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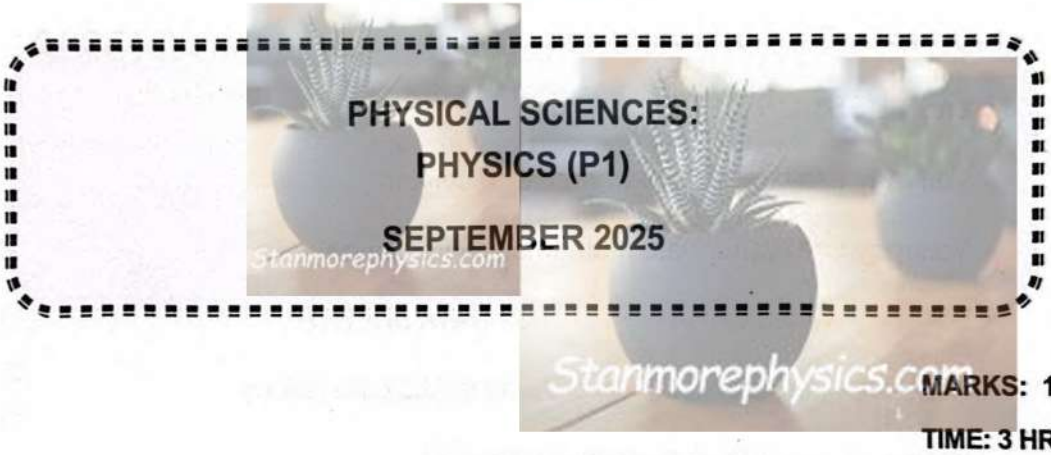

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2025

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MARKS: 150

TIME: 3 HRS

EPHSCP1

This question paper consists of 17 pages and 3 data sheets

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INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK
2. This question paper consists of 9 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, 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. 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 motivations, discussions et cetera where required.
12. Write neatly and legibly.

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QUESTION 1: MULTIPLE CHOICE QUESTIONS

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

1.1 Which ONE of the following statements regarding kinetic friction is TRUE?

A It is equal to the normal force and the friction coefficient

B It is inversely proportional to the normal force on the object

C It is dependent on the surface area of the object

D It is directly proportional to the normal force on the object (2)

1.2 The gravitational acceleration on the surface of the Earth is **g**.

The gravitational acceleration on another planet whose mass is FOUR TIMES and the radius TWO TIMES that of the Earth, is...

A $\frac{1}{2}$ g.

B g.

C 2 g.

D 4 g. (2)

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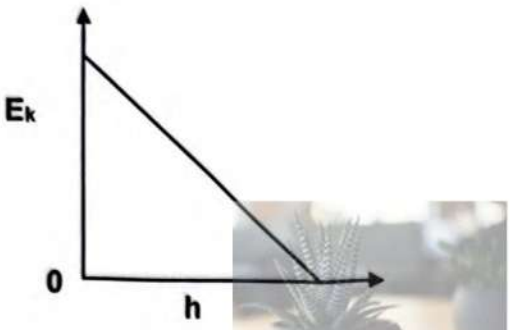
1.3 An object is dropped from a height **h** above the ground.

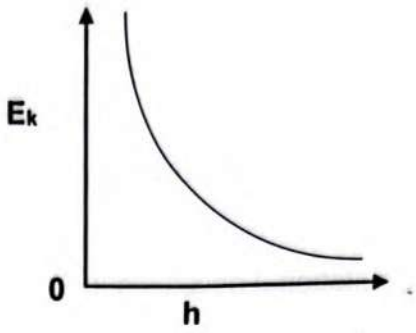
Neglect the effects of air resistance.

Which ONE of the following sketch graphs BEST represents the relationship between its kinetic energy (E_k) and its height above the ground?

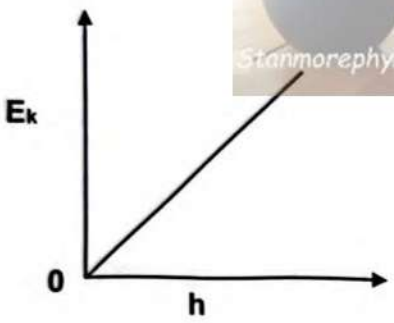
A



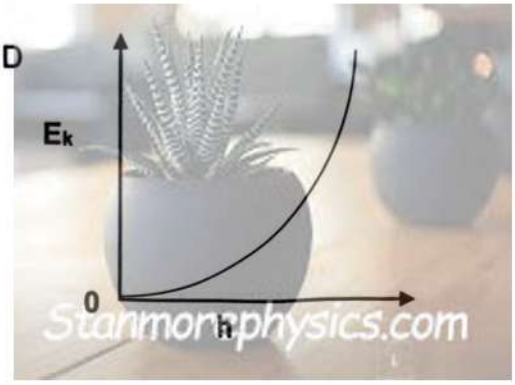
B



C

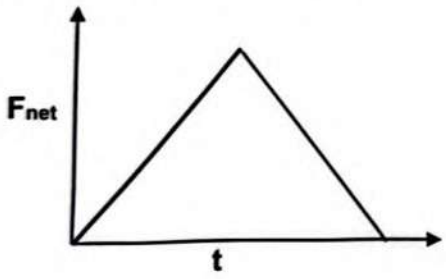


D



(2)

1.4 Study the following sketch graph.



The **area** between the graph and the time axis is EQUAL TO the…

A change in momentum.

B displacement.

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C momentum.

D change in kinetic energy. (2)

1.5 A body falls freely from REST. After it has "lost" **E** joules of the gravitational potential energy, its speed is **v** $m \cdot s^{-1}$. The mass (m), in kg, of the body is equal to…

A $\frac{v^2}{2g}$.

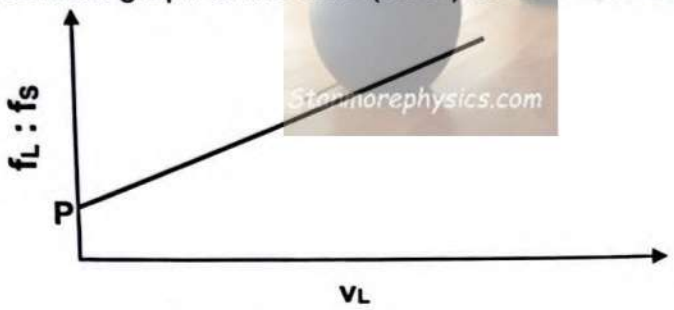
B $\frac{g}{v^2}$.

C $\frac{E}{g}$.

D $\frac{2E}{v^2}$. (2)

1.6 A listener is moving towards a stationary sound source.

A sketch graph of the ratio ($f_L : f_s$)-versus-v_L is shown below:



Which ONE of the following combinations gives the value of the intercept, **P**, and the gradient, **m**, of the graph CORRECTLY?

