KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL STANDARDISED ASSESSMENT

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2026

MARKS: 150

TIME: 3 Hours

This question paper consists of 17 pages and 3 data sheets.

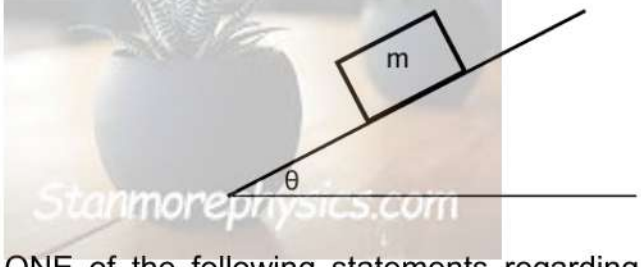
INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate spaces 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 between two sub-questions, for example, between QUESTION 2.1 and 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. Provide brief motivations, discussions, etc., where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. 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 A crate of mass m is STATIONARY on a plane inclined at an angle θ with the horizontal as shown in the diagram below.



Which ONE of the following statements regarding the magnitude of the Normal force acting on the crate is CORRECT?
The magnitude of the Normal force acting on the crate is …

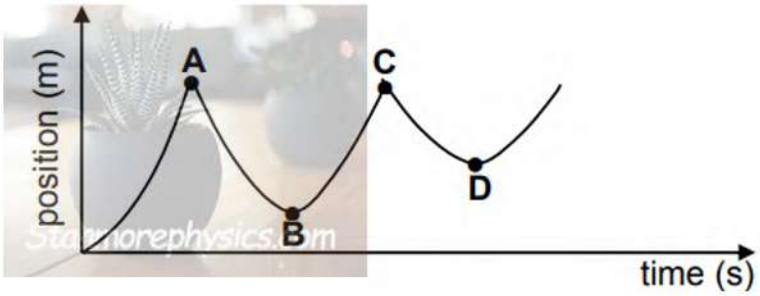
A equal to the component of the weight of the crate which is parallel to the plane. downloaded from Stanmorephysics
B equal to the component of the weight of the crate which is perpendicular to the plane.
C larger than the component of the weight of the crate which is parallel to the plane.
D larger than the component of the weight of the crate which is perpendicular to the plane. (2)

1.2 The acceleration due to gravity on Earth is **g**.
Which ONE of the following represents the acceleration due to gravity on a planet that has TWICE the mass and HALF the radius of the Earth?

A $8\mathbf{g}$
B $4\mathbf{g}$
C $2\mathbf{g}$
D $\frac{1}{2}\mathbf{g}$

(2)

1.3 A ball is released from rest from a certain height above the floor and bounces off the floor a number of times. The position-time graph below represents the motion of the bouncing ball from the instant it is released from rest. Air resistance is ignored.



Which point (**A**, **B**, **C**, or **D**) on the graph represents the position of the ball at the instant it strikes the ground for the second time?

A A

B B

C C

D D (2)

1.4 Two hard objects collide INELASTICALLY in an isolated system.
Which ONE of the following statements is CORRECT for this collision?

A Both total momentum and total kinetic energy are conserved.

B Neither total momentum nor total kinetic energy is conserved.

C Total momentum is not conserved, but total kinetic energy is conserved.

D Total momentum is conserved, but total kinetic energy is not conserved. (2)

1.5 The kinetic energy of an object of mass **m** moving at velocity **v** is $\mathbf{E_k}$.
What will the NET WORK done on the object be if its velocity changes from **v** to **3v**?

A $8\mathbf{E_k}$

B $4\mathbf{E_k}$

C $-4\mathbf{E_k}$

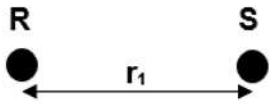
D $2\mathbf{E_k}$ (2)

1.6 An astronomer observes that the light spectrum of a star has been Red shifted. How have the observed frequency of light from the star and the distance between the star and Earth changed?

	OBSERVED FREQUENCY OF LIGHT	DISTANCE BETWEEN THE STAR AND THE EARTH
A	Increased	Increased
B	Decreased	Increased
C	Increased	Decreased
D	Decreased	Decreased

(2)

1.7 Two POSITIVE point charges **R** and **S**, with magnitudes Q_R and Q_S, respectively, are placed a distance $\mathbf{r_1}$ apart, as shown below.



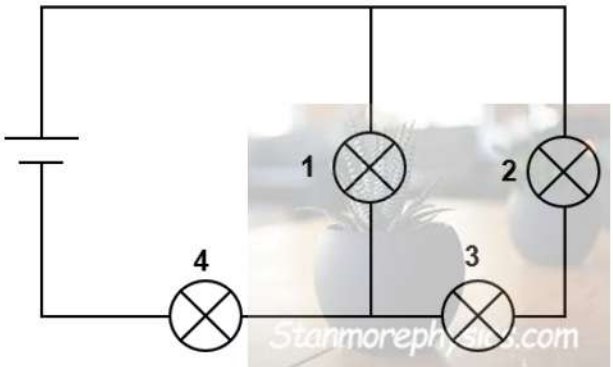
When a third point charge **T**, with magnitude Q_T, is placed at a distance $\mathbf{r_2}$ to the right of point charge **S**, the net force on point charge **S**, due to **R** and **T**, becomes zero. Distance r_1 is shorter than r_2.

Which ONE of the following combinations regarding the nature of point charge **T** and the magnitudes of charges Q_T versus Q_R is correct?

	Nature of charge T	Magnitudes of QT vs QR
A	Positive	$Q_T > Q_R$
B	Negative	$Q_T < Q_R$
C	Positive	$Q_T < Q_R$
D	Negative	$Q_T > Q_R$

(2)

1.8 The circuit diagram below shows four identical bulbs, **1**, **2**, **3**, and **4**, connected to a cell. The currents through bulbs 1, 2, 3, and 4 are I_1, I_2, I_3, and I_4, respectively.



Which ONE of the following expressions is correct for the current passing through light bulb **4**?

