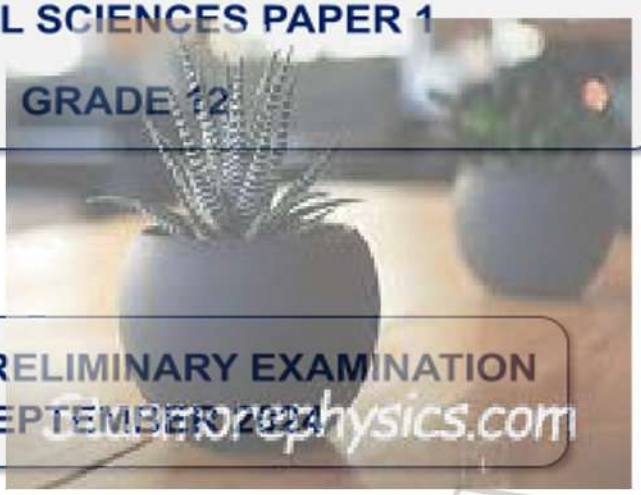
Western Cape Government
Education
FOR YOU

CAPE WINELANDS EDUCATION DISTRICT

PHYSICAL SCIENCES PAPER 1

GRADE 12



COMMON PRELIMINARY EXAMINATION
SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

This exam paper consists of 14 pages and 3 datasheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the space below and submit the question paper with your answer s

   NAME AND SURNAME: ……

   GRADE: ……

2. This question paper consists of **10 QUESTIONS**. Answer ALL the questions on your ANSWER SHEETS.
3. Start EACH question on a NEW page on your ANSWER SHEETS.
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. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief (concise) motivations, discussions etc. where required.
12. Write neatly and legibly.

QUESTION 1 (MULTIPLE-CHOICE)

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) on your ANSWER SHEETS.

1.1 The net force acting on an object is equal to the ...

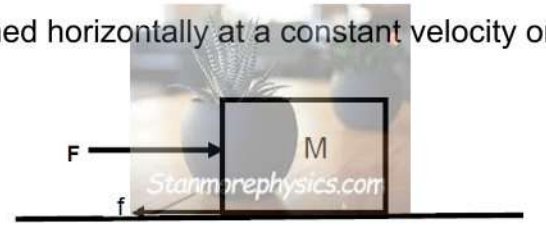
A mass of the object.

B acceleration of the object.

C change in momentum of the object.

D rate of change in momentum of the object. (2)

1.2 A box **M** is being pushed horizontally at a constant velocity on a rough surface by a force **F**.



If the force **F** acting on the box decreases, then the ...

A frictional force acting on the box decreases.

B acceleration of the box increases.

C velocity of the box decreases.

D normal force increases. (2)

1.3 A police car, with its siren on, is traveling at a constant speed TOWARDS a stationary sound detector. The siren emits sound waves of frequency f and speed v. Which ONE of the following combinations best describes the frequency and speed of the detected sound waves?

	FREQUENCY	SPEED
A	Less than f	v
B	Less than f	Less than v
C	Greater than f	Less than v
D	Greater than f	v

(2)

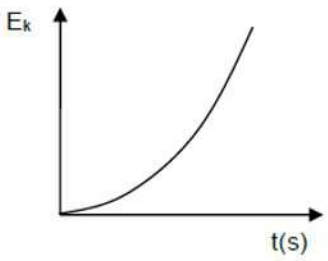
1.4 In which of the following rows does the type of collision match with total linear momentum and kinetic energy?

	TYPE OF COLLISION	TOTAL MOMENTUM	KINETIC ENERGY
A	Elastic	Conserved	Not conserved
B	Inelastic	Conserved	Not conserved
C	Inelastic	Not conserved	Conserved
D	Elastic	Not conserved	Conserved

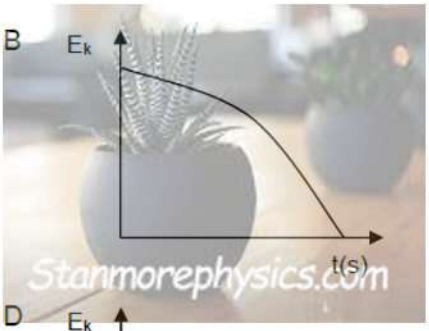
(2)

1.5 A stone is dropped from the edge of a cliff. Which ONE of the following graphs best represents the change in kinetic energy of the stone during its fall?

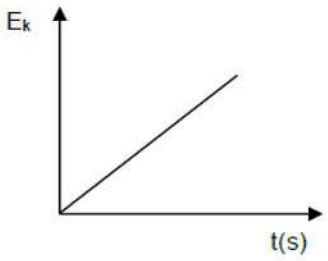
A



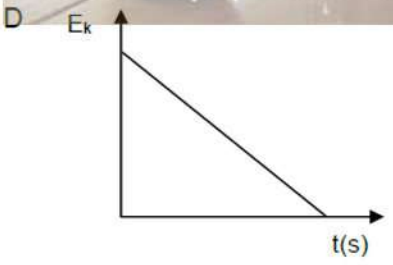
B



C



D



(2)

1.6 An object moves in a straight line on a ROUGH horizontal surface. If the net work done on the object is zero, then …

A the object has zero kinetic energy.

B the object moves at constant speed.

C the object moves at constant acceleration.

D there is no frictional force acting on the object. (2)

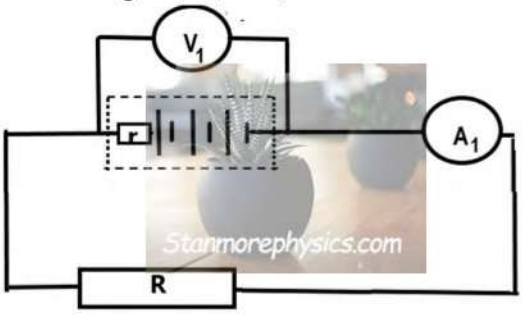
1.7 Two charges of + 2 nC and - 2 nC are located on a straight line. **S** and **T** are two points that lie on the same straight line as shown in the diagram below.

Which ONE of the following correctly represents the directions of the RESULTANT electric fields at **S** and at **T**?

	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT S	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT T
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

1.8 The circuit below is set up. The battery has an EMF of 9 V and an internal resistance of 0,2 Ω. The reading on A_1 is 1,8 A.



Which statement is CORRECT when a charge of 1 C flows in the circuit?

