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**ST. MARY'S DSG KLOOF****Physical Sciences****GRADE 12
TRIALS 2022****Trials Paper 1****Time: 3 hours + 10 min reading
Marks: 200****Examiners and Moderators: T. Kirsten, K. Bolton and G. Main****Examination number:**

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Read the Following Instructions Carefully:

1. This paper consists of:
A question paper of 31 pages
A Data sheet
2. Read the questions carefully.
3. Answer **ALL** questions on the paper.
4. It is in your own interest to write legibly and to set your work out neatly.
5. Show all the necessary steps in calculations.
6. Use the data and formulae whenever necessary.
7. All working should be shown and units **MUST** be given with answers. Work to two decimal places or significant figures where appropriate. **Make sure your calculator is in the correct mode.**
8. Two blank pages (30-31) are included at the end of the question paper. If you run out of space for a question, use these extra pages. Clearly indicate the question number of your answer, should you use this extra space.

ACKNOWLEDGEMENTS:

St. Andrew's College and DSG Paper 1 Trials 2019

St. Andrew's College and DSG Paper 1 Trials 2020

Redhill Paper 1 Prelims 2019

DBE Grade 11 June 2018

WCED Common cluster Exam Grade 12 2020

Cambridge International AS & A Level. PHYSICS. Paper 2 AS Level Structured Questions.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Mark										
Question total	20	25	14	25	38	19	19	14	15	10

QUESTION 1 MULTIPLE CHOICE

Answer the multiple-choice questions on the answer grid below. Make a clear cross (X) in the box corresponding to the letter that you consider to be correct. Every question has only one correct answer.

A	B	C	D
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Here the option C has been marked as an example.

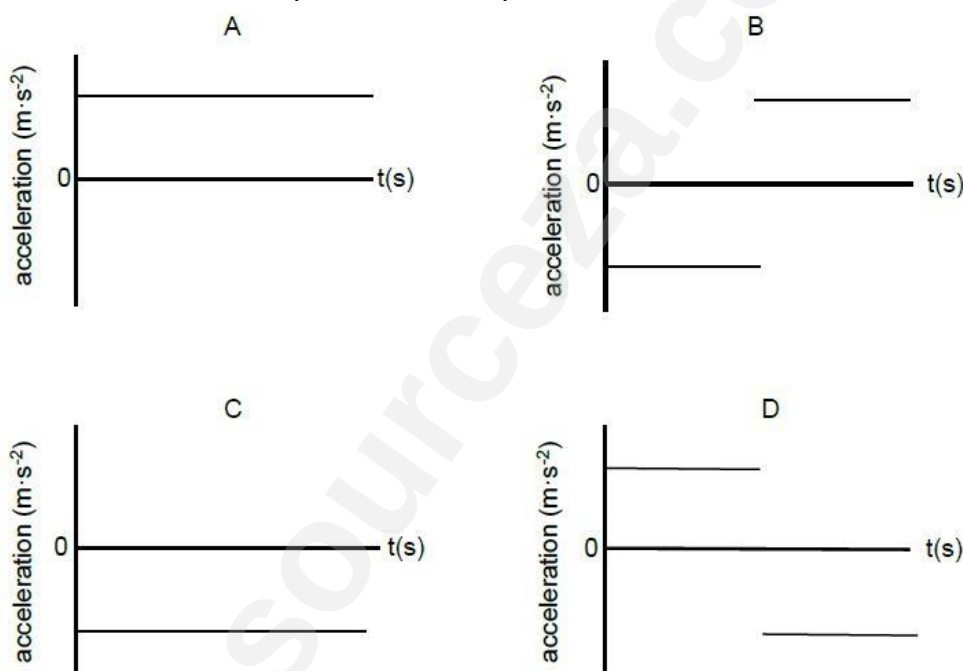
1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D

QUESTION 1 MULTIPLE CHOICE- Answer the multiple-choice questions on the answer grid.

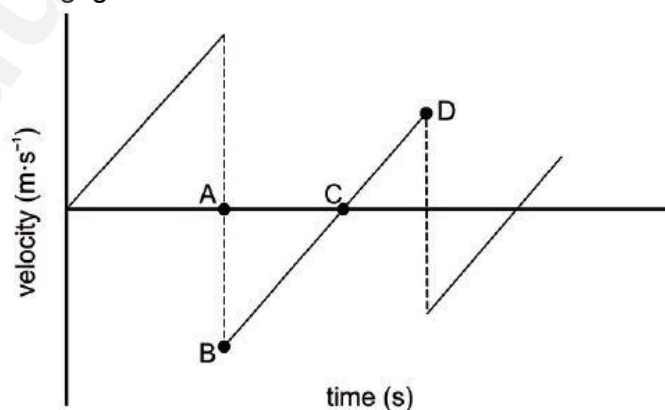
1.1 Linear momentum is defined as *the product of the mass and velocity of the object* ($p = mv$). This consists of:

- A one vector quantity and two scalar quantities
- B two vector quantities and one scalar quantity
- C three vector quantities
- D three scalar quantities

1.2 A ball is thrown vertically upwards and caught. Which graph best shows the relationship between acceleration and time for the entire motion of the ball? Ignore air friction and take upwards as the positive direction.