A $I_4 = I_2 + I_3$

B $I_4 = I_1 + I_2 + I_3$

C $I_4 = 2 \times I_3$

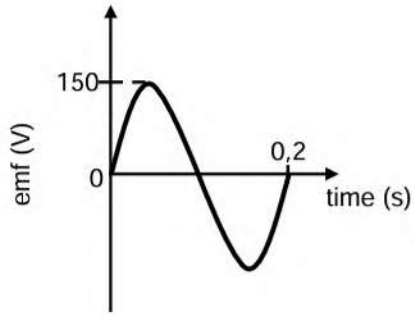
D $I_4 = 3 \times I_2$ (2)

1.9 An atom has a ground state energy of x. When the atom moves to a higher energy state y, a line spectrum is observed. downloaded from Stanmorephysics
Which ONE of the following combinations is CORRECT for the ENERGY CHANGE of the atom and the TYPE OF LINE SPECTRUM observed during the transition?

	ENERGY CHANGE	TYPE OF LINE SPECTRUM
A	x-y	Absorption
B	x-y	Emission
C	y-x	Absorption
D	y-x	Emission

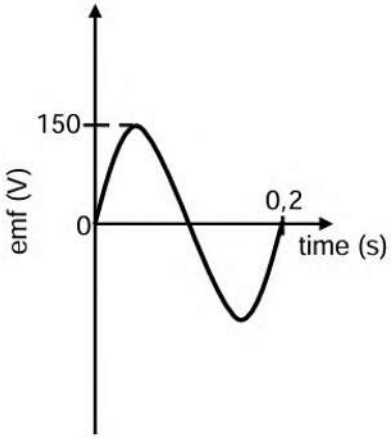
(2)

1.10 An AC generator consists of a coil which is rotated in a magnetic field. The emf time graph for one complete rotation of the coil is shown below.

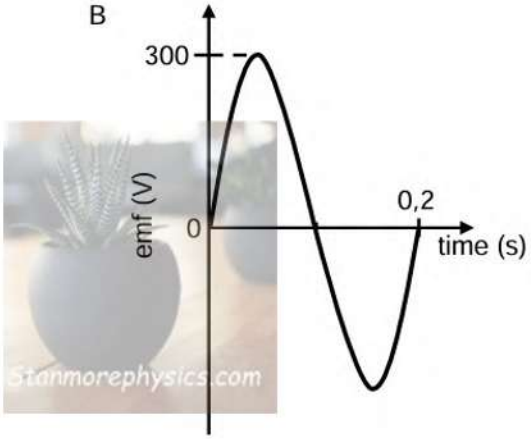


If the coil's rotational speed is now DOUBLED, which ONE of the following graphs is CORRECT for one complete rotation of the coil?

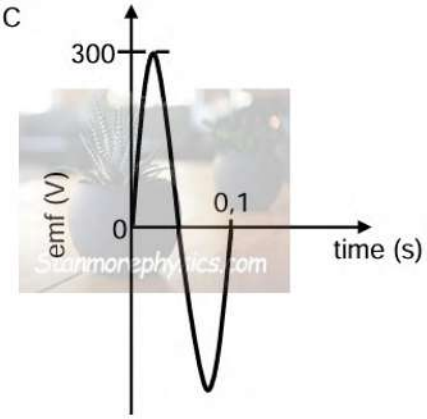
A



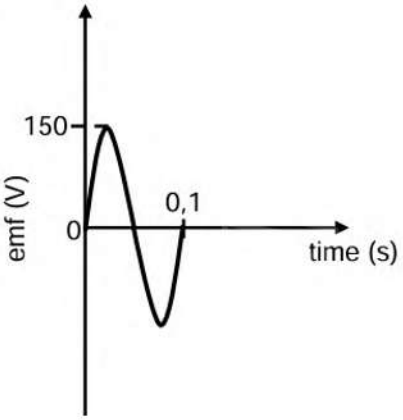
B



C



D

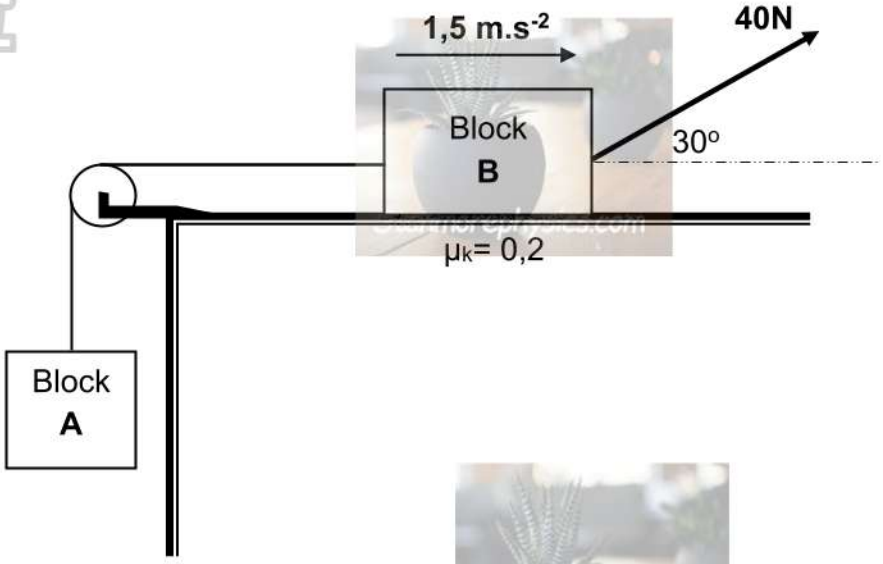


(2)

[20]

QUESTION 2 (Start on a new page).

The diagram below shows block **A**, of mass x, attached to block **B**, of mass $2x$, by a light, inextensible string that passes over a frictionless pulley. A constant force of 40 N, applied at an angle of 30° to the horizontal, accelerates block **B** to the right at 1.5 m s^{-2}.



