Western Cape Government

METRO NORTH EDUCATION DISTRICT

SCHOOL-BASED ASSESSMENT

SEPTEMBER TRIAL COMMON EXAMINATION

PHYSICAL SCIENCES P1 (PHYSICS)

TASK NO: 5

SEPTEMBER 2026

MARKS: 150

DURATION: 3 hours

This question paper consists of 16 pages and 3 data sheets

INSTRUCTIONS AND INFORMATION:

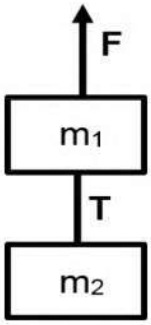
1. Write your name, surname and class on your ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL questions in your ANSWER BOOK.
3. Start EACH question on a NEW page in your ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.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

Copyright reserved

QUESTION 1: MULTIPLE CHOICE QUESTIONS

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

1.1 Two blocks, masses m_1 and m_2, are connected by a piece of string of negligible mass. The blocks are accelerated upwards by a force F.



The tension, **T**, in the string between the blocks is:

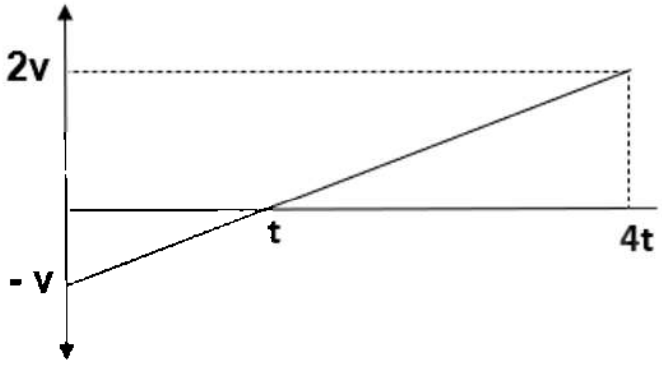
A equal to **F**.

B greater than $\mathbf{m_2g}$.

C less than $\mathbf{m_2g}$.

D equal to $\mathbf{m_2g}$. (2)

1.2 A velocity-time graph is displayed for an object that is moving under the influence of gravitational force only.



The displacement of the object at **4t** is …

A 3,5 **vt**

B **vt**

C 2,5 **vt**

D 0,5 **vt** (2)

Copyright reserved

1.3 A trolley with a mass **m** has momentum **p**. Which ONE of the following formulae can be used to determine the kinetic energy of the trolley?

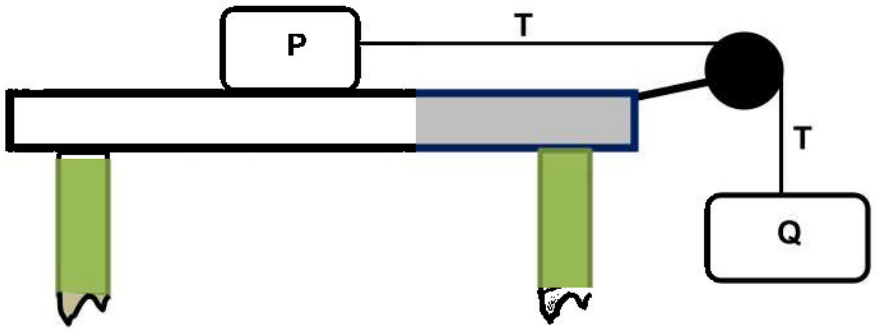
A $\mathbf{pm}$

B $\frac{\mathbf{p}}{\mathbf{m}}$

C $\frac{\mathbf{p^2}}{\mathbf{2m}}$

D $\frac{\mathbf{p^2 m}}{\mathbf{2}}$ (2)

1.4 Block **P** is connected to block **Q** by a light, inextensible rope which passes over a frictionless pulley. Block **P** is accelerating to the right on a frictionless table while the tension in the string is **T**.



Which ONE of the following statements is CORRECT for the work done by the gravitational force, $\mathbf{W_{Fg}}$, and the work done by the tension in the rope, $\mathbf{W_T}$, on blocks **P** and **Q**?

