text{ N against the trolley/} \\ \text{teen die trollie } \checkmark$$

(3)

4.4

Decreases/Afneem ✓

Acceleration is inversely proportional to the mass/Versnelling is omgekeer eweredig aan die massa ✓

$$a \propto \frac{1}{m}$$

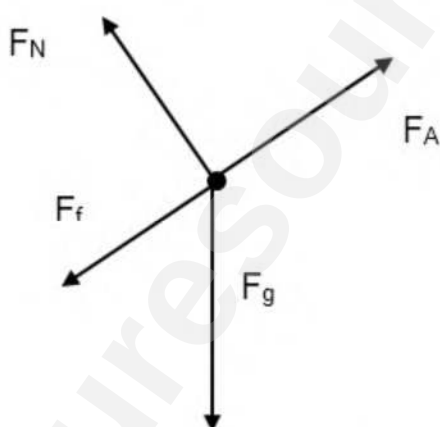
(2)

[10]

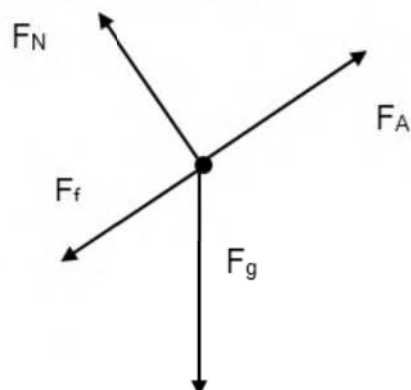
QUESTION 5/VRAAG 5

5.1

OPTION 1/OPSIE 1



OPTION 2/OPSIE 2



Accepted labels/Aanvaarde benoemings

N ✓

F_N /Normal/Normal force
Normaal /Normaalkrag

F ✓

F_A /Applied force force
 F_A /Toegepaste krag

F_f / f ✓

Force of friction/Wrywingskrag

w ✓OR/OF

$F_{g\parallel}$ and/en $F_{g\perp}$

F_g /mg/weight/ gravitational force
 F_g /mg/gewig/ gravitasiekrag

(4)

5.2.1 $W_{Ff} = F_f \Delta x \cos\theta \checkmark$
 $W_{Ff} = (55)(50) (\cos 180^\circ) \checkmark$
 $= -2750 \text{ J} \checkmark$ (3)

5.2.2 $F_{g\parallel} = mg \sin\theta$
 $= (70)(9,8)(\sin 30^\circ) \checkmark$
 $= 343 \text{ N}$
 $W_{g\parallel} = F_{g\parallel} \Delta x \cos\theta$
 $= (343)(50)(\cos 180^\circ) \checkmark$
 $= -17150 \text{ J} \checkmark$ (3)

5.2.3 **POSITIVE MARKING FROM QUESTION 5.2.1 and 5.2.2**
POSITIEWE NASIEN VANAF 5.2.1 and 5.2.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$W_{\text{net}} = W_{F_{\text{app}}} + W_{Ff} + W_{F_{g\parallel}} \checkmark$ $0 \checkmark = W_{F_{\text{app}}} - 2750 - 17150 \checkmark$ $W_{F_{\text{app}}} = 19900 \text{ J} \checkmark$	$W_{FA} = F_A \Delta x \cos\theta \checkmark$ $= (70 \times 9,8 \times \sin 30^\circ + 55) \checkmark (50)(\cos 0^\circ) \checkmark$ $= 19900 \text{ J} \checkmark$

(4)

5.3 **POSITIVE MARKING FROM QUESTION 5.2.3**
POSITIEWE NASIEN VANAF 5.2.3

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$W_{F_{\text{app}}} = F_{\text{app}} \Delta x \cos\theta$ $19900 = F_{\text{app}} \times 50 \times \cos 0^\circ \checkmark$ $F_{\text{app}} = 398 \text{ N} \checkmark$	$F_{\text{app}} = F_f + F_{g\parallel}$ $F_{\text{app}} = 55 + 343 \checkmark$ $F_{\text{app}} = 398 \text{ N} \checkmark$
OPTION 3/OPSIE 3 $F_{\text{net}} = ma$ $F_A - (F_{g\parallel} + f) = ma$ $F_A = (70 \times 9,8 \times \sin 30^\circ) + 55 \checkmark$ $= 398 \text{ N} \checkmark$	

(2)

