Hillcrest High School

PHYSICAL SCIENCE P1

TRIALS 2025

Grade 12

MARKS: 150
TIME: 3 Hours

EXAMINER: Ms N. Badenhorst
MODERATOR: Mrs J. Knox-Whitehead

Instructions:

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (130)

   Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places

SECTION A

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.

1.1 In which ONE of the following cases is the resultant force acting on an object equal to zero?

A An object moving with constant acceleration.

B When the only force acting on the object is the gravitational force.

C An object undergoes equal displacements every second.

D An object moving with increasing acceleration.

1.2 Ball A is thrown vertically upwards from the edge of the top of a building. At the same time, ball B is thrown vertically downwards with the same speed as ball A. Ignore the effects of air resistance.

Which ONE of the following statements is CORRECT regarding the velocities of the balls when they hit the ground?

A The velocity of ball A is equal to the velocity of ball B.

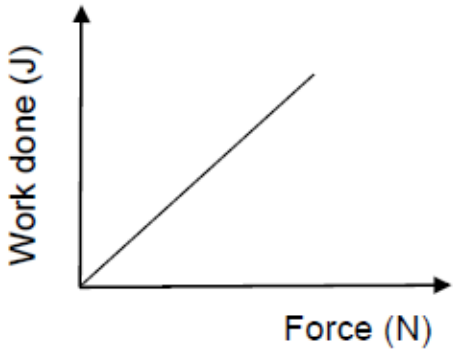
B The velocity of ball A is greater than the velocity of ball B.

C The velocity of ball B is greater than the velocity of ball A.

D The velocity of ball A is equal to the velocity of ball B in direction but not in magnitude.

1.3 A horizontal force F_A is applied on an object placed on a smooth surface as shown below.

The graph below represents the relationship between the applied force and the work done on the object.



The gradient of the graph represents the……...

A velocity the object.

B acceleration of the object.

C distance moved by the object.

D time taken by the object.

1.4 The net force acting on an object is a measure of the … object.

A change in momentum

B rate of change of momentum

C change in velocity

D rate of change of displacement

1.5 A cricket player moves his hands backwards when catching the ball. Which ONE of the following statements is a possible explanation for this?

A It increases contact time and reduces the net force acting on his hands.

B It reduces contact time and increases the net force acting on his hands.

C It increases contact time and increases the net force acting on his hands.

D It reduces contact time and reduces the net force acting on his hands.

1.6 Study the emission spectrum B of a distant star as observed from Earth.

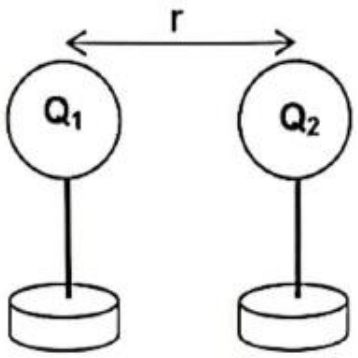
Spectrum A is the laboratory reference spectrum of the same star.

The following is true for spectrum B

	Star is moving:	Wavelength	Frequency
A	Moving towards the earth	Increases	Decreases
B	Moving towards the earth	Decreases	Increases
C	Moving away from the earth	Increases	Decreases
D	Moving away from the earth	Decreases	Increases