	P	m
A	1	$\frac{1}{v}$
B	1	v
C	2	$-\frac{1}{v}$
D	2	$-v$

(2)

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1.7 Two charged particles in a vacuum exert electrostatic forces on each other. The system of the particles is changed in such a way that the force that one particle exerts on the other particle is 25% of the INITIAL FORCE.

Which ONE of the following statements BEST represents what happened during the process of transformation?

A The charge on one of the particles is doubled.
B The charges on both particles are doubled.
C The distance between the two particles is doubled.
D The distance between the two particles is halved. (2)

1.8 A hairdryer is rated 1200 W. It is used for a total of 15 minutes. If the cost of electricity is R3,40 per kWh, the total cost will be...

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A R 1,02
B R 6,12
C R 61,20
D R 10,20 (2)

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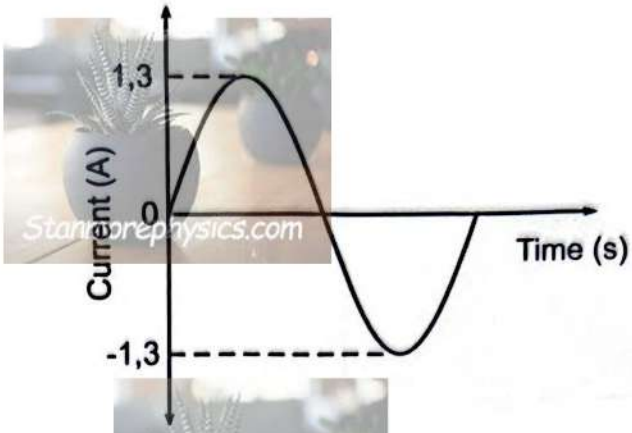
1.9 The following sketch graph shows the change in current in a generator.



Which ONE of the following combinations of statements correctly describes the generator?

	Type of Generator	No of rotations	I_{rms}
A	DC	½	1,3
B	AC	1	0,92
C	AC	½	1,3
D	DC	1	0,92

(2)

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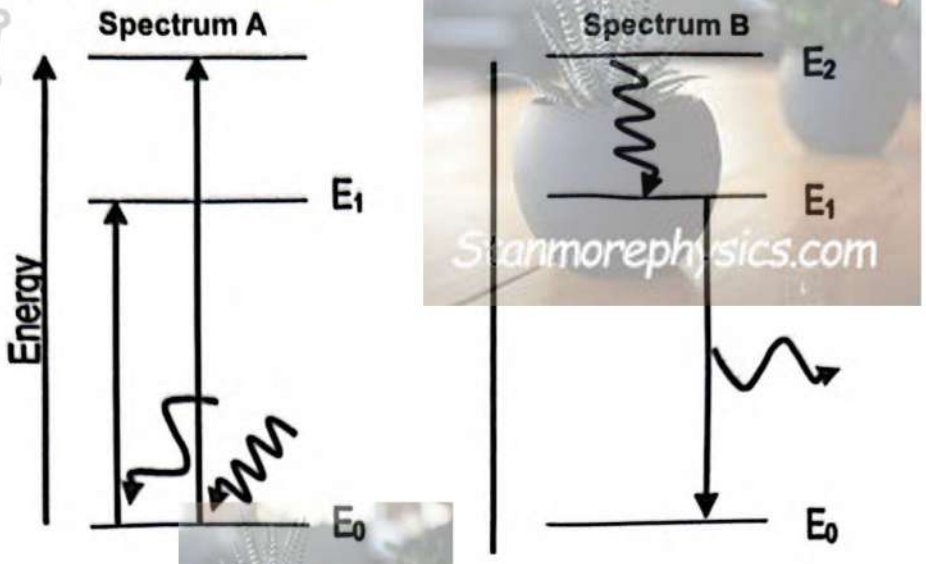
1.10 The following two diagrams illustrate the simple differences between atomic absorption and emission spectra.



Which ONE of the following combinations regarding the spectra is CORRECT?

	SPECTRUM A	LIGHT FREQUENCIES	SPECTRUM B	LIGHT FREQUENCIES
A	Emission	Absorbed	Absorption	Emitted
B	Absorption	Absorbed	Emission	Emitted
C	Emission	Emitted	Absorption	Absorbed
D	Absorption	Emitted	Emission	Absorbed

(2)

[20]

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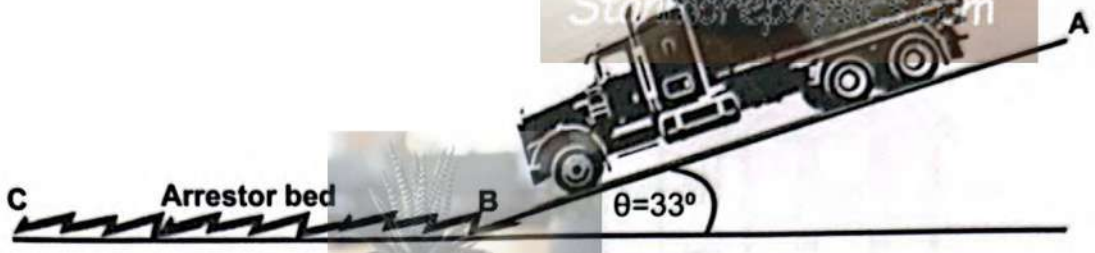
QUESTION 2 (Start on a new page)

A large 18-wheel truck drives down a mountain pass as illustrated in the diagram below. The total mass of the truck and its load is 40 000 kg. The truck driver must decide to use the arrestor bed on a horizontal surface (represented by **BC**) to keep the truck and other road users safe. The truck accelerates down the 400-m slope (**AB**) with an initial speed of 5,4 $m \cdot s^{-1}$ at point **A**. The driver applies a braking force of 10 000 N from point **A** to point **B**. The kinetic friction coefficient between the wheels and the road is 0,42.



Neglect the effects of air resistance.

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

2.2 Draw a labelled free body diagram for the truck whilst moving down the incline. (4)

2.3 Calculate the:

2.3.1 Component of the gravitational force that acts **parallel** to the incline (2)

2.3.2 Work done by the brakes over 400 m (3)

2.4 The driver realises that he is in trouble and enters the arrestor bed.

Assume that the driver has completely lost control of the braking system.

2.4.1 Calculate the speed of the truck as it enters the arrestor bed, at point **B**, *without using any energy considerations*. (5)

2.4.2 Define the term *impulse* in words, as applied in Physics. (2)

2.4.3 The truck comes to a standstill after travelling 55 m in 2,5 s.

Calculate the magnitude of the average frictional force provided by the gravel in the arrestor bed, by using the *impulse-momentum theorem*. (4)

2.4.4 Calculate the work done by friction. (3)

[25]

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QUESTION 3 (Start on a new page)

A person standing on the roof of a three storey building throws a ball vertically upwards from point **A** at an unknown velocity. The ball moves upwards and upon falling towards the ground, bounces off a roof of the ground floor level (**B**) and eventually hits the ground at point **C**.
Ignore any horizontal motion and air friction.