	Block P	**Block Q**
A	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} > 0$	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} > 0$
B	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} < 0$	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} = 0$
C	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} > 0$	$\mathbf{W_{Fg}} > 0$ and $\mathbf{W_T} < 0$
D	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} > 0$	$\mathbf{W_{Fg}} = 0$ and $\mathbf{W_T} < 0$

(2)

Copyright reserved

1.5 A crate is pulled across a rough, horizontal floor by a constant horizontal force. The crate moves at a constant velocity.
Which ONE of the following statements is CORRECT?

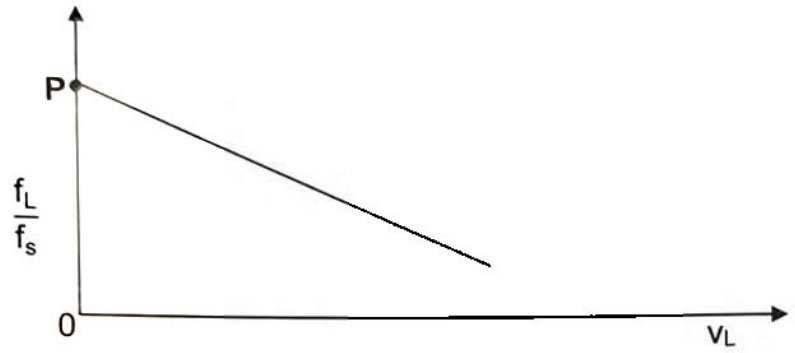
A The applied force does positive work and friction does zero work.

B Both the applied force and friction do positive work on the crate.

C The net work done on the crate is positive because the crate is moving.

D The applied force does positive work, friction does negative work and the net work done on the crate is zero. (2)

1.6 The sketch graph below represents the relationship between the *ratio of observed frequency to the frequency of a source* $\left(\frac{f_L}{f_S}\right)$ and the *speed of a listener* for a stationary source.



Which ONE of the following combinations correctly represents the value of **P** and the direction in which the listener moves?

	Value of P	**DIRECTION of listener**
A	1	Away from source
B	1	Towards the source
C	2	Away from source
D	2	Towards the source

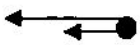
(2)

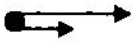
Copyright reserved

1.7 Three point charges, Q_1, Q_2 and Q_3, carrying the same NEGATIVE charge, are arranged as shown below. The distance between the charges is given in terms of **x**.

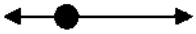


Which ONE of the following is the correct free-body diagram (the length of the vector indicates the magnitude of the field) showing the electric field acting on Q_2 due to Q_1 and Q_3?

A 

B 

C 

D 

(2)

1.8 The difference between a DC and an AC generator is that a DC generator…

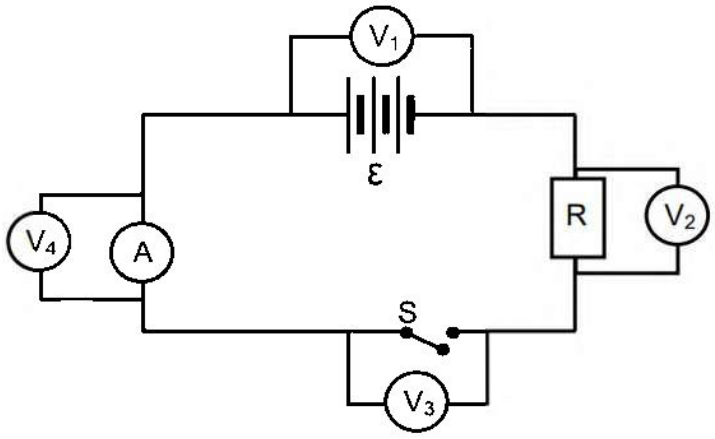
A Uses brushes for commutation, while an AC generator uses slip rings.

B Operates at a constant frequency, whereas an AC generator varies its frequency.

C Produces a lower current than an AC generator.