The coefficient of kinetic friction between block **B** and the surface is 0,2.

2.1 Draw a free-body diagram of ALL THE NON-VERTICAL forces acting on block **B**. (3)

2.2 Prove by means of calculations that the magnitude of the kinetic friction between block **B** and the surface, in terms of x, is $(3{,}92x - 4)$ *Newtons*. (3)

2.3 State Newton's second law of motion in words. (2)

2.4 Apply Newton's second law of motion to each block separately to determine the mass of block **B**. downloaded from Stanmorephysics (6)

2.5 The angle between the applied force on block **B** and the horizontal is now decreased. How will this change affect the following?
Write down INCREASES, DECREASES, or REMAINS THE SAME.

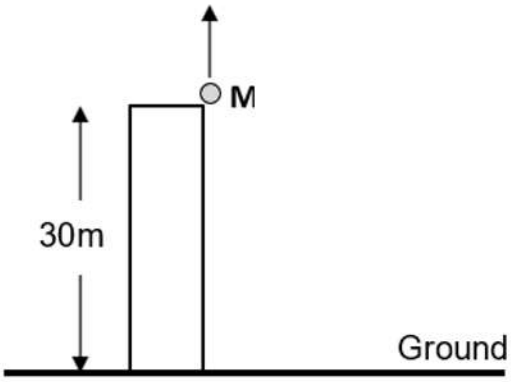
2.5.1 The coefficient of kinetic friction between block **B** and the surface. (1)

2.5.2 The normal force acting on block **B**. (1)

[16]

QUESTION 3 (Start on the new page).

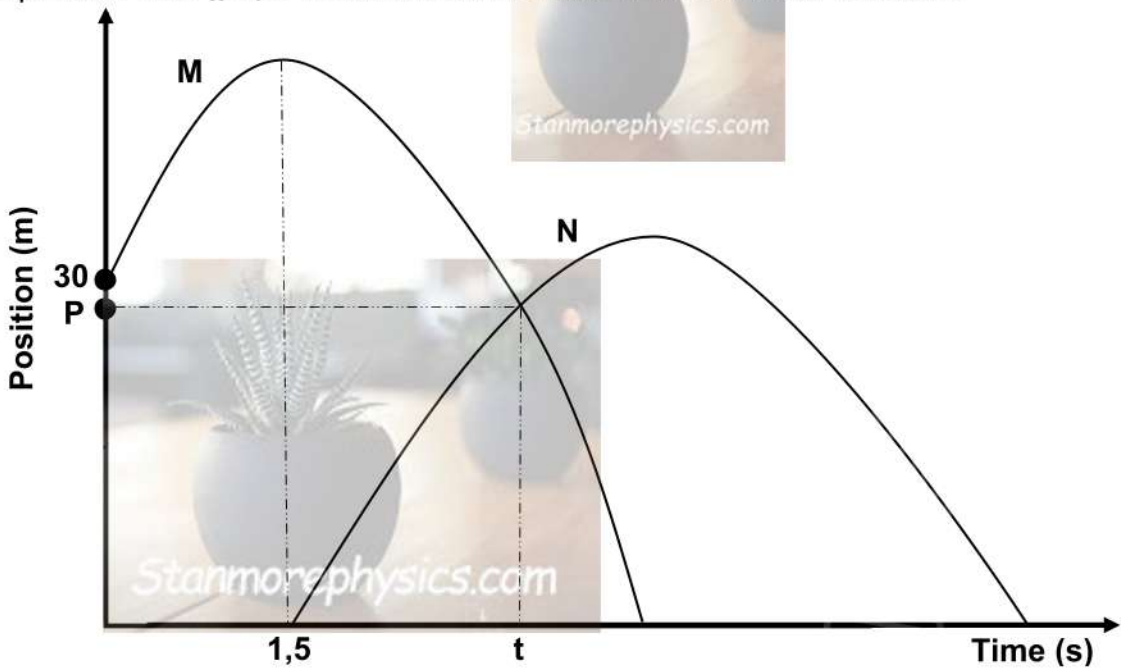
A ball, M, is thrown vertically upward from a 30 m tall building. The velocity of the ball decreases to zero after 1, 5 s from the time it was thrown. The ball falls to the ground below the throwing point.



3.1 Define the term *Projectile*. (2)

3.2 Calculate the velocity with which the ball was thrown from the top of the building. (3)

At the instant ball M reaches its maximum height, another ball, N, is thrown vertically upwards from the ground with a velocity of 25 $m.s^{-1}$.
The position-time graph below shows the motion of both balls M and N.



3.3 Calculate the time it will take ball N to reach the top of the building on its way up. (3)

3.4 Determine the value of **P**, shown on the graph above. (5)

3.5 On the same set of axes, draw the velocity-time graph of BOTH balls, M and N, from the time ball M was thrown to the time when the balls cross each other.

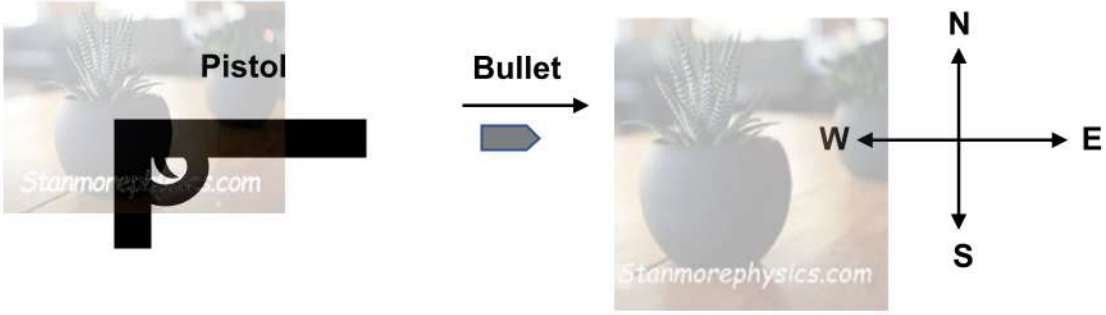
Indicate the following on the graph: (4)

- Initial velocities of both balls.
- Time **t**.