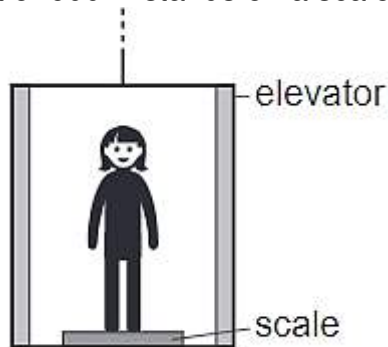


1.3 A ball is dropped vertically from rest above a hard, horizontal surface. The motion for the bouncing ball is represented on the velocity vs time graph shown below. Air resistance is negligible.



At which point labelled on the graph does the ball reach its maximum height after the first bounce?

- 1.4 A person with a weight of 600 N stands on a scale in an elevator.



What is the acceleration of the elevator when the scale reads 900 N?

- A 5 m.s^{-2} downwards
 - B $1,5 \text{ m.s}^{-2}$ downwards
 - C $1,5 \text{ m.s}^{-2}$ upwards
 - D 5 m.s^{-2} upwards
- 1.5 Which one of the following is NOT a statement of one of Newton's laws of motion?
- A If body X exerts a force on body Y, body Y simultaneously exerts an equal and opposite force on body X.
 - B If no resultant force acts on a body, it has constant velocity.
 - C The rate of change of momentum of a body is proportional to the resultant force acting on it and takes place in the direction of the force.
 - D The total momentum of a system of interacting bodies is constant if there is no external force.
- 1.6 In a high-wire circus act, a man of mass 85 kg is standing at rest at the midpoint of the wire.



The wire on either side of the man is at an angle of 20° to the horizontal. What is the tension T in the wire?

- A 0,44 kN
- B 0,89 kN
- C 1,2 kN
- D 2,4 kN

- 1.7 An electric pump lifts 500 kg of water per hour to a height of 4 m. The power output rating of the pump can be calculated by:

A $\frac{500 \times 9,8 \times 4}{1}$

B $\frac{500 \times 9,8 \times 4}{60}$

C $\frac{500 \times 9,8}{60 \times 4}$

D $\frac{500 \times 9,8 \times 4}{3600}$

- 1.8 An astronaut is travelling away from Earth in a rocket. If the radius of Earth is r , how far from Earth's centre must the astronaut travel in order to weigh one quarter of what they weigh on Earth's surface?

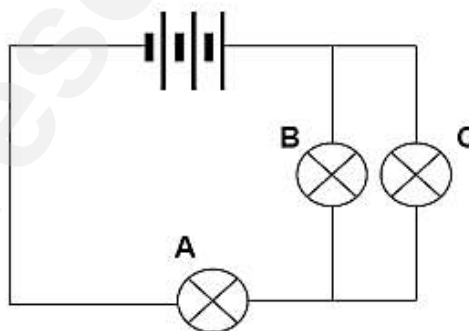
A $\frac{1}{2} r$

B r

C $2r$

D $4r$

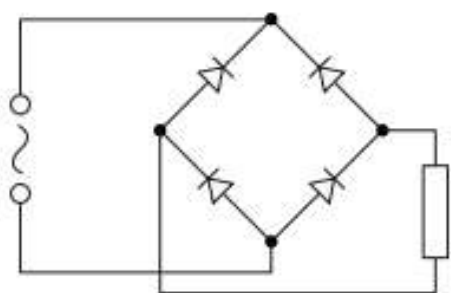
- 1.9 Three identical bulbs, A, B and C, are connected to a battery. Assume the battery has negligible internal resistance.



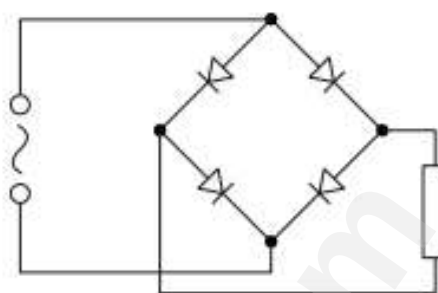
Which ONE of the following combinations correctly represents the brightness of bulbs A and B, **compared** to their original brightness, if bulb C is removed?

	New brightness of bulb A	New brightness of bulb B
A	Dimmer	Dimmer
B	Brighter	Brighter
C	Dimmer	Brighter
D	Brighter	Dimmer

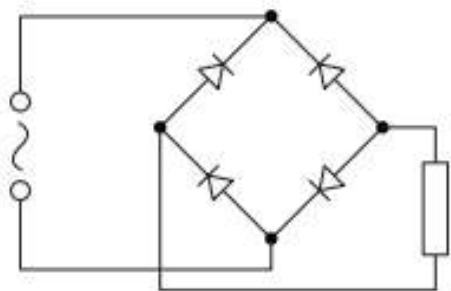
1.10 In which of these circuits can full-wave rectification take place?



