



education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2024

Stanmorephysics.com

MARKS: 150

TIME: 3 HOURS



This question paper consists of 19 pages including data sheets.

INSTRUCTIONS AND INFORMATION

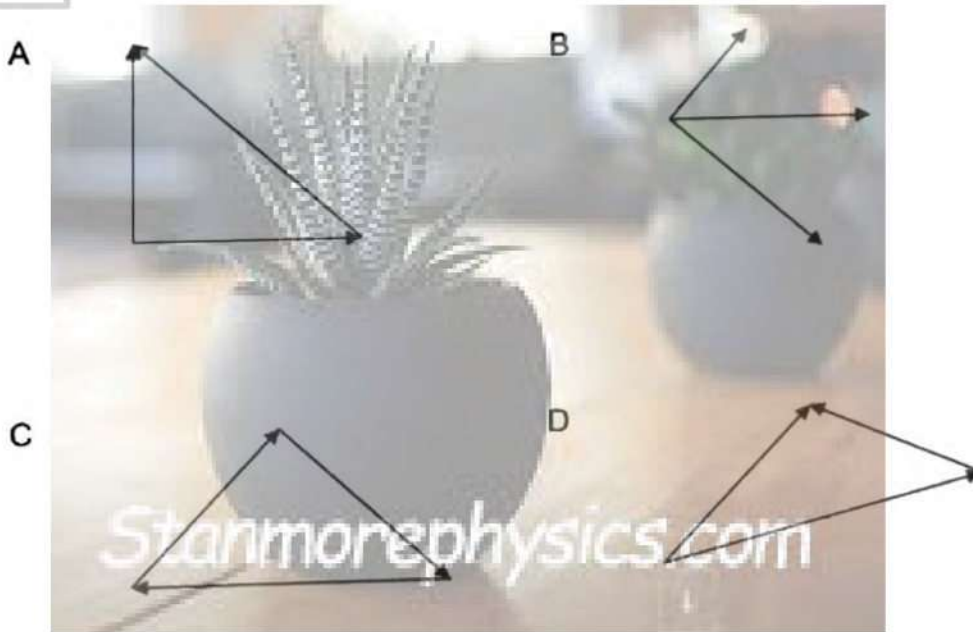
1. Write your name on the FOLIO PAPERS.
2. This question paper consists of TEN questions. Answer ALL the questions on the FOLIO PAPERS.
3. Start EACH question on a NEW page on the FOLIO PAPERS.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. 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, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.



QUESTION 1: MULTIPLE CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1 to 1.10) on the FOLIO PAPERS, e.g. 1.11 D.

1.1 Consider the following vector diagrams. Which one of these vector diagrams represents a zero resultant?



(2)

1.2 How far above the earth's surface will an object, mass m be, if the weight is nine times smaller than on the earth's surface? (r represents the radius of the earth)

- A $\frac{1}{2} r$
- B $2r$
- C r
- D $3r$

(2)

1.3 Two objects with equal masses are dropped from different heights. When they are both 1 m above the ground, they have ...

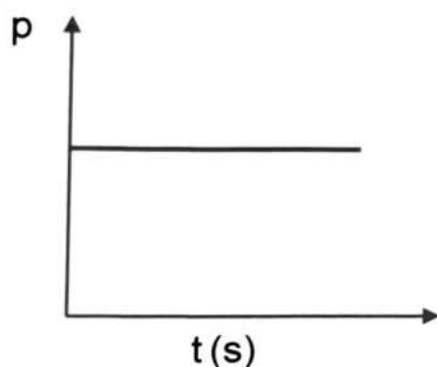
- A the same kinetic energy.
- B the same acceleration and velocity.
- C different velocities and the same potential energy.
- D the same velocity and different acceleration.

(2)

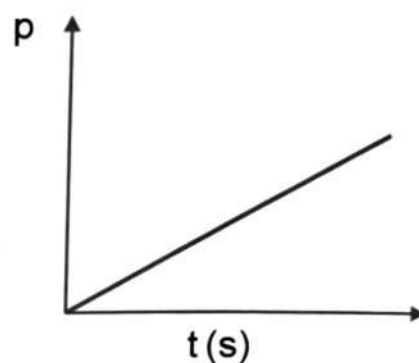
- 1.4 Which one of the following momentum versus time graphs best represents the motion of an object moving from rest in a straight line under the influence of a constant net force?



A

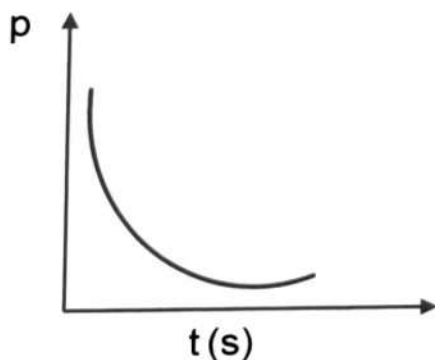


B

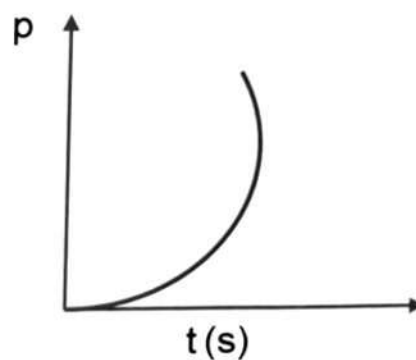


(2)

C



D



- 1.5 Which one of the following is a conservative force?

- A Gravitational force
- B Frictional force
- C Applied force
- D Tension in a rope



(2)

1.6 A stationary person listens to the siren of an approaching ambulance.

Which ONE of the following characteristics associated with the sound of the siren, as heard by the person, is/are CORRECT?

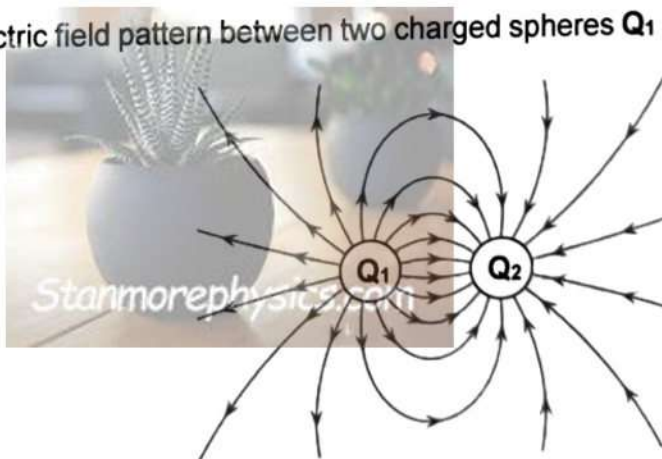


- (i) The pitch increases
- (ii) The wavelength increases
- (iii) The frequency increases
- (iv) The wavelength decreases