[17]

QUESTION 4 (Start on the new page).

During a controlled firearms-training exercise at a shooting range, a police officer uses a pistol of mass 0,80 kg. The pistol is loaded with THREE IDENTICAL bullets, each having a mass of 0,012 kg. The pistol is initially at rest. Ignore all external forces acting on the pistol-bullet system.



When the first bullet is fired eastwards, the pistol recoils westwards at a speed of 4,8 $m \cdot s^{-1}$.

4.1 Define *Impulse* in words. (2)

4.2 Calculate the magnitude of the impulse on the Pistol during the first shot. (3)

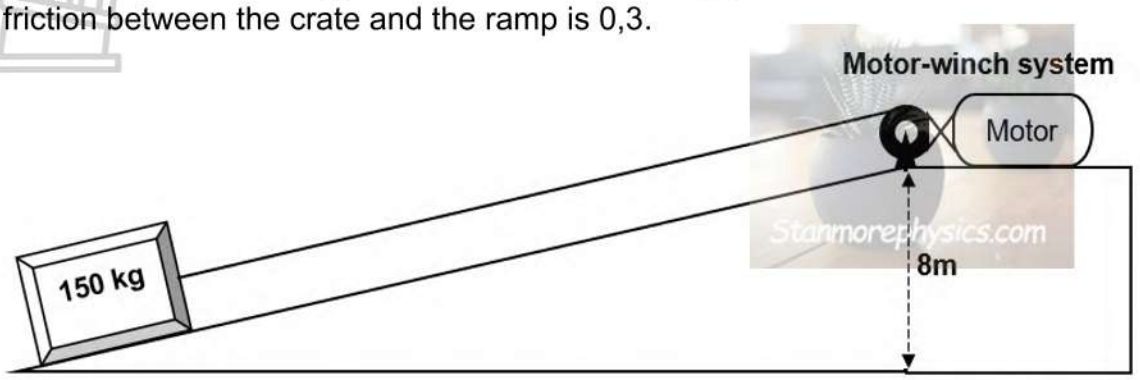
The officer fires all three bullets, one at a time. After each shot, the pistol is brought back to rest before the next bullet is fired. Assume that each bullet is fired from the pistol with the same velocity.downloaded from Stanmorephysics

4.3 Calculate the recoil velocity of the pistol when the third and last bullet is fired. (5)

[10]

QUESTION 5 (Start on the new page).

The diagram below shows a crate of mass 150 kg that is pulled up a straight ramp at a CONSTANT VELOCITY of 1.5 m·s^{-1} by an electric motor-winch system. The ramp has a vertical height of 8 m above its starting point. The coefficient of kinetic friction between the crate and the ramp is 0,3.



5.1 Define the term *work done*. (2)

5.2 Calculate the work done by the gravitational force on the crate. (3)

A group of Grade 12 learners has been tasked with selecting a suitable motor-winch system that will move the crate up the ramp in 12 seconds.
Two systems are available, with specifications as shown in the table below.

	Motor-winch system	
	A	**B**
Maximum power output	1,00 kW	1,60 kW

5.3 Calculate the work done by friction. (6)

5.4 Define the term Power in words. (2)

5.5 Which ONE of the motor-winch systems above will be suitable for this operation? Write down only **A** or **B**.
Show by means of calculations how you arrived at your choice. (5)

[18]

QUESTION 6 (Start on the new page).

The siren of a police car moving at a constant speed of 14,745 $m \cdot s^{-1}$ emits sound at a constant frequency of 750 Hz. A stationary observer detects a frequency that is 31 Hz LESS than the frequency emitted by the siren.

6.1 Define the *Doppler effect*. (2)

6.2 Is the police car moving TOWARD or AWAY from the observer?
Give a reason. (2)

6.3 Calculate the speed of sound in air. (5)

6.4 The speed of the police car increases. How will this increase affect the following?

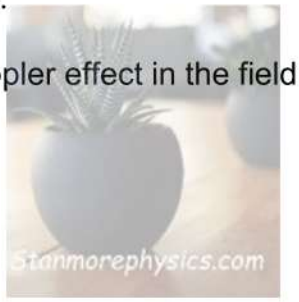
Write down only INCREASES, DECREASES, or REMAINS THE SAME.

6.4.1 The frequency detected by the observer. (1)

6.4.2 The speed of sound in air. (1)

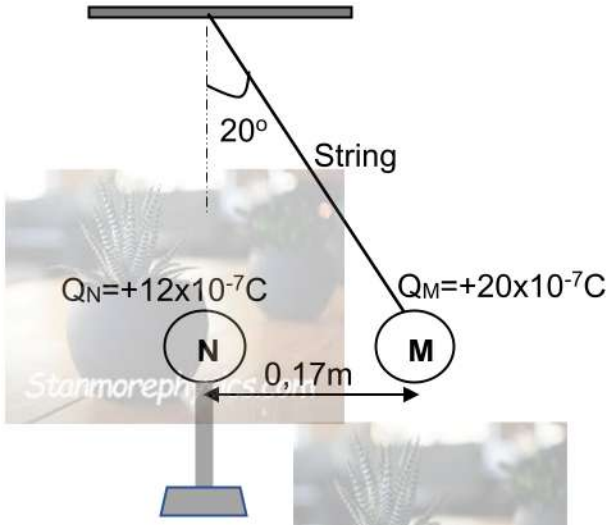
6.5 State ONE application of the Doppler effect in the field of medicine. (1)

[12]



QUESTION 7 (Start on the new page).

7.1 A sphere, **M**, carrying a charge of +20 x 10^{-7}C, is suspended at the end of a light inextensible string which is attached to a fixed point. Another sphere, **N**, carrying a charge of +12 x 10^{-7} C, on an insulated stand, is brought closer to sphere **M**. Sphere **M** experiences an electrostatic force and comes to rest when the string makes an angle of 20 ° with the vertical, as shown in the diagram below.