[16]

QUESTION 6/VRAAG 6

6.1.1 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 (toonhoogte) van die waargenome klank deur die luisteraar agv die klankbron en die luisteraar wat verskillende snelhede relatief tot mekaar het.
OR/OF

An (apparent) change in (observed/detected) frequency (pitch), ✓ as a result of the relative motion between a source and an observer ✓ (listener). 'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

6.1.2 Doppler flow meter/Doppler vloeimeter ✓

(1)

6.1.3 Less than/Minder as 800 Hz. ✓

As the police car moves away, fewer waves arriving per second ✓✓ and
 lesser the frequency/Soos die polisiemotor weg beweeg, verminder die
 golwe per sekonde en verminder die frekwensie

OR/OF

wavelength is inversely proportional to the frequency
 golflengte is omgekeerd eweredig aan die frekwensie

(3)

6.1.4 **Marking criteria/Nasienkriteria**

Formula to calculate f_L ✓

Substitution of (340-0) ✓

Substitution of (800) ✓

Final answer ✓

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

$$v_s = 100 \text{ km} \cdot \text{h}^{-1}$$

$$v_s = 27,78 \text{ m} \cdot \text{s}^{-1}$$

$$f_L = \frac{(340-0) \checkmark}{(340+27,78)} (800) \checkmark$$

$$f_L = 739,57 \text{ Hz} \checkmark$$

(4)

6.2 Galaxy/Sterrestelsel B ✓

The more distant the galaxy is, ✓ the greater the speed at which it is
 moving. ✓

Hoe verder weg die sterrestelsel is, hoe groter is die spoed waarteen dit
 beweeg.

(3)

[13]

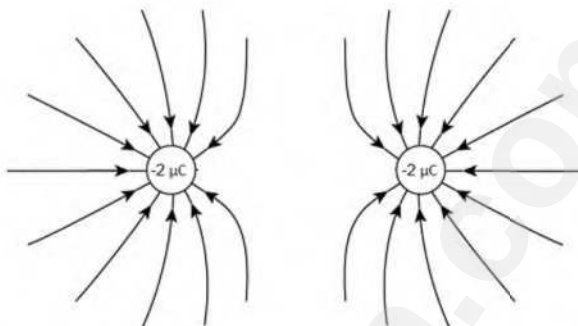


QUESTION 7/VRAAG 7

7.1 Electrostatic force/*Elektrostatiese krag* ✓ (2)
 They repel each other/*stoot mekaar weg* ✓

7.2 By friction/*deur wrywing* ✓ (1)

7.3



Marking criteria/Nasienkriteria

Shape/*Vorm* ✓

Correct direction/*Korrekte rigting* ✓

(2)

7.4

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$6,48 \times 10^{-3} \checkmark = \frac{(9 \times 10^9)(6 \times 10^{-9})(3 \times 10^{-9})}{(r)^2} \quad \checkmark$$

$$r = 0,005 \text{ m} \checkmark / 5 \times 10^{-3} \text{ m}$$

(4)

7.5

Marking criteria/Nasienkriteria

Formula to calculate *E*/*Formule om E te bereken* ✓

Correct substitution to calculate E_{6nC} /*Korrekte vervanging om E_{6nC} te bereken* ✓

Correct substitution to calculate E_{3nC} /*Korrekte vervanging om E_{3nC} te bereken* ✓

Vector addition (subtraction) to calculate E_{net} /*Vektor addisie (aftrekking) om E_{net} te bereken* ✓

Final answer/*Finale antwoord* ✓

POSITIVE MARKING FROM QUESTION 7.4

POSITIEWE NASIEN VAN VRAAG 7.4

$$E = \frac{kQ}{r^2} \quad \checkmark$$

$$E_{6nC} = \frac{(9 \times 10^9)(6 \times 10^{-9})}{(2,5 \times 10^{-3})^2} \quad \checkmark$$

$$= 8,64 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{3nC} = \frac{(9 \times 10^9)(3 \times 10^{-9})}{(2,5 \times 10^{-3})^2} \quad \checkmark$$

$$= 4,32 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the right/na regs}$$

$$E_{net} = (8,64 \times 10^6) - (4,32 \times 10^6) \quad \checkmark$$

$$= 4,32 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links} \quad \checkmark$$



(5)

[14]

QUESTION 8/VRAAG 8

8.1.1 18 V ✓ (1)