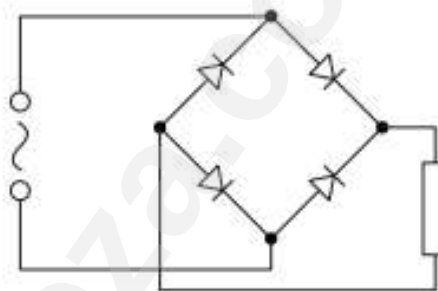
A



B



C



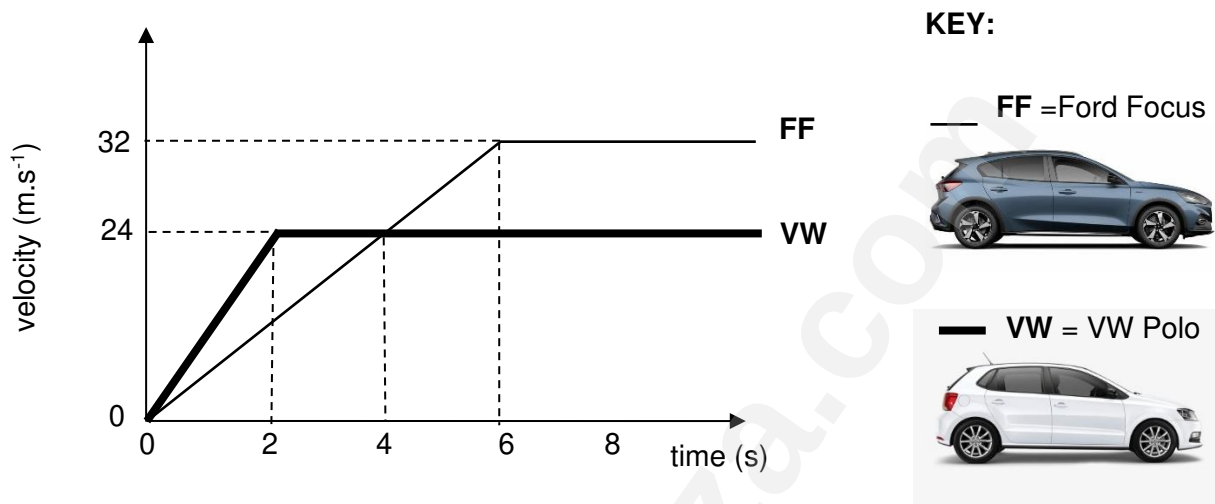
D

[2x10=20]

QUESTION 2

A VW Polo and a Ford Focus travel **due east** from the same starting position on a straight road.

The velocity of each car is shown against time in the graph below.



2.1 Define *velocity*.

(2)

2.2 Calculate the magnitude of the acceleration of the Ford Focus (**FF**) during the first 6 s.

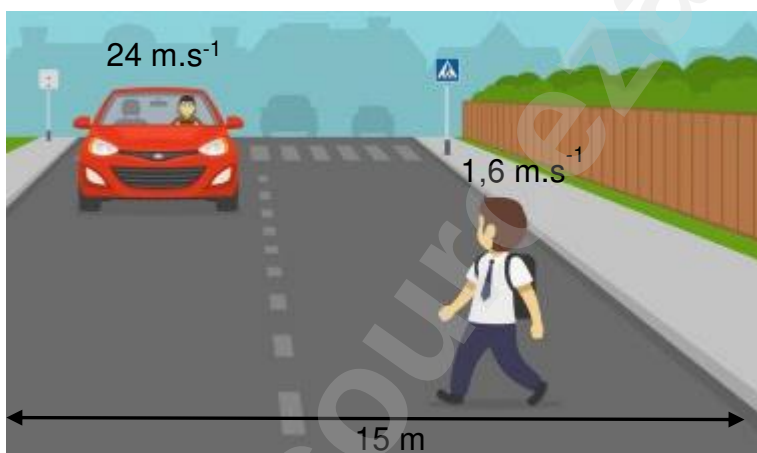
(3)

2.3 Calculate the distance travelled by the VW Polo (**VW**) in the first 6 s.

(3)

- 2.4 At what time (from the start) will the Ford Focus (**FF**) draw level with the VW Polo (**VW**)? (5)

- 2.5 A pedestrian wants to cross the road in front of an approaching car.



The road is 15 m wide and the pedestrian walks across the road at a constant speed of $1,6 \text{ m.s}^{-1}$. The car is travelling at a constant speed of 24 m.s^{-1} . To avoid being hit by the car, the pedestrian must start crossing the road timeously. What is the minimum distance in front of the car that the pedestrian must start crossing the road, in order to cross safely to the other side? (5)

- 2.6 A cell phone is dropped from a height h above the top of a window on the Umhlanga lighthouse, as shown in the diagram below. The window is 1,3 m tall, and the cell phone takes 0,075 s to fall past the window. Air resistance can be ignored.