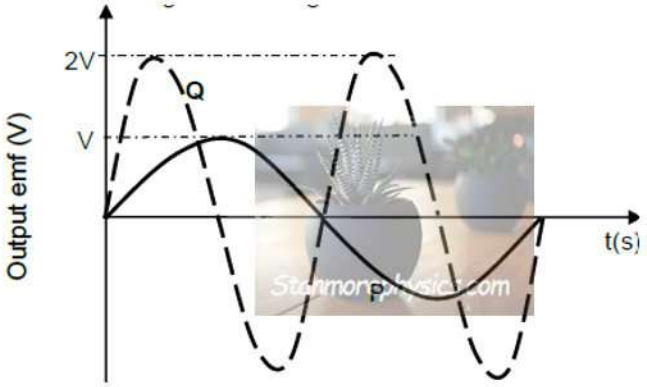
A 9 J of energy is dissipated in the resistor.

B 9 V is the potential difference across the resistor.

C 8,64 A is flowing in the circuit.

D 8,64 J of energy is dissipated in the resistor. (2)

1.9 Graph **P** represents the output emf of an AC generator. Graph **Q** is the output emf after a change has been made using the SAME generator.



Which ONE of the following changes has been made to the generator to produce graph **Q**?

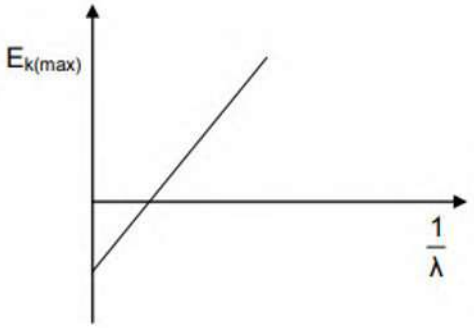
A The number of turns of the coil has been doubled.

B The surface area of the coil has been doubled.

C The speed of rotation has been doubled.

D The strength of the magnetic field has been doubled. (2)

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



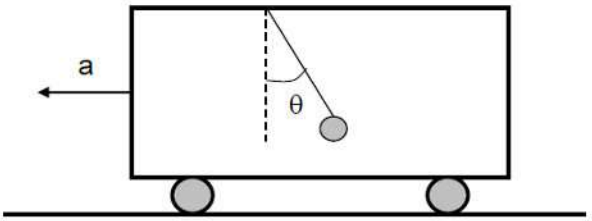
Which ONE of the following represents the gradient of the graph?

A hc B h C $Ek_{(max)}\lambda$ D W_0

[20]

QUESTION 2 (Start on a new page)

A group of learners design a device that consists of a light ball on a string hanging from the roof of a cargo truck. This device is used to determine the acceleration of the truck. When the truck is stationary or moving at a constant speed, the ball will hang straight down, but when it is undergoing a constant acceleration, the ball hangs down at an angle θ, as shown in the diagram below.



2.1 Draw a free body diagram of all the forces acting on the ball while in the position indicated in the sketch above. (2)

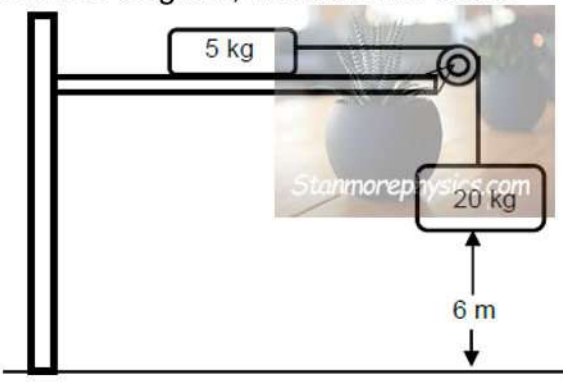
2.2 The mass of the ball is 50 g.

If the angle θ is 18°, calculate the:

2.2.1 Horizontal force on the ball. (4)

2.2.2 Magnitude of the acceleration of the truck. (3)

2.3 A 5 kg mass and a 20 kg mass are connected by a light inextensible string which passes over a light frictionless pulley. Initially, the 5 kg mass is held stationary on a horizontal surface, while the 20 kg mass hangs vertically downwards, 6 m above the ground, as shown in the diagram, not drawn to scale.



When the stationary 5 kg mass is released, the two masses begin to move. The coefficient of kinetic friction, μ_k, between the 5 kg mass and the horizontal surface is 0,4. Ignore the effects of air friction.

2.3.1 Calculate the acceleration of the 20 kg mass. (5)

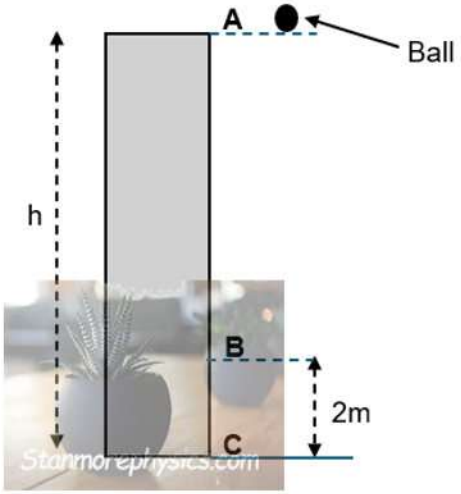
2.3.2 Calculate the speed of the 20 kg mass as it strikes the ground. (4)

[18]

QUESTION 3 (Start on a new page)

A group of learners set up an experiment to determine the height h of their school. They release a tennis ball from point **A** at the edge of the roof of the school building as shown in the diagram below. Point **B** is 2 m above the ground and the ball takes 0,125 s to cover the distance from point **B** to the ground (point **C**).

Ignore the effects of air friction.



3.1 Write down the magnitude of the rate of change of velocity of the ball. (1)

3.2 Calculate the:

3.2.1 Height, h, of the school building. (5)

3.2.2 Time it takes for the ball to reach the ground. (4)

3.2.3 Velocity with which the ball strikes the ground. (3)

3.3 Sketch a position versus time graph for the motion of the ball from the moment it was released until it strikes the ground. Use the ground as the zero-reference point.