1.7 Two identical charges are placed a distance **r** from each other in a vacuum.

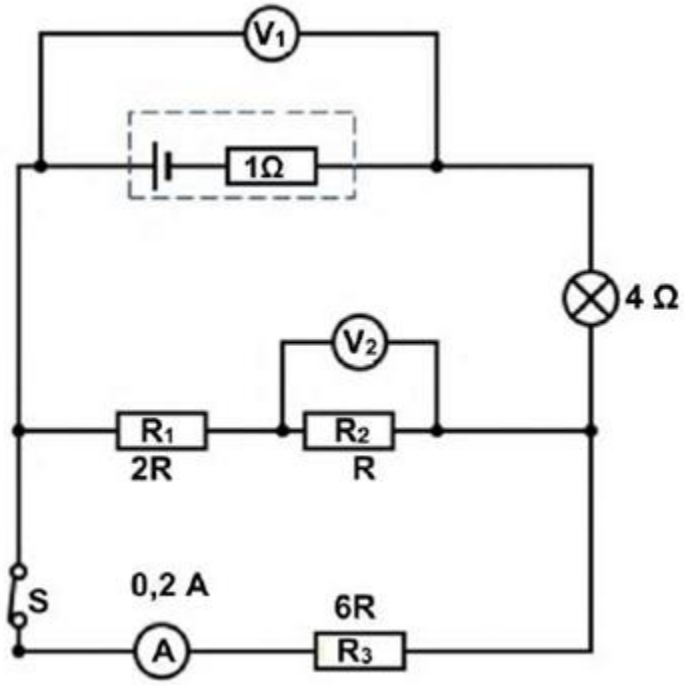
Charge $\mathbf{Q_1}$ experiences an electrostatic force F due to charge $\mathbf{Q_2}$. The charge on $\mathbf{Q_2}$ and the distance between the charges is changed.



Which ONE of the following combinations will result in a force of 16 F exerted on $\mathbf{Q_1}$?

	Charge Q2	**Distance r**
A	$\frac{1}{2}$ Q_2	2r
B	4 Q_2	$\frac{1}{2}$ r
C	2 Q_2	$\frac{1}{2}$ r
D	8 Q_2	2r

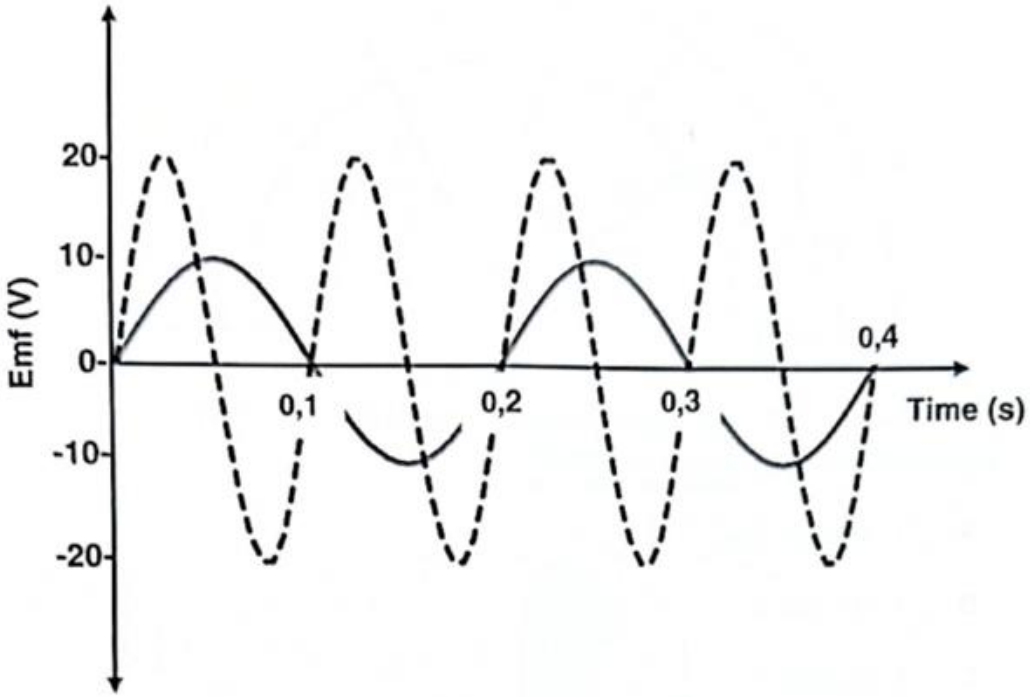
1.8



When the switch, S, is opened the following will happen:

	Emf reading	**Total current**	**Power of 4Ω resistor in series**
A	Remains constant	Increases	Increases
B	Decreases	Increases	Decreases
C	Remains constant	Decreases	Decreases
D	Increases	Decreases	Increases

1.9 In the graph below the solid curve shows how the emf produced by a simple generator changes with time. The broken curve shows the output of the same generator after changes have been made to the generator.