Determine the height above the top of the window, h , from which the cell phone was dropped. (5)

- 2.7 On the axes below, draw a sketch displacement vs time graph for the motion of the cell phone from the moment it is dropped to when it hits the ground. Use UP as negative and the GROUND as your reference point. (2)



[25]

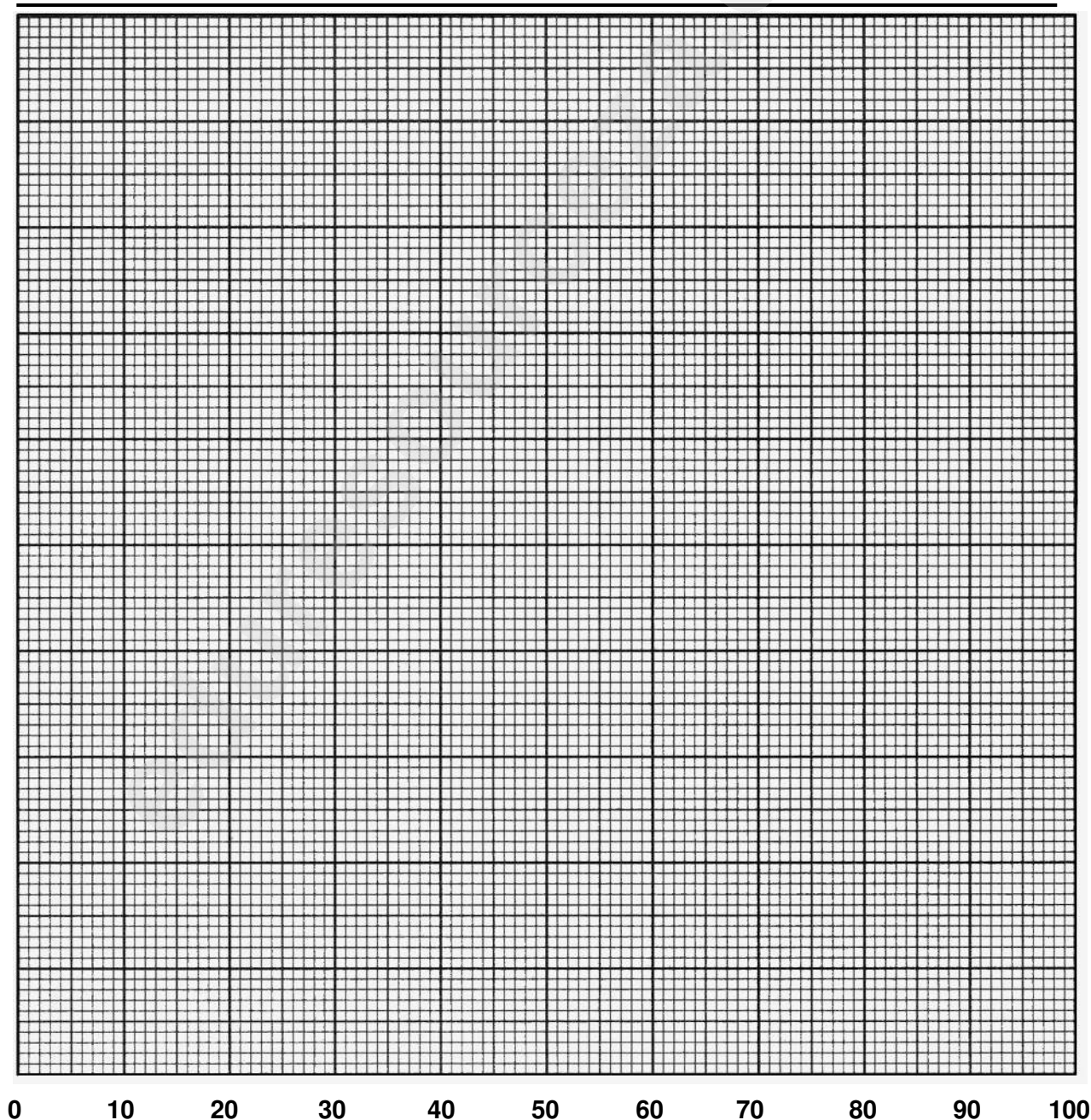
QUESTION 3

An engineer conducts a test on an electric car to establish a relationship between the distance travelled by the car (Δx) and time (t). The car starts from rest and has the same uniform acceleration in each test. The results are shown below.

$t \text{ (s)}$	$t^2 \text{ (s}^2\text{)}$	$\Delta x \text{ (m)}$
3	9	26
4	16	44
6	36	100
7	49	138
8	64	180

3.1 Plot a graph of distance, Δx vs final time squared, t^2 .

(6)



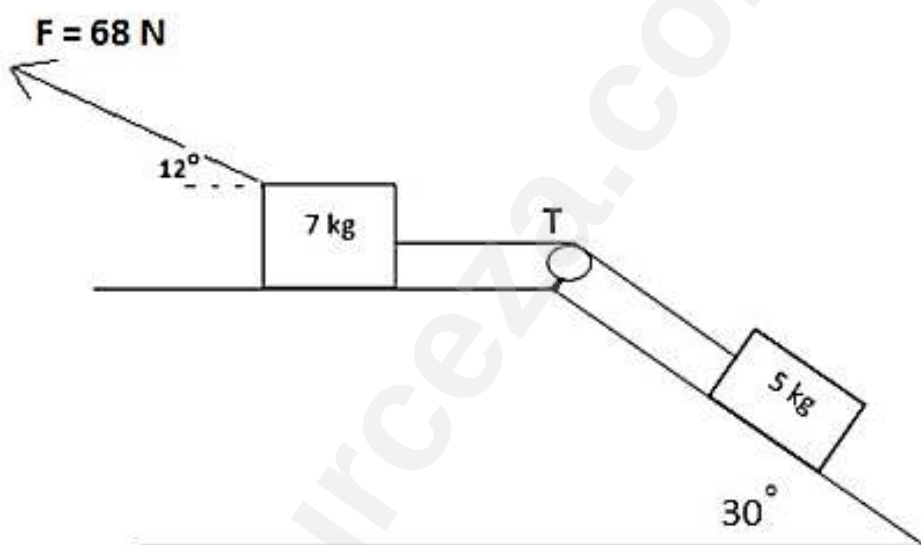
- 3.2 Calculate the gradient of your graph. Show the values you used on your graph and derive a suitable UNIT. (4)
- 3.3 The graph can be represented by the equation $\Delta x = v_i t + \frac{1}{2}at^2$.
Rearrange this equation in the format $y = mx + c$.
Hence, identify the physical quantity represented by the gradient (m). (2)
- 3.4 Use your answers to Question 3.2 and Question 3.3 to calculate the acceleration of the car. (2)