D Generates a direct current, whereas an AC generator generates alternating current. (2)

1.9 Four voltmeters, $\mathbf{V_1}$, $\mathbf{V_2}$, $\mathbf{V_3}$ and $\mathbf{V_4}$, are connected in a circuit, as shown in the diagram below.



Which voltmeter(s) will have the same reading as voltmeter $\mathbf{V_1}$ when the switch **S** is open?

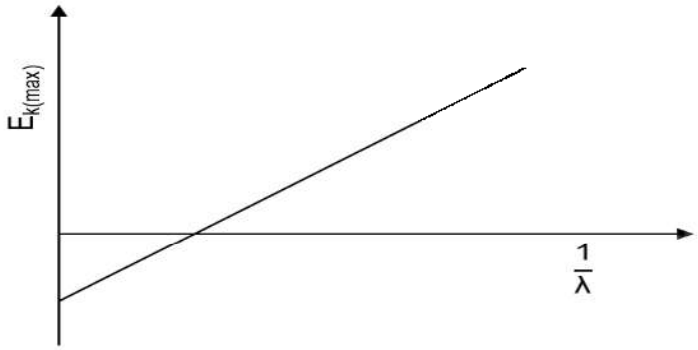
A $\mathbf{V_2}$ and $\mathbf{V_4}$

B $\mathbf{V_3}$ only

C $\mathbf{V_4}$ only

D $\mathbf{V_2}$ only (2)

1.10 The graph below was obtained from an experiment on the photoelectric effect.



Which ONE of the following represents the gradient of the graph?

A hc

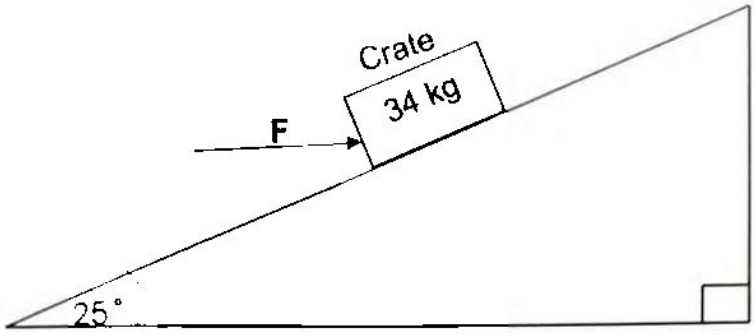
B h

C $\frac{E_{k(max)}}{\lambda}$

D W_0 (2)
[20]

QUESTION 2: (Start on a new page)

2.1 A crate, mass 34 kg, is pushed up a ramp (which is inclined at 25° to the horizontal) with a horizontal force **F** as shown in the diagram below.



The coefficient of kinetic friction between the crate and the surface is 0,25.

2.1.1 Suggest a reason as to why the coefficient of kinetic friction is dimensionless (has no unit). (1)

The crate moves up the ramp at CONSTANT VELOCITY.

2.1.2 State Newtons First Law of motion, in words. (2)

2.1.3 Draw a free-body diagram for the crate. (4)

2.1.4 Using an appropriate calculation, show that the kinetic frictional force acting on the crate can be given by **75,495 + 0,106F**. (3)

