Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porofensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

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PHYSICAL SCIENCES P1

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MARKS: **150**

TIME: **3 hours**

This question paper consists of 20 pages, including 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. You may use a non-programmable calculator.
5. Leave ONE line between TWO sub-questions, for example QUESTION 2.1 and QUESTION 2.2.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. All diagrams are NOT necessarily drawn according to scale.
11. Write neatly and legibly.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. question Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A student throws a basketball vertically upwards into the air. She catches the ball 10 s later at the same height from which she threw it.

Which ONE of the following statements is INCORRECT with regards to the above situation?

A The velocity of the ball decreases as it moves upwards.

B The velocity of the ball is zero when it reaches its maximum height.

C The ball returns to the student's hands with the same speed with which she threw the ball upwards.

D The acceleration of the ball as it goes upwards is equal to the acceleration of the ball as it falls downwards but in the opposite direction. (2)

1.2 When a car moves at a constant velocity, it means that the net force acting on the car is zero. This phenomenon is best explained by …

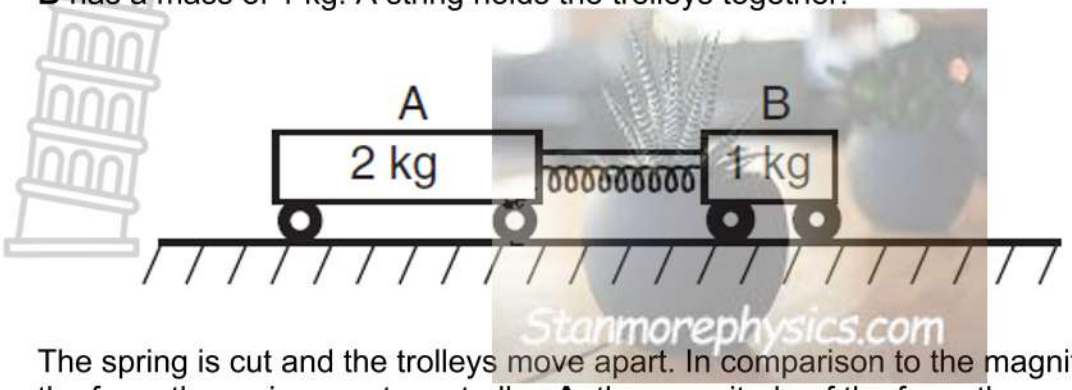
A Newton's 1st law of motion.

B Newton's 2nd law of motion.

C Newton's 3rd law of motion.

D Newton's law of Universal Gravitation. (2)

1.3 The diagram below shows a compressed spring between two trolleys, initially at rest, on a horizontal, frictionless surface. Trolley **A** has a mass of 2 kg and trolley **B** has a mass of 1 kg. A string holds the trolleys together.



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The spring is cut and the trolleys move apart. In comparison to the magnitude of the force the spring exerts on trolley **A**, the magnitude of the force the spring exerts on trolley **B** is …

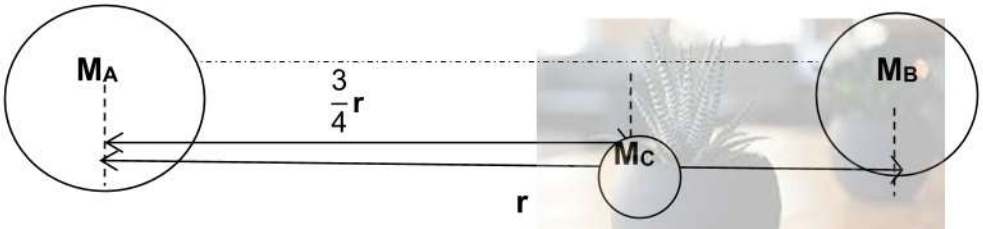
A half as great.

B twice as great.

C the same.