Indicate the following on the graph:

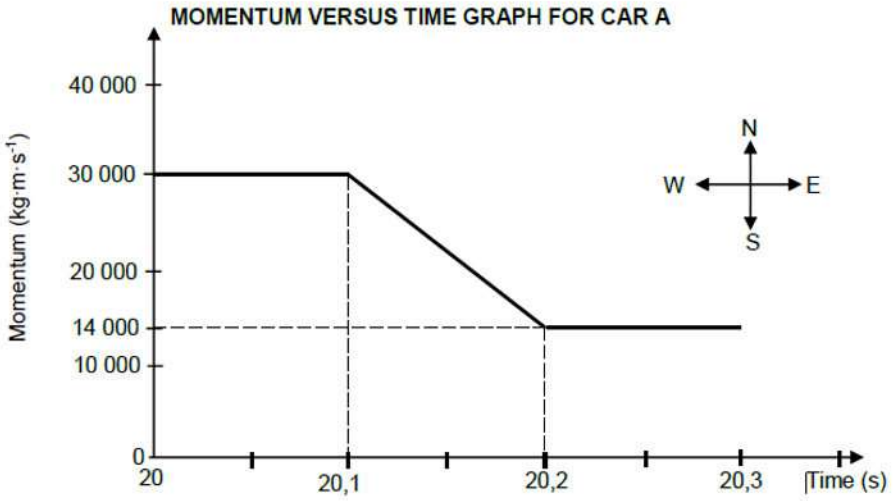
- The height from which the ball was released.
- Time when the ball strikes the ground. (3)

[16]

QUESTION 4 (Start on a new page)

The graph below shows how the momentum of car **A** changes with time just before and just after a head-on collision with car **B**. Car A has a mass of 1 500 kg, while the mass of car **B** is 900 kg. Car **B** was travelling at a constant velocity of 15 $m \cdot s^{-1}$ west before the collision.

Take east as positive and consider the system as isolated.



Use the information in the graph to answer the following questions.

Calculate the:

4.1 Magnitude of the velocity of car **A** just before the collision. (3)

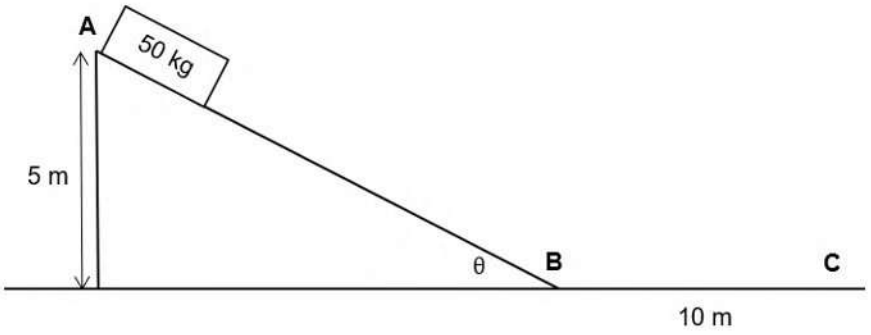
4.2 Velocity of car **B** just after the collision. (5)

4.3 Magnitude of the net average force acting on car **A** during the collision. (4)

[12]

QUESTION 5 (Start on a new page)

A crate of mass 50 kg is at rest at point **A** which is at a vertical height of 5 m above the horizontal surface. The inclined surface makes an angle θ with the horizontal, as shown in the diagram below. When the crate is released, it slides down the incline and reaches point B at the bottom of the incline with a speed of 8 $m \cdot s^{-1}$. The incline exerts a constant frictional force of 72 N on the crate while it slides from **A** to **B**.



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

5.2 Use energy principles to calculate the angle θ. (6)

After passing point **B**, the crate slides along a rough horizontal surface, coming to rest at point **C**, which is 10 m away from point **B**.

5.3 Draw a free body diagram of all forces acting on the crate while it slides from **B** to **C**. (3)

5.4 Calculate the work done by the frictional force to bring the crate to rest. (4)

[15]

QUESTION 6 (Start on a new page)

A police van with its siren on, travels at a constant speed between two observers, **A** and **B**. Observer A detects sound with a frequency of 545 Hz from the siren, while observer **B** detects a frequency of 615 Hz.

6.1 State the Doppler effect in words. (2)

6.2 In which direction is the police van moving?

Choose from TOWARDS OBSERVER **A** or TOWARDS OBSERVER **B**.

Give a reason for your answer. (2)

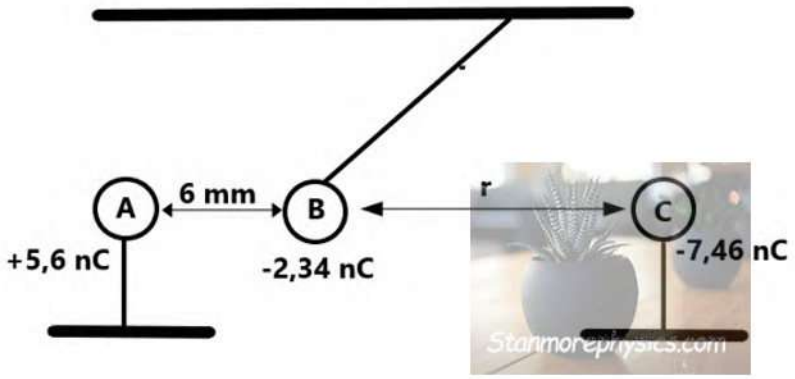
6.3 The speed of sound in air is 343 $m \cdot s^{-1}$. Calculate the frequency of the siren. (7)

6.4 Spectral lines of a certain gas observed from a distant star appear to be red shifted. Explain this observation by referring to the MOTION OF THE STAR and the FREQUENCY of the spectral lines. (2)

[13]

QUESTION 7 (Start on a new page)

A small polystyrene sphere, **B**, hangs from the ceiling and is attached by a string of negligible mass. Two other spheres, A and **C** are suspended on insulated stands. The charges on each sphere are **A** = +5,6 nC, **B** = - 2,34 nC and **C** = -7,46 nC. Assume that the surfaces of all the three spheres are conducting.