3.1 Explain what is meant by a *projectile*. (2)

3.2 The ball reaches a maximum height of 7 m above the starting point **A**.

Calculate the initial velocity of the ball. (3)

3.3 It takes the ball 2,83 s to reach the roof of the ground floor (**B**).

Calculate the velocity with which it reaches the roof. (3)

3.4 The ball leaves the roof of the first storey (**B**) with 75% of the velocity with which it hits the roof. It hits the ground at the point **C** with a velocity of 14,93 $m \cdot s^{-1}$.

Calculate the time the ball takes from **B** to **C**. (5)

3.5 Use the information from QUESTIONS **3.2 - 3.4** to calculate the height of point **A** above point **C**. (5)
[18]

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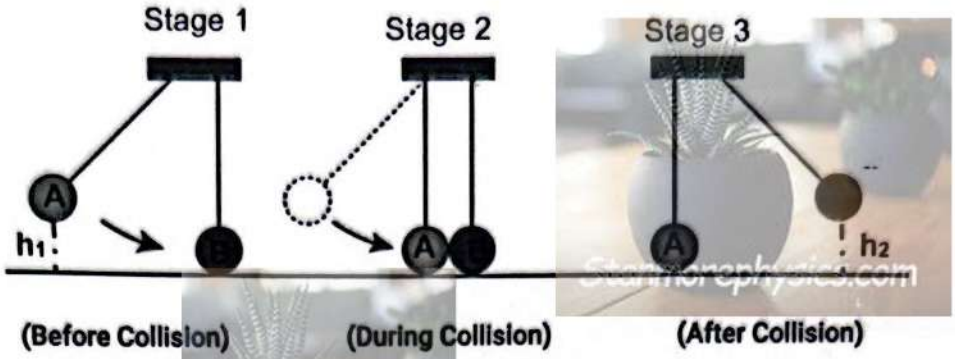
QUESTION 4 (start on a new page)

The diagram below shows three stages of the movement of two IDENTICAL small metal balls, each of mass 85 g, **before**, **during** and **after** collision.



Neglect the effect of air friction.

4.1 Calculate the mechanical energy of ball **A** in **STAGE 1** if the vertical height $h_1 = 0,7$ m. (3)

4.2 Hence, determine the speed with which ball **A** strikes ball **B** during **STAGE 2**. (3)

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

4.4 Use the principle in **QUESTION 4.3** to calculate the velocity of ball **B** just after the collision (**STAGE 3**) (4)

4.5 Write down the value of h_2, as shown in **STAGE 3.** (1)
[13]

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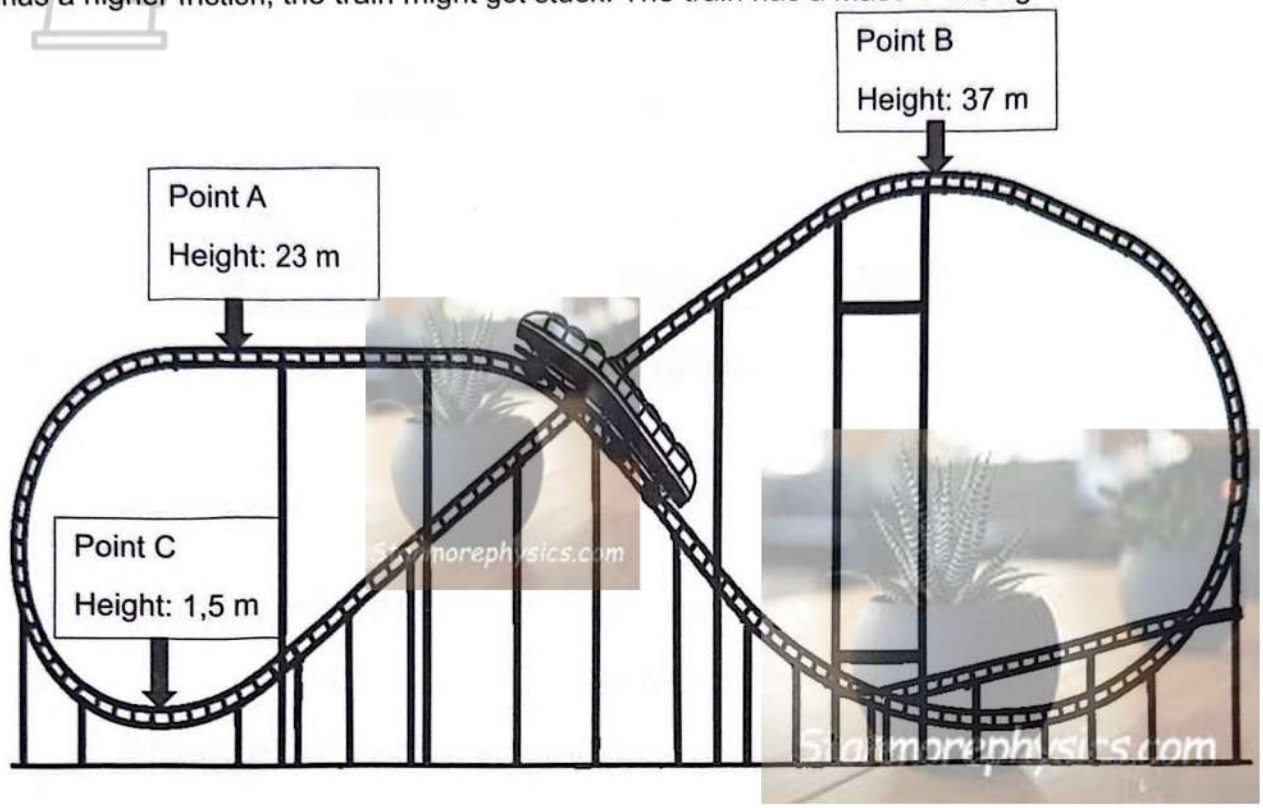
QUESTION 5 (Start on a new page)

The diagram below shows a roller coaster train moving on a track.
B represents the **highest point** where the amount of kinetic energy is a minimum. If the track has a higher friction, the train might get stuck. The train has a mass 4 410 kg.



5.1 State the *principle of conservation of mechanical energy* in words. (2)

The train passes point **A** with a velocity of 18 $m \cdot s^{-1}$ towards point **B**.