- A (iii) and (iv) only
- B (i) and (iii) only
- C (ii) and (iii) only
- D (i), (iii) and (iv) only

(2)

1.7 The electric field pattern between two charged spheres Q_1 and Q_2 is shown below.



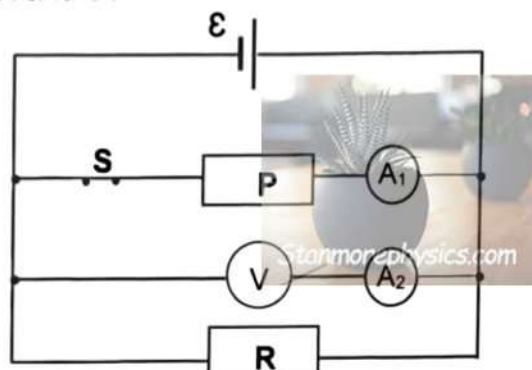
Which ONE of the following statements regarding the charge on sphere Q_1 and Q_2 is CORRECT?

	Charge on sphere Q_1	Charge on sphere Q_2
A	Negative	Negative
B	Positive	Negative
C	Negative	Positive
D	Positive	Positive



(2)

- 1.8 Two identical resistors **P** and **R** are connected in the circuit as shown below. The cell has an emf ϵ and negligible internal resistance. The switch is initially CLOSED. Switch **S** is now OPENED. Which ONE of the following combinations of changes will occur in **P**, **R** and **V**?



	CURRENT IN P	CURRENT IN R	VOLTMETER V
A	Decreases	Increases	Increases
B	Decreases	Remains the same	Remains the same
C	Decreases	Decreases	Remains the same
D	Increases	Remains the same	Decreases

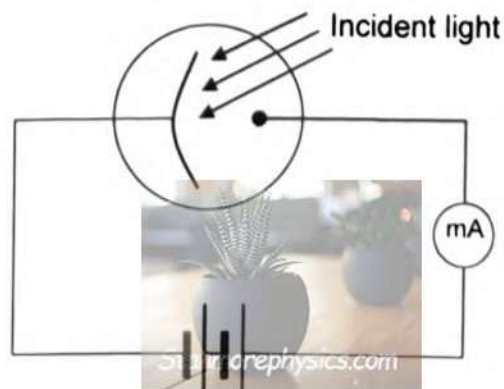
(2)

- 1.9 The component of an AC generator that maintains electrical contact between the rotating part/parts and the external circuit is/are the...

- A carbon brushes.
- B battery.
- C split rings.
- D slip rings.

(2)

- 1.10 YELLOW light shines on the cathode of a photo-electric cell. A milli-ammeter in the circuit registers a reading.



How does the velocity of the photo-electrons and the number of photo-electrons released per second change when the yellow light is replaced by a GREEN light of HIGHER intensity?

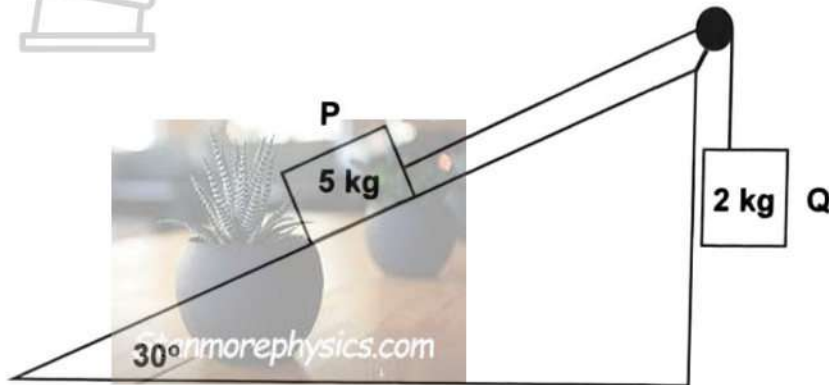
	VELOCITY OF PHOTO-ELECTRONS	NUMBER OF PHOTO-ELECTRONS PER SECOND
A	Increases	Increases
B	Stays the same	Decreases
C	Decreases	Stays the same
D	Increases	Decreases

(2)
[20]



QUESTION 2 (Start on a new page.)

Block **P**, of mass 5 kg, is placed on a rough surface that is inclined at an angle of 30° to the horizontal. It is connected to a second block **Q**, of mass 2 kg, by a light inextensible string passing over a light frictionless pulley. An average constant frictional force of 2,5 N acts on block **P** as it moves on the incline, as shown in the diagram below. Ignore the effects of air resistance

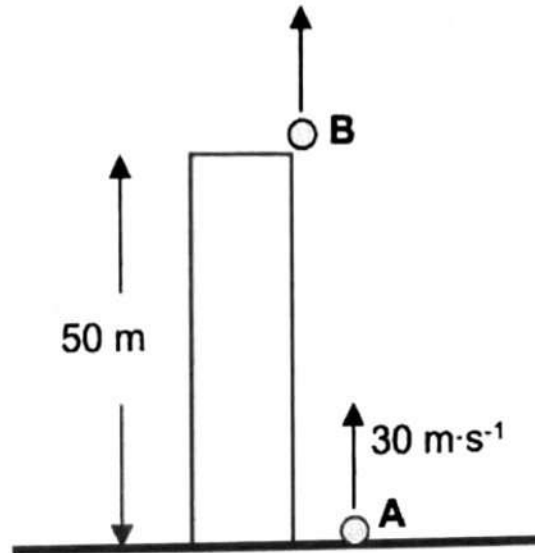


- 2.1 State Newton's second law of motion in words. (2)
- 2.2 In which direction will the system move? Choose from DOWN THE INCLINE or UP THE INCLINE. (1)
- 2.3 Draw a labelled free-body diagram for block **P** as it is moving on the incline. (4)
- 2.4 Apply Newton's second law to each of the blocks and calculate the magnitude of the acceleration of block **P** while moving on the incline. (5)
- 2.5 If the string between block **P** and **Q** now breaks, how will block **P**'s acceleration compare to that calculated in QUESTION 2.4? Choose from GREATER THAN, SMALLER THAN or EQUAL TO. Give a reason for the answer. (2)

[14]

QUESTION 3 (Start on a new page.)

Ball **A** is projected vertically upwards from the ground, near a tall building, with a speed of $30 \text{ m}\cdot\text{s}^{-1}$. Ignore the effects of air friction.



- 3.1 Explain what is meant by a projectile. (2)
- 3.2 Calculate the: (4)
- 3.2.1 total time that ball **A** will be in the air. (4)
- 3.2.2 magnitude of the displacement of ball **A** during the last second before reaching maximum height. (4)

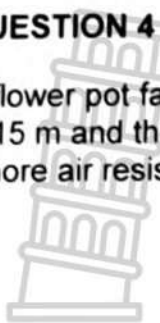
Two seconds after ball **A** is projected upwards, ball **B** is projected vertically upwards from the roof of the same building. The roof of the building is 50 m above the ground. Both balls **A** and **B** reach the ground at the same time. Refer to the diagram above. Ignore the effects of air friction.