7.1 Define electrical field strength at a point. (2)

7.2 Sketch the electric field pattern around spheres **B** and C if **A** was removed. (3)

7.3 Charge **B** experiences a net electrostatic force of 0,004078 N due to charges **A** and **C**. Find the distance, **r**, between charges **B** and **C**. (5)

7.4 Charges **A** and **B** are allowed to touch and then moved back to the original distance between them.

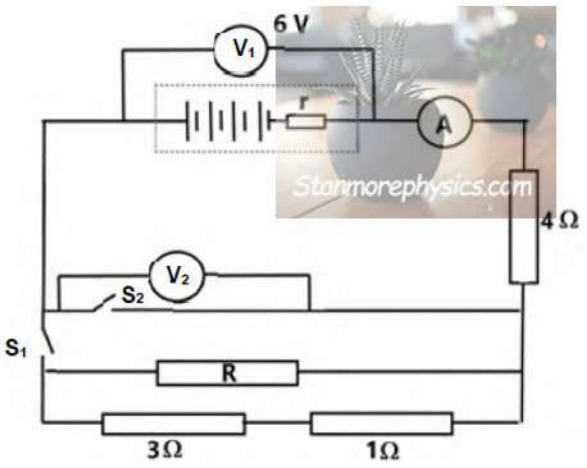
7.4.1 Calculate the new charge on each sphere. (2)

7.4.2 Explain the change, if any, to the field pattern between **B** and **C**. (2)

[14]

QUESTION 8 (Start on a new page)

The battery in the circuit diagram below has an EMF of **6 V** and an internal resistance of 0,4 Ω.



8.1 With both S_1 and S_2 open, give the reading on V_2. (1)

8.2 With only S_1 closed, the ammeter records a reading of 0,75 A. Explain the meaning of 0,75 A. (2)

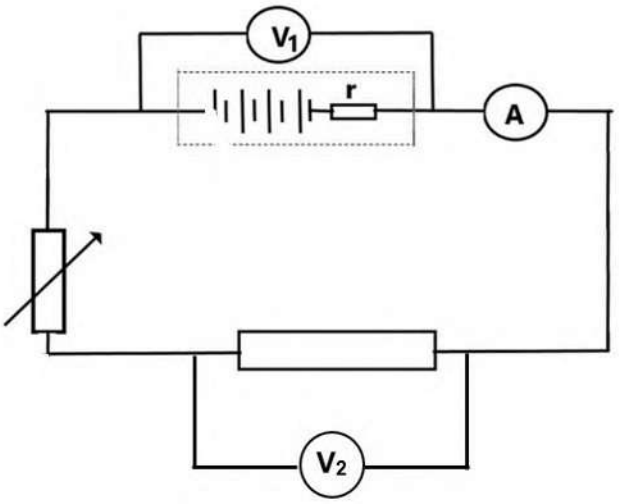
8.3 With only S_1 closed, calculate the:

8.3.1 External resistance of the circuit. (3)

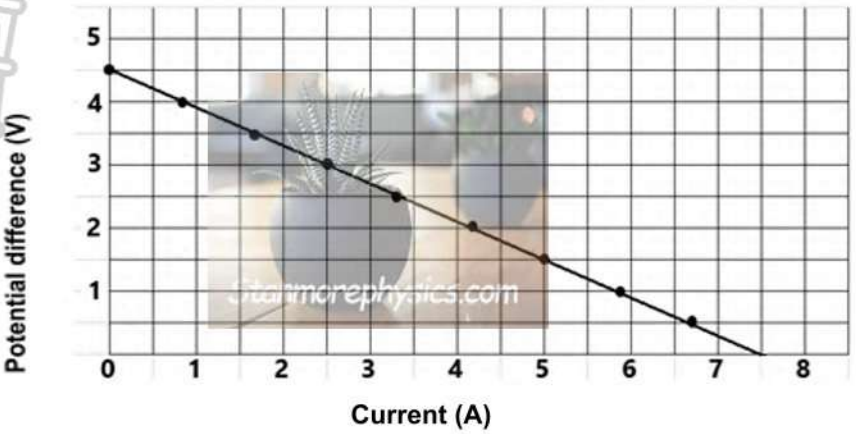
8.3.2 Resistance of resistor **R.** (3)

8.4 **S1** is now open and **S2** is closed. How will the power dissipated by the 4 Ω resistor change? Write only INCREASE, DECREASE OR REMAIN THE SAME. Explain the answer. (4)

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.



8.5 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 (Start on a new page)

A coal power station uses AC generators to produce electricity.

9.1 State the energy conversion that takes place in a generator. (2)

9.2 Draw a sketch graph of emf generated versus time for two complete cycles for an AC generator. (2)

9.3 Alternating current is used for the long-distance transmission of electricity. Give a reason why AC is preferred over DC to transmit electricity over long distances. (1)

9.4 An electrical kettle is marked 220 V. What does the 220 V represent? (1)

9.5 A certain AC generator produces a peak current of 6,25 A when connected to an electrical kettle of resistance 45 Ω.

Calculate the:

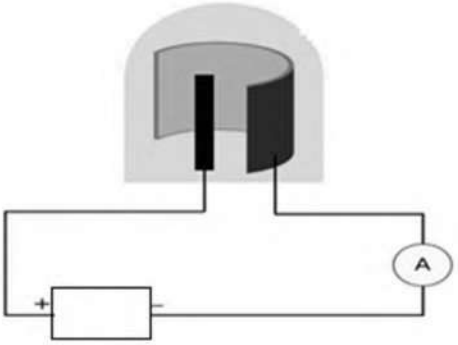
9.5.1 Root mean square (rms) current. (3)

9.5.2 Average power dissipated by the kettle when connected to this generator. (3)

[12]

QUESTION 10 (Start on a new page)

The diagram below shows a phototube that was used to demonstrate the photoelectric effect. The demonstration was carried out by shining light from a red; a green; a blue and an ultraviolet light source onto the surface of the phototube.



The results were recorded in the table below.

DEMONSTRATION NUMBER	COLOUR OF LIGHT USED	READING ON AMMETER
1	Red	No
2	Green	Yes
3	Blue	Yes
4	Ultraviolet	Yes

10.1 Explain what is meant by the photoelectric effect. (2)

10.2 Explain why there is no reading on the ammeter when a red light is used. (2)

10.3 For the following statements, use INCREASES, DECREASES or REMAINS THE SAME to complete the statement:

10.3.1 The kinetic energy of the photoelectrons … when ultraviolet light is shone onto the surface of the phototube instead of green light. (1)

10.3.2 The reading on the ammeter … when green light of higher intensity is shone onto the surface of the phototube. Explain this observation. (3)

10.4 The cathode is made of copper with a work function of $3,52 \times 10^{-19}$ J. If ultraviolet light with a wavelength of 390 nm was used during demonstration **4**, calculate the speed of the photoelectrons that were ejected. (5)

[13]

