education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

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PHYSICAL SCIENCES: PHYSICS P1

JUNE 2025

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MARKS: 150

TIME: 3 HOURS

This question paper consists of 18 pages including 3 information sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name on the FOLIO PAPERS.
2. This question paper consists of NINE 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 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. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answer 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.

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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 PAPER, e.g. 1.11 E.

1.1 A trolley moves on a flat horizontal surface while a constant force **F** is applied on it.



Which ONE of the following physical quantities will ALWAYS remain constant while the trolley is moving?

A Momentum

B Velocity

C Kinetic energy

D Gravitational potential energy (2)

1.2 There is a gravitational force of **F** between objects **A** and **B** at a distance **R** apart. What will be the gravitational force in terms of **F**, if the mass of **A** doubles and the distance triples?

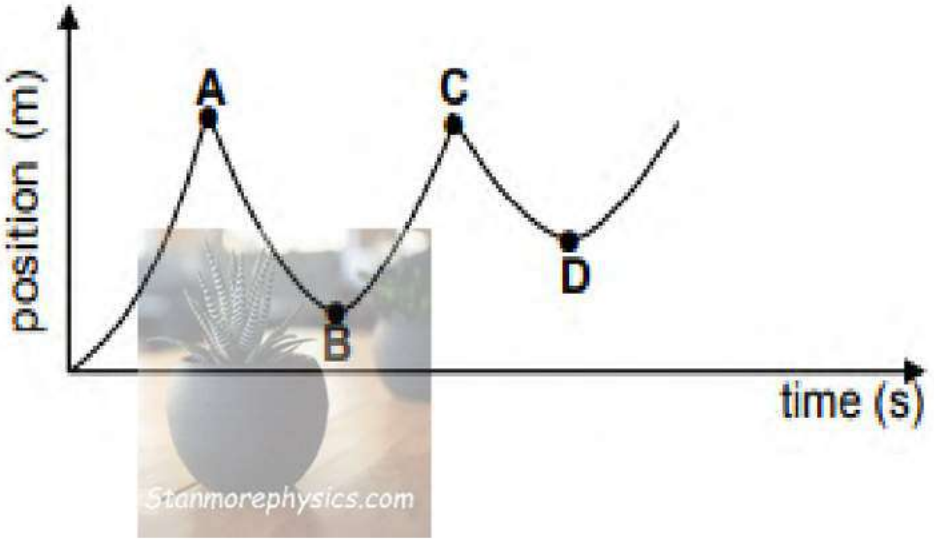
A **F**

B ⅔ **F**

C $\frac{2}{9}$ **F**

D 3**F** (2)

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



Neglecting air resistance, which point (**A**, **B**, **C** or **D**) on the graph represents the position-time coordinates of the maximum height reached by the ball after the SECOND bounce?

A **A**

B **B**

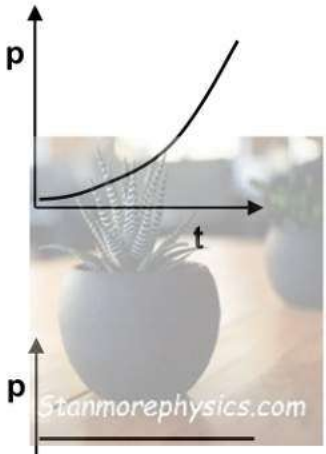
C **C**

D **D**

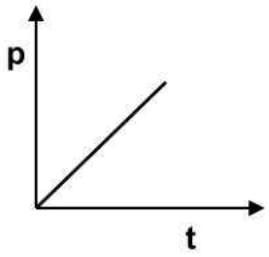
(2)

1.4 An object moves from rest in a straight line under the influence of a constant net force.
Which one of the following momentum-time graphs represent the motion of the object best?