8.1.2 0 A ✓ (1)

8.2.1 When the charges moves through the battery, some of the energy is lost ✓
in the form of heat due to internal resistance. ✓ Therefore there is less
potential difference available to the charges. ✓
Soos wat ladings deur die battery beweeg, sal van die energie verlore gaan
in die vorm van hitte a.g.v. interne weerstand. Daarom is daar minder
potensiaalverskil bekikbaar vir die ladings. (3)

8.2.2 $V_{\text{lost/verlore}} = I_r$ ✓
 $0,72 = 7,2 r$ ✓
 $r = 0,1 \Omega$ ✓ (3)

8.2.3 **POSITIVE MARKING FROM QUESTION 8.1.1 and 8.2.2**
POSITIEWE NASIEN VAN VRAAG 8.1.1 EN 8.2.2
 $\text{emf } (\mathcal{E}) = I(R + r)$ ✓
 $18 \checkmark = 7,2 (R_T + 0,1)$ ✓
 $R_T = 2,4 \Omega$
 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
 $\frac{1}{2,4} = \frac{1}{6} + \frac{1}{R}$ ✓
 $R = 4 \Omega$ ✓ (5)

8.3 Decreases/Afneem ✓
 There are fewer bulbs in parallel. Total resistance of the external circuit increases and total current decreases. ✓ Decrease in current results in a decrease in the power. ✓
Daar is minder gloeilampe in parallel. Totale weerstand van die eksterne stroombaan verhoog en totale stroom(sterkte) neem af. Afname in stroom(sterkte) lei tot 'n afname in drywing. (3)
[16]



QUESTION 9/VRAAG 9

- 9.1 A current carrying conductor will experience a force, ✓ when placed in a magnetic field. ✓

Accept: Fleming's left hand motor rule.

'n Stroomdraende geleier sal 'n krag ervaar wanneer dit in 'n magnetiese veld geplaas word.

Aanvaar: Fleming se linkerhand motorreël

(2)

- 9.2 Direct current motor/Gelykstroom motor ✓

(1)

- 9.3 Split ring commutator/Split ring kommutator ✓

(1)

- 9.4 A to B/A na B ✓

(1)

9.5.1
$$T = \frac{1}{50}$$

$$= 0,02 \text{ s} \checkmark$$

(1)

9.5.2
$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$= \frac{10,6}{\sqrt{2}} \checkmark$$

$$I_{\text{rms}} = 7,5 \text{ A} \checkmark$$

(3)

- 9.5.3 **POSITIVE MARKING FROM QUESTION 9.5.2**
POSITIEWE MERK VAN VRAAG 9.5.2
OPTION 1/OPSIE 1

$$P_{\text{ave}} = I_{\text{rms}}^2 \times R \checkmark$$

$$1800 \checkmark = 7,5^2 \times R \checkmark$$

$$R = 32 \Omega \checkmark$$

- POSITIVE MARKING FROM QUESTION 9.5.2**
POSITIEWE MERK VAN VRAAG 9.5.2
OPTION 2/OPSIE 2

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$1800 \checkmark = \frac{240^2}{R} \checkmark$$

$$R = 32 \Omega \checkmark$$

(4)

- 9.6.1 Use stronger magnets/Gebruik sterker magnete ✓
 Use a higher voltage battery/Gebruik 'n battery met hoër potensiaalverskil ✓
 Increase number of turns of the armature (coil)./Verhoog die aantal draaie(windings) van die spoel.

Any two/enige twee

(2)

- 9.6.2 Rotate poles of the magnet ✓ **OR** change the poles of the battery ✓
 Roteer die pole van die magneet **OF** verander die pole van die battery

(2)

[17]

QUESTION 10/VRAAG 10

10.1 Light energy converts to electrical energy/*Lig energie omgeskakel in elektriese energie* ✓✓ (2)

10.2 To determine which wavelengths of light are suitable for use in a solar cell ✓✓
Om te bepaal watter golflengtes lig geskik sal wees vir 'n sonsel (2)