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QUESTION 4

Two blocks of masses 7 kg and 5 kg respectively are connected by a light inextensible string that runs over a light frictionless pulley as shown in the diagram below.

- The 7 kg block is pulled to the left with a force of 68 N at an angle of 12° to the horizontal.
- The 7 kg block experiences a frictional force of 6 N.
- The coefficient of kinetic friction between the 5 kg block and the surface of the inclined plane is 0,18.



- 4.1 Define the term *normal force*. (2)

- 4.2 Draw a labelled, free-body diagram to indicate ALL the forces acting on the **5 kg block**. (5)

4.3 State *Newton's second law of motion*. (2)

4.4 Calculate the frictional force acting between the **5 kg block** and the surface of the inclined plane. (4)

4.5 Using the formula, $F_{\text{net}} = ma$, write a simplified expression for the net force acting on the **5 kg block**. (3)

4.6 Calculate the acceleration of the **7 kg block**. (5)

4.7 Calculate the magnitude of the tension T in the string between the blocks. (2)

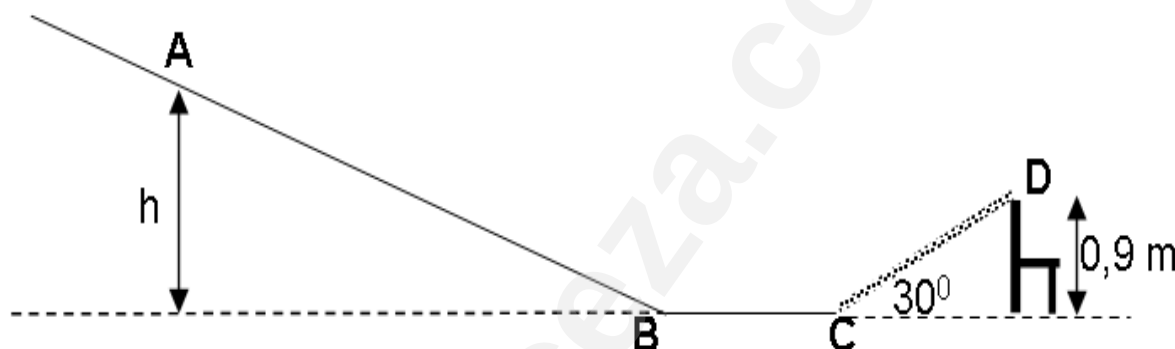
4.8 If the angle of the slope is INCREASED, explain using a suitable formula, how this will affect the frictional force acting on **the 5 kg block**? (3)

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QUESTION 5

The Matric science students of 2022 decide they are going to slide down a virtually **frictionless** plastic sheet on the bank below the Astroturf, to see if they can ramp up a plank onto a bench. They do all their preliminary calculations using Mary, a hypothetical student.

- All friction from point A to point C (on the plastic sheet in the rain) can be ignored,
- While Mary is sliding up the plank (from point C to point D), she experiences a steady frictional force of 200 N.
- Mary has a mass of 65 kg.



- 5.1 If Mary has to reach a height of 0,9 m to make it onto the bench, how long is the plank (from point C to point D)? (2)
- 5.2 Calculate the rate at which energy is dissipated as heat between point C and point D if Mary takes 3,5 s to reach point D from point C. (3)

- 5.3 State the *work-energy theorem*. (2)
-
-
- 5.4 What is the minimum kinetic energy that Mary will need to have at point C to just reach point D? (4)
- 5.5 Using energy principles only, calculate the height, h , that Mary will have to begin at (point A) to reach the bench. (3)
- 5.6 What is the maximum speed that Mary will attain? (3)

On a rainy October day, the science students start to set up the apparatus, but first arrange the plastic **horizontally** for a bit of slip-and-slide fun.



- A student (let's call her A), mass 58 kg, runs and dives, sliding along the plastic at a constant velocity of $2,5 \text{ m}\cdot\text{s}^{-1}$, towards the right.
- Another student (let's call her B), mass 67 kg, runs and dives from the other side of the plastic sheet, travelling at a constant velocity of $3 \text{ m}\cdot\text{s}^{-1}$, towards the left.
- A and B collide and B moves to the left at $0,25 \text{ m}\cdot\text{s}^{-1}$.