5.2 Calculate the velocity with which the train reaches point **B.** (4)

5.2 Assume that the track is an isolated system from A to B.

5.3 The train moves past point **C** at a speed of 25 $m \cdot s^{-1}$.

5.3.1 Calculate the work done by friction as the train moves from point **B** to point **C**. (4)

5.3.2 Is this system ISOLATED? State only YES or NO.

Suggest a reason for the answer. (2)

[12]

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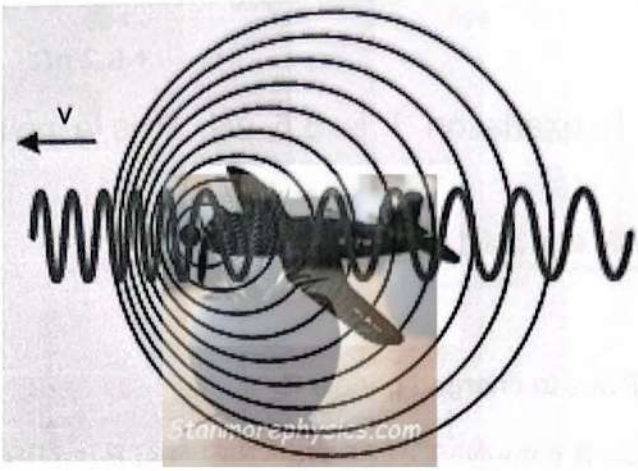
QUESTION 6 (Start on a new page)

A Cessna airplane is flying at an unknown constant speed towards a stationary observer on the ground. The plane's engine emits a steady sound with a frequency of 1 000 Hz.
After passing directly overhead, the observer hears a change in the sound.
Speed of sound in air is taken as 340 $m \cdot s^{-1}$



6.1 Name the wave phenomenon that is observed. (1)

6.2 The observer detects a frequency of 2428,57 Hz as the plane approaches.

Calculate the speed of the airplane. (4)

6.3 What change in frequency of sound is detected as the airplane **moves away** from the observer? Write down only INCREASES, DECREASES or REMAINS THE SAME.

Justify the answer with reference to the OBSERVED WAVELENGTH. (2)

6.4 Name ONE application of this phenomenon in medical fields. (1)
[8]

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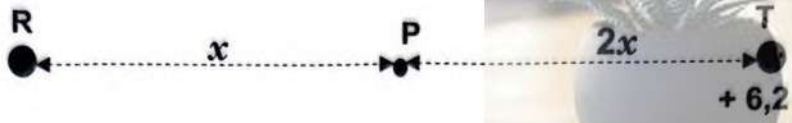
QUESTION 7 (Start on a new page)

Two **similar** charged particles, **R** and **T**, are placed $3x$ meters apart, as shown in the diagram below.



The electrostatic force that **R** exerts on **T** is 3,5 μN. **P** is a point between **R** and **T**.

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

7.2 Calculate the:

7.2.1 Electric field at **T** due to charged partcle **R** (3)

7.2.2 Charge on particle **R** if the NET ELECTRIC FIELD at **P** is ZERO (4)

7.2.3 Value of x (4)

Particles **R** and **T** are now allowed to touch.

7.3 In what direction will electrons flow? Only write **R** to **T** or **T** to **R** (1)

7.4 Calculate the new charge on EACH of the two particles, **R** and **T**. (2)

[16]

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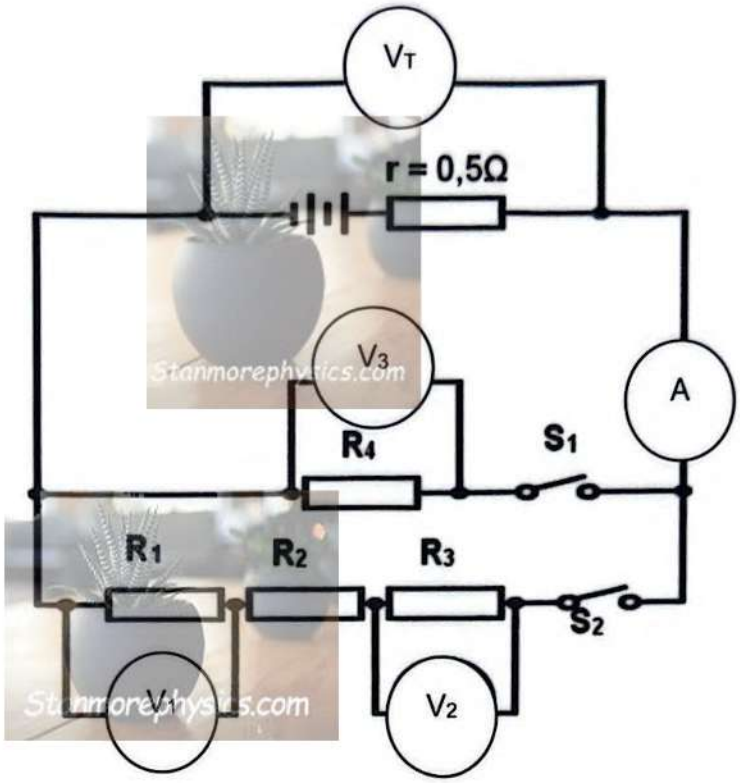
QUESTION 8 (Start on a new page)

The following circuit diagram consists of four resistors with IDENTICAL resistance. Both switches are open. The reading on V_T is 12 V.

S_1 is closed and the reading of V_T decreases to 11,3 V.



8.1 Define the term *emf* in words. (2)

8.2 Calculate the reading on **A.** (3)

S_2 is NOW closed, which causes a change in the reading on **A.**

8.3 How will the reading on **A** change? Only write INCREASE, DECREASE or REMAIN THE SAME. (1)

8.4 Explain the answer to QUESTION **8.3** above *without showing any calculations.* (2)

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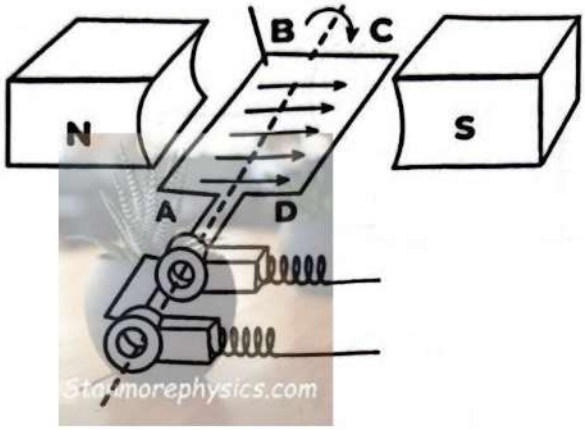
The reading on V_3 is 11,10 V.
Calculate the:

8.5 Resistance of R_2 (5)

8.6 Current through R_1 (3)
[16]

QUESTION 9 (start on a new page)

The following diagram shows a simple **GENERATOR**.