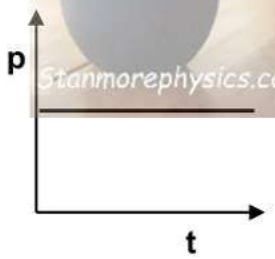
A



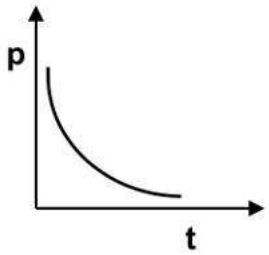
B



C



D



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(2)

1.5 A box 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)

1.6 The hooter of a car emits sound of constant frequency as the car moves away from a stationary listener holding a detector.
Which ONE of the following properties of the sound will NOT change?

A Velocity

B Frequency

C Both wavelength and frequency

D Both frequency and loudness (2)

1.7 Particle **R** has a charge Q and particle **S** has a charge 2Q.They are a distance **r** apart.Which ONE of the following statements regarding the electrostatic force, F_{RS}, that particle **R** exerts on particle **S** , and the electrostatic force, F_{SR} , that particle **S** exerts on particle **R**, is correct?



A $F_{RS} = 2\,F_{SR}$

B $F_{RS} = \frac{1}{2}\,F_{SR}$

C $F_{RS} = F_{SR}$

D $F_{RS} = -F_{SR}$ (2)

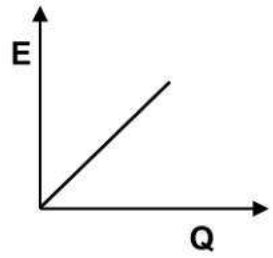
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1.8 The magnitudes of electric fields caused by different point charges are measured at a fixed point. Which ONE of the following graphs is the correct representation of the relationship between the magnitude of the electric field (**E**) and the magnitude of the charge (**Q**)?

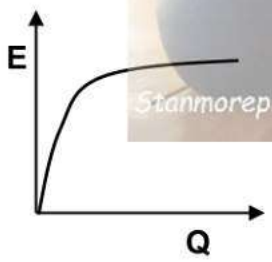
A



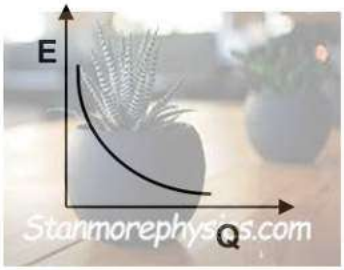
B



C

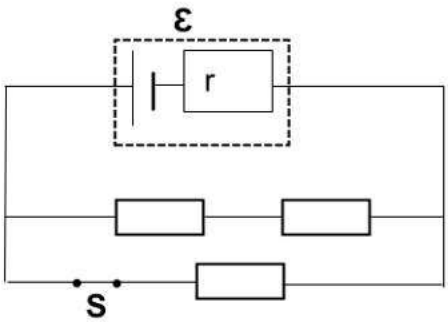


D



(2)

1.9 A cell, with an emf **Ɛ** and an internal resistance **r**, three identical resistors are connected in a circuit as shown in the diagram below. Initially the switch **S** is closed.