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

7.1.2 Draw a free-body diagram of all the forces acting on sphere **M**. (3)

7.1.3 Calculate the mass of sphere **M**. (5)

7.2 Two point charges, Q_1 and Q_2, are placed a distance **d** apart. Q_1 carries a charge of +20 nC, and Q_2 carries a charge of +5 nC. **T** is a point in space located 6 cm to the left of Q_2, as shown below.

The net electric field at point **T** due to Q_1 and Q_2 is zero.

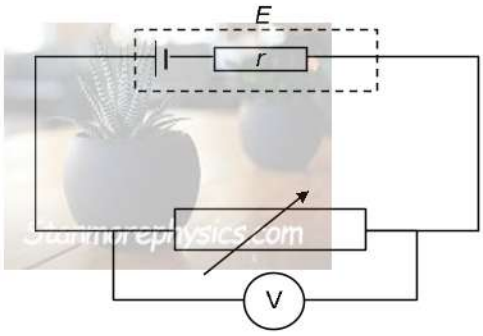
7.2.1 Define the term *Electric field*. (2)

7.2.2 Calculate the distance **d** between the charges Q_1 and Q_2. (4)

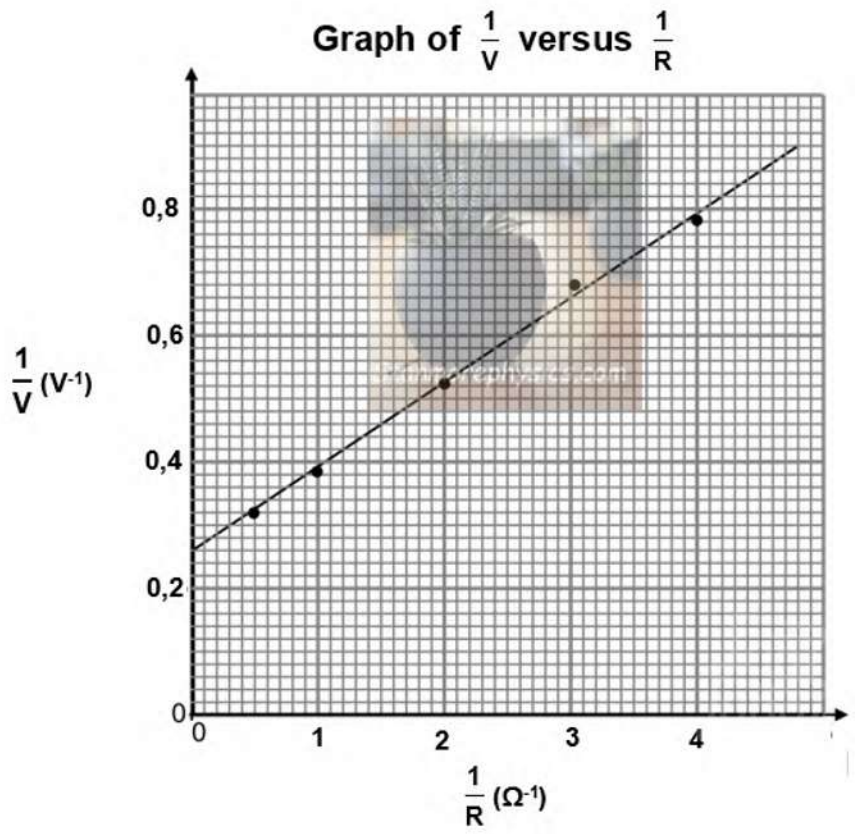
[16]

QUESTION 8 (Start on the new page).

8.1 The circuit below is used to determine a cell's internal resistance. A variable resistor is connected to a cell with emf E and unknown internal resistance r. A voltmeter is connected across the variable resistor, which can be set to multiple known values of **R**.



The graph below is obtained from the recorded values:

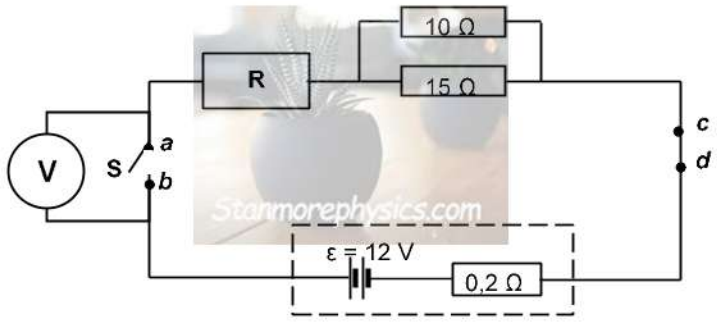


8.1.1 Define the term *emf*. (2)

8.1.2 What does the y-intercept of the graph above represent? Explain your answer by writing the equation of the graph in the form **y = mx + c**. (3)

8.1.3 Calculate the internal resistance of the cell. (4)

8.2 In the circuit below, the battery has an emf (ε) of 12 V and an internal resistance of 0,2 Ω. The connecting wires have negligible resistance.



Write down the reading on the voltmeter V when:

8.2.1 Switch **S** is open. (1)

8.2.2 Switch **S** is closed. (1)

When switch **S** is closed, a current of 0,72 A passes through the 10Ω resistor.

8.2.3 Calculate the resistance of resistor **R**. (6)

The 10Ω resistor is now REPLACED by a 15Ω resistor.
How will this change affect the following?

Write down only INCREASES, DECREASES or NO EFFECT.

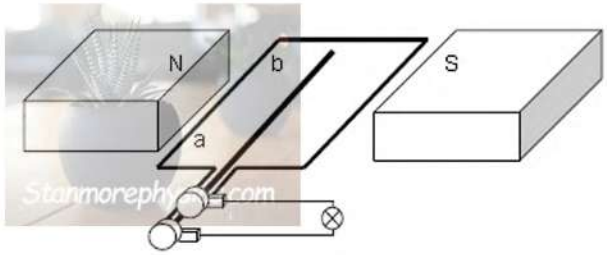
8.2.4 Emf of the battery. (1)

8.2.5 Potential difference across resistor **R**. (2)

[20]

QUESTION 9 (Start on the new page).