Which change has been made to result in the broken curve?

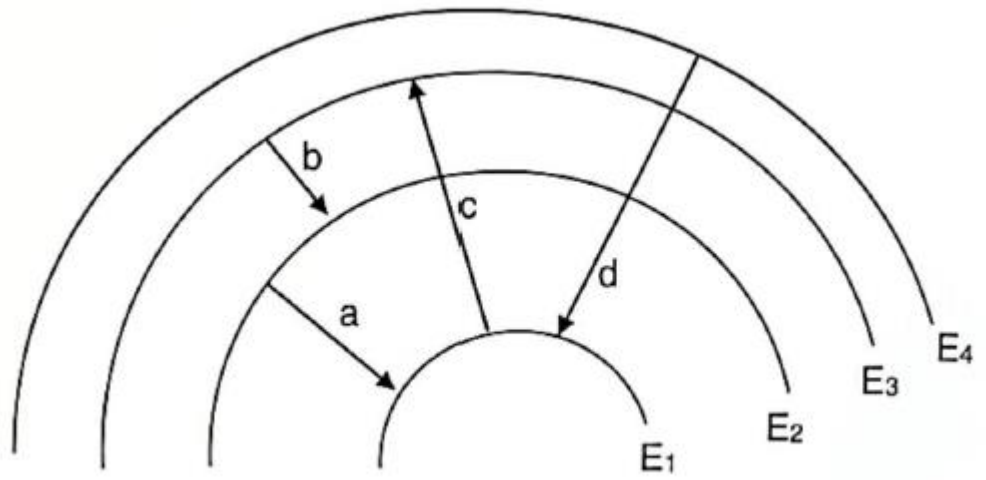
A The number of windings in the coil is doubled.

B The speed of rotation is doubled.

C A split ring commutator is added.

D The strength of the magnet is doubled.

1.10 The diagram below shows the possible transitions of electrons between ENERGY LEVELS (E_1 to E_4) in an atom of a specific element.



Which transition will produce the line of the SHORTEST WAVELENGTH on the emission spectrum of the element?

A Transition a

B Transition b

C Transition c

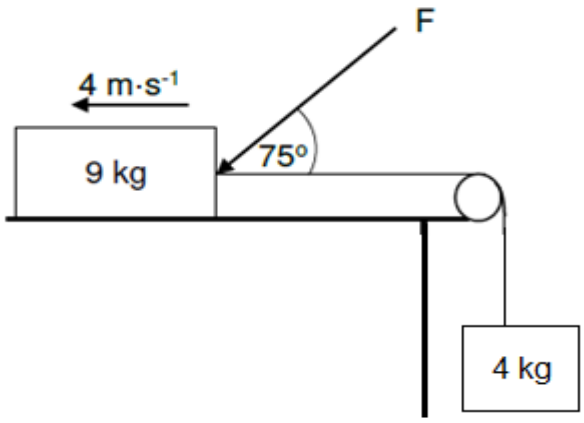
D Transition d

[2 x 10 = 20]

Section B

Question 2

Two blocks of masses 9 kg and 4 kg are connected by a light, inextensible string. A constant force, **F**, acting at 75° to the horizontal, is applied to the 9 kg block as shown in the diagram below. The string runs over a frictionless pulley.



The 9 kg block moves at a CONSTANT velocity of $4 m.s^{-1}$. The coefficient of kinetic friction on the 9kg block is 0,1.