2.1.5 Hence, or otherwise, calculate the magnitude of force **F**. (3)

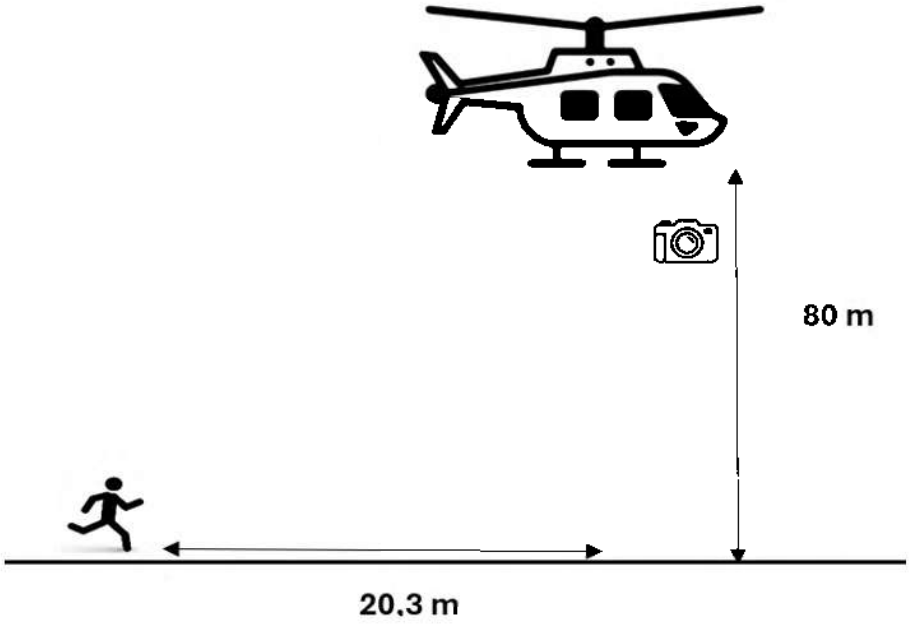
2.2 The mass of Earth is $5{,}98 \times 10^{24}$ kg and the radius of Earth is $6{,}38 \times 10^{6}$ m. A small satellite which is 1 000 km above the surface of Earth is accelerating towards Earth. Assume the only force acting on the satellite is the gravitational force of Earth. If the weight of the satellite is 3 660 N at that point, calculate the weight of the satellite on the surface of Earth. (4)

[17]

Copyright reserved

QUESTION 3: (Start on a new page)

A helicopter, with a group of tourists, takes off vertically upwards at a constant velocity of 8 $m \cdot s^{-1}$. After reaching a height of 80 m above the ground, a tourist accidently drops his camera.



3.1 Define the term *projectile*. (2)

3.2 Calculate the maximum height reached by the camera above the ground after it is dropped. (4)

3.3 Calculate the total time taken for the camera to reach the ground after it is released. (4)

3.4 A friend of the tourist who is standing 20,3 m away from where the helicopter has taken off, wants to try and catch the camera. He starts running from rest towards the landing point. Calculate the magnitude of the minimum acceleration the friend must maintain in order to reach the landing point just as the camera reaches the ground. (3)

3.5 On the same system of axes, draw a velocity versus time graph for the helicopter and the camera, from the moment the camera is dropped from the helicopter until it lands on the ground. **Clearly label the graphs as helicopter and camera**. Indicate the following on the graph:

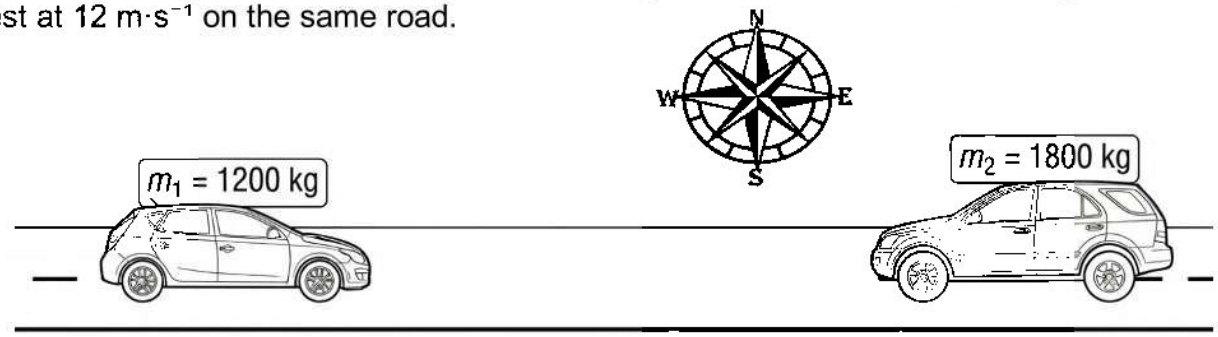
- Initial velocity of helicopter and camera
- Time when the camera lands on the ground. (3)

[16]

Copyright reserved

QUESTION 4: (Start on a new page)

A 1 200 kg car travels east at 24 m·s^{-1} on a straight horizontal road. A 1 800 kg car travels west at 12 m·s^{-1} on the same road.