- 3.3 Calculate the velocity at which ball **B** was projected upwards from the roof. (4)
- 3.4 Sketch velocity-time graphs for the motion of both balls **A** and **B** on the same set of axes. Clearly label the graphs for balls **A** and **B** respectively. Indicate the following on the graphs: (4)
- (a) Time taken by both balls **A** and **B** to reach the ground
- (b) Time taken by ball **A** to reach its maximum height

[18]

QUESTION 4 (Start on a new page.)

A flower pot falls from an apartment balcony. The height of the balcony above the mud is 15 m and the mass of the flower pot is 1.5 kg. Ignore air resistance and frictional force of the mud.



- 4.1 Calculate the velocity with which the flower pot hits the mud. (3)

The flower pot falls into the mud and comes to rest within 0.5 s.



- 4.2 Define the term *impulse* in words. (2)
- 4.3 Calculate the magnitude of the:
- 4.3.1 Net force on the flower pot as it falls into the mud (3)
- 4.3.2 Force of the mud on the flower pot (3)
- 4.4 How will the force be influenced if the time taken for the flower pot to come to rest is longer?
Choose from INCREASE, DECREASE or STAY THE SAME.
Explain the answer. (3)

**[14]**

QUESTION 5 (Start on a new page.)

A 5 kg block is released from rest at point T, from a height of 5 m and slides down a frictionless incline to P. It then moves along a frictionless horizontal surface PQ and finally moves up a rough inclined plane QR. It comes to rest 3 m above the horizontal at point R. The frictional force between the surface QR and the block is 18 N, as shown in the diagram below.



- 5.1 Define the term *non-conservative force*. (2)
- 5.2 Using conservation of mechanical energy only to calculate the speed of the block at point P. (4)
- 5.3 Draw a free-body diagram for the block as it is sliding between TP. (2)
- 5.4 Explain why the kinetic energy at point P is the same as that at point Q. (1)
- 5.5 State the work-energy theorem in words. (2)
- 5.6 Calculate the angle (θ) of the slope QR. (6)

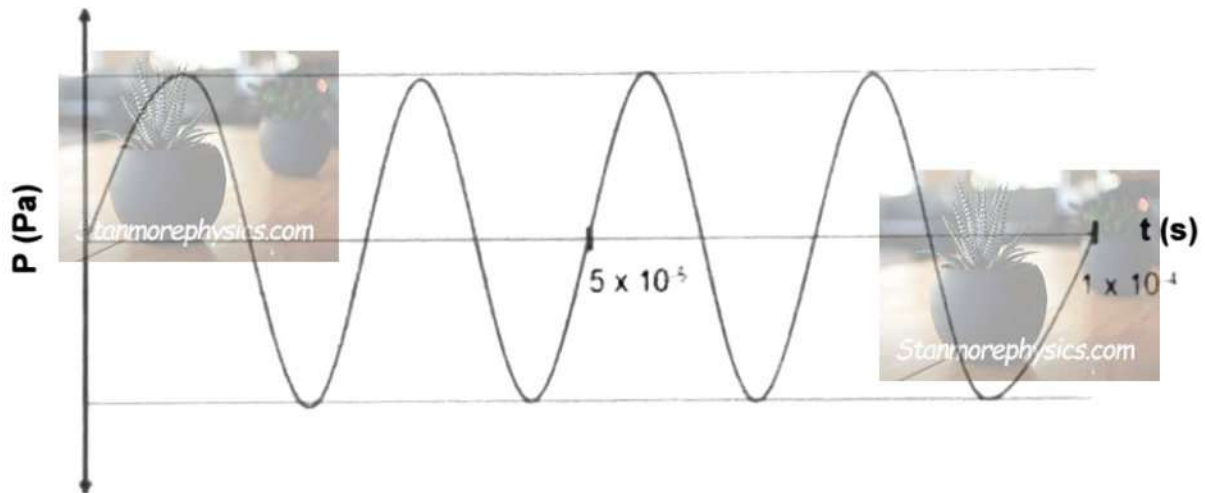
[17]



QUESTION 6 (Start on a new page.)

Scientists studying the social interaction of dolphins in captivity connected an underwater sound recorder to an oscilloscope and immersed it in the dolphin tank at an aquarium.

They recorded the sound waves emitted by a dolphin as it approached the microphone. The waves recorded on the oscilloscope are represented in the diagram below.

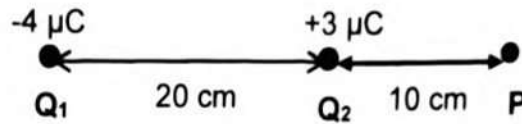


- 6.1 State the Doppler effect in words. (2)
- 6.2 The average frequency of the social vocalisations of dolphins is 39 kHz. Proof by means of calculation that the frequency recorded is 1 kHz higher than the actual frequency. (2)
- 6.3 Explain why the recorded frequency is higher than the actual frequency. (2)
- 6.4 Calculate the speed at which the dolphin is approaching the recorder. The speed of sound in sea water is $1500 \text{ m}\cdot\text{s}^{-1}$. (5)

[11]

QUESTION 7 (Start on a new page.)

Two point charges Q_1 and Q_2 are placed 20 cm apart as shown in the diagram below. Point P is 10 cm to the right of charge Q_2 .



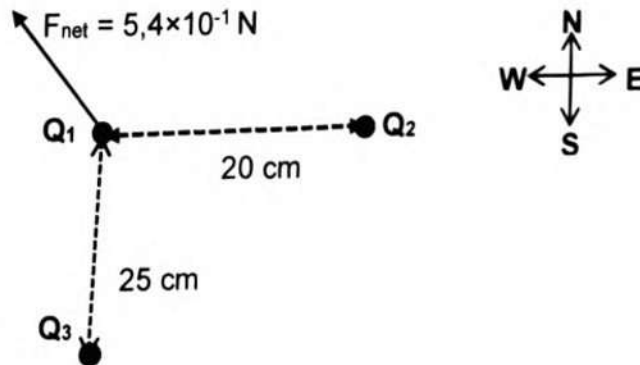
7.1 Define the term *electric field at a point*. (2)

7.2 Calculate the magnitude and direction of the net electric field at point P. (6)

The two charges are brought into contact with each other and placed back at their original positions.

7.3 Calculate the charge on each of the point charges after contact. (2)

After Q_1 and Q_2 were brought into contact and placed at their original positions, a charge Q_3 is placed 25 cm south of Q_1 . Charge Q_1 experiences a net force of $5,4 \times 10^{-1}$ N due to the other two charges as shown in the diagram below.