2.1.1 State Newton's First Law of Motion in words. (2)

2.1.2 Draw a labelled free-body diagram for the 9 kg block. (5)

2.1.3 Calculate the magnitude of the force F acting on the 9 kg block. (6)

2.2 The mass of the Earth is $5,98 \times 10^{24}$ kg and the radius of the Earth is $6,38 \times 10^{6}$ m. A small satellite that is 1000 km above the surface of the Earth is accelerating towards the Earth. The only force acting on the satellite is the gravitational force of the Earth. If the weight of the satellite is 3 660 N at 1000 km above the surface of the Earth, calculate its weight on the surface of the Earth. (5)

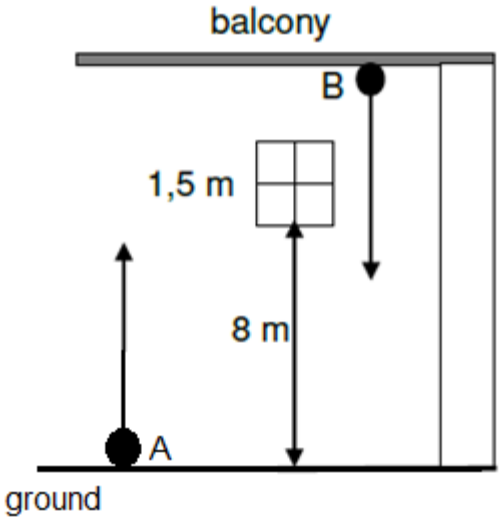
[18]

Question 3

Object A is projected vertically upwards from the ground. It takes 0,8 s to pass a window which is 1,5 m high and 8 m above the ground. It strikes a balcony at a velocity of 1,4 $m.s^{-1}$ and falls back to the ground.

At the same time, object B is projected vertically downwards at a velocity of 8 $m.s^{-1}$.

Ignore the effects of air friction.



3.1 Define the term projectile. (2)

3.2 Calculate the:

3.2.1 Velocity of object A at the bottom edge of the window when moving upwards. (4)

3.2.2 Velocity with which object A is projected from the ground. (3)

3.2.3 Height above the ground at which object A and B will pass each other. (6)

3.3 Draw a position-time graph (not to scale) for the entire motion of objects A and B on the same set of axes from the moment they are projected.

Label the graphs and clearly indicate the following:

- Height where the objects pass each other
- Time the objects pass each other as t (4)

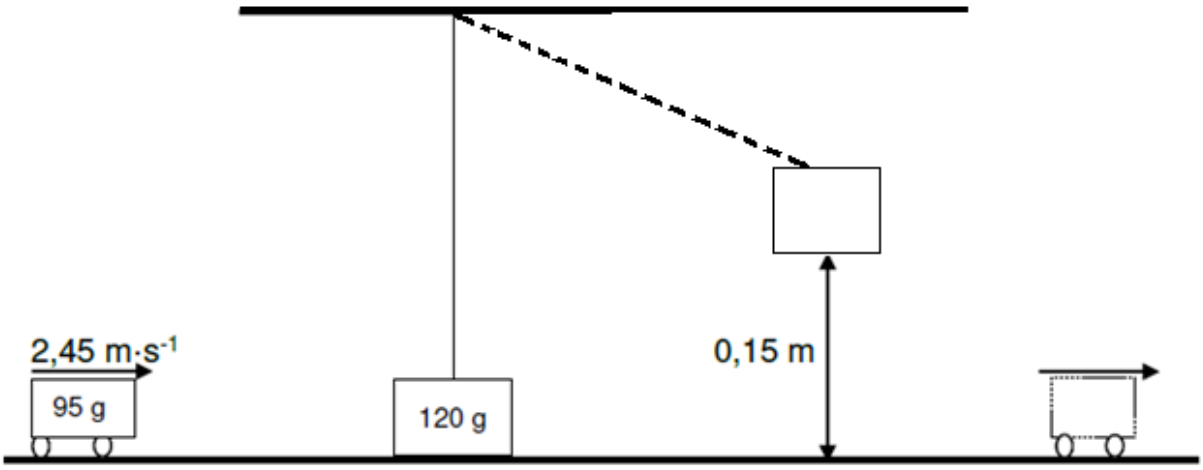
[19]

Question 4

A toy trolley of mass 95 g is moving east at a speed of 2,45 $m.s^{-1}$. It collides with a stationary wooden block of mass 120 g, which is suspended with a rope, as shown in the diagram below.