A simplified diagram of an AC generator is shown below. The current in the coil flows from b to a.



9.1 State the energy conversion taking place in this machine. (1)

9.2 In which direction is the coil being rotated?
Write only CLOCKWISE or ANTICLOCKWISE. (1)

9.3 Apart from using a stronger magnet and more conductors in the coil, state ONE practical way to make the light bulb burn brighter. (1)

9.4 Explain your answer in 9.3 by referring to the principle of Electromagnetic induction. (2)

9.5 Eskom supplies electricity to homes with a maximum voltage of 311,127 V.
A hair dryer dissipates 1200 W of power when plugged in at home.

9.5.1 What does the abbreviation ***rms*** stand for? (1)

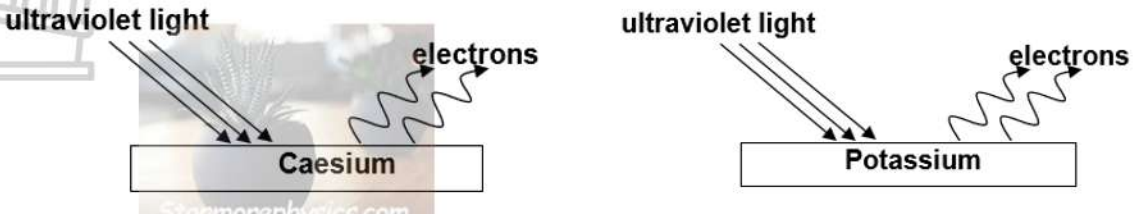
9.5.2 Calculate the resistance of the hair-dryer. (4)

9.5.3 How will the hair-dryer's resistance be affected if it is connected to another AC source with a maximum voltage of 270 V?
Write INCREASES, DECREASES, or REMAINS THE SAME. (1)

[11]

QUESTION 10 (Start on the new page).

During a Photoelectric effect investigation, Ultraviolet light is shone onto TWO different metals, Caesium and Potassium. The minimum frequency required to emit electrons from the surface of Cesium is 5,07 x 10^{14} Hz, and that of Potassium is 5,55 x 10^{14} Hz.



10.1 Write down ONE word or term for the underlined sentence. (1)

During this investigation, it is found that the maximum kinetic energy of electrons emitted from potassium is 83% of that of Caesium.

10.2 Which metal, CAESIUM or POTASSIUM, has a higher work function? (1)

10.3 Calculate the frequency of the ultraviolet light. (6)

10.4 The intensity of the ultraviolet light is now increased. How will this change affect the following? Write down only INCREASES, DECREASES or REMAINS THE SAME.

10.4.1 The speed of the emitted electrons. (1)

10.4.2 The number of emitted electrons. (1)

[10]

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·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*

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

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

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

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 (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*

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

FINAL

KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

PROVINCIAL STANDARDISED ASSESSMENT

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

MARKING GUIDELINES

SEPTEMBER 2026

Marks: 150

Duration: 3 hours

This marking guidelines consists of 10 pages.

QUESTION 1

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

[20]

QUESTION 2

2.1

(3)

NB: Any force including vertical forces deduct one mark

2.2 $f_k = \mu_k N$ ✓
$f_k = \mu_k(mg - F\sin\theta)$

$= \underline{0,2\ (2x \times 9,8)}$ ✓ $\underline{- 0,2\ (40 \sin 30°)}]$ ✓
$= 3,92x - 4$ N

(3)

2.3 When a net force acts on an object, the object will accelerate in the direction of the net force, and the acceleration is directly proportional to the force ✓ and inversely proportional to the mass ✓ of the object. (2)
NB: If any of the underlined words or phrases are missing deduct 1 mark.

2.4

Block A	**Block B**
$F_{net} = ma$ ✓	$F_{net} = ma$
$T - Fg = ma$	$F\cos\theta - T - f_k = ma$
$\underline{T - 9,8x}$ ✓ $= \underline{1,5x}$	$\underline{40\cos 30° - T - (3,92x - 4)}$ ✓ $= \underline{3x}$

$x = 2,12$ kg
mass of block B = 2,12 x 2 ✓ = 4,24 kg ✓ ✓ (6)

2.5.1 Remains the same. ✓ (1)

2.5.2 Increases. ✓ (1)

[16]

QUESTION 3

3.1 An object that has been given an initial velocity and then moves under the influence of the gravitational force only. ✓✓

(2 or 0)

3.2

Upward as positive	**Downward as positive**
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = vi + (-9,8).\ 1,5$ ✓	$0 = vi + (9,8).\ 1,5$ ✓
$v_i = 14,7\ m.s^{-1}$	$v_i = -14,7\ m.s^{-1}$
Therefore the initial velocity is	Therefore the initial velocity is
$14,7\ m.s^{-1}$ upwards✓	$14,7\ m.s^{-1}$ upwards✓

(3)

3.3 **OPTION 1**

Upward as positive	Downward as positive
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$30 = 25\Delta t + \frac{1}{2}(-9.8)\Delta t^2$ ✓	$-30 = -25\Delta t + \frac{1}{2}(9.8)\Delta t^2$ ✓
$\Delta t = 1,93$ s ✓	$\Delta t = 1,93$ s ✓

OPTION 2

Upward as positive	Downward as positive
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = 25^2 + 2(-9,8)(30)$	$v_f^2 = (-25)^2 + 2(9,8)(-30)$
$v_f = 6,08\ m \cdot s^{-1}$	$v_f = 6,08\ m \cdot s^{-1}$
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
$6,08 = 25 + (-9,8)\ \Delta t$ ✓	$-6,08 = -25 + (9,8)\ \Delta t$ ✓
$\Delta t = 1,93$ s✓	$\Delta t = 1,93$ s✓