The two vehicles collide head-on and lock together immediately after the collision. Ignore the effects of friction.

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

4.2 Calculate the velocity of the combined vehicles immediately after the collision. (4)

4.3 During the collision, the impact lasts one quarter of a second.
Calculate the magnitude of the average force exerted by car m_2 on car m_1.
(Use east as the positive direction.) (4)

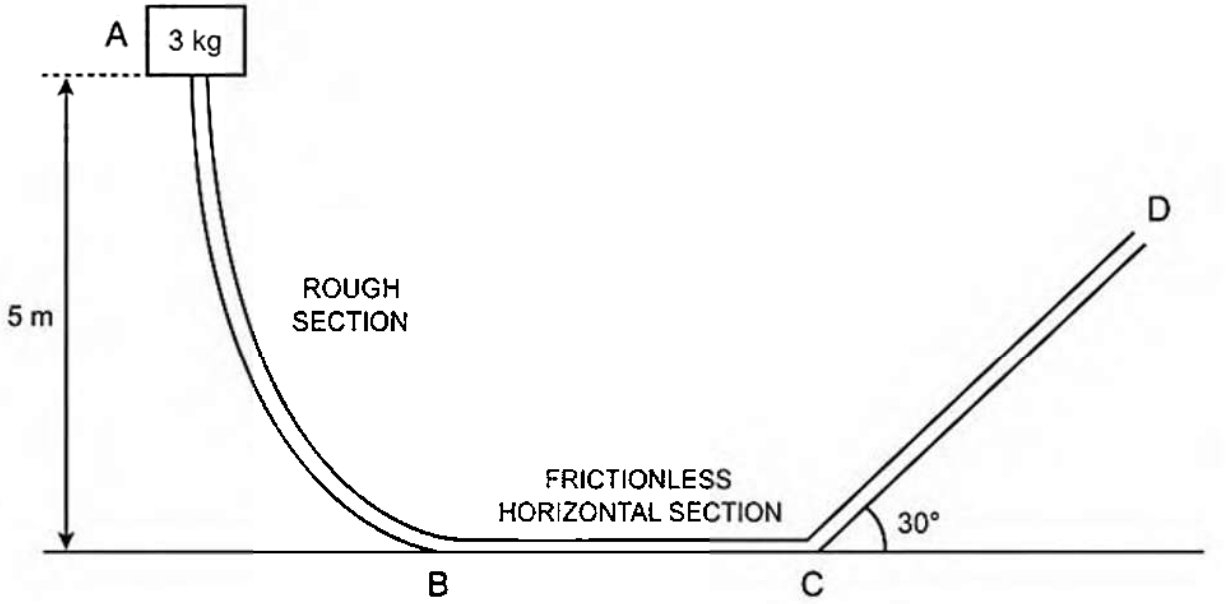
4.4 The magnitude of the force exerted by car m_2 on car m_1 is **F**.
Will the magnitude of the force exerted by car m_1 on car m_2 be GREATER THAN **F**, LESS THAN **F** or EQUAL TO **F**? (1)

4.5 Name the Physics law that explains the answer to QUESTION 4.4. (1)
[12]

Copyright reserved

QUESTION 5: (Start on a new page)

A block of mass 3 kg is released from rest at point **A**, which is at a vertical height of 5 m above the ground. The block can either fall vertically downwards directly to the ground, or slide down a curved track **AB**. The curved track **AB** has a rough surface.



The block slides down the curved track and reaches point **B** at the bottom with a speed of 7 $m \cdot s^{-1}$. It then moves along a frictionless horizontal surface **BC** and proceeds up a frictionless inclined plane **CD**, which makes an angle of 30° with the horizontal.