7.4 Calculate the magnitude and nature of the charge on Q_3 .

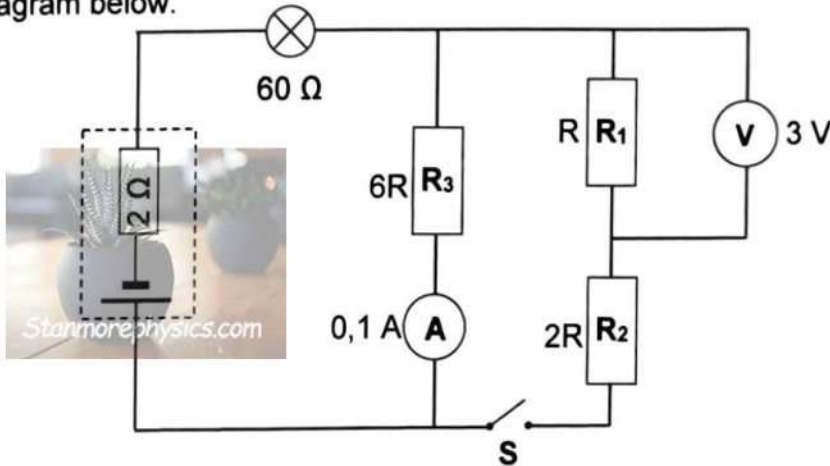
(6)

[16]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows a cell with an internal resistance $2\ \Omega$, connected to three resistors, a light bulb, a switch, an ammeter and connecting wires. The resistance of the three resistors are R , $2R$ and $6R$ respectively and the resistance of the bulb is $60\ \Omega$.

When switch **S** is CLOSED, the voltmeter and ammeter have readings as shown in the diagram below.



- 8.1 Write down the value of the:
 - 8.1.1 Potential difference across resistor R_2 (1)
 - 8.1.2 Current through R_2 (1)
- 8.2 Calculate the:
 - 8.2.1 Resistance of resistor R_1 (3)
 - 8.2.2 Emf of the cell (5)
 - 8.2.3 Power dissipated in the light bulb (3)

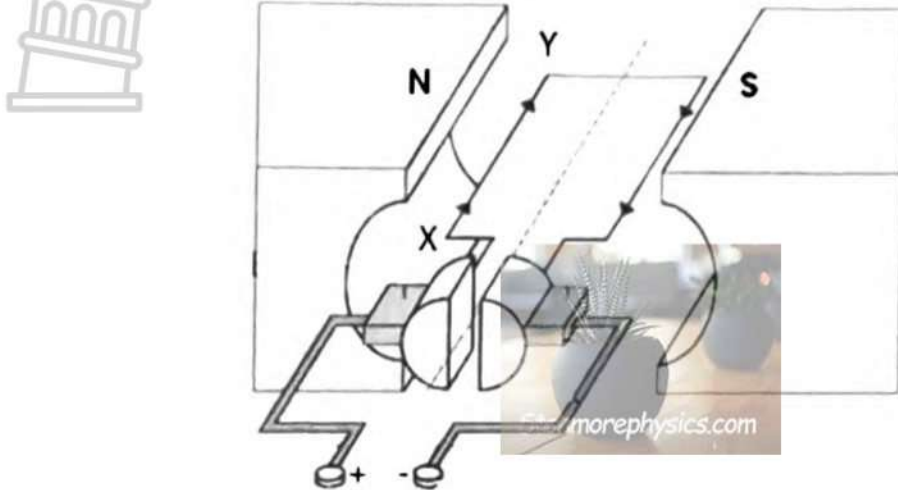
Switch **S** is now OPENED.

- 8.3 Write down the reading on voltmeter **V**. (1)
- 8.4 What will happen to the 'lost volts'?
Choose from INCREASES, DECREASES, REMAINS THE SAME.
Explain the answer with reference to total resistance and current. (3)

[17]

QUESTION 9 (Start on a new page.)

- 9.1 The simplified diagram of a DC motor is shown below.
The current in the coil is in the direction **XY**.



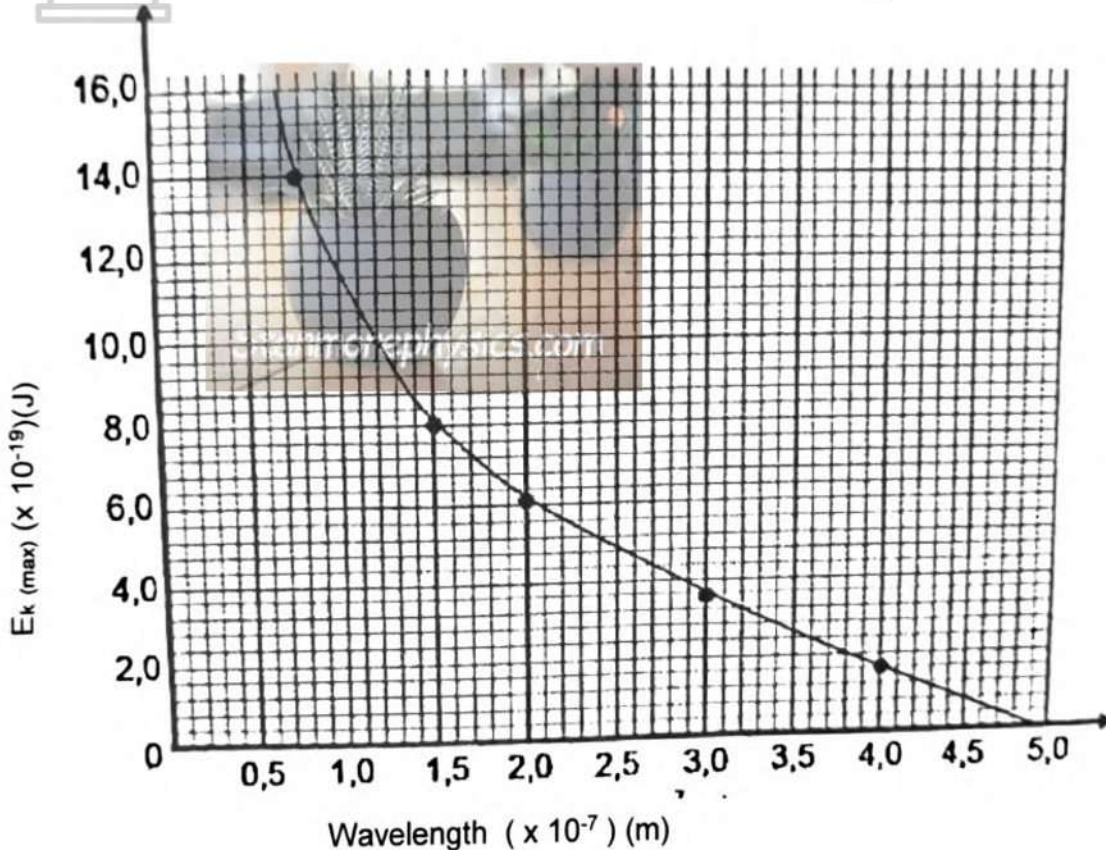
- 9.1.1 In which direction will the above coil rotate?
Choose from **CLOCKWISE** or **ANTI-CLOCKWISE**. (1)
- 9.1.2 Write down the energy conversion that takes place in a motor. (1)
- 9.1.3 Sketch an emf versus time graph for two complete rotations of the coil, starting from the position of the coil as shown in the simplified diagram above. (2)
- 9.2 The specifications of an electric drill are as follows:
- 2100 W; 230 V**
- 9.2.1 Define the term *root mean square potential difference*. (2)
- 9.2.2 Calculate the maximum value of the current that can flow through the drill. (4)