(3)

3.4 **POSITIVE MARKING FROM 3.2**

Ball M

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

$-(30 - P) = 14,7\ t + \frac{1}{2}(-9.8)t^2$ ✓

Equating equations 1 and 2 ✓

$P = 27,86$ m ✓

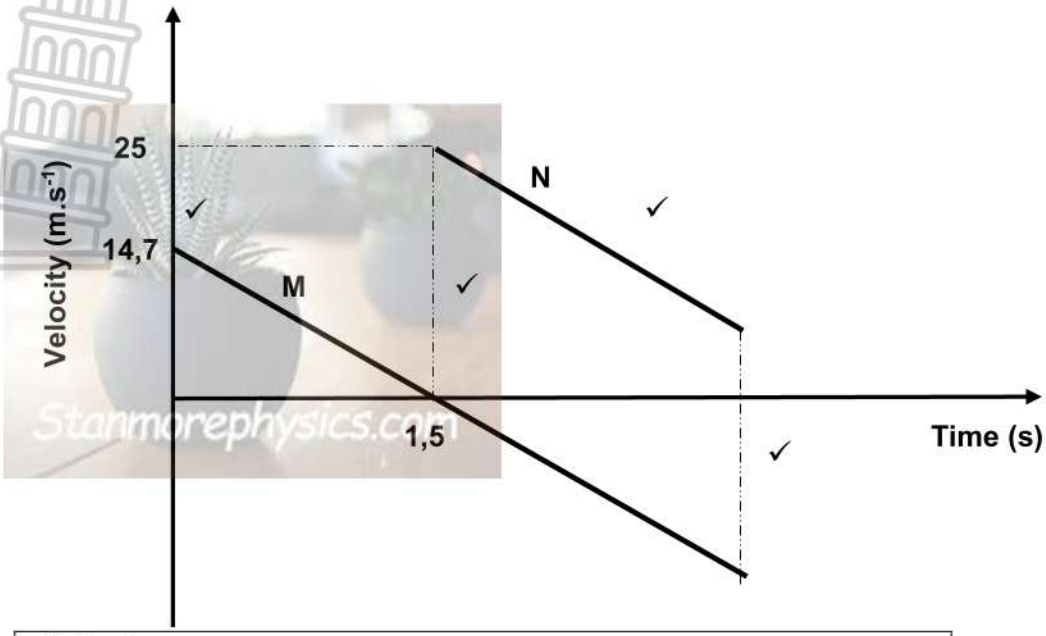
Ball N

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

$P = 25\ (t - 1,5) + \frac{1}{2}(-9.8)(t - 1,5)^2$ ✓

(5)

3.5 **POSITIVE MARKING FROM 3.2**



(4)

Criteria	
Both initial velocities of M and N on y-axis.	✓
Graph of N starts at time 1,5 s.	✓
Graphs are parallel to each other.	✓
Both graphs end at same time, with graph of N above the x-axis and M below the x-axis.	✓

[17]

QUESTION 4

4.1 The product of the net force acting on an object and the time the net force acts on the object. ✓✓ (2 or 0)

(2)

4.2 (Combined mass of pistol and two bullets = 0,8 + 2(0,012) = 0,824kg)

Choosing West as Positive

Impulse = m (v_f – v_i) ✓

= 0, 824 (4,8 – 0) ✓

= 3,96 N.s ✓

(3)

4.3 $\sum p_{before} = \sum p_{after}$

$v_i(m_p + m_b) = m_p v_{pf} + m_b v_{bf}$ ✓

Bullets velocity v_b.

$\underline{0 = [(0,8 + 0,024) \times (-4,8)] + (0,012.v_b)}$ ✓

$V_b = 329,6\ m.s^{-1}$, East.

Recoil velocity after the last bullet is shot.

$v_i(m_p + m_b) = m_p v_{pf} + m_b v_{bf}$

$0 = \underline{0,8\ v_p}$ ✓ $+ \underline{(0,012 \times 329,6)}$ ✓

$v_p = -4,94\ m.s^{-1}$

Therefore $v_p = \underline{4,94\ m.s^{-1}, \text{West}}$ ✓

(5)
[10]

QUESTION 5

5.1 Work done is W = FΔxcos θ, where F is the magnitude of the force, Δx is the magnitude of the displacement, and ~~Θ~~ the angle between the force and the displacement. ✓✓

or

The product of the force and the displacement of the object in the direction of the displacement. ✓✓ (2 or 0) (2)

5.2 $W_{Fg} = mghcos\theta$ ✓

$= 150 \times 9,8 \times 8 \times \cos 180^o$ ✓

$= -11760\ J$ ✓ (3)

5.3 $\Delta x = v.\Delta t = 1,5 \times 12$ ✓ $= 18m$

$\sin\theta = \frac{8}{18}$ ✓; therefore $\theta = 26,39^o$

$W_{fk} = f_k \Delta x cos\theta$

$= (\mu mg cos\theta)\Delta x cos\ \theta$ ✓

$= [\underline{0,3\ (150 \times 9,8 \times cos26,39^o)}$ ✓ $\times 18x\ cos180^o]$ ✓

$W_{fk} = -7110,78\ J.$ ✓ (6)

5.4 The rate at which work is done. ✓✓(2 or 0) (2)

5.5 $W_{net} = W_T + W_N + W_{Fg} + W_{fk}$

$0 = W_T + 0 + (-11760) + (-7110,78)$ ✓

$W_T = 18870,78$ J

$P = \frac{W}{\Delta t}$ ✓ $= \frac{18870,78}{12}$ ✓ $= 1572,57$W ✓

Therefore, Motor-winch **B.** ✓ (5)

[18]

QUESTION 6

6.1 The change in frequency of the sound detected by a listener, because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓
Or
An (apparent) change in observed/detected frequency/pitch as a result of the relative motion between a source and an observer/listener. ✓✓ (2)
NB: If any of the underlined words or phrases are missing deduct 1 mark downloaded from Stanmorephysics.