The impact causes the block to move to a maximum height of 0,15 m from its original position, while the trolley continues moving eastwards.

Ignore the effects of friction and air friction.



4.1 State the principle of conservation of linear momentum in words. (2)

4.2 Draw a force diagram for the block at a height of 0,15 m above the ground. (2)

4.3 Calculate the speed of the trolley immediately after the collision. (5)

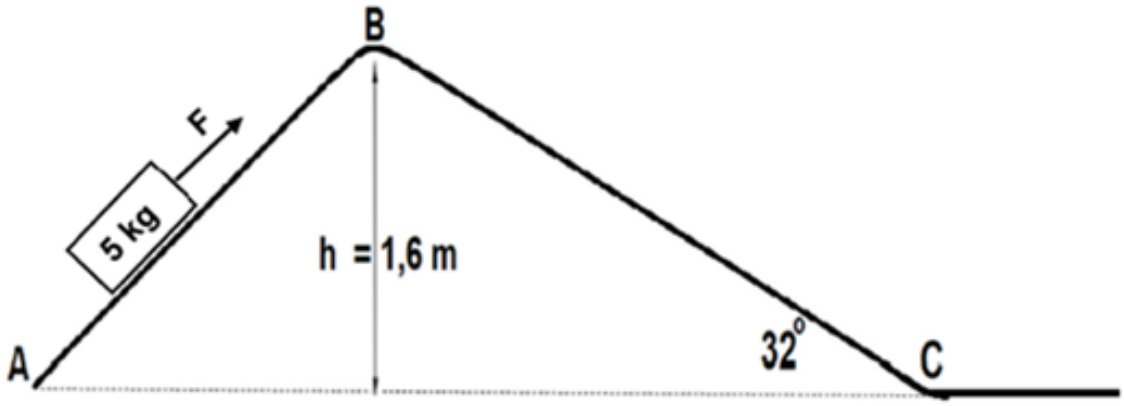
4.4 The contact time between the trolley and the block is 0,08 s,

Calculate the magnitude of the force applied on the trolley by the block. (3)

[12]

Question 5

A 5 kg box moves up an inclined plane from A to B at a constant velocity of 1,2 $m.s^{-1}$ when a force F, is applied.



5.1 Calculate the magnitude of the force **F** if the power that is used to move the box up the incline **AB** is equal to 57,6 W. (3)

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

The box is then pulled, with the force of F, down the incline from point B to C.

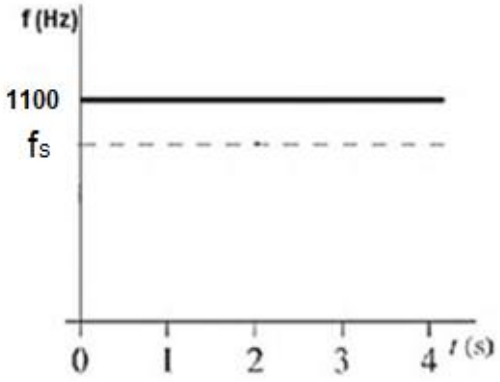
5.3 If the coefficient of kinetic friction of slope **BC** in the diagram above is 0,25, calculate the velocity of the block at point **C**, by using ENERGY PRINCIPLES only. (6)

[11]

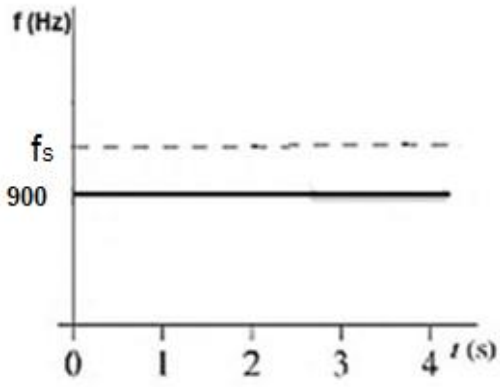
Question 6

An observer with a detector, standing on the side of a straight road, records the frequency of a police car siren moving in a straight line on two separate occasions. The police car moves at the same CONSTANT SPEED on both occasions. The results are shown on graphs **A** and **B** drawn below.