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CAPE WINELANDS MEMORANDUM

GRADE 12

PHYSICAL SCIENCES P1
SEPTEMBER 2024

MARKS: 150

TIME: 3 hours

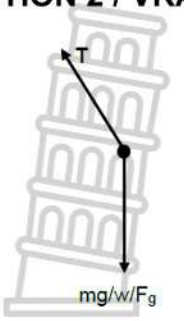
This memorandum consists of 12 pages

QUESTION 1/ VRAAG 1

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

QUESTION 2 / VRAAG 2

2.1



Marking Guidelines:	Nasienriglyne:
✓ for each force with label Arrow with line	✓ vir elke krag met 'n byskrif

(2)

2.2.1

OPTION/*OPSIE* 1

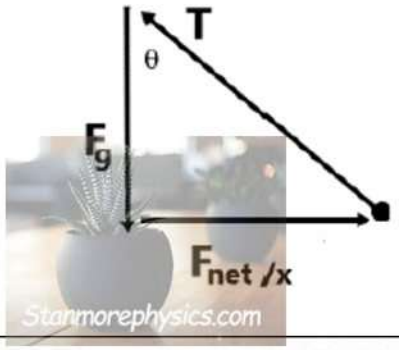
$F_g = mg$ ✓
$= 0,05 \times 9,8$ ✓
$= 0,49$ N

$\tan\theta = \frac{F_x}{F_g}$
$\tan 18° = F_x \div 0,49$ ✓
$F_x = 0,159$ N ✓

OPTION/*OPSIE* 2

$T\cos 18° = mg$ ✓
$T \cos 18° = 0,05 \times 9,8$ ✓
$T = 0,5152$N

$F_x = T \sin 18°$
$= 0,5152 \times \sin 18°$✓
$= 0,1592$N ✓



Marking Guidelines:/ Nasienriglyne:
✓ Formula
✓ Fg = 0,49 N (substitution)
✓ Trig calculation/trigonometrie bewerking
✓ Answer: Fx = 0,159 N (0,16)
Antwoord: Fx = 0,159 N (0,16)

(4)

2.2.2 $F_{net} = ma$ ✔
$\underline{0,159 = 0,05}$ x a ✔
a = 3,1842 m.s^{-2} ✔ (3,2)

Marking Guideline: Positive marking from 2.2.1	Nasienriglyne: Positiewe nasien vanaf 2.2.1
✓ $F_{net} = ma$	✓ $F_{net} = ma$
✓ Substitution	✓ Invervanging
✓ Final answer	✓ Finale antwoord

(3)

2.3.1

For the 5 kg mass/*Vir die 5 kg massa*:
$T - f = ma$
$T - \mu_k(mg) = ma$✓
$T - (0,4)(5)(9,8)$✓ $= 5a$✓.....(1)

For the 20 kg mass/*Vir die 20 kg massa*
$mg - T = ma$
$\underline{20(9,8) - T = 20a}$✓.....(2)

$176,4 = 25a$ (1) + (2)
$\therefore a = 7,06\ (7,056)$ m·s^{-2}✓

(5)

2.3.2 Positive marking from 2.3.1/ Positiewe nasien vanaf 2.3.1

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$v_f^2 = v_i^2 + 2a\Delta y$✓ $= 0$✓ + (2)(7,056)(6)✓ $v_f = 9,20$ m·s^{-1}✓	The 5 kg mass travels as fast as the 20 kg mass *Die 5 kg massa beweeg net so vinnig soos die 20 kg massa* $W_{net} = \Delta K$✓ $\underline{(5)(7,056)(6\cos 0^0)}$✓ $\underline{= ½(5)}(v_f^2 - 0)$✓ $v_f = 9,20$ m·s^{-1}✓

(4)

[18]

QUESTION 3 / VRAAG 3

3.1 $9,8\ m.s^{-2}$ ✔ (1)

3.2.1

UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$-2 = v_i \times 0,125 + \frac{1}{2} \times (-9,8)(0,125)^2$ ✓	$2 = v_i \times 0,125 + \frac{1}{2} (9,8)(0,125)$ ✓
$v_i = -15,388\ m.s^{-1}$	$v_i = 15,388\ m.s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$-15,388^2 = 0^2 + 2(-9,8)\ \Delta y$ ✓	$15,388^2 = 0^2 + 2(9,8)\ \Delta y$ ✓
$\therefore \Delta y = 12,08\ m$	$\therefore \Delta y = 12,08\ m$
Height / *Hoogte* = 12,08 + 2 ✓	Height / *Hoogte* = 12,08 + 2 ✓
Height / *Hoogte* = 14,08 m ✓	Height / *Hoogte* = 14,08 m ✓

Any one/ *Enige een* ✓ (applies to both columns)

(5)

3.2.2

UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$-15,388 = 0 + (-9,8)(\Delta t)$ ✓	$15,388 = 0 + (9,8)(\Delta t)$ ✓
$\therefore \Delta t = 1,57\ s$	$\therefore \Delta t = 1,57\ s$
$\Delta t = 1,57 + 0,125$ ✓	$\Delta t = 1,57 + 0,125$ ✓
$\Delta t = 1,70\ s$ ✓	$\Delta t = 1,70\ s$ ✓

(4)

3.2.3

OPTION 1/*OPSIE 1*

UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = -15,388^2 + 2(-9,8)(-2)$ ✓	$v_f^2 = 15,388^2 + 2(9,8)(2)$ ✓
$\therefore v_f = 16,61\ m.s^{-1}$ downwards / *afwaarts* ✓	$\therefore v_f = 16,61\ m.s^{-1}$ downwards/*afwaarts* ✓

OPTION 2/*OPSIE 2*

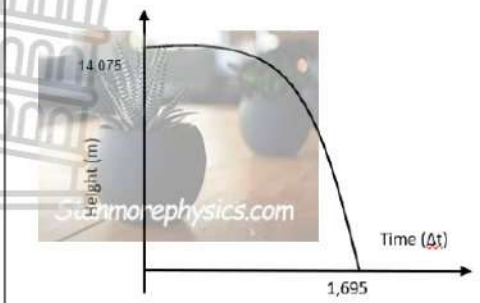
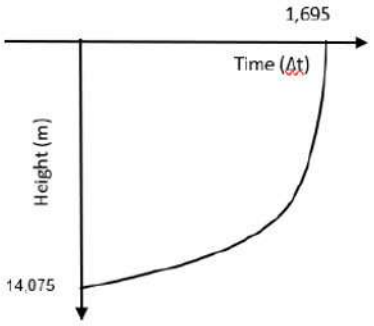
UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$v_f = -15,388 + (-9,8)(0,125)$ ✓	$v_f = 15,388 + (9,8)(0,125)$ ✓
$v_f = -16,61$	$\therefore v_f = 16,61\ m.s^{-1}$ downwards/*afwaarts* ✓
$\therefore v_f = 16,61\ m.s^{-1}$ downwards / *afwaarts* ✓	