5.1 Define the term *conservative force*. (2)

5.2 Name the conservative force acting on the block as it moves from **A** to **B**. (1)

5.3 Calculate the work done by the gravitational force as the block slides along **AB**. (3)

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

5.5 Use energy principles to calculate the work done by friction on the block as it moves from **A** to **B**. (4)

5.6 The block continues to move past point **C** and up the frictionless incline **CD**. Calculate the maximum distance, ***d***, the block moves up the incline before coming to a momentary stop. (4)
[16]

Copyright reserved

QUESTION 6: (Start on a new page)

The diagram below shows a police car moving along a straight road where the speed limit is 80 km·h^{-1}. The siren of the police car emits sound waves of frequency 465 Hz, while the wavelength of the sound waves detected by a nearby stationary observer is 0,68 m. The speed of sound in air is 340 m·s^{-1}.



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

6.2 The Doppler effect has various practical applications in different fields of life.
State ONE application of the Doppler effect in the field of transport. (1)

6.3 Calculate the frequency of the sound waves detected by the observer. (2)

6.4 Is the police car moving TOWARDS or AWAY FROM the observer?
Give a reason for the answer. (2)

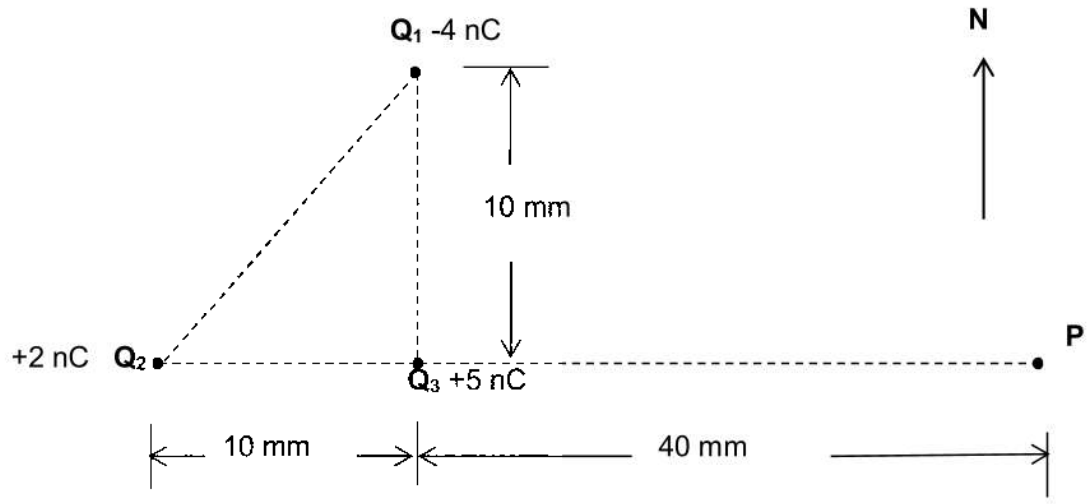
6.5 Calculate the speed at which the police car is moving and hence determine whether it was speeding or not? (6)

6.6 If the police car moves at a higher constant speed, how will this affect the frequency detected by the observer?
Write down INCREASE, DECREASE or REMAIN THE SAME. (1)
[14]

Copyright reserved

QUESTION 7: (Start on a new page)

Three point charges, Q_1, Q_2 and Q_3, carrying charges of -4 nC, +2 nC and +5 nC respectively are situated at distances apart as indicated in the diagram below. **P** is a point situated 40 mm to the right of Q_3. Q_1 is perpendicularly to the north of Q_3.