D four times as great. (2)

1.4 Two masses $\mathbf{M_A}$ and $\mathbf{M_B}$ are placed at a distance **r** apart. A third mass $\mathbf{M_C}$ experiences a ZERO resultant horizontal gravitational force when it is placed $\frac{3}{4}\mathbf{r}$ from $\mathbf{M_A}$ on the line between $\mathbf{M_A}$ and $\mathbf{M_B}$.



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The ratio of the two masses $\mathbf{M_A : M_B}$ are:

A 16 : 1

B 4 : 3

C 3 : 1

D 9 : 1 (2)

1.5 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 moves at constant speed.

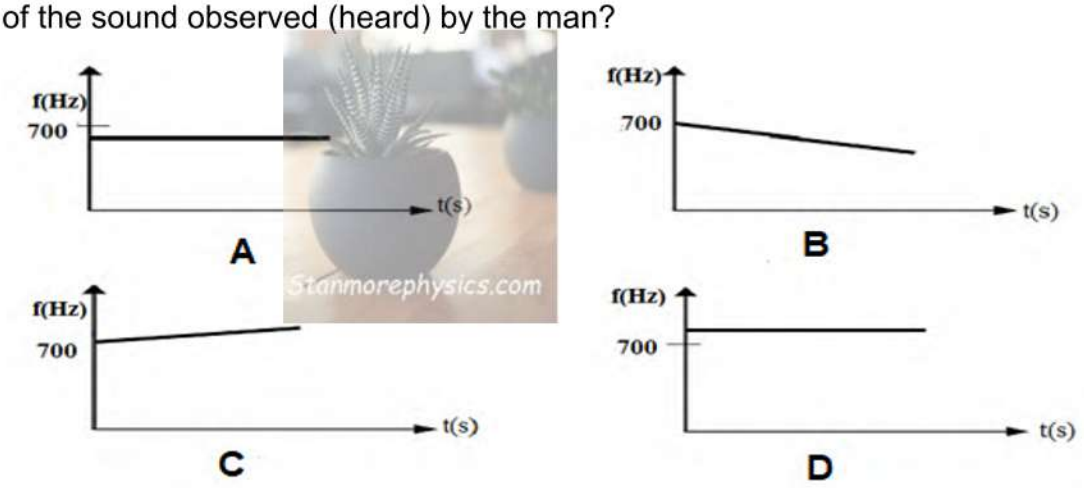
B the object has ZERO kinetic energy.

C the object moves with constant acceleration.

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

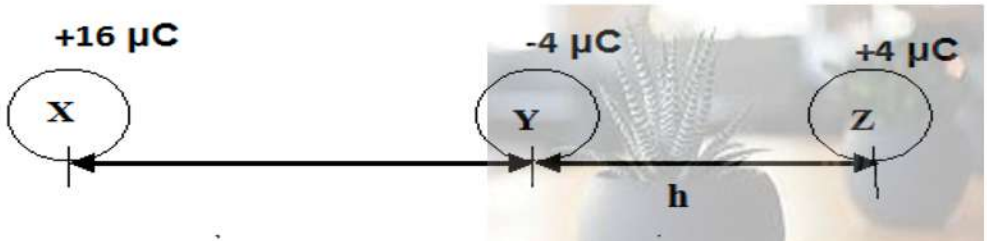
1.6 The siren of an ambulance travelling down a straight road at constant speed emits sound waves of frequency 700 Hz. A man sitting next to the road notices that the frequency (pitch) of the sound changes as the ambulance moves towards him.

Which ONE of the following frequency vs time graphs best shows the frequency of the sound observed (heard) by the man?



(2)

1.7 Three small identical spheres, **X**, **Y** and **Z** are charged as shown in the diagram below. The distance between sphere **Y** and **Z** is **h**.



For sphere **Y** to experience a ZERO resultant electrostatic force, the distance between **X** and **Y** must be …

A 2 **h**.