[10]

QUESTION 10 (Start on a new page.)

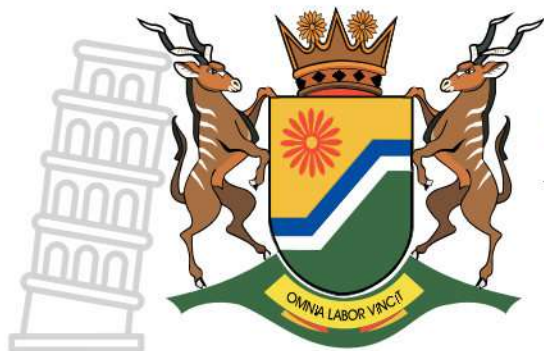
When light of different frequencies shines on the metal cathode of a photo-cell, photo-electrons are released from the surface of the cathode. The graph below shows the relationship between the maximum kinetic energy ($E_{k(max)}$) of a released photo-electron and the wavelength of the incident light.

GRAPH of $E_{k(max)}$ versus WAVELENGTH



- 10.1 Determine, by using the graph, the maximum kinetic energy of the released photo-electron if the wavelength of the incident light is 3×10^{-7} m. (1)
- 10.2 What is the relationship, deduced from the graph, between the wavelength of the incident light and the maximum kinetic energy of the released photo-electron? (2)
- 10.3 Define the term *work function*. (2)
- 10.4 Use the graph and calculate the work function of the metal that is used as a cathode for this photo-cell. (3)
- 10.5 The velocity of the released photo-electron is $2,6 \times 10^6$ m·s⁻¹. Calculate the wavelength of the incident light. (5)

TOTAL: [13] 150



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GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSAPPE: FISIKA (V1)**

SEPTEMBER 2024

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MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

These marking guidelines consists of 13 pages

Hierdie nasienriglyne bestaan uit 13 bladsye

QUESTION 1 / VRAAG 1

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



QUESTION 2 / VRAAG 2

2.1 **Marking criteria/Nasienkriteria**

If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. /Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

When a net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die resultante/netto krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The resultant/net force acting on an object is equal to the rate of change of momentum of the object. **(2 or 0)**

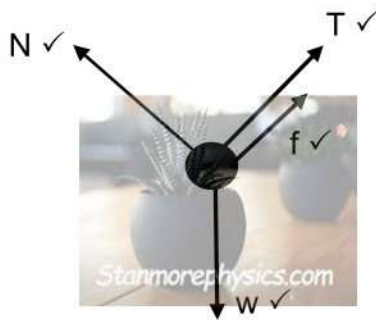
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. **(2 of 0)**

(2)

2.2 **DOWN THE INCLINE / AFWAARTS TEEN DIE HELLING** ✓

(1)

2.3



(4)

Accepted labels / Aanvaarde benoemings

w	F_g / F_w / force of earth on block / weight / mg / gravitational force / VALUE / gravitasiekrag
T	Tension in rope / F_T / spankrag
F	$F_{\text{friction}} / F_f$ / frictional force / wrywing
N	Normal force / F_N / Normalkrag

Notes/Aantekeninge:

- Mark awarded for label and arrow.
- Any additional forces: deduct 1 mark: max $\frac{3}{4}$
- No labels: deduct 1 mark: max $\frac{3}{4}$
- If everything correct, but no arrows: deduct 1 mark: $\frac{3}{4}$
- Force(s) not touching object: deduct 1 mark: max $\frac{3}{4}$
- Ignore relative sizes of the vectors

2.4

Marking criteria/Nasienkriteria:

- Formula for block P or block Q ✓
- Substitution of Fnet for block P ✓
- Substitution of Fnet for block Q ✓
- 5a **OR** 2a ✓
- Answer ✓

For Block P:

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ F_{\text{gll}} + (-T) + (-f) &= ma \end{aligned} \right\} \text{Any one } \checkmark$$

$$(5)(9,8)\sin 30^\circ - T - 2,5 \checkmark = 5a \checkmark$$

$$22 - T = 5a$$

$$T = -5a + 22$$

For Block Q:

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ T - F_g &= ma \\ T - (2)(9,8) \checkmark &= 2a \end{aligned} \right\}$$

$$T - 19,6 = 2a$$

$$T = 2a + 19,6$$

$$\therefore -5a + 22 = 2a + 19,6$$

$$7a = 2,4$$

$$a = 0,34 \text{ m}\cdot\text{s}^{-2} \checkmark$$

(5)

2.5 GREATER THAN / GROTER AS ✓

Fnet increases – no more tension pulling back ✓

Fnet neem toe – geen meer spankrag wat terug trek nie

(2)

[14]

QUESTION 3 / VRAAG 3

3.1

An object which has been given an initial velocity and then it moves under the influence of the gravitational force only. ✓ ✓ **(2 or 0)**

'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg. **(2 or 0)**

(2)

3.2.1

**Upwards positive/
Opwaarts positief:**

$$v_f = v_i + a\Delta t \checkmark$$

$$-30 \checkmark = 30 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 6,12\text{s} \checkmark$$

**Downwards positive/
Afwaarts positief:**

$$v_f = v_i + a\Delta t \checkmark$$

$$30 \checkmark = -30 + (9,8)\Delta t \checkmark$$

$$\Delta t = 6,12\text{s} \checkmark$$

(4)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1**
POSITIEWE NASIEN VANAF VRAAG 3.2.1