5.7 State the *law of conservation of linear momentum*. (2)

5.8 Calculate A's velocity after the collision. (4)

5.9 Define an *inelastic collision*. (2)

5.10 Show, by calculation, that the collision is inelastic. (5)

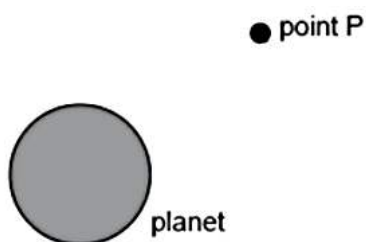
5.11 If the collision lasts for 0,4 s, determine the force that B experiences during the collision. (4)

5.12 Calculate the impulse that A experiences during the collision. (4)

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QUESTION 6

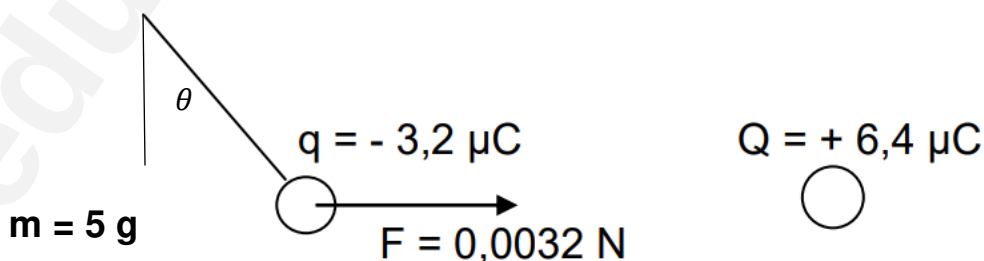
- 6.1 A planet has a radius of $3,1 \times 10^6$ m. At a point P a distance $2,4 \times 10^7$ m above the surface of the planet the gravitational field strength is $2,2 \text{ N.kg}^{-1}$.



- 6.1.1 Define a *gravitational field*. (2)

- 6.1.2 Calculate the mass of the planet. (4)

- 6.2 A small spherical conductor with a mass of 5 g and negative charge of $-3,2 \mu\text{C}$ is suspended by a light string which does not conduct charge. It is attracted to another fixed sphere carrying a charge of $+6,4 \mu\text{C}$ with a horizontal, electrostatic force of $0,0032 \text{ N}$.



- 6.2.1 Define the *magnitude of an electric field at a point*. (2)

6.2.2 Calculate the magnitude of the electric field at the point of the suspended conductor carrying the charge, $q = -3,2 \mu\text{C}$. (3)

6.2.3 Which of the two charges, Q or q , is creating the field that you calculated in 6.2.2?

(1)

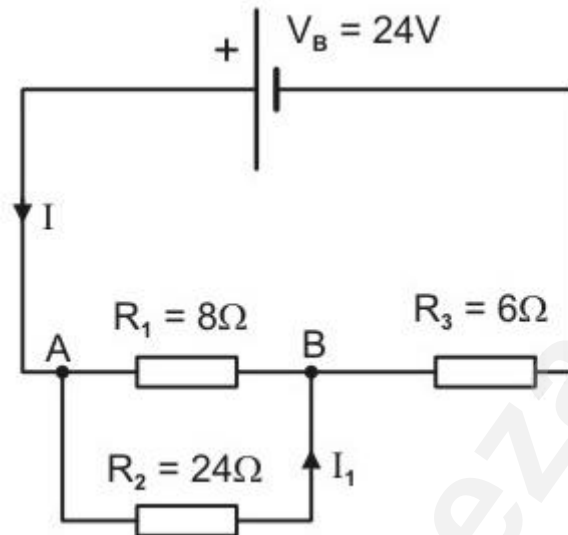
6.2.4 Calculate the distance between q and Q . (4)

6.2.5 Calculate the angle θ that the string makes with the vertical. (3)

[19]

QUESTION 7

In the circuit below, the 24 V supply has zero internal resistance.



7.1 Define *resistance*.

(2)

7.2 Calculate the total resistance of the circuit.

(4)

7.3 Calculate the total current I .

(2)