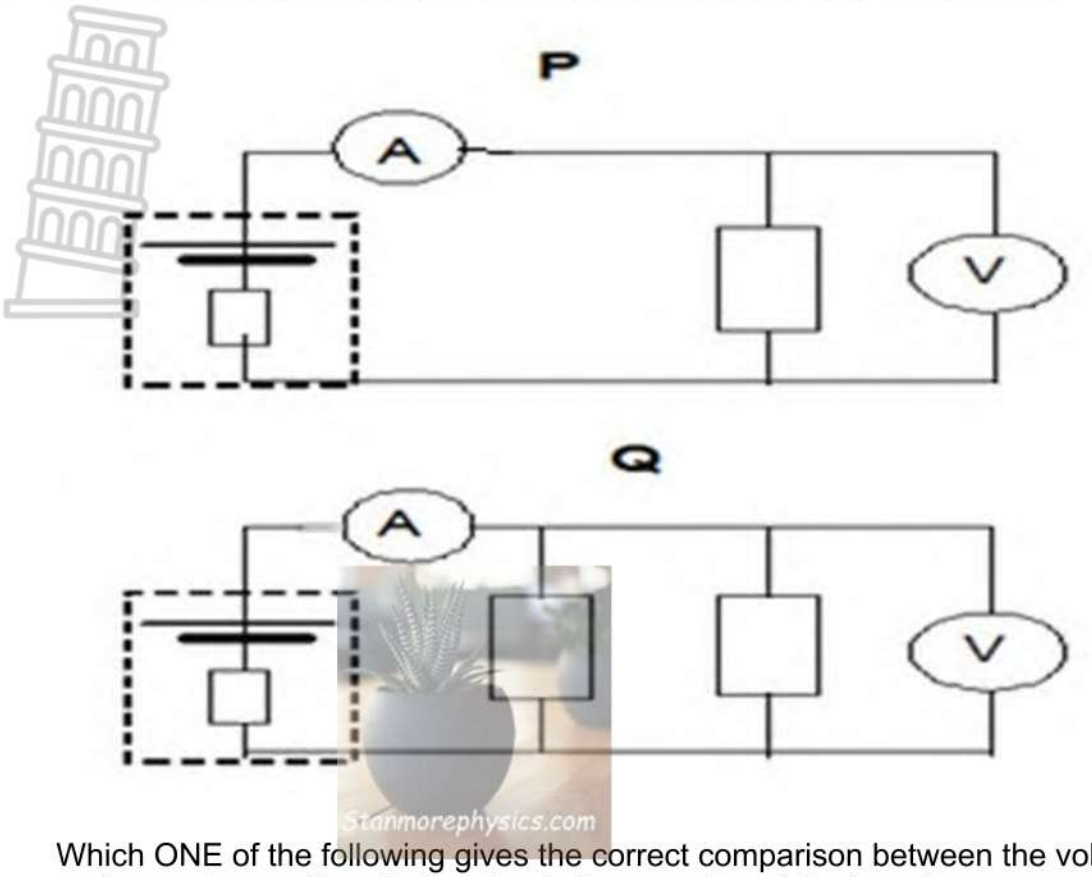
B ½ **h**.

C ¼ **h**.

D 4 **h**. (2)

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1.8 In the circuit diagrams shown below all resistors and cells are identical.