$v_f = v_i + a\Delta t$ $0 = -30 + (9,8)\Delta t$ $\Delta t = 3,06s$	
Upwards Positive/ Opwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $\Delta y = (30)(3,06) + \frac{1}{2}(-9,8)(3,06)^2 \checkmark$ $\Delta y = 45,92 \text{ m}$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = (30)(2,06) + \frac{1}{2}(-9,8)(2,06)^2 \checkmark$ $\Delta y = 41,01 \text{ m}$ displacement in the last second $= 45,92 - 41,01 = 4,91 \text{ m} \checkmark$	Downwards Positive/ Afwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $\Delta y = (-30)(3,06) + \frac{1}{2}(9,8)(3,06)^2 \checkmark$ $\Delta y = -45,92 \text{ m}$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y = (-30)(2,06) + \frac{1}{2}(9,8)(2,06)^2 \checkmark$ $\Delta y = -41,01 \text{ m}$ displacement in the last second $= 45,92 - 41,01 = 4,91 \text{ m} \checkmark$

(4)

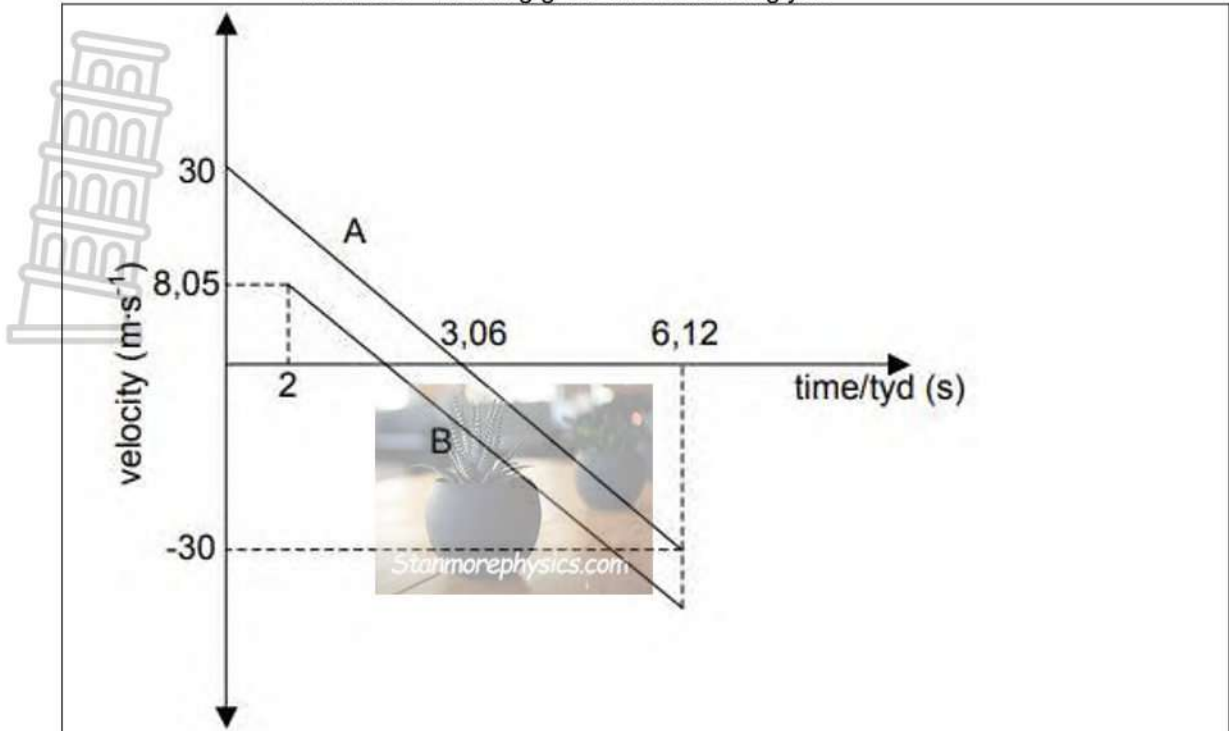
3.3 Upwards positive / Opwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $-50 \checkmark = v_i(4,12) + \frac{1}{2}(-9,8)(4,12)^2 \checkmark$ $v_i = 8,05 \text{ m}\cdot\text{s}^{-1} \checkmark$	Downwards positive/ Afwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $50 \checkmark = v_i(4,12) + \frac{1}{2}(9,8)(4,12)^2 \checkmark$ $v_i = -8,05 \text{ m}\cdot\text{s}^{-1}$ $v_i = 8,05 \text{ m}\cdot\text{s}^{-1} \checkmark$
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(4)

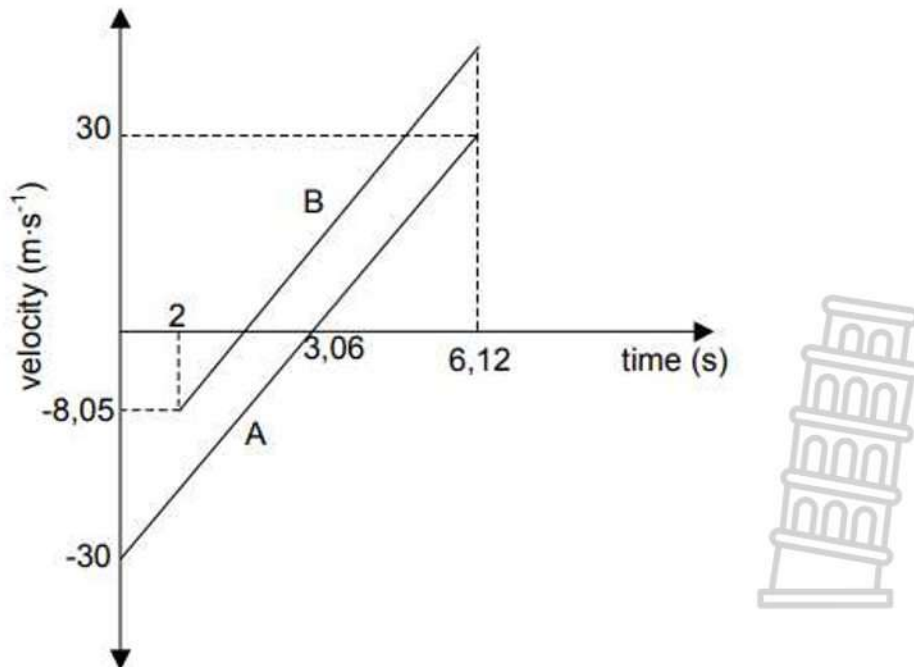
3.4 **POSITIVE MARKING FROM/POSITIEWE MERK VANAF 3.2.1 & 3.2.2 & 3.3**
UPWARDS POSITIVE/OPWAARTS POSITIEF

Criteria/Kriteria	Marks/Punte
Correct shape of A Korrekte vorm van A	✓
Correct shape of Graph B parallel to A above A Korrekte vorm van Grafiek parallel met A bo A	✓
Time at which both A and B reach the ground (6,12 s) Tyd wat beide A en B die grond bereik (6,12 s)	✓
Time for A to reach the maximum height (3,06 s) shown Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui	✓

(4)