7.4 Explain what is being measured if a voltmeter is connected across the points A and B.(2)

7.5 Calculate the current I_1 . (3)

7.6 How much energy will be converted to internal energy (thermal energy) by the 6Ω resistor in 5 minutes? (3)

7.7 Calculate the power dissipated in the 8Ω resistor. (3)

QUESTION 8

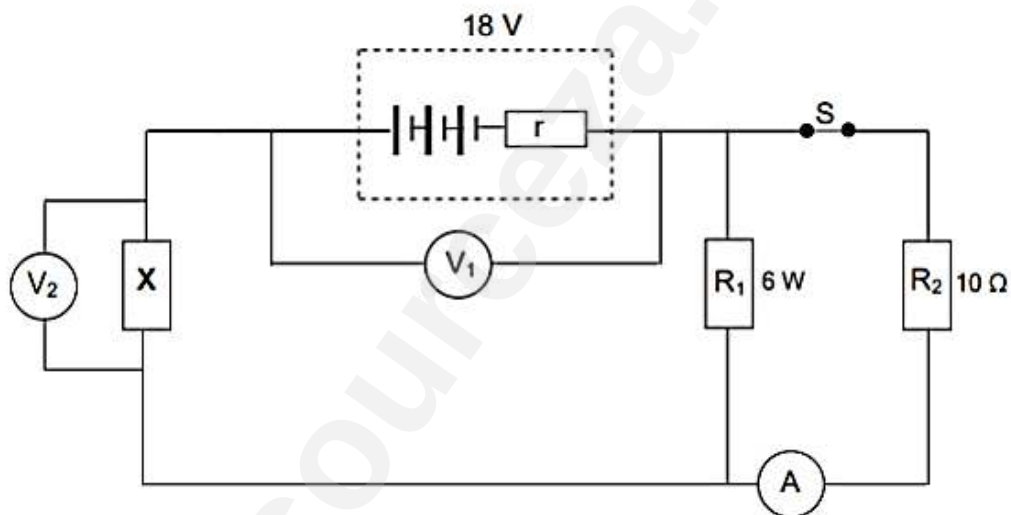
In the circuit diagram below, resistor R_1 is rated at 6 W.

Resistor R_2 has a resistance of $10\ \Omega$.

X is a resistor with an unknown resistance.

The resistance of the switch, ammeter and connecting wires are negligible, while the voltmeters have a very high resistance.

The *emf* of the battery is 18 V and its internal resistance r is unknown.



When switch S is closed, the ammeter A, reads 1,2 A while voltmeter V_2 reads 3,8 V.

8.1 Explain what is meant by “The emf of the battery is 18 V”, as stated above. (2)

8.2 If the internal resistance, r , is $1,29 \Omega$, calculate the resistance of resistor X. (6)

8.3 Switch S is now opened. How will the reading on each of the following voltmeters be affected? State only INCREASES, DECREASES or REMAINS CONSTANT.

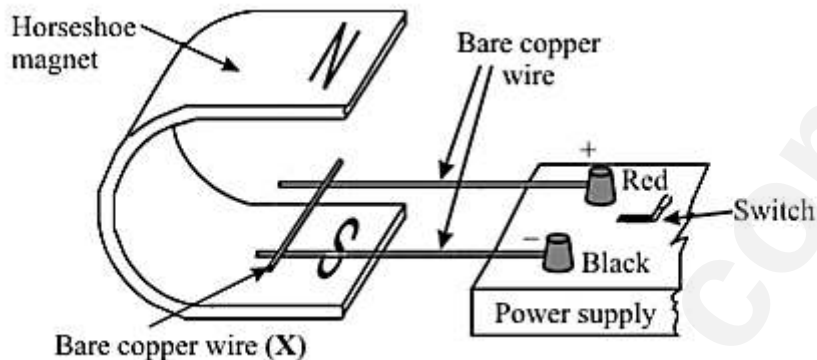
(a) voltmeter V_1 (2)

(b) voltmeter V_2 . Explain your answer using an appropriate formula. (4)

[14]

QUESTION 9

- 9.1 The diagram shows apparatus used to demonstrate the motor effect. **X** is a short length of bare copper wire resting on two other wires and is free to move.



- 9.1.1 Describe what happens to wire X when the current is switched on. (2)

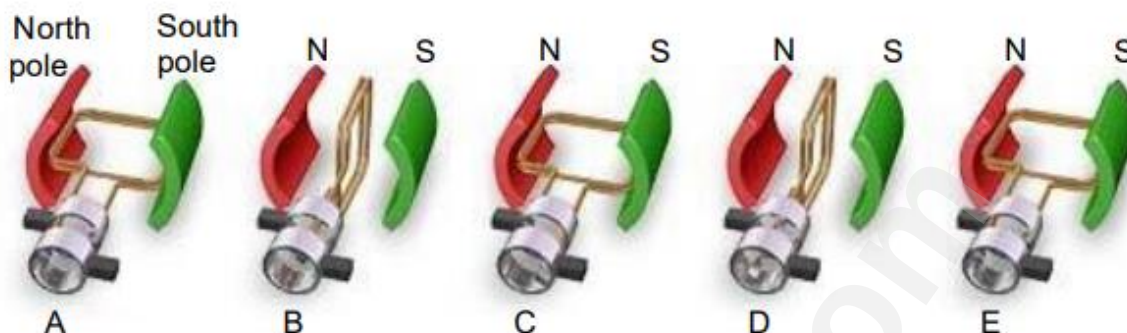
- 9.1.2 Name the hand rule you used in your answer to q9.1.1. (2)

- 9.1.3 What difference do you notice if the following changes are made?

- (a) The magnetic field is reversed. (2)

- (b) The current is increased (2)

- 9.2 The diagrams below illustrate a generator with a rotating coil, between magnetic poles, shown in a number of different positions labelled A – E. The coil is rotated clockwise at constant speed in a uniform magnetic field.