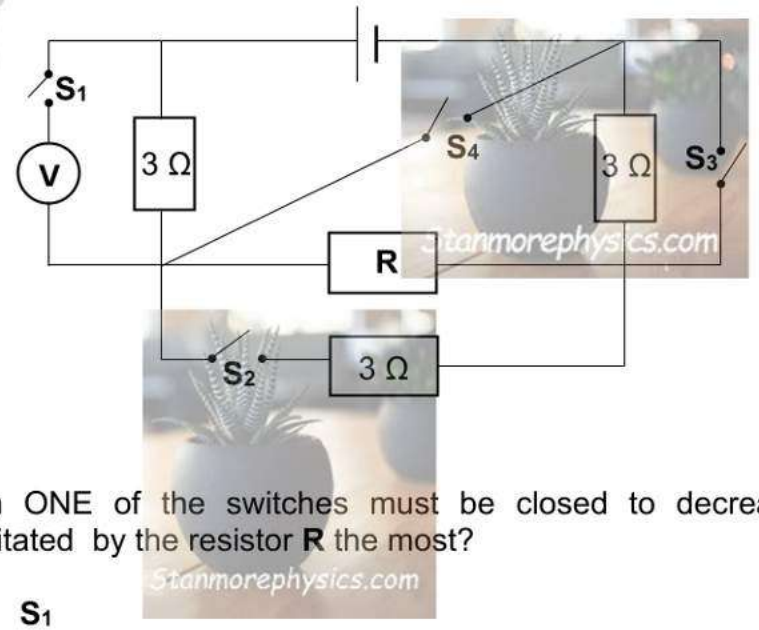


The switch **S** is now open.
Which ONE of the following represents the changes in the emf (**Ɛ**) and the total resistance in the circuit correctly?

	EMF (Ɛ)	**TOTAL RESISTANCE**
A	Stays the same	Increases
B	Stays the same	Decreases
C	Decreases	Decreases
D	Increases	Increases

(2)

1.10 Consider the following circuit diagram.



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Which ONE of the switches must be closed to decrease the power dissipitated by the resistor **R** the most?

A **S_1**

B **S_2**

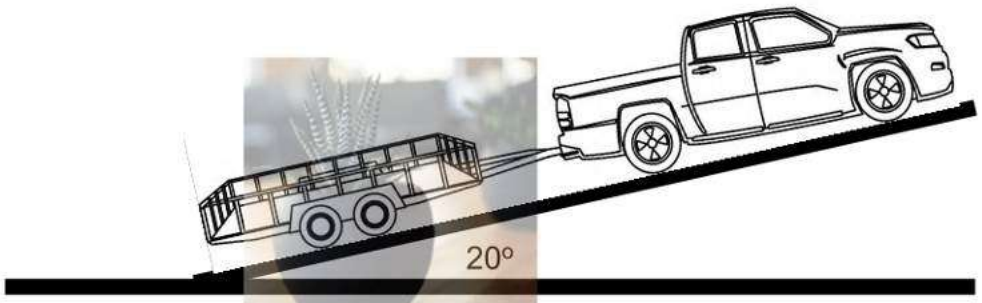
C **S_3**

D **S_4** (2)

[20]

QUESTION 2 (Start on a new page.)

A bakkie with a trailer drives up an incline with a constant acceleration of 2,5 $m.s^{-2}$ (the mass of the bakkie is 2 700kg and the trailer is 1 200kg). The incline makes an angle of 20° with the horizontal.



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The coefficient of kinetic friction for the bakkie is 0,3 and for the trailer is 0,2.
The force that the bakkie exerts on the trailer is parallel to the surface.

2.1 State Newton's Second Law of Motion in words. (2)

2.2 Draw a labelled free-body diagram indicating all the forces acting on the trailer as it is pulled up the inclined plane. (4)