DOWNWARDS POSITIVE/AFWAARTS POSITIEF



[18]

QUESTION 4 / VRAAG 4

4.1 $v_f^2 = v_i^2 + 2a\Delta y$ ✓
 $v_f^2 = 0 + 2(9,8)(15)$ ✓
 $v_f = 17,15 \text{ m}\cdot\text{s}^{-1}$ ✓

(3)

4.2. Impulse is the product of the resultant/net force ✓ acting on an object and the time the net force acts on the object. ✓

Impuls is die produk van die resulterende/netto krag ✓ wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk. ✓

(2)

4.3.1 **POSITIVE MARKING FROM QUESTION 4.1**

$F_{\text{net}} \cdot \Delta t = mv_f - mv_i$ ✓
 $F_{\text{net}} (0,5) = (1,5)(0 - 17,15)$ ✓
 $F_{\text{net}} = -51,45 \text{ N}$
 $F_{\text{net}} = 51,45 \text{ N}$ ✓ upwards/opwaarts

(3)

4.3.2 **POSITIVE MARKING FROM QUESTION 4.3.1**

$F_{\text{net}} = F_{\text{mud}} + F_g$ ✓
 $-51,45 = F_{\text{mud}} + (1,5)(9,8)$ ✓
 $F_{\text{mud}} = 66,15 \text{ N}$ ✓

(3)

4.4 **DECREASE/VERMINDER** ✓
 $\Delta p = \text{constant value}$ ✓
 F_{net} is inversely proportional to Δt , therefore the longer the time of contact, the smaller the net force if the change in momentum stays the same. ✓

(3)

[14]

QUESTION 5 / VRAAG 5

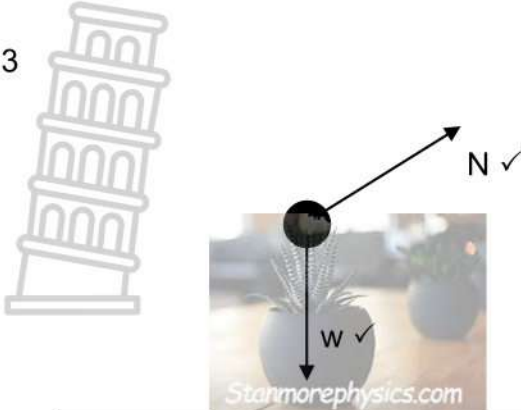
5.1 **Marking criteria/Nasienkriteria**
 If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. /Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.
 A force for which the work done in moving an object between two points depends on the path taken ✓✓
 'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanglik is van die roete wat gevolg word.

(2)

5.2 $E_{\text{KT}} + E_{\text{pT}} = E_{\text{Kp}} + E_{\text{pp}}$ ✓
 $\frac{1}{2}(5)(0)^2 + (5)(9,8)(5)$ ✓ = $\frac{1}{2}(5)v^2 + (5)(9,8)(0)$ ✓
 $245 = 2,5 v^2$
 $v = 9,90 \text{ m}\cdot\text{s}^{-1}$ ✓

(4)

5.3



(2)

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / mg / gravitational force /
N	Normal force / F_N

5.4 Velocity stays the same there is no friction working in on the object.

(1)

5.5 **Marking criteria/Nasienkriteria**

If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. /Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The net work done on an object is equal to the change in kinetic energy of the object. ✓✓

Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp **OF** die arbeid verrig op die voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.

(2)

5.6 **POSITIVE MARKING FROM QUESTION 5.2**

OPSIE 1/OPTION 1

$$W_{\text{net}} = \Delta E_k$$

$$F_{\text{net}} \Delta x \cos \theta = \left[\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \right]$$

$$(18 + (5)(9,8) \sin \theta) \Delta x \cos 180^\circ = \left[\frac{1}{2} (5) 0^2 - \frac{1}{2} (5) (9,90)^2 \right]$$

$$-18x - 49 \left(\frac{3}{x} \right) x = \left[\frac{1}{2} (5) 0^2 - \frac{1}{2} (5) (9,90)^2 \right]$$

$$-18x - 49(3) = -245,025$$

$$\Delta x = 5,445 \text{ m}$$

$$\sin \theta = \frac{t}{s}$$

$$\sin \theta = \frac{3}{5,445}$$

$$\theta = 33,43^\circ$$



(6)

OPSIE 2/OPTION 2

$$W_{nc} = \Delta E_k + \Delta E_p$$

$$f \Delta x \cos \theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$$

$$\frac{18 \Delta x \cos 180^\circ}{-18 \Delta x} = \frac{[\frac{1}{2}(5) 0^2 - \frac{1}{2}(5) (9,90)^2]}{-245 + 147} + \frac{[(5)(9,8)(3) - (5)(9,8)(0)]}{-18 \Delta x}$$

$$\Delta x = 5,44 \text{ m}$$

$$\sin \theta = \frac{t}{s}$$

$$\sin \theta = \frac{3}{5,44}$$

$$\theta = 33,47^\circ$$

} Any one ✓



[17]

QUESTION 6 / VRAAG 6

6.1 **Marking criteria/Nasienkriteria**

If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. /Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The change in frequency/pitch/wavelength of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Die verandering van frekwensie/toonhoogte/golflengte van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoorplanting het.

OR/OF

An (apparent) change in observed frequency/pitch/wavelength as the result of the relative motion between a source and an observer/listener. ✓✓
'n (Skynbare) verandering in waargenome frekwensie/toonhoogte/golflengte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar. (2)

6.2

$$f = \frac{2}{4 \times 10^{-5}} \quad \text{or} \quad \frac{1}{1 \times 10^{-4}}$$

$$= 40\,000 \text{ Hz} \quad \checkmark \checkmark$$


(2)

6.3

Waves in front of source are more compact/ wavelength decreases ✓
Dolphin is moving towards the recorder. ✓

(2)

6.4 **POSITIVE MARKING FROM QUESTION 6.2**


$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \checkmark \quad \text{OR} \quad f_L = \frac{v}{v - v_S} f_S$$

$$40\,000 \checkmark = \frac{1500 + 0}{1500 - v_S} \checkmark 39\,000 \checkmark$$

$$v_S = 37,5 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(5)
[11]

QUESTION 7 / VRAAG 7

7.1 **Marking criteria/Nasienriglyne:**

-1 mark for each of the 3 key words omitted in the correct context.

-1 punt vir elk van die 3 sleutelwoorde weggelaat in die korrekte konteks.