GRAPH A



GRAPH B



6.1 State the *Doppler effect* in words. (2)

6.2 Which graph, A or B, shows the police car moving away from the observer?

Give a reason for your answer. (2)

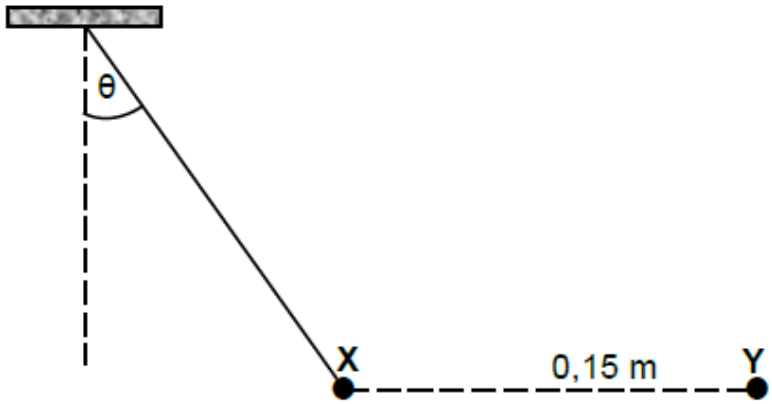
6.3 Calculate the speed of the police car.

(Take the speed of sound in air to be 340 $m.s^{-1}$.) (5)

[9]

Question 7

7.1 A small sphere X having a mass of 8×10^{-2} kg and a charge of $+6 \times 10^{-7}$ C hangs vertically by a thin wire of negligible mass. When the charge Y of -9×10^{-7} C is brought closer to the sphere, the wire makes an angle Θ to the vertical when brought to rest 0,15 m away from the charge Y, as shown in the diagram below.



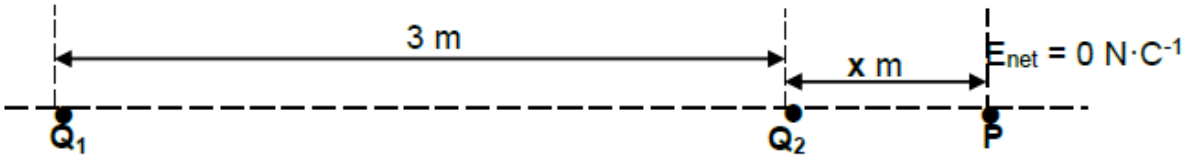
7.1.1 State *Coulomb's Law* in words. (2)

7.1.2 Draw a labelled free-body diagram for the sphere X when at rest. (3)

Calculate the:

7.1.3 Angle Θ shown in the diagram. (5)

7.2 Two-point charges, $\mathbf{Q_1}$ and $\mathbf{Q_2}$, with charges -16×10^{-7} C and $+4 \times 10^{-7}$ C respectively, are placed 3 m apart as shown in the diagram below.