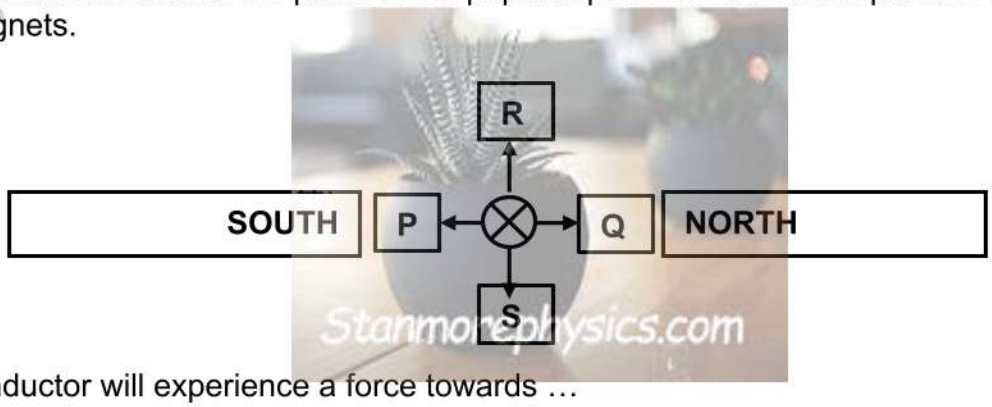
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Which ONE of the following gives the correct comparison between the voltmeter and ammeter readings in the circuit diagrams **P** and **Q** above?

	VOLTMETER READING	AMMETER READING
A	$V_P > V_Q$	$A_p > A_Q$
B	$V_P > V_Q$	$A_p < A_Q$
C	$V_P < V_Q$	$A_p = A_Q$
D	$V_P = V_Q$	$A_p < A_Q$

(2)

1.9 Two strong magnet bars are arranged with the north and south poles facing each other as shown in the diagram below. A current-carrying conductor carries conventional current into the plane of the paper is placed between the poles of the two magnets.



The conductor will experience a force towards …

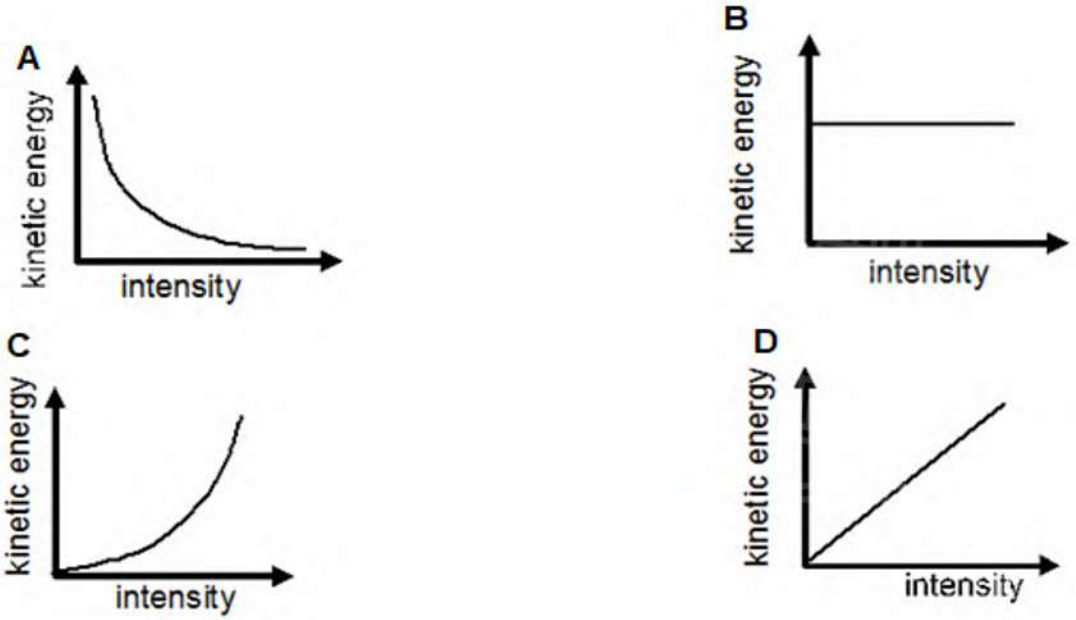
A **P**.

B **Q**.

C **R**.

D **S**.

1.10 Which ONE of the following graphs best represents the relationship between the maximum kinetic energy of the emitted photo-electrons and the intensity of the incident radiation?