OPTION 3/*OPSIE 3*

UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
$\Delta x = \frac{v_f + v_i}{2}\ \Delta t$ ✓	$\Delta x = \frac{v_f + v_i}{2}\ \Delta t$ ✓
$-2 = (\frac{v_f + (-15,388)}{2}) \times 0,125$ ✓	$2 = (\frac{v_f + 15,388}{2}) \times 0,125$ ✓
$\therefore v_f = 16,61\ m.s^{-1}$ downwards /*afwaarts* ✓	$\therefore v_f = 16,61\ m.s^{-1}$ downwards /*afwaarts* ✓

(3)

3.3

UPWARD POSITIVE/*OPWAARTS AS POSITIEF*	UPWARD NEGATIVE/*OPWAARTS AS NEGATIEF*
	

CRITERIA FOR MARKING / *NASIENKRITERIA*	
Correct shape / *Korrekte vorm*	✓
Initial position indicated / Aanvanklike posisie aangedui	✓
Time when ball hits the ground / *Tyd wanneer bal die grond tref*	✓

(3)

[16]

QUESTION 4 / VRAAG 4

4.1

OPTION 1	OPTION 2
$p = mv$✓ ∴ $30\ 000 = (1\ 500)v$ ✓ $\therefore v = 20\ m{\cdot}s^{-1}$✓	$\Delta p = mv_f - mv_i$ ✓ ∴ $0 = (1\ 500)v_f - 30\ 000$ ✓ $\therefore v = 20\ m{\cdot}s^{-1}$✓

(3)

4.2 POSITIVE MARKING FROM QUESTION 4.1./POSITIEWE NASIEN VANAF VRAAG 4.1

OPTION 1	OPTION 2
$\sum p_i = \sum p_f$ $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ } ✓ for any $30\ 000 + (900)(-15)$ ✓ $= 14\ 000 + 900v_B$✓ $\therefore v_B = 2{,}78\ m{\cdot}s^{-1}$ ✓east ✓	$\Delta p_A = -\Delta p_B$ $p_f - p_i = -(mv_f - mv_i)$ } ✓ for any $14\ 000 - 30\ 000$ ✓$= 900v_f - 900(-15)$ ✓ $v_f = 2{,}78\ m{\cdot}s^{-1}$✓ east

(5)

4.3 **OPTION 3**

$F_{net}\Delta t = \Delta p$ ✓ ∴ $F_{net}(0,1)$ ✓ $= 900[(2{,}78) - (-15)]$ ✓ ∴ $F_{net} = -160\ 020$ N

$F_A = -F_B$ ∴ $F_{net} = 160\ 020$ N ✓

POSITIVE MARKING FROM QUESTION 4.2/POSITIEWE NASIEN VANAF VRAAG 4.2

OPTION 3

$F_{net}\Delta t = \Delta p$ ✓ ∴ $F_{net}(0,1)$ ✓ $= 900[(2{,}78) - (-15)]$ ✓ ∴ $F_{net} = -160\ 020$ N

$F_A = -F_B$ ∴ $F_{net} = 160\ 020$ N ✓

(4)

[12]

QUESTION 5 / VRAAG 5

5.1 The work done on an object by a net force is equal to the change in kinetic energy of the object. ✓✓
Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

5.2 **OPTION 1 / *OPSIE 1***

$W_{net} = \Delta E_k$
$W_{Fg} + W_f = \Delta E_k$
$-\Delta E_p + W_f = \Delta E_k$
$[-mg(h_2 - h_1)] + f.\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

Any one / Enige een ✓

$\underline{-50 \times 9{,}8\,(0-5)}$ ✓ $+ \underline{72\Delta x\cos 180^\circ}$ ✓ $= \underline{\frac{1}{2} \times 50 \times 8^2 - 0}$ ✓

$\Delta x = 11{,}81$ m
$\theta = \sin^{-1}\left(\frac{5}{11{,}81}\right)$ ✓
$\theta = 25{,}05^\circ$ ✓

OPTION 2 / *OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$
$W_{nc} = [mg(h_2 - h_1)] + \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f = [mg(h_2 - h_1)] + \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

Any one / *Enige een* ✓

$\underline{72\Delta x\cos 180^\circ}$ ✓ $= \underline{50 \times 9{,}8\,(0-5)}$ ✓ $+ \underline{\frac{1}{2} \times 50 \times 8^2 - 0}$ ✓

$\Delta x = 11{,}81$ m
$\theta = \sin^{-1}\frac{5}{11{,}81}$ ✓
$\theta = 25{,}05^\circ$ ✓

OPTION 3 / *OPSIE 3*

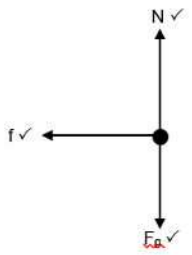
$W_{net} = \Delta E_k$
$(F_g - F_f).\Delta x.\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

Any one / *Enige een* ✓

$(mg\sin\theta - 72).\Delta x.(1) = \underline{\frac{1}{2}(50)(8^2 - 0^2)}$ ✓
$\frac{50(9{,}8)(5)\,\Delta x}{\Delta x}$ ✓ $- \underline{72\Delta x}$ ✓ $= 1\,600$

$\Delta x = 11{,}81$ m
$\theta = \sin^{-1}\frac{5}{11{,}81}$ ✓
$\theta = 25{,}05^\circ$ ✓ (6)

5.3



(3)

5.4

OPTION 1 / *OPSIE 1*

$W_{net} = \Delta E_k$
$W_f = \Delta E_k$ } Any one / *Enige een* ✓
$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f = 0$ ✓ $- \frac{1}{2} \times 50 \times 8^2$ ✓
$W_f = 1\ 600$ J ✓

OPTION 2 / *OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$ } Any one / *Enige een* ✓
$W_f = \Delta E_p + \Delta E_k$
$W_f = 0$ ✓ $- \frac{1}{2} \times 50 \times 8^2$ ✓
$W_f = 1\ 600$ J ✓

OPTION 3 / *OPSIE 3*

$v_f^2 = v_f^2 + 2a\Delta x$
$0^2 = 8^2 + 2a(10)$ ✓
$\therefore a = -3{,}2\ m \cdot s^{-1}$

$F_{nett} = ma$ ← (Any ONE / *Enige EEN* ✓)
$= 50 \times (-3{,}2)$ ✓
$= -160$ N $(= F_f)$

$W_f = F_f \cdot \Delta x \cdot \cos\theta$
$= (160)(10)(\cos 180^\circ)$
$= 1\ 600$ J ✓

(4)

[15]

QUESTION 6 / VRAAG 6

6.1 The (apparent) change in frequency observed by a listener because the listener and source of sound have different velocities relative to the medium of sound propagation. ✓ ✓
Die verandering in frekwensie van die klank waargeneem deur 'n luisteraar omdat die klankbron en luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.