6.2 Away. ✓
The detected frequency is lower than the emitted sound frequency. ✓ (2)

6.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

719 ✓$= \left(\frac{V}{V + 14,745}\right)$ ✓ 750 ✓

$v = 341,99$ m.s^{-1} ✓ (5)

6.4.1 Decreases. ✓ (1)

6.4.2 Remains the same. ✓ (1)

6.5 Ultrasound scanning✓/ Doppler flowmeter. (any other correct answer) (1)

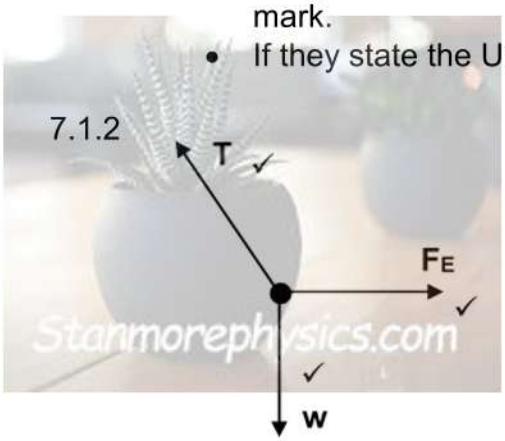
[12]

QUESTION 7

7.1.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. ✓✓ (2)

NB:
- If any of the underlined words or phrases are missing deduct 1 mark.
- If they state the Universal Law of gravitation = 0/2

7.1.2



(3)

7.1.3

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

$$F = \frac{9\times10^{9} \times 12\times10^{-7} \times 20 \times 10^{-7}}{(0,17)^2} \checkmark$$

$$F = 0,7474 \text{ N}$$

$$\frac{mg}{\sin 70^o} = \frac{0,7474}{\sin 20^o} \checkmark$$

m x 9,8 = 2,053 ✓

m = 0, 21 kg. ✓

$$\tan 70^0 = \frac{mg}{0,7474} \checkmark$$

0,7474 $\tan 70^0$ = m x 9,8✓

m = 0,21 kg✓

(5)

7.2.1 Region in space where an electric charge can experience a force. ✓✓(2 or 0) downloaded from Stanmorephysics (2)

NB: If they define **electric field at point** award full marks.

7.2.2 $E = \frac{kQ}{r^2}$ ✓

$$\frac{9\times10^{9}\times20\times10^{-9}}{(d - 0,06)^2} \checkmark = \frac{9\times10^{9}\times5\times10^{-9}}{(0,06)^2} \checkmark$$

= 0,18 m ✓

(4)

[16]

QUESTION 8

8.1.1 The maximum energy provided by a battery per unit charge passing through it. ✓✓ (2 or 0) (2)

8.1.2 Inverse of emf ✓ (Reciprocal of emf)

Equation in the form y=mx + c

$\frac{1}{V} = \frac{r}{\varepsilon R} + \frac{1}{\varepsilon}$ ✓✓ (3)

8.1.3 y-intercept from the graph = 0,26

$\frac{1}{\varepsilon} r = m$

$0,26 \checkmark r = \frac{0,78 - 0,38 \checkmark}{3,9 - 0,9 \checkmark}$

r = 0,51 Ω ✓ (4)

8.2.1 12V ✓ (1)

8.2.2 0 V (Zero) ✓ (1)

8.2.3 $V_{10} = IR = 0,72 \times 10 \checkmark = 7,2V$

$I_{15} = \frac{V}{R} = \frac{7,2}{15} \checkmark = 0,48$ A

✓

$I_T = I_{10} + I_{15} = 0,72 + 0,48 = 1,2$ A

$\varepsilon = I(R + r)$

$\varepsilon = IR + Ir + V_{//}$ ✓

$\underline{12 = 1,2R + 1,2x0,2 + 7,2}$ ✓

R = 3,80 Ω ✓ (6)

8.2.4 No effect. ✓ (1)

8.2.5 Decreases. ✓✓ (2)

[20]

QUESTION 9

9.1 Mechanical to electrical energy. ✓ (1)

9.2 Anticlockwise. ✓ (1)

9.3 Increase the rotational speed. ✓ (1)

9.4 Increasing the rotational speed increases the rate of change of the magnetic flux. ✓
The induced emf is directly proportional to the rate of change of the magnetic flux. ✓ (or $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$) (2)

9.5.1 Root mean square. ✓ (1)

9.5.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{311,127}{\sqrt{2}}$ ✓ = 220V

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$1200 = \frac{220^2}{R}$ ✓

R = 40,33 Ω ✓ (4)

9.5.3 Remains the same ✓ (1)

[11]

QUESTION 10

10.1 Threshold/ Cut-off frequency. ✓ (1)

10.2 Potassium. ✓ (1)

10.3 **Caesium**

$E = W_o + E_{kmax}$ ✓ Any

$hf = hf_o + E_{kmax}$

$\underline{6,63x10^{-34}.\ f = 6,63x10^{-34} \times 5,07 \times 10^{14} + E_{kmax}}$ ✓… eqn 1

Potassium

$hf = hfo + E_{kmax}$

$\underline{6,63x10^{-34}.\ f = 6,63x10^{-34} \times 5,55 \times 10^{14} + 0,83E_{kmax}}$ ✓… eqn 2

Equate eqn 1 and 2:

✓

$6,63x10^{-34} \times 5,07 \times 10^{14} + E_{kmax} = 6,63x10^{-34} \times 5,55 \times 10^{14} + 0,83E_{kmax}$

$E_{kmax} = 1,872 \times 10^{-19}J$

E_{kmax} value in eqn 1

$\underline{6,63x10^{-34}.\ f = 6,63x10^{-34} \times 5,07 \times 10^{14} + 1,872 \times 10^{-19}}$ ✓

$f = 7,89 \times 10^{14}$ Hz ✓ (6)

10.4.1 Remains the same. ✓ (1)

10.4.2 Increases. ✓ (1)

[10]

TOTAL: [150]