2.3 Calculate the magnitude of the kinetic friction experiences by the trailer. (3)

2.4 Is the frictional force opposing the motion of the trailer?
Choose from YES or NO. (1)

2.5 Calculate the force that the bakkie exerts on the trailer parallel to the surface. (5)

2.6 State Newton's First Law of Motion in words. (2)

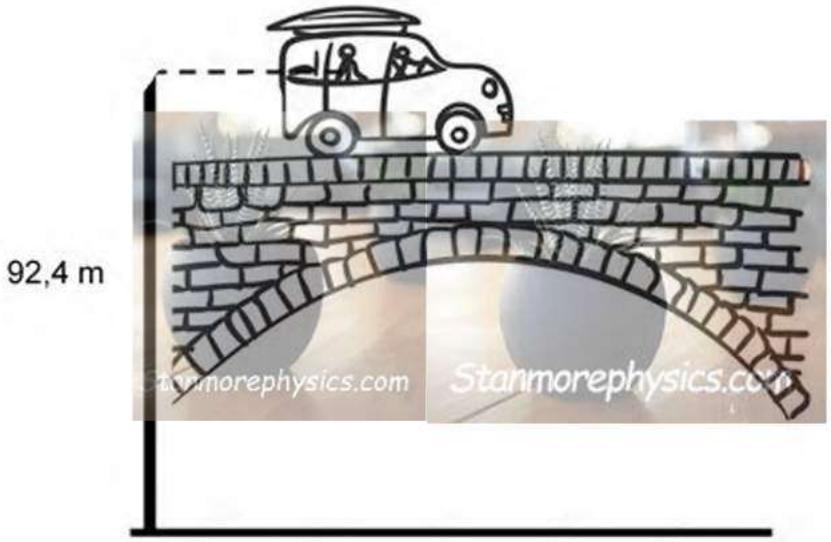
The bakkie and trailer combination is moving up the incline at a constant velocity.

2.7 Calculate the magnitude of the applied force that the engin exerts on the bakkie. (5)

[22]

QUESTION 3 (Start on a new page.)

A car stops on a bridge so that the tourist can take a photo of the scene. The tourist accidently drops her camera over the side of the bridge. The height that the camera falls, is 92,4 m as shown in the diagram below. Ignore the effects of air friction.



3.1 What is the acceleration of the camera at the instant that it is dropped? (2)

3.2 Define the term *free fall*.. (2)

3.3 Calculate:

3.3.1 The speed at which the camera strikes the ground by using equations of motion only. (3)

3.3.2 How long does it take the camera to hit the ground (3)

3.4 Draw a sketch graph of velocity versus time for the entire motion of the camera.

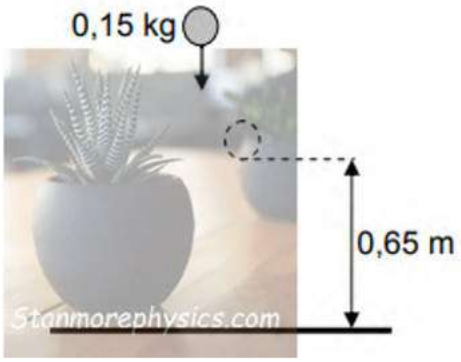
Indicate the following on the graph:
• Final velocity
• Time at which it reaches the ground (3)

3.5 If a stone with a different mass is dropped at the same time as the camera, will it take LONGER THAN, or SHORTER THAN or SAME time as the camera to hit the ground. Choose one of the answers and explain. (2)

[15]

QUESTION 4 (Start on a new page.)

The bounce of a cricket ball is tested before it is used. The standard test is to drop a ball from a certain height onto a hard surface and then measure how high it bounces. During such a test, a cricket ball of mass 0,15 kg is dropped from rest from a certain height and it strikes the floor at a speed of 6,5 $m \cdot s^{-1}$. The ball bounces straight upwards at a velocity of 3,65 $m \cdot s^{-1}$ to a height of 0,65 m, as shown in the diagram below. The effects of air friction may be ignored.



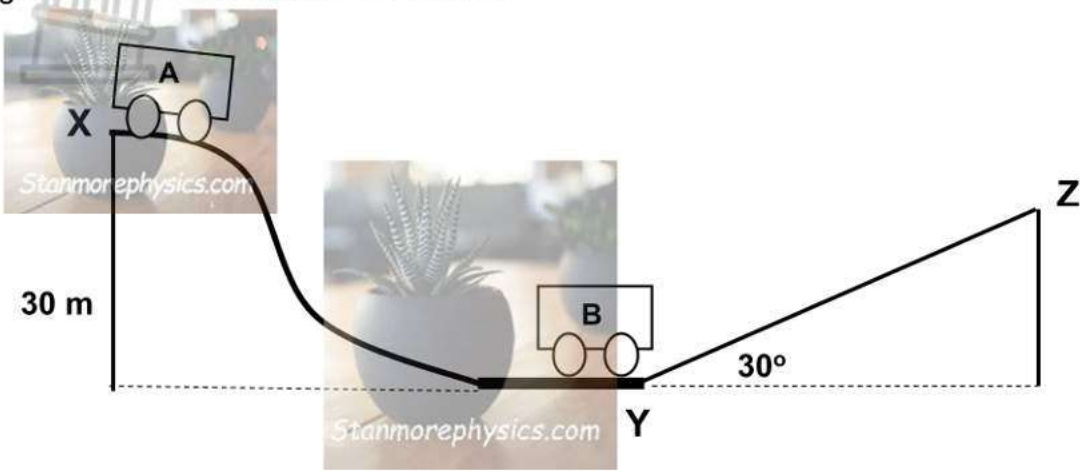
4.1 Define the term *impulse* in words. (2)