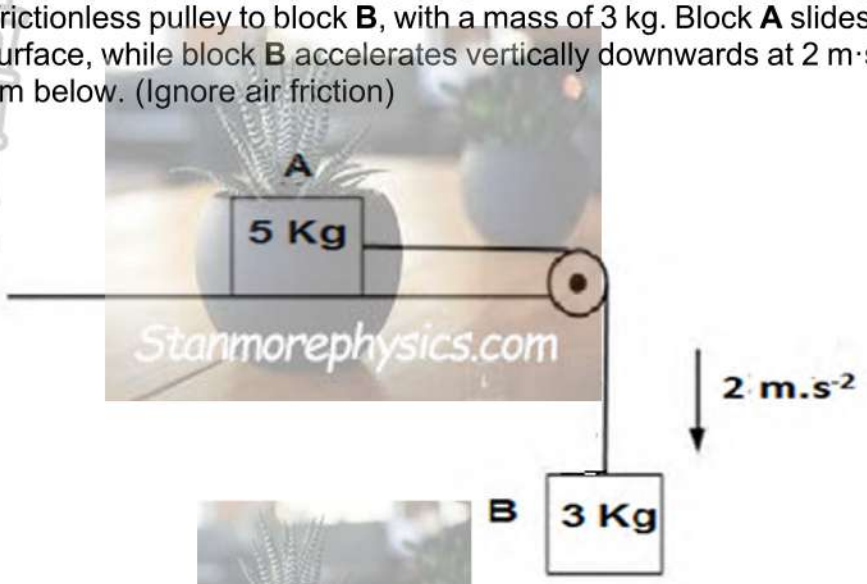


(2)

[20]

QUESTION 2 (Start on a NEW page.)

A block **A** of mass 5 kg, is connected by a light inextensible string of negligible mass over a light, frictionless pulley to block **B**, with a mass of 3 kg. Block **A** slides horizontally on a rough surface, while block **B** accelerates vertically downwards at 2 $m \cdot s^{-2}$ as shown in the diagram below. (Ignore air friction)



2.1 State Newton's First Law of motion in words. (2)

2.2 Draw a free-body diagram showing ALL the forces acting on block **B**. (2)

2.3 Give a reason why block **B** is accelerating downward. (1)

2.4 Calculate the:

2.4.1 Magnitude of the frictional force acting on object **A** (5)

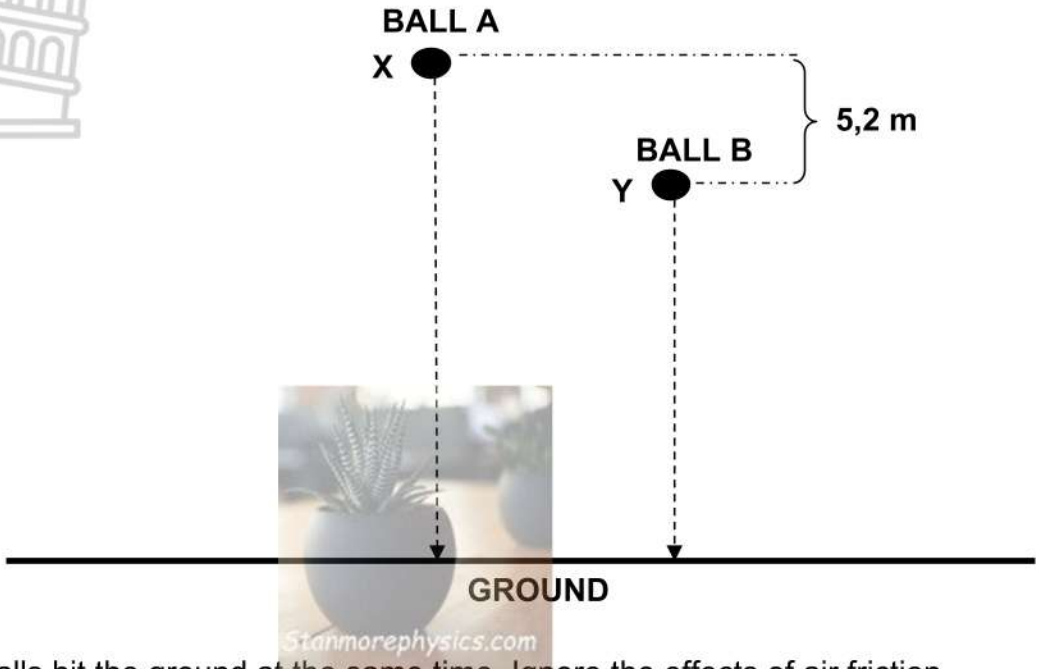
2.4.2 Coefficient of kinetic friction between block **A** and the surface (3)