The (apparent) change in frequency observed by a listener due to relative motion between the sound source and the listener. ✓ ✓

Die verandering in die (waargenome) frekwensie waargeneem deur 'n luisteraar omdat daar relatiewe beweging is tussen die luisteraar en die klankbron.

(2)

6.2 Towards observer **B**. ✓ Frequency detected by observer B is higher than the frequency detected by observer **A**. ✓

*Na waarnemer **B**. Die frekwensie wat waargeneem word deur luisteraar **B** is hoër as die waargenome frekwensie deur luisteraar **A**.*

(2)

6.3

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

545 ✓ $= \frac{343}{343 + v_s}$ ✓ x f_s .....(1)

615 ✓ $= \frac{343}{343 - v_s}$ ✓ x f_s .....(2)

$v_s = 20{,}70\ m\cdot s^{-1}$ $(20{,}69827586\ m\cdot s^{-1})$

$f_s = \frac{545(343 + 27{,}70)}{343}$ ✓ OR/OF $f_s = \frac{615(343 - 27{,}70)}{343}$

$f_s = 577{,}91$ Hz ✓ (range / *gebied* 577,89 Hz to 577,91 Hz)

(7)

6.4 The star is moving away. ✓
The spectral lines show a decrease in frequency (towards red). ✓

OR/OF

The spectral lines show an increase in wavelength (towards red).

Die ster beweeg weg.
Die spektralelyne toon 'n afname in frekwensie (na rooi).

OR/OF

Die spektralelyne toon 'n toename in golflengte (na rooi). (2)

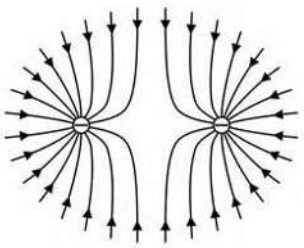
[13]

QUESTION 7 / VRAAG 7

7.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point.✔✔
Die elektriese veld by 'n punt in die elektrostatiese krag ondervind per eenheid positiewe lading geplaas by daardie punt.

(2 marks or zero). (2)

7.2



Marking criteria/*Nasienriglyne*
- ✓ Shape/form/ all lines need to be curved / *Vorm / alle lyne moet 'n kurwe hê.*
- ✓ Direction of arrows towards sphere/*Rigting van pyle na die sfere*
- ✓ All other field rules applied. / *Alle ander veldreëls toegepas.*

Do not penalise if different amounts of lines around the charges.
Ignore if different number of lines are drawn around each charge. / *Ignoreer indien die verskillende aantal lyne getrek is rondom elke lading.*

(3)

7.3 **OPTION/*OPSIE 1***

$F_{net\ on/op\ B} = F_{A\ on/op\ B} + F_{C\ on/op\ B}$

$F_{net\ on/op\ B} = \frac{kQ_A\ Q_B}{r^2} + \frac{kQ_C\ Q_B}{r^2}$ ✓

$0{,}004078$ ✓ $= \frac{9 \times 10^9 \times 5{,}6 \times 10^{-9} \times 2{,}34 \times 10^{-9}}{0{,}006^2}$ ✓ $+ \frac{9 \times 10^9 \times 7{,}46 \times 10^{-9} \times 2{,}34 \times 10^{-9}}{r^2}$ ✓

r = 0,01399 m (accept/*aanvaar* 0,014 m) ✓

OPTION/*OPSIE* 2

$F_{A\ on/op\ B} = \frac{kQ_A\ Q_B}{r^2}$ ✓

$= \frac{9\ x\ 10^9\ x\ 5{,}6\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{0{,}006^2}$ ✓

= 0,003276 N

$F_{C\ on/op\ B} = \frac{kQ_C\ Q_B}{r^2}$

$= \frac{9\ x\ 10^9\ x\ 7{,}46\ x\ 10^{-9}\ x\ 2{,}34\ x\ 10^{-9}}{r^2}$ ✓

$F_{C\ on/op\ B} = \frac{1{,}57\ x\ 10^{-7}}{r^2}$

$F_{net\ on/op\ B} = F_{A\ on/op\ B} + F_{C\ on/op\ B}$

$0{,}004078$ ✓$= 0{,}003272 + \frac{1{,}57\ x\ 10^{-7}}{r^2}$

r = 0,01399 m (accept/*aanvaar* 0,014 m) ✓

accept 0,01 m rounding off

(5)

7.4.1

$Q_{new/nuwe} = \frac{Q_A + Q_B}{2}$

$= \frac{+5{,}6 + (-2{,}34)}{2}$ ✓

= 1,63 nC

= 1,63 x 10^{-9} C ✓ accept either

(2)

7.4.2 B is now positively charged✔ and C negative. Attractive pattern.✔
The electric field pattern is now originating from B and ending at C.
B is positief gelaai en C is negatief gelaai. Aantrekkende patroon.
Die elektriese veldpatroon begin nou vanaf B en eindig by C . (2)

[14]

QUESTION 8 / VRAAG 8

8.1 6 V ✔ (1)

8.2 When a charge of 0,75 Coulomb (C)✔ travels in the circuit in one second.✔
OR
Total of 0,75 Coulombs (C) per unit time
OR
The rate at which 0,75 Coulomb (C) flows
Wanneer 'n lading van 0,75 Coulomb (C) in een sekonde in die stroombaan beweeg.
OF
Totaal van 0,75 Coulombs (C) per eenheidstyd
OF
Die tempo waarteen 0,75 Coulomb (C) vloei (2)