4.2 Calculate the magnitude of the impulse of the net force applied to the ball during its collision with the floor. (3)

4.3 To meet the requirements, a cricket ball must bounce to one third of the height that it is initially dropped from. Use ENERGY PRINCIPLES to determine whether this ball meets the minimum requirements. (5)
[10]

QUESTION 5 (Start on a new page.)

A 300 kg trolley A moves from rest from point **X** down a frictionless path towards trolley B where it collides against the stationary trolley B with a mass of 250 kg at point **Y**. The trolleys join and continue along the rough track from **Y** to **Z** and come to rest at point **Z**. Ignore rotational effect of the wheels.



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

5.2 Draw a free body diagram for trolley B the instant that trolley A is in contact with trolley B. (3)

5.3 Use the principle conservation of mechanical energy only to calculate the speed of the trolley A just before it collides with trolley B. (4)

5.4 Calculate the velocity of the trolleys just after the collision at point **Y**. (5)

The combination of the trolleys move up the slope from point **Y** and come to rest at point **Z**. The trolleys experience 10 N frictional force.

5.5 Calculate the distance **YZ**. (5)

[19]

QUESTION 6 (Start on a new page.)

6.1 A speedboat is moving towards a stationary listener. The siren of the boat is emitting a sound with a frequency of 850 Hz. The listener is observing another frequency. Take the speed of sound in air as 335 $m \cdot s^{-1}$.

6.1.1 State the Doppler effect in words. (2)

6.1.2 How wil the frequency observed by the listener compare to the frequency released by the siren of the speedboat? Choose from HIGHER THAN, LOWER THAN or THE SAME. (1)

6.1.3 If the speedboat is constantly moving at 20 $m \cdot s^{-1}$, calculate the frequency of the siren that is detected by the listener. (5)

6.1.4 Calculate the distance travelled by the speedboat in 3 seconds. (3)

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6.2 A helium line from the spectrum of the sun has a frequency of 6,20 x 10^{14} Hz. The frequencies of the same helium line from the Earth, which was observed in the line emission spectrum of two stars, are:

Star **X :** 6,24 x 10^{14} Hz

Star **Y** : 6,04 x 10^{14} Hz

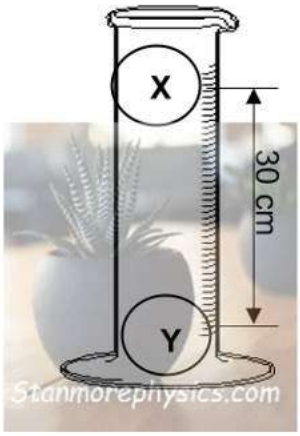
6.2.1 Which ONE of the stars (**X** or **Y**) has a red shift? (2)

6.2.2 In which direction does star **Y** move? Write only AWAY FROM the Earth or TOWARDS the Earth. (2)

[15]

QUESTION 7 (Start on a new page.)