2.5 Identify ONE, Newton's Third Law, action-reaction force pair that is acting on block **B**. (2)

[15]

QUESTION 3 (Start on a NEW page.)

A ball **A**, is thrown vertically downwards, with an initial speed of 2,5 $m.s^{-1}$, from a point **X** above the ground. **At the same instant,** a second identical ball **B** is dropped from a point **Y** which is located 5,2 m below point **X**.



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Both balls hit the ground at the same time. Ignore the effects of air friction.

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

3.2 Calculate the:

3.2.1 Time taken by the balls to hit the ground (5)

3.2.2 Velocity with which ball **A** strikes the ground (3)

3.3.3 Height of point **Y** above the ground (3)

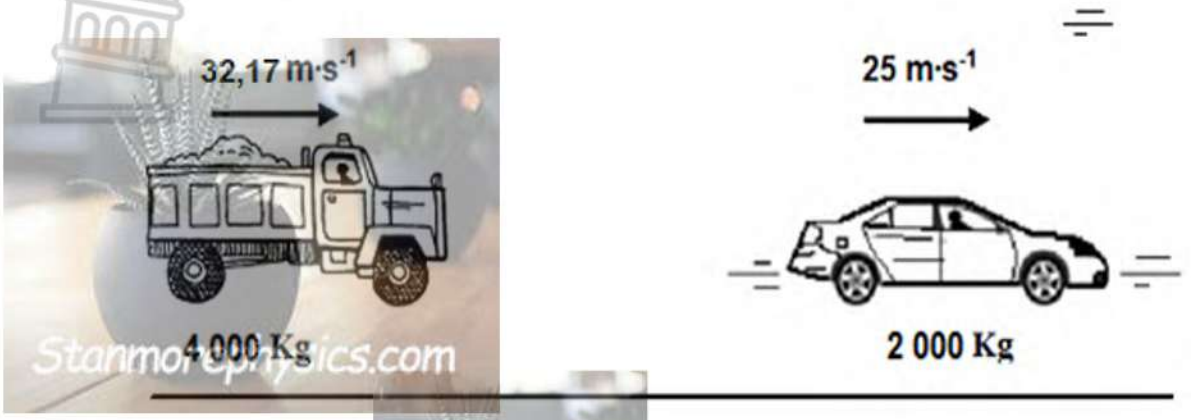
3.3 On the same system of axes, sketch the relevant velocity-time graphs for the entire motion of both balls **A** and **B**.

- Indicate on your graph the corresponding velocity and time values.
- Label your graphs. (4)

[17]

QUESTION 4 (Start on a NEW page.)

A truck of mass 4 000 kg is travelling at 32,17 $m \cdot s^{-1}$ to the right on a straight horizontal road. At the same time a car of mass 2 000 kg is travelling at 25 $m \cdot s^{-1}$ in the same direction ahead of the truck as shown in the diagram below.



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The truck collided with the car and the two vehicles stick together and move as one unit. Ignore the effects of friction.