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

9.2 What type of generator (**AC** or **DC**) is illustrated in the diagram?

Refer to the diagram and give a reason for the answer. (2)

9.3 The frequency of the generator is 50 Hz.

Calculate the period. (2)

9.4 The rms voltage is 220 V.

9.4.1 Define the term *rms voltage* (2)

9.4.2 Calculate the maximum voltage induced in the coil (3)

9.5 Sketch a voltage-versus-time graph for two full rotations of the coil.

Clearly show the values of the following on the graph:

- Period of the full rotation (1 cycle)
- V_{max} (3)

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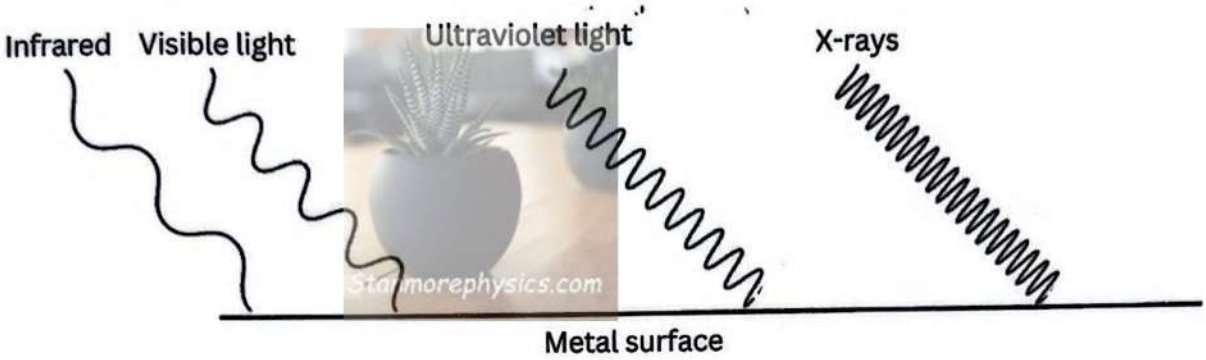
[14]

QUESTION 10 (start on a new page)

Electromagnetic (EM) waves have the ability to expel electrons from certain surfaces under certain conditions. This process also illustrates a specific nature of light. A group of learners conducts an investigation by shining different EM waves on a sodium metal surface to determine if electrons are emitted. The work function of sodium metal is $3,66 \times 10^{-19}$ J.



EM Waves	Frequency (Hz)
Infrared waves	10^{13}
Visible light	4×10^{14}
Ultraviolet	10^{15}
X-rays	10^{17}

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

10.2 NAME the phenomenon and STATE the characteristic of EM waves demonstrated in this investigation. (2)

10.3 Calculate the maximum speed of photo-electrons that are emitted when the EM wave with **highest energy** in the investigation, is used. (4)
[8]

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant	h	6,63 x 10^{-34} J·s
Coulomb's constant	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron	e	1,6 x 10^{-19} C
Electron mass	m_e	9,11 x 10^{-31} kg
Mass of the Earth	M	5,98 x 10^{24} kg
Radius of the Earth	R_E	6,38 x 10^6 m

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TABLE 2: FORMULAE

MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ OR $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ OR $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ OR $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE

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

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ OR $E_P = mgh$
$K = \frac{1}{2}mv^2$ OR $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ OR $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ OR $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ OR $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

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WAVES, SOUND AND LIGHT

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ OR $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ OR $E = W_o + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv_{max}^2$ OR $K_{max} = \frac{1}{2}mv_{max}^2$	

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ELECTROSTATICS

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

ELECTRIC CIRCUITS

$R = \frac{V}{I}$	emf (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

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

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GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

PREPARATORY 2025

MARKING GUIDELINE/ MERK RIGLYNE

ERRATA

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MARKS: 150

These marking guidelines consist of 12 pages

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QUESTION/VRAAG 1

1.1 D✓✓

1.2 B✓✓

1.3 A✓✓

1.4 A✓✓

1.5 D ✓✓

1.6 A ✓✓

1.7 C ✓✓

1.8 A✓✓

1.9 B ✓✓

1.10 B ✓✓

(2 x 10 =20)

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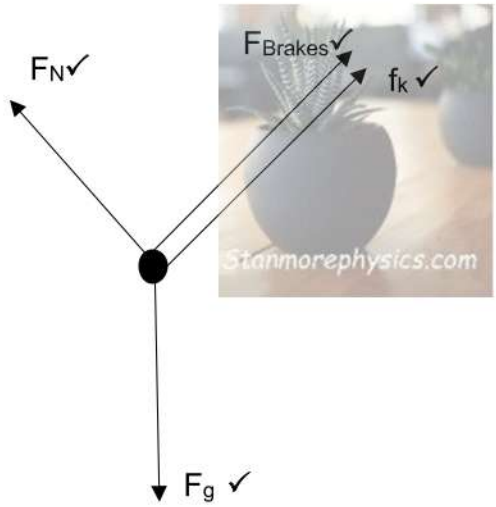
QUESTION/VRAAG 2

2.1 When a (non-zero) net force acts on an object, the object will accelerate in the direction of the (net) force at an acceleration that is directly proportional to the (net) force and inversely proportional to the mass of the object.✓✓

Wanneer 'n (nie-nul) resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die (netto)krag en omgekeerd eweredig aan die massa van die voorwerp.✓✓ (2)

2.2



ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
F_N	Normal force/N /$F_{surface\ on\ truck}$	*Normaalkrag/ N/$F_{oppervlak\ op\ trok}$*
f_k	Kinetic friction / friction /Frictional force	*Kinetiese wrywing/wrywing/wrywingskrag*
F_g	w, weight/Gravitational force/ $F_{earth\ on\ truck}$	*Gewing/Gravitasiekrag/ $F_{aarde\ op\ die\ trok}$*
F_{Brakes}	Force of Brakes/ F_A/Applied force	F_{remme} */ Krag van remme/ F_T/ Toegepaste krag*
Notes: • Mark awarded for label and arrow • Do not penalize for length of arrows • Any additional force/s: -1 • If force(s) do not make contact with the body: -1 mark • -1 mark if all arrowheads are omitted but correctly labelled.		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *Addisionele krag/te:-1* • *As kragte nie kontak maak met kol nie: -1* • *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.*
		(4)

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2.3.1 F_{gll} = $mg\sin\theta$ (no mark for formula)
= (40 000)(9,8)(sin 33º ✓
= 213 498,50 N ✓ (213 498,5017 N) (2)

2.3.2 W = $F\Delta x\cos\theta$ ✓
= (10 000)(400)(cos180º) ✓
= - 4,0 x 10^6 J ✓ (- 4 000 000 J) (3)

2.4.1 POSTIVE MARKING FROM 2.3.1

The speed of the truck is calculated from the motion of A to B. The pre-amble clearly states that the brakes were still functional during this motion.

Fnet = ma

$F_{gll} - F_{Brakes} - f_k = ma$

$mg\sin\theta - 10000 - \mu_k mg\cos\theta = ma$

40000(9,8)(sin33º) – 10000 – (0,42)(40000)(9,8)cos33º✓= 40000a✓

OR

213 498,50 – 10000 – (0,42)(40000)(9,8)cos33 ✓ = 40000a ✓

a = 1,64 m·s^{-2} (downhill)
(Range: 1,63549 – 1,64) (5)

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ **Carry over**

= $(5,4)^2$ + 2(1,64)(400) ✓

v_f = 36,62 m·s^{-1} (downhill/down the incline) ✓ (Range: 36,5726-36.62)
(*af teen helling/afwaarts)*

2.4.2 The product of the resultant/net force acting on an object and the time the net force acts on the object. ✓✓

Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk ✓✓ (2)

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2.4.3 **POSITIVE MARKING FROM QUESTION 2.4.1**

The only horizontal force present, is the friction caused by the gravel. Therefore friction is seen as the net force.