10.3 **OPTION 1/ OPSIE 1**
Marking criteria/Nasienkriteria
 Any of the formula/*Enige formule* ✓
 Correct substitution to calculate E for blue light/*Korrekte substitusie om E vir die blou lig te bereken* ✓
 Correct substitution of kinetic energy/*Korrekte substitusie van kinetiese energie* ✓
 Final answer for W_0 /*Finale antwoord vir W_0* ✓
 Correct substitution to calculate E for red light/*Korrekte substitusie om E vir die rooi lig te bereken* ✓
 Final answer for E for red light/*Finale antwoord vir E van die rooi lig* ✓
 Writing the answer/*Skryf van die antwoord $E_{\text{red/rooi}} > W_0$* ✓

$E = W_0 + E_{k(\text{max})}$
 $hc = hf_0 + \frac{1}{2}mv^2$
 $\frac{hc}{\lambda}$
 $E = \frac{hc}{\lambda}$

} any one/enige een ✓

$W_0 = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(460 \times 10^{-9})} - (1,6 \times 10^{-19})$ ✓
 $= 2,72 \times 10^{-19} \text{ J}$ ✓
 Energy of a red light photon/*Energie van 'n rooilig foton*
 $E = \frac{hc}{\lambda}$
 $E = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(700 \times 10^{-9})}$ ✓
 $= 2,84 \times 10^{-19} \text{ J}$ ✓
 Red light will emit electrons since/*Rooilig sal fotone vrystel want*
 $E_{\text{red/rooi}} > W_0$ ✓



OPTION 2/ OPSIE 2

Marking criteria/Nasienkriteria

Any of the formula/Enige formule ✓

Correct substitution to calculate E for blue light/Korrekte substitusie om E vir die blou lig te bereken ✓

Correct substitution of kinetic energy/Korrekte substitusie van kinetiese energie ✓

Final answer for W_0 /Finale antwoord vir W_0 ✓

Correct substitution to calculate f_0 /Korrekte substitusie om f_0 te bereken ✓

Correct substitution to calculate f for red light/Korrekte vervanging om f van die rooi lig te bereken. ✓

Writing the answer/Skryf die antwoord $f > f_0$ ✓

$$E = W_0 + E_{k(max)}$$

$$\frac{hc}{\lambda} = hf_0 + \frac{1}{2} mv^2$$

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

$$E = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(460 \times 10^{-9})} \checkmark$$

$$= 4,32 \times 10^{-19} \text{ J}$$

$$E = W_0 + E_{k(max)}$$

$$(4,32 \times 10^{-19}) = W_0 + (1,6 \times 10^{-19} \checkmark)$$

$$W_0 = 2,72 \times 10^{-19} \text{ J} \checkmark$$

$$W_0 = hf_0$$

$$(2,72 \times 10^{-19}) = (6,63 \times 10^{-34}) (f_0) \checkmark$$

$$f_0 = 4,10 \times 10^{14} \text{ Hz}$$

$$f = \frac{c}{\lambda}$$

$$f = \frac{3 \times 10^8}{700 \times 10^{-9}} \checkmark$$

$$= 4,29 \times 10^{14} \text{ Hz} \checkmark$$

Red light will emit electrons since/Rooilig sal fotone vrystel want $f > f_0$ ✓

(7)

10.4 Yes/Ja ✓

Red light has the longest wavelength in the visible light spectrum. ✓

If red light could emit electrons from the material, all other light colours will emit electrons.

Rooilig het die langste golflengte in die sigbare lig spektrum.

Indien rooilig elektrone vrystel vanuit die materiaal, sal alle ander kleure lig ook elektrone kan vrystel.

(2)

[13]