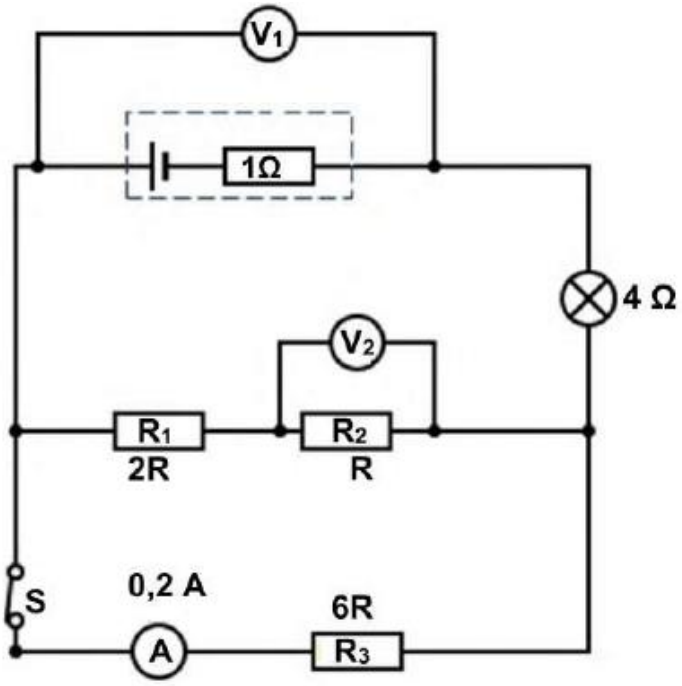
The net electric field at point **P** due to the presence of the two point charges, is ZERO.

Determine the value of **x**, shown in the diagram. (5)

[15]

Question 8

A battery with unknown emf and an internal resistance of 1 Ω is connected to three resistors, a lightbulb, a high-resistance voltmeter, a switch, and an ammeter of negligible resistance, as shown below. The resistance of the lightbulb is 4 Ω and the resistance of the three resistors are 2R, R and 6R respectively.



8.1 Define the term *emf*. (2)

8.2 When switch S is closed, the current through the ammeter is 0,2 A and the potential difference across R_1 is 6 V.

Write down the value of:

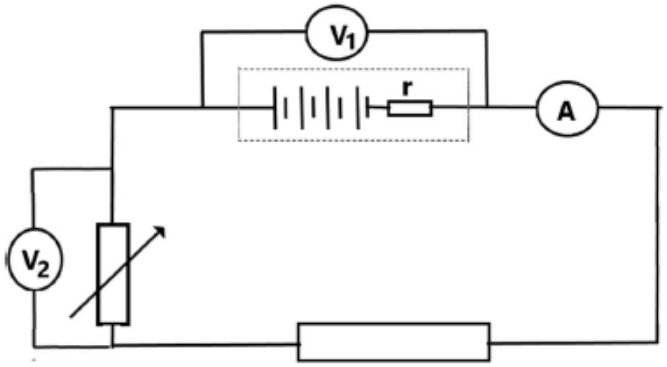
8.2.1 V_2 (1)

8.2.2 The current through R_2 (1)

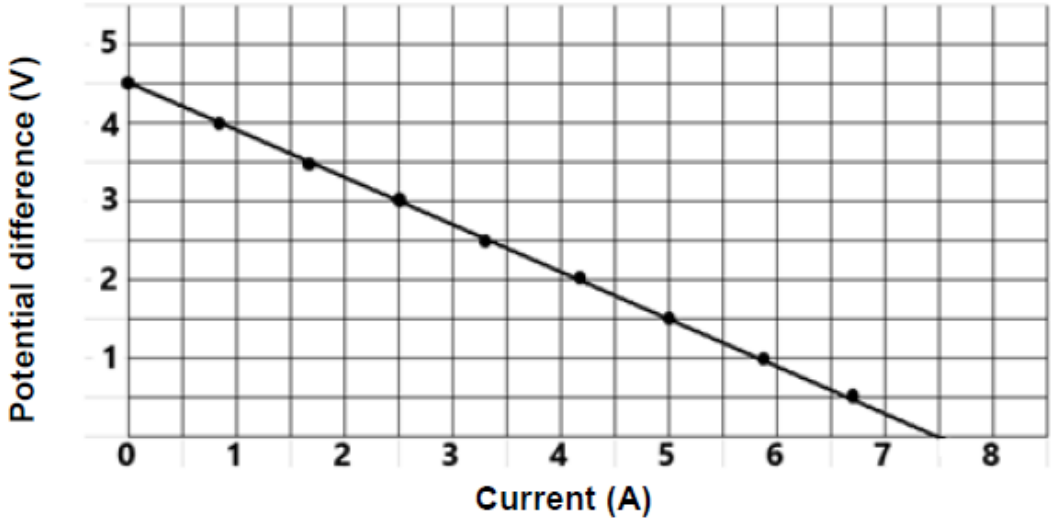
8.3 Calculate the resistance of R_3. (3)

8.4 Calculate the value of the emf. (6)

8.5 Grade 12 learners conducted an investigation to determine the internal resistance of a battery. The circuit used is shown below. By varying the rheostat settings, the corresponding values of the circuit current and the potential difference, V_2, were recorded.