The electric field is an **area in space** where an electric **charge** experiences a **force**. ✓ ✓

Die elektriese veld is 'n **gebied in die ruimte** waarin 'n elektriese **lading** 'n **krag** ondervind

(2)

7.2

$$E_{\text{nett}} = E_1 + E_2$$

$$E_{\text{net}} = \frac{kQ}{r^2} - \frac{kQ}{r^2} \quad (\text{Mark for/Punt vir } E = \frac{kQ}{r^2})$$

$$= \frac{(9 \times 10^9)(4 \times 10^{-6})}{(0,3)^2} \checkmark - \checkmark \frac{(9 \times 10^9)(3 \times 10^{-6})}{(0,1)^2} \checkmark$$

$$= 2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \quad \text{right/ regs/east/oos} \checkmark$$

(6)

7.3 $-0,5 \times 10^{-6} \text{ C} \checkmark \checkmark$

(2)

7.4 **POSITIVE MARKING FROM QUESTION 7.3**

$$F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$F = \frac{kQ_1 Q_2}{r^2}$$

$$F (Q_1 \text{ on } 3) = \frac{(9 \times 10^9)(0,5 \times 10^{-6}) Q_3}{(0,25)^2} \checkmark$$

$$F (Q_1 \text{ on } 2) = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,5 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$= 72000 \times Q_3 \text{ N}$$

$$= 0,05625 \text{ N}$$

$$F_{\text{net}} = \sqrt{(F_{1,3})^2 + (F_{1,2})^2} \checkmark$$

$$5,4 \times 10^{-1} \checkmark = \sqrt{(72000 Q_3)^2 + (0,05625)^2}$$

$$Q_3 = 7,459 \times 10^{-6} \text{ C} \checkmark$$

(6)

[16]

QUESTION 8 / VRAAG 8

8.1.1 6V ✓

(1)

8.1.2 0,2 A ✓

(1)

8.2.1 POSITIVE MARKING FROM Q 8.1.1 AND 8.1.2

$$R = \frac{V}{I} \quad \checkmark$$

$$= \frac{3}{0,2} \quad \checkmark$$

$$= 15 \Omega \quad \checkmark$$

(3)

8.2.2 POSITIVE MARKING FROM Q8.1.2 (I=0,1A + Answer Q8.1.2)

OPTION 1

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} \quad \left. \vphantom{\frac{1}{R}} \right\} \text{Any one } \checkmark$$

$$= \frac{1}{45} + \frac{1}{90}$$

$$R = 30 \Omega$$

$$R_e = 30 + 60 \quad \checkmark = 90 \Omega$$

$$\varepsilon = I(R+r) \quad \checkmark$$

$$= (0,3)(90 + 2) \quad \checkmark$$

$$= 27,6 \text{ V } \quad \checkmark$$

OPTION 2

$$V_p = IR$$

$$= (0,3)(30) \quad \checkmark$$

$$= 9 \text{ V}$$

$$V_{\text{bulb}} = IR \quad \checkmark$$

$$= (0,3)(60)$$

$$= 18 \text{ V } \quad \checkmark$$

$$V_i = Ir$$

$$= (0,3)(2)$$

$$= 0,6 \text{ V}$$

$$\varepsilon = V_p + V_{\text{bulb}} + V_i$$

$$= 9 + 18 + 0,6 \quad \checkmark$$

$$= 27,6 \text{ V } \quad \checkmark$$

(5)

8.2.3 POSITIVE MARKING FROM Q8.1.2 + Q8.2.2

OPTION 1

$$P = I^2 R \quad \checkmark$$

$$= (0,3)^2 (60) \quad \checkmark$$

$$= 5,4 \text{ W } \quad \checkmark$$

OPTION 2

$$P = VI \quad \checkmark$$

$$= (18)(0,3) \quad \checkmark$$

$$= 5,4 \text{ W } \quad \checkmark$$

OPTION 3

$$P = \frac{V^2}{R} \quad \checkmark$$

$$= \frac{18^2}{60} \quad \checkmark$$

$$= 5,4 \text{ W } \quad \checkmark$$

(3)

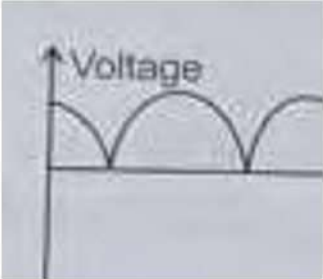
8.3 0 V ✓ (1)

8.4 Total resistance increases ✓
 ∴ Total current decreases ✓
 ∴ 'lost volts' (V_i) DECREASE ✓ because $V_i \propto I$ ($r = \text{constant}$) (3)
 [17]

QUESTION 9 / VRAAG 9

9.1.1 Anti-clockwise ✓ (1)


9.1.2 Electrical energy to kinetic(mechanical) energy ✓
 Elektriese energie na kinetiese(meganiese) energie (1)

9.1.3  **Marking criteria for graph:**
 Correct shape *Korrekte vorm* ✓
 Two complete cycle/*Twee volledige siklus* ✓ (2)

9.2.1 The AC potential difference/voltage which dissipates the same amount of energy ✓ as DC potential difference. ✓
Die WS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as GS potensiaalverskil/spanning.
 OR/OF
 (The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy ✓ as AC potential difference/voltage. ✓
Dit is die GS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as WS potensiaalverskil/spanning. (2)

9.2.2

<p>OPTION 1</p> $P_{ave} = V_{rms} \cdot I_{rms} \checkmark$ $= 230 \cdot \frac{I_{max}}{\sqrt{2}} \checkmark$ $2100 \checkmark = 230 \frac{I_{max}}{\sqrt{2}} \checkmark$ $I_{max} = 12,9 \text{ A} \checkmark$	<p>OPTION 2</p> $P_{ave} = V_{rms} \cdot I_{rms} \checkmark$ $2100 = 230 I_{rms} \checkmark$ $I_{rms} = 9,13 \text{ A}$ $I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$ $9,13 = \frac{I_{max}}{\sqrt{2}} \checkmark$ $I_{max} = 12,91 \text{ A} \checkmark$
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 (4)
 [10]

QUESTION 10 / VRAAG 10

10.1 $3,6 \times 10^{-19} \text{ J}$ ✓

(1)

10.2 The maximum kinetic energy is inversely proportional✓✓ to the wavelength.

(2)

10.3 **Marking criteria/Nasienkriteria**

If any one of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark. /Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel..

(2)

10.4

$$W_0 = \frac{hc}{\lambda_0} \checkmark$$

$$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{4,9 \times 10^{-7}} \checkmark$$

$$= 4,06 \times 10^{-19} \text{ J} \checkmark$$

(3)

10.5 **POSITIVE MARKING FROM 10.4**

$$E = W_0 + E_{k(\max)} \checkmark$$

$$\frac{hc}{\lambda} = W_0 + \frac{1}{2}mv^2$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda} \checkmark = (4,06 \times 10^{-19}) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})(2,6 \times 10^6)^2 \checkmark$$

$$\lambda = 5,7 \times 10^{-8} \text{ m} \checkmark$$

(5)
[13]

TOTAL/TOTAAL: 150