NOTE: ONLY THE IMPULSE-MOMENTUM THEORY METHOD IS ALLOWED (4)

$F_{net}\Delta t = \Delta p$ ✓

$F_{net}(2,5)$ ✓ $= 40\,000(0 - 36,62)$ ✓

$F_{net} = 585\,161,71$N (range: 585 161,71 – 585 920 N) ✓

2.4.4 **POSITIVE MARKING FROM QUESTIONS 2.4.1 , 2.4.3**

OPTION 1

$W = f\Delta x\cos\theta$ ✓

$= 585\,161,71\,(55)\cos180$ ✓

$= -3,22 \times 10^7$ J ✓

OPTION 2 (OPTIONS 2 and 3 Provides a different answer)

$W_{nc} = \Delta E_p + \Delta E_k$ ✓

$\therefore W_f = 0 + \frac{½\,(40\,000)(0)^2 - ½\,(40\,000)(36,62)^2}{}$ ✓

$= -2,675 \times 10^7$ N (Range: $=2,675 \times 10^7 - 2,68 \times 10^7$ N) ✓

OPTION 3

$W_{net} = \Delta E_k$ ✓

$= \frac{½\,(40\,000)(0)^2 - ½\,(40\,000)(36,62)^2}{}$ ✓

$= -2,675 \times 10^7$ N (Range: $=2,675 \times 10^7 - 2,68 \times 10^7$ N) ✓

(3)

[25]

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QUESTION/ VRAAG 3

3.1 An object that has an initial velocity and moves under the influence of the gravitational force only. ✓✓ (2)

'n Voorwerp met 'n aanvangsnelheid wat slegs onder die invloed van die gravitasiekrag beweeg.✓✓

3.2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(9{,}8)(-7)$ ✓

$v_i = 11{,}71\ m \cdot s^{-1}$ upward ✓ (3)

3.3 **POSITIVE MARKING FROM QUESTION 3.2**

$v_f = v_i + at$ ✓

v_f = (-11,71) +9,8(2,83) ✓

= 16,02 m·s^{-1} downward ✓ (3)

3.4 **POSITIVE MARKING FROM QUESTION 3.3**

NOTE: Candidate may not show calculation, but is credited if it was calculated and substituted

75 % of 16,02= 12,015 m·s^{-1}✓

Carry over mark – if initial value calculated incorrectly, candidate gets mark for substituting correctly but not further.

$v_f = v_i + a\Delta t$ ✓

14,93✓ = -12,015 + 9,8 ·Δt✓

Δt = 2,7495 s ✓ (Range: 2,7495 – 2,75) (5)

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3.5 **POSITIVE MARKING 3.2,3.3,3.4**

OPTION 1:

AB:

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

= (-11,71)(2,83) + ½ (9,8)(2,83)² ✓

= 6,10 m (6,10431 m)

BC:

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

= (-12,015)(2,749) + ½ (9,8)(2,749)² ✓

= 4,00 m

OPTION 2:

AB

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(16,02)^2 = (-11,71)^2 + 2(9,8)\Delta y$ ✓

Δy = 6,0977m

BC

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(14,93)^2 = (-12,015)^2 + 2(9,8)\Delta y$ ✓

Δy = 4,00m

OPTION 3

AB

$\Delta y_{AB} = \left(\frac{v_f + v_i}{2}\right) \Delta t$ ✓

$\Delta y_{AB} = \left(\frac{-16,02 + 11,71}{2}\right) (2,83)$ ✓

Δy = -6,09865

BC:

$\Delta y_{AB} = \left(\frac{v_f + v_i}{2}\right) \Delta t$

$\Delta y_{AB} = \left(\frac{-14,93 + 12,015}{2}\right) (2,749)$ ✓

Δy = -4,015

Total height: 6,09865 + 4,015 = 10,11 m ✓

(5)

[18]

MARKING CRITERIA:

- One mark for either formula present to calc Δy for AB or BC
- Substitution to calc AB
- Substitution to calc BC
- Addition of AB + BC
- Final answer

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QUESTION/VRAAG 4

Afrikaans and English papers differ in mass of objects:

Afrikaans = 85 kg

English = 85 g

NOTE: Mass conversions is imperative. Penalise when conversion is not done correctly.

4.1 $E_M = E_p + E_k$ ✓ Any one

$= mgh + ½ mv^2$

$= (85 \times 10^{-3})(9,8)(0,7) + \frac{1}{2}(85 \times 10^{-3})(0)^2$ ✓

$= 0,5831$ J ✓

AFRIKAANS:

$= (85)(9,8)(0,7) + \frac{1}{2}(85)(0)^2$

$= 583,1$ J

(3)

4.2 **POSTIVE MARKING FROM 4.1**

OPTION 1

$E_{Mtop} = E_{Mbottom}$ ✓ any one

$= E_p + ½ mv^2$

$0,5831 = 0 + \frac{1}{2}(85 \times 10^{-3})v^2$ ✓

$v = 3,70$ m·s^{-1} right ✓ (3,7041 m·s^{-1})

AFRIKAANS:

$583,1 = 0 + \frac{1}{2}(85)v^2$

$v = 3.70$ m·s^{-1}

OPTION 2:

$W_{net} = \Delta E_k + \Delta E_p$ ✓

$0 = (mgh_{bottom} - mgh_{top}) + (½ mv^2 - ½ mv^2)$

$0 = [0-(85 \times 10^{-3})(9,8)(0,7)] + [½ (85 \times 10^{-3})v^2 - 0]$ ✓

$v = 3,70$ m·s^{-1} right ✓

(3)

4.3 The total linear momentum of an isolated system remains constant/is conserved. ✓✓

Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant/ bly behoue ✓✓ (2)

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4.4 POSITIVE MARKING 4.2

$\Sigma p_i = \Sigma p_f$ ✓any one

$mv_A + mv_B = mv_A + mv_B$ (4)

$(85 \times 10^{-3})(3,7)$ ✓$+0 = 0 + 85 \times 10^{-3} v_f$✓

$v_f = 3,7 \text{ m·s}^{-1}$ Right ✓

AFRIKAANS:

$\Sigma p_i = \Sigma p_f$ ✓any one

$mv_A + mv_B = mv_A + mv_B$

$(85)(3,7)$ ✓$+0 = 0 + (85)v_f$✓

$v_f = 3,7 \text{ m·s}^{-1}$right ✓

OPTION 2:

$\Delta p_A = -\Delta p_B$ ✓

$[0 - (85 \times 10^{-3})(3,7)] = -[(85 \times 10^{-3})(v_B)-0]$ ✓

$V_b = 3,7 \text{ m.s}^{-1}$ Right✓

4.5 0,7m ✓ **Same value as A started** (1)

[13]

QUESTION/VRAAG 5

5.1 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. ✓✓

Die totale meganiese energie (som van gravitasie- potensiële energie en kinetiese energie) in 'n geïsoleerde sisteem bly konstant. ✓✓ (2)