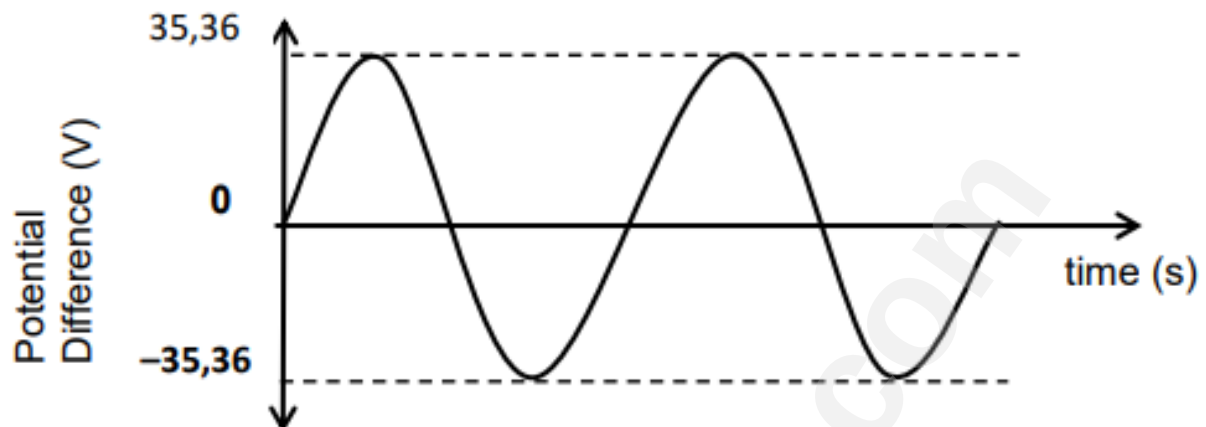
- 9.2.1 On which principle is the working of the generator based? (1)

- 9.2.2 Write down the energy conversion that takes place while the generator is in operation. (1)

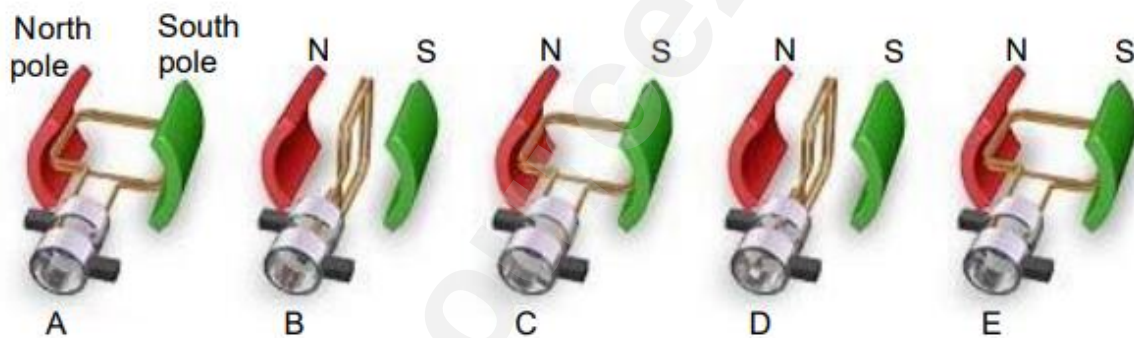
- 9.2.3 A student states that the diagrams illustrate an AC generator. Give a reason why this statement is correct. (1)

- 9.2.4 State the direction of the current in the coil i.e. CLOCKWISE OR ANTI-CLOCKWISE. (2)

9.2.5 The graph of potential difference and time for the generator in QUESTION 9.2 is shown below.



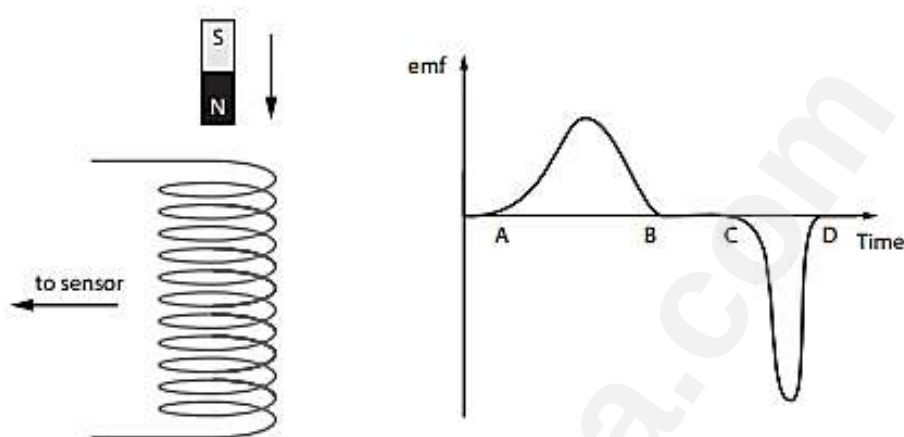
Clearly indicate positions A and B on the graph that correspond to the diagrams below. (2)



[15]

QUESTION 10

The diagram shows a small magnet that has been dropped from above a solenoid. As the magnet falls through the solenoid, a sensor shows how the induced emf in the solenoid varies with time.



10.1 Explain why an emf is induced in the solenoid from A to B. (2)

10.2 State *Lenz's Law*. (2)

10.3 Explain why the induced emf from C to D, when compared to that from A to B, has:

10.3.1 a greater peak value. Use a suitable formula to explain your answer. (3)

P.T.O

10.3.2 has a negative value

(3)

[10]

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