A 40 g polystyrene sphere **Y** that is covered with a thin layer of graphite, is positively charged and placed in the glass cylinder. An identical sphere **X** that is neutral, is dropped in the glass cylinder. **X** makes contact with **Y**. **X** is now repelled upward by **Y** to a distance of 30 cm above the centre of **Y** as shown in the diagram below. **X** is now stationary.



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

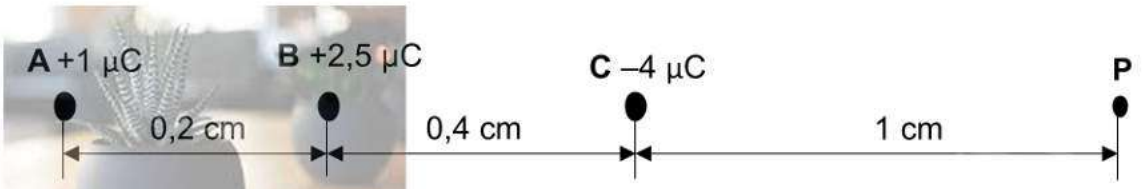
7.2 Draw a labelled free-body diagram to show all the forces acting on sphere **X.** (2)

7.3 Calculate the original charge on sphere **Y**. (6)

[10]

QUESTION 8 (Start on a new page.)

The following point charges **A**, **B** and **C** are placed as shown in the diagram below.



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

8.2 Draw the electric field pattern between the charges **A** and **B** ONLY. (3)

8.3 Were electrons ADDED TO or REMOVED FROM charge **C**? (1)

8.4 Calculate the:

8.4.1 Number of electrons added or removed from charge **C** (3)

8.4.2 Net electric field at point **P** (6)

. **[15]**

QUESTION 9 (Start on a new page)

A battery is connected to three resistors in parallel, the voltmeter reading over the battery will be 10 V as shown in DIAGRAM **A** below. When the SAME battery is connected to a 5,5 Ω resistor , the voltmeter reading is 12 V as shown in DIAGRAM **B** below.

DIAGRAM A

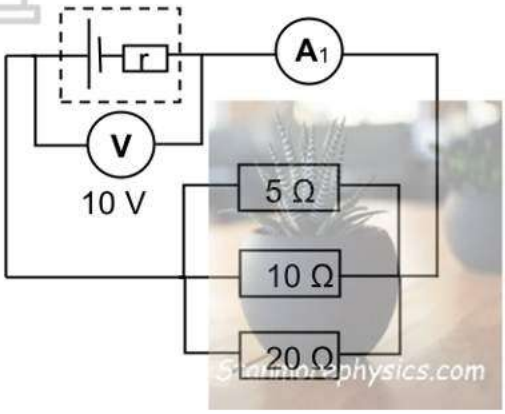
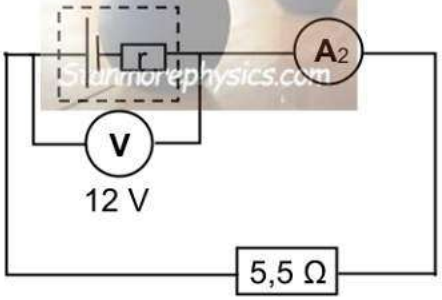


DIAGRAM B



9.1 Define the term *emf*. (2)

9.2 Calculate the total resistance of the parallel connection in DIAGRAM **A**. (3)

9.3 Explain why the voltmeter reading is higher in DIAGRAM **B** than in DIAGRAM **A**. (3)

9.4 Calculate the:

9.4.1 Reading on ammeter $\mathbf{A_1}$ (3)

9.4.2 Internal resistance of the battery (5)

9.4.3 Emf of the battery (2)

9.4.4 Power dissipated in the 5,5 Ω resistor (3)

9.5 The 5 Ω resistor in diagram A is removed. What will be the effect on the internal voltage(V_{in})? Choose from INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (3)

[24]

TOTAL:150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of the Earth *Massa van die Aarde*	M	5,98 x 10^{24} kg
Radius of the Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m

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TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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

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

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

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

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