7.1 State *Coulomb's law* in words. (2)

7.2 Draw a free-body diagram of the electrostatic forces acting on charge Q_3 due to charges Q_1 and Q_2. (2)

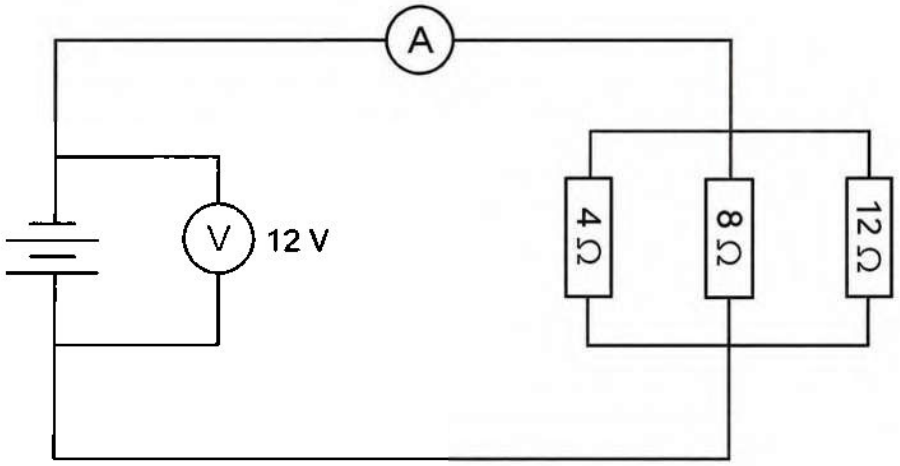
7.3 Calculate the magnitude of the resultant electrostatic force experienced by Q_3 due to the presence of Q_1 and Q_2. (5)

7.4 Charge Q_1 is now removed. Calculate the net electric field experienced at point **P**. (5)
[14]

Copyright reserved

QUESTION 8: (Start on a new page)

8.1 A circuit consists of a battery with an emf of 16,5 V and an unknown internal resistance. When current flows in the circuit, the reading on the voltmeter shows a potential difference of 12 V. The circuit is connected as shown below.



8.1.1 State *Ohm's law* in words. (2)

8.1.2 Calculate the total resistance of the parallel combination. (3)

8.1.3 Determine the internal resistance of the battery. (5)

8.2 An electric heater has a resistance of 55 Ω and is connected across a 220 V power supply.

8.2.1 Define the term *power*. (2)

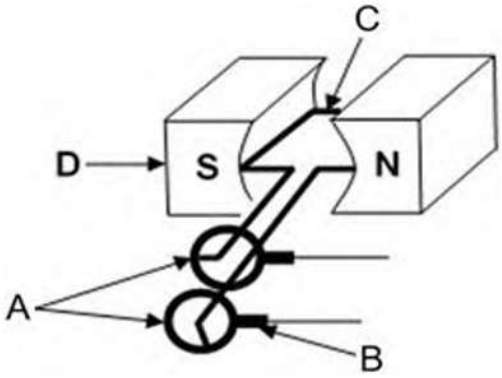
8.2.2 Calculate the power of this electric heater. (3)

8.2.3 Given that the price of electricity is R 1,24 per kWh. How long can you operate this heater for R 80 pre-paid electricity? (2)
[17]

Copyright reserved

QUESTION 9: (Start on a new page)

The simplified sketch represents an AC generator.The main components are labelled **A**, **B**, **C** and **D**.



9.1 Write down the name of component:

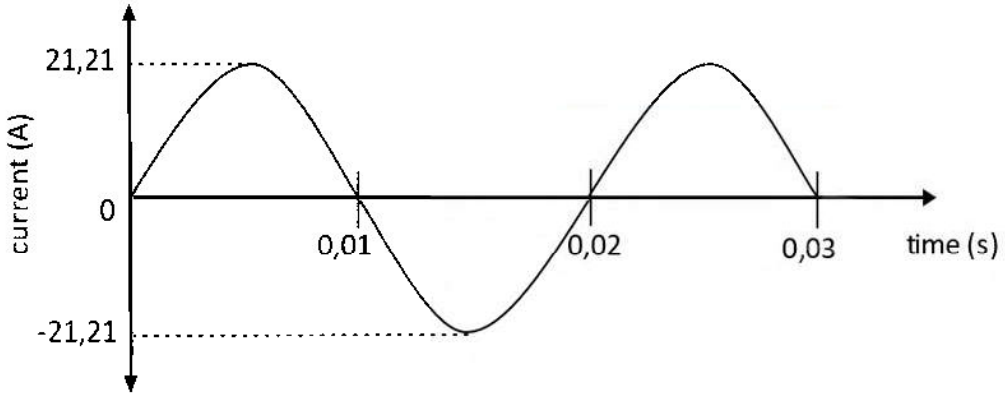
9.1.1 **A** (1)