The results obtained were used to plot the graph below.



From this graph:

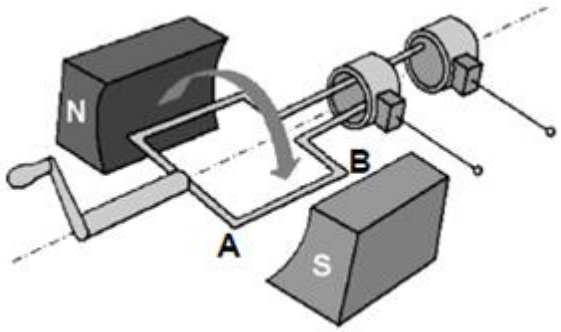
8.5.1 Deduce the EMF of the battery. (1)

8.5.2 Calculate the internal resistance of the battery. (3)

[17]

Question 9

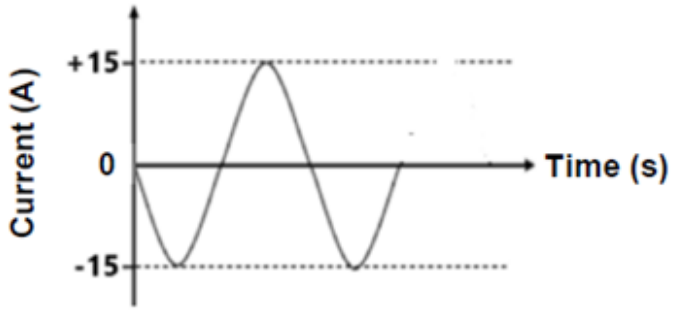
Study the diagram below and answer the questions that follow.



9.1 What type of generator is shown in the diagram above? Motivate the answer by referring to the names of specific components in the diagram. (2)

9.2 Indicate the direction in which the current will flow in section **AB**. Use **A** to **B** or **B** to **A**. (1)

9.3 The following graph is obtained from an AC generator.



9.3.1 How many rotations of the coil are shown in the diagram? (2)

9.3.2 Define *rms current*. (2)

9.3.3 Calculate the average power that can be delivered by this generator to an apparatus with a with a resistance of 30 Ω. (5)

9.4 An electric hair dryer is rated at 2 200 W at 240 V. Assume that the hair dryer is a pure resistor. Calculate the maximum current that flows through the hair dryer when it is used. (4)

[16]

Question 10

Learners conduct an experiment to investigate the photoelectric effect. Metal disc M is irradiated with three light sources of different wavelengths and the results obtained are noted in the table below.

Light Source	**Wavelength (x 10^{-9}m)**	**Emission of photoelectrons**
A	480	Photoelectrons emitted that move away from metal
B	620	No photoelectrons emitted
C	570	Photoelectrons emitted and do NOT move away from metal

10.1 Define the term *work function* in words. (2)

10.2 Explain why light source **A** releases photoelectrons from the metal disc **M**, but not light source B. (2)

10.3 Calculate:

10.3.1 Work function of metal **M** (3)

10.3.2 Speed with which the photoelectrons are moving if metal disc **M** is irradiated with light source **A**. (5)

10.4 Light source **A** is BLUE light and light source **B** is ORANGE light. Which colour of light is light source **C**? Choose between VIOLET, GREEN or RED. (1)

[13]

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

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*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$

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 $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/of $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/of $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = F\cdot v_{av}$ / $P_{gem} = F\cdot v_{gem}$	

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

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

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

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