8.3.1 **OPTION 1: / *OPSIE 1***

$\mathcal{E} = I(R + r)$ ✓

6 = 0,75(R + 0,4) ✓

R = 7,6 Ω ✓

OPTION 2: *OPSIE 2*

$R = \frac{V}{I}$ ✓

$= \frac{(6-0,3)}{0,75}$ ✓

= 7,6 Ω ✓

(3)

8.3.2

OPTION 1/*OPSIE 1*:

$R_P = R_{ex} - R_s$

$= 7,6 - 4$ ✓

$= 3,6\ \Omega$

$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R_3 + R_1}$

$\frac{1}{3,6} = \frac{1}{R} + \frac{1}{3+1}$ ✓

R = 36 Ω ✓

OPTION 2/*OPSIE 2*:

$R_{ext} = R_{//} + R_s$

$7,6$ ✓ $= \left(\frac{4R}{4+R} + 4\right)$ ✓

$7,6\ (4 + R) = 4R + 4(4 + R)$

$R = 36\ \Omega$ ✓

OPTION 3/ *OPSIE 3*

$I_{//(1+3)} = \frac{V_{//}}{R_{(1+3)}}$

$= \frac{2,7}{4}$

$= 0,675\text{A}$

$I_R = 0,75 - 0,675$ ✓

$= 0,075\ \text{A}$

$R = \frac{V_R}{I_R}$

$= \frac{2,7}{0,075}$ ✓

R = 36 Ω ✓

(3)

8.4 INCREASES / VERHOOG

R_{ex} decreases✔

I increases ($I \propto R_{ex}$).✔

According to $P = I^2R$, for the same R, P will increase✔ because $P \propto I^2$

OR

R_{ex} decreases✔

V over the resistor increases.✔

According to $P = \frac{V^2}{R}$, for the same R, P will increase✔ because $P \propto V^2$

$R_{ekstern}$ verminder

I verhoog ($I \propto R_{eks}$).

Volgens $P = I^2R$, vir dieselfde R, sal P toeneem omdat $P \propto I^2$

OF

$R_{ekstern}$ verminder

V oor die weerstand neem toe.

Volgens $P = \frac{V^2}{R}$, vir dieselfde R, sal P toeneem omdat $P \propto V^2$ (4)

8.5.1 4,5 V✔ (1)

8.5.2 gradient = - r = $\frac{\Delta y}{\Delta x}$

$= \frac{1,5 - 4,5}{5 - 0}$ ✓ ✓

$= -0,6$

$\therefore r = 0,6\ \Omega$ ✓

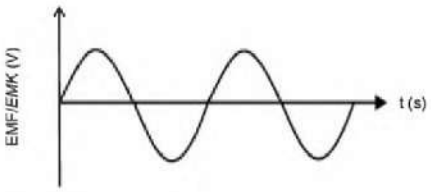
(3)

[17]

QUESTION 9 / VRAAG 9

9.1 Mechanical energy ✓ to electrical energy. ✓
Meganiese energie na elektriese energie. (2)

9.2



Marking criteria / *Nasienkriteria*	
Correct shape/ *Korrekte vorm*	✓
Two complete waves / *Twee volledige golwe*	✓

(2)

9.3 AC can be transmitted over long-distances because it causes minor energy loss. ✓

OR/*OF*

The potential difference can be increased or decreased.
WS kan oor lang afstande met minimale energie verlies oorgedra word.

OR/*OF*

Die potensiaalverskil can verhoog of verlaag word. (1)

9.4 $V_{rms/\ wgk}$ **OR** Root mean square voltage/*wortel gemiddelde kwadraat spanning* ✔ (1)

9.5.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

$I_{rms} = \frac{6,25}{\sqrt{2}}$ ✓

$I_{rms} = 4,42$ A ✓ (3)

9.5.2 Positive marking from 9.5.1/ Positiewe nasien vanaf 9.5.1

$P_{average\ /\ gemiddeld} = I^2_{rms} R$ ✓

$= 4,42^2 \times 45$ ✓

$= 879,14$ W ✓ (3)

[12]

QUESTION 10 / VRAAG 10

10.1 The process whereby electrons are ejected from a metal surface✔ when light of a suitable frequency✔ is incident on that surface.
Die proses waar elektrone vrygestel word van 'n metaal oppervlak wanneer lig met 'n geskikte frekwensie op die oppervlak skyn (2)

10.2 The frequency of the red light must be lower✔ than the threshold frequency✔ for the phototube metal surface. (must be a comparison for both marks)
OR
The red light does not have enough energy to eject electrons from the phototube metal surface. ($E_{red\ light} < W_0$ metal surface)
OR
The wavelength of the light is higher than the threshold wavelength.

Die frekwensie van die rooi lig moet laer wees as die drumpel frekwensie vir die fotobuis se metaal oppervlak. (moet vergelyk word vir 2 punte)
OF
Die rooi lig het nie genoeg energie om elektrone uit die fotobuis se metaaloppervlak te verwyder nie. ($E_{rooi\ lig} < W_0$ metaaloppervlak)
OF
Die golflengte van die lig is hoër as die drumpelggolflengte (2)

10.3.1 INCREASES✔ / VERHOOG (1)

10.3.2 INCREASES.✔
If the intensity of the light increases, the number of photons per unit time / per second of light striking the phototube increases .✔
This increases the number of electrons ejected per unit time / per second✔ and therefore the reading on the ammeter increases.

VERHOOG
Indien die intensiteit van die lig verhoog, verhoog die aantal fotone per tydseenheid / per sekonde van die lig wat die fotobuis tref
Dit verhoog die aantal elektrone wat per eenheid tyd vrygestel word en dus verhoog die lesing op die ammeter. (3)

10.4

$$E = W_0 + Ek_{max} \checkmark$$

$$h\frac{c}{\lambda} = W_0 + Ek_{max}$$

$$\frac{(6{,}63\times10^{-34}\times3\times10^{8})}{(390\times10^{-9})} \checkmark = 3{,}52\times10^{-19} \checkmark + \frac{1}{2}(9{,}11\times10^{-31})v^2 \checkmark$$

$$5{,}108\times10^{-19} - 3{,}52\times10^{-19} = \frac{1}{2}(9{,}11\times10^{-31})v^2$$

$$v = \sqrt{\frac{1{,}588\times10^{-19}}{\frac{1}{2}(9{,}1\times10^{-31})}} = 5{,}89\times10^{5}\ m\cdot s^{-1} \checkmark$$

(5)

[13]