9.1.2 **B** (1)

9.2 Write down the function of component **B**. (1)

9.3 State the energy conversion which takes place in an AC generator. (1)

A coil is rotated in a magnetic field .The graph below shows how the alternating current produced by the AC generator varies with time:



9.4 How many rotations are made by the coil in 0,03 seconds? (1)

9.5 Calculate the frequency of the alternating current. (3)

9.6 Will the plane of the coil be **PERPENDICULAR TO** or **PARALLEL TO** the magnetic field at t = 0,015 s? (1)

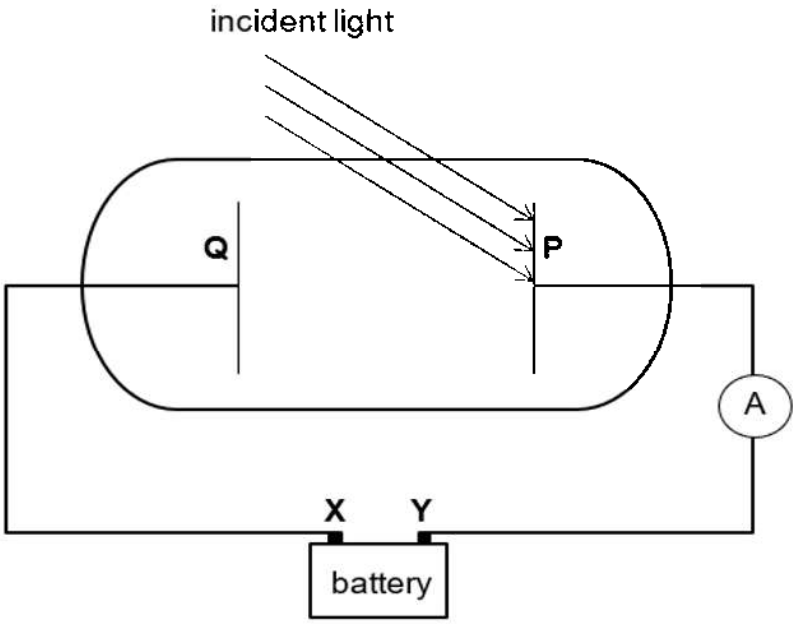
9.7 If the generator produces a maximum potential difference of 311 V, calculate its average power output. (5)

[14]

Copyright reserved

QUESTION 10: (Start on a new page)

A photocell is set up as shown to investigate the photoelectric effect.
Metal plates **P** (cathode) and **Q** (anode) are connected to the terminals of a battery. An ammeter is connected in series with the battery.



The cathode is made up of silver with a work function of $7{,}42 \times 10^{-19}$ J.

10.1 Define the term *photo-electric effect*. (2)

10.2 Light with a wavelength of 300 nm is incident on the cathode.
Will there be a reading on the ammeter? Explain your answer using calculations. (3)

10.3 A different wavelength of light is used. The energy of each photon is 9×10^{-19} J.

10.3.1 Calculate the maximum speed of a photoelectron ejected from the cathode. (4)

10.3.2 The **intensity** of light is now increased. How will this change the reading on the ammeter? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)
[10]

GRAND TOTAL: 150

Copyright reserved

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	SYMBOL	VALUE
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Mass of Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} J·s
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 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 $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

Copyright reserved

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_k N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ 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 $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ 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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave/gem} = Fv_{ave/gem}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

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

Copyright reserved

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

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

ALTERNATING CURRENT/WISSELSTROOM

$I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ $V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$	$P_{ave/gem} = V_{rms/wgk}I_{rms/wgk}$ $P_{ave/gem} = I^2_{rms/wgk}R$ $P_{ave/gem} = \frac{V^2_{rms/wgk}}{R}$

Copyright reserved