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5.2 **OPTION 1**

$E_{MA} = E_{MB}$

$(E_p + E_k)_A = (E_p + E_k)_B$ Any ✓

$\frac{(4410)(9,8)(23) + \left(\frac{1}{2}\right)(4410)(18)^2}{}$ ✓ $= \frac{(4410)(9,8)(37) + \left(\frac{1}{2}\right)(4410)v^2}{}$ ✓

$v_B = 7,04\ m{\cdot}s^{-1}$ ✓ $(7,04273\ m{\cdot}s^{-1})$ (4)

OPTION 2

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

$0 = [(4410)(9,8)(37) - (4410)(9,8)(23)] + [\left(\frac{1}{2}\right)(4410)(18)^2 - \left(\frac{1}{2}\right)(4410)v^2]$ ✓

$v = 7,04\ m.s^{-1}$

5.3.1 **POSITIVE MARKING from 5.2**

OPTION 1

$W_{nc} = \Delta E_P + \Delta E_k$ ✓

$= (4410)(9,8)(1,5 - 37)$ ✓ $+ \left(\frac{1}{2}\right)(4410)(25^2 - 7,04273^2)$ ✓ (4)

= - 265 482,1011 J ✓ (- 265 397,33 J)

OPTION 2

Calculate $E_{mechanical}$ at points B and C

$E_{MC} = E_p + E_k$

$E_{MC} = \frac{1}{2}mv^2 + mgh$ ✓(Formula at either MC or MB)

$= \frac{1}{2}(4410 \times 25^2) + (4410 \times 9,8 \times 1,5)$ ✓

= 1 442 952 J

$E_{MB} = \frac{1}{2}(4410 \times 7,04^2) + (4410 \times 9,8 \times 37)$ ✓

=1 708 349,328 J

$W_{fk} = E_{MC} - E_{MB}$

= 1 442 952 – 1 708 349,328

= - 265 397,328 J ✓

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5.3.2 NO ✓

Friction is present / The external net force is not equal to zero

There is a non-conservative force acting. ✓

Nee✓

Wrywing (is teenwoordig)/Die eksterne netto krag is nie nul nie

Daar is 'n nie-konservatiewe krag teenwoordig ✓ (2)

[12]

QUESTION/VRAAG 6

6.1 Doppler Effect

Doppler Effek ✓ (1)

6.2 $f_L = \left(\frac{v \pm v_L}{v \pm v_S}\right) f_S$ ✓

$2428{,}57$✓ $= \left(\frac{340}{340 - v_S}\right) 1000$ ✓

v_s = 200,00 m·s^{-1} ✓ (199,9999176 m·s^{-1})

(4)

6.3 DECREASES✓

The wavelengths are longer. ✓

ACCEPT: Waves are stretched out/Wave crests are farther apart/wavelength increase ✓

$f = \frac{1}{\lambda}$

(2)

VERLAAG ✓

Die golflengtes is langer ✓

AANVAAR:*Golwe is uitgerek/Golffronte is verder uit mekaar* ✓

6.4 Ultrasound
Detection of blood clots
Detection of heart problems Any ✓
Fetal blood flow
Blood flow in the heart/organs

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Ultraklank
Bloedklonte
Hart probleme
Fetale bloed vloei
Bloed vloei in hart/organe

(1)
[8]

QUESTION/VRAAG 7

7.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point ✓✓

Die elektrostatiese krag wat per eenheid positiewe lading wat by daardie punt geplaas is, ondervind word. ✓✓

(2)

7.2.1 $E = \frac{F}{q}$ ✓

$= \frac{3{,}5 \times 10^{-6}}{6{,}2 \times 10^{-9}}$ ✓

$= 564{,}516\ N \cdot C^{-1}$ Right ✓

(3)

7.2.2 Take to the right as positive:

OPTION 1

$E = \frac{kQ_R}{r^2}$ Use of formula ✓

$E_{net} = \frac{kQ}{r^2} + \frac{kQ}{r^2}$ Substitution of any one ✓

0 ✓ $= \frac{(9x10^9)Q_R}{(x)^2} - \frac{(9x10^9)(6{,}2x10^{-9})}{(2x)^2}$

SIMPLIFY BY MULTIPLYING WITH x^2 THROUGHOUT

$0 = (9x10^9)Q_R - \frac{(9x10^9)(6{,}2x10^9)}{4}$

$Q_R = 1{,}55 \times 10^{-9} C$ ✓

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OPTION 2

$E = \frac{kQ_R}{r^2}$ Use of formula ✓

$E_{T\text{ at }P} = E_{R\text{ at }P}$ ✓

Substitution of any one ✓

$\frac{(9x10^9)Q_R}{(x)^2} = \frac{(9x10^9)(6{,}2x10^{-9})}{(2x)^2}$

$Q_R = 1{,}55 \times 10^{-9}C$ ✓

(4)

NOTE: Consider to the left as positive also.

7.2.3 **POSITIVE MARKING FROM 7.2.2**

OPTION 1

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$3{,}5 \times 10^{-6} = \frac{(9x10^9)(6{,}2x10^{-9})(1{,}55x10^{-9})}{r^2}$ ✓

r = 0,157 – 0,1572

$3x$ = 0.1572 ✓ (Division with 3)

x = 0,052 m ✓ (0,0524 m)

OPTION 2

$E = \frac{kQ_1}{r^2}$

$E = \frac{(9x10^9)(1{,}5x10^{-9}}{(3x)^2}$

X = 0,0157 m

(4)

7.3 **POSITIVE MARKING FROM 7.2.2**

R to T ✓

(NOTE: Wrong calculation in QUESTION 7.2.2 giving $Q_R > Q_T$: T to R)

(1)

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7.4 **POSITIVE MARKING FROM 7.2.2**

$$Q_{new} = \frac{(1{,}55\text{x}10^{-9}) + (6{,}2\text{x}10^{-9})}{2}$$ ✓

(2)

$Q_{new} = 3{,}875\ \text{x}10^{-9}\text{C}$ ✓ (3,88 x 10^{-9}C) **[16]**

QUESTION/VRAAG 8

8.1 It is the maximum energy provided by a battery per unit charge passing through it. ✓✓

Dit is die maksimum energie wat 'n battery lewer per eenheidslading wat daardeur vloei. (2)

8.2 **OPTION 1**

$V_{internal} = Ir$ ✓

$12 - 11{,}3 = I(0{,}5)$

OR

$0{,}7 = I(0{,}5)$ ✓

$I = 1{,}4\ \text{A}$ ✓

OPTION 2

$\varepsilon = V_{external} + V_{internal}$ ✓

$12 = 11{,}3 + I(0{,}5)$ ✓

$I = 1{,}40\ \text{A}$ ✓

(3)

8.3 INCREASE ✓

TOENEEM (1)

8.4 S_2 causes a parallel circuit:

R_{total} decreases ✓

I_{total} increases since $I \propto \frac{1}{R}$ ✓

OR:

I is inversely proportional to R. Therefore, as R_{total} decrease, I_{total} will increase. ✓✓

S_2 veroorsaak dat die stroombaan verander in parallel skakeling:

R_{totaal} neem af ✓

I_{totaal} neem toe want $I \propto \frac{1}{R}$ ✓

OF:

I is omgekeerd eweredig aan R. Daarom, wanneer R_{totaal} afneem, sal I_{totaal} toeneem. ✓✓

(2)

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8.5 **OPTION 1**

$\varepsilon = I(R + r)$

$\varepsilon = V_{external} + Ir$

$12 = 11{,}10 + I(0{,}5)$ ✓

$I = 1{,}8\ A$

Carry over mark✓

$V_p = IR_p$

$11{,}10 = 1{,}8\ R_p$

$R_p = 6{,}17\ \Omega$ (6,1667 Ω)

✓Formula for R_p

$\frac{1}{R_p} = \frac{1}{R_4} + \frac{1}{R_s}$

$\frac{1}{6{,}17} = \frac{1}{x} + \frac{1}{3x}$ ✓

$x = 8{,}23\ \Omega$ ✓ (8,2267 Ω

OR

$\frac{1}{R_P} = \frac{R_4 + (R1 + 2 + 3)}{R_4 x R_s}$ ✓

$\frac{1}{6{,}17} = \frac{x + 3x}{3x^2}$ ✓

$3x = 24{,}6667$

$X = 8{,}222\Omega$✓

OPTION 2

$V_{internal} = Ir$

$0{,}9 = I(0{,}5)$ ✓

$I_T = 1{,}8\ A$

Carry over mark✓

$\varepsilon = I(R + r)$

$12 = 1{,}8(R + 0{,}5)$

$R = 6{,}1667$

OPTION 3

Calculate R_4 in the initial circuit,

$V = IR_4$ ✓

11,3 ✓= I(1,4) ✓

$R_4 = 8{,}07\Omega$ ✓

$R_2 = R_4$✓ (5)

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8.6 **POSITIVIE MARKING**

OPTION 1

$V = IR$ ✓
$11{,}10 = I(24{,}6801)$
$I = 0{,}4498\ A$ ✓

R_s = 24,68 (8,2267 x 3) ✓

OPTION 2

Ratio's:

1,8 x $\frac{1}{4}$ ✓✓ = 0,45 A ✓

(3)

[16]

OPTION 3

$V = IR$ ✓
11,10 = I(8,22) ✓
I_{RH} = 1,3504

$I_{Tot} = I_{R1} + I_{R4}$
1,8 = I_{R1} + 1,3596
I_{r1} = 0,45A ✓

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Resistors in series are potential dividers:

$\frac{V}{3} = \frac{11{,}1}{3}$ ✓ $= 3{,}7$ V

$I = \frac{V}{R}$ ✓ $= \frac{3{,}7}{8{,}22} = 0{,}45$ A ✓

QUESTION/VRAAG 9

9.1 Mechanical (energy) to Electrical (energy) ✓✓
Meganiese (energie) na Elektriese (energie) (2)

9.2 AC / Alternating ✓
It has slip rings ✓

WS/Wisselstroom ✓
Dit het sleep ringe ✓ (2)

9.3 $T = \frac{1}{f}$

$= \frac{1}{50}$ ✓

= 0,02 s ✓ (2)

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9.4.1 The AC potential difference which dissipates/produces the same amount of energy as an equivalent DC potential difference. ✓✓

Die WS potensiaalverskil wat dieselfde hoeveelheid energie verbruik/oordra as 'n ekwivalente GS potensiaalverskil. ✓✓

(2)

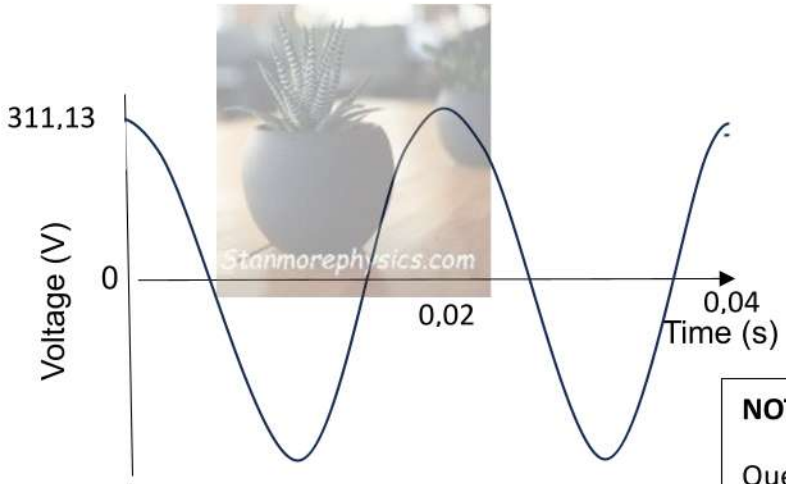
9.4.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$220(\sqrt{2})$✓ $= V_{max}$

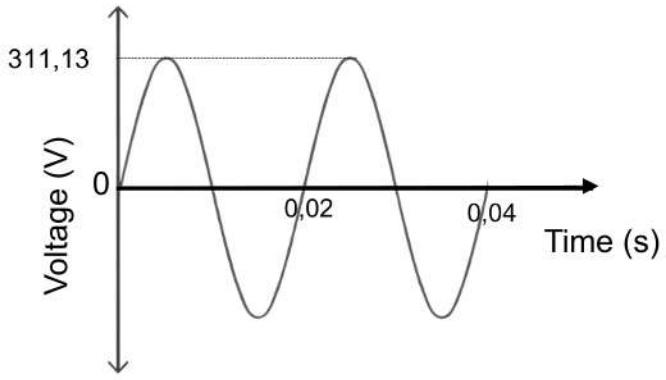
$V_{max} = 311{,}13$ V ✓

(3)

9.5



ACCEPT, since the instruction does not specify That the graph must start with same orientation As the diagram.



NOTES:

Question does not require 2 cycles to start at the same position as the coil in the diagram.

Period (0,02 s) ✓

V_{max} =311,13 ✓

Correctness: (Shape and 2 full cycles) ✓

(3)

[14]

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QUESTION/VRAAG 10

10.1 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)

10.2 Photoelectric effect ✓ **and** particle nature of light ✓

Foto-elektriese effek ✓ **en** *deeltjie-aard van lig* ✓ (2)

10.3 $E_{light} = W_o + E_{k(max)}$ ✓ (note that subscript (max) is essential)

$(6{,}63\ x10^{-34})(1x10^{17})$✓ $= (3{,}66\text{x}10^{-19}) + \left(\frac{1}{2}\right)(9{,}11\text{x}10^{-31})v_{max}^2$✓

v_{max} = 1,20 x 10^7 m·s^{-1} ✓ (12 031 243,63 m·s^{-1}) (4)

[8]

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GRAND TOTAL/GROOTTOTAAL: 150