TOTAL/TOTAAL: 150

SUBJECT: PHYSICAL SCIENCES PAPER 1										GRADE 12			
ANALYSIS GRID										SEPTEMBER 2023			
QUESTION	Mark	Cognitive Levels				Topics				TOTAL	Difficulty Levels		
		2	3	4		Mechanics ≈ 65 Marks	Waves, Sound & Light ≈ 15 Marks	Electricity & Magnetism ≈ 55 Marks	Matter & Materials ≈ 15 Marks		Easy	Moderate	Difficult
1.1	2	2				2				2	2		
1.2	2		2			2				2	2		
1.3	2			2		2				2			2
1.4	2			2		2				2	2		
1.5	2		2				2			2		2	
1.6	2			2				2		2			2
1.7	2	2						2		2		2	
1.8	2			2				2		2			2
1.9	2		2					2		2	2		
1.10	2	2							2	2	2		
Ques 1	20	6	6	8	0	8	2	8	2	20	10	4	6
2.1.1	3			3		3				3	3		
2.1.2	2		2			2				2		2	
2.2.1	2	2				2				2	2		
2.2.2	2		2			2				2		2	
2.2.3	4			4		4				4			4
2.2.4	2			2		2				2		2	
Ques 2	15	2	4	9	0	15	0	0	0	15	5	6	4
3.1	2	2				2				2	2		
3.2	1			1		1				1			1
3.3	3			3		3				3		3	
3.4	3			3		3				3			3
3.5	3				3	3				3			3
3.6	2		2			2				2	2		
3.7	2			2		2				2		2	
Ques 3	16	2	2	9	3	16	0	0	0	16	4	5	7
4.1	2	2				2				2	2		
4.2	3		3			3				3		3	
4.3	3			3		3				3			3
4.4	2		2			2				2			2
Ques 4	10	2	5	3	0	10	0	0	0	10	2	3	5
5.1	4			4		4				4		4	
5.2.1	3		3			3				3		3	
5.2.2	3		3			3				3		3	
5.2.3	4			4		4				4			4
5.3	2				2	2				2			2
Ques 5	16	0	6	8	2	16	0	0	0	16	0	10	6
6.1.1	2	2					2			2	2		
6.1.2	1		1				1			1	1		
6.1.3	3		3				3			3			
6.1.4	4		4				4			4			4
6.2	3			3			3			3		3	
Ques 6	13	2	8	3	0	0	13	0	0	13	6	3	4
7.1	2	2						2		2	2		
7.2	1		1					1		1	1		
7.3	2		2					2		2	2		
7.4	4		4					4		4		4	
7.5	5			5				5		5		5	

SUBJECT: PHYSICAL SCIENCES PAPER 1										GRADE 12			
ANALYSIS GRID										SEPTEMBER 2023			
QUESTION	Mark	Cognitive Levels				Topics				TOTAL	Difficulty Levels		
		1	2	3	4	Mechanics = 65 Marks	Waves, Sound & Light = 15 Marks	Electricity & Magnetism = 55 Marks	Matter & Materials = 15 Marks		Easy	Moderate	Difficult
Ques 7	14	2	7	5	0	0	0	14	0	14	5	9	0
8.1.1	1	1						1		1	1		
8.1.2	1	1						1		1	1		
8.2.1	3		3					3		3		3	
8.2.2	3			3				3		3		3	
8.2.3	5		5					5		5			5
8.3	3			3				3		3		3	
Ques 8	16	2	8	6	0	0	0	16	0	16	2	9	5
9.1	2	2						2		2	2		
9.2	1		1					1		1	1		
9.3	1		1					1		1	1		
9.4	1				1			1		1			1
9.5.1	1	1						1		1	1		
9.5.2	3		3					3		3		3	
9.5.3	4			4				4		4		4	
9.6.1	2			2				2		2	2		
9.6.2	2			2				2		2		2	
Ques 9	17	3	5	8	1	0	0	17	0	17	7	9	1
10.1	2	2							2	2	2		
10.2	2		2						2	2	2		
10.3	7				7				7	7			7
10.4	2			2					2	2		2	
Ques 10	13	2	2	2	7	0	0	0	13	13	4	2	7
SUMMARY													
QUES 1	20	6	6	8	0	8	2	8	2	20	10	4	6
QUES 2	15	2	4	9	0	15	0	0	0	15	5	6	4
QUES 3	16	2	2	9	3	16	0	0	0	16	4	5	7
QUES 4	10	2	5	3	0	10	0	0	0	10	2	3	5
QUES 5	16	0	6	8	2	16	0	0	0	16	0	10	6
QUES 6	13	2	8	3	0	0	13	0	0	13	6	3	4
QUES 7	14	2	7	5	0	0	0	14	0	14	5	9	0
QUES 8	16	2	8	6	0	0	0	16	0	16	2	9	5
QUES 9	17	3	5	8	1	0	0	17	0	17	7	9	1
QUES 10	13	2	2	2	7	0	0	0	13	13	4	2	7
Total mark	150	23	53	61	13	65	15	55	15	150	45	60	45
Norm mark	150	22,5	52,5	60	15	65	15	55	15	150	45	60	45
Total %	100	15	35	41	9	100	100	100	100	100	30	40	30
Norm %	100	15	35	40	10					0	30	40	30