4.1 State the principle of conservation of linear momentum in words. (2)

4.2 Calculate the velocity of the truck-car-system immediately after the collision. (4)

4.3 Is the collision between the truck and the car ELASTIC or INELASTIC? (1)

4.4 On impact the truck exerts a force of magnitude **F** on the car.

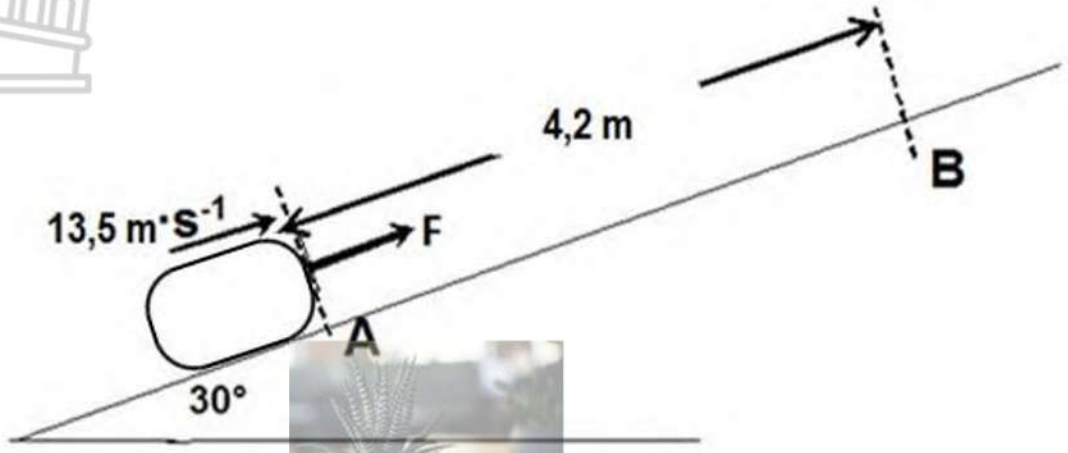
4.4.1 Will the magnitude of the force that the car exerts on the truck, on impact, be GREATER THAN, LESS THAN or EQUAL TO, F? (1)

4.4.2 Name and state a relevant physics law that explains the answer to QUESTION 4.4.1. (3)

[11]

QUESTION 5 (Start on a NEW page.)

A constant force **F** is applied to a crate of mass 20 kg to move it upwards along a frictionless inclined plane. The speed of the crate at point **A** and point **B** is 13,5 $m \cdot s^{-1}$ and 12,2 $m \cdot s^{-1}$ respectively. The distance between point **A** and point **B** is 4,2 m as shown in the diagram below.



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5.1 Draw a labelled free-body diagram showing ALL the forces acting on the crate while it is moving up the incline. (3)

5.2 Is mechanical energy conserved during this motion? Write down YES or NO and briefly explain the answer. (2)

5.3 Write down the name of the conservative force that acts on the crate. (1)

5.4 Give a reason why the normal force does no work on the crate during its movement up the incline. (1)

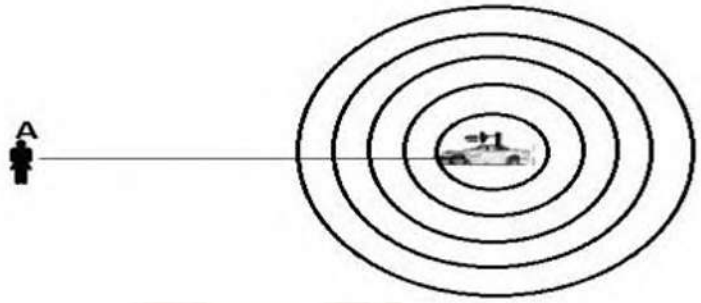
5.5 In which direction does the net force act on the crate as it moves up the incline? Write only FROM A TO B or FROM B TO A. (1)

5.6 Use energy principles to calculate the magnitude of the force **F**. (5)
[13]

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QUESTION 6 (Start on a NEW page.)

A car that is initially at rest has its radio playing music. The diagram below (not drawn to scale) represents the sound wave fronts arising from a musical note of frequency 440 Hz, spreading out from the car.
The speed of sound in air is 330 $m \cdot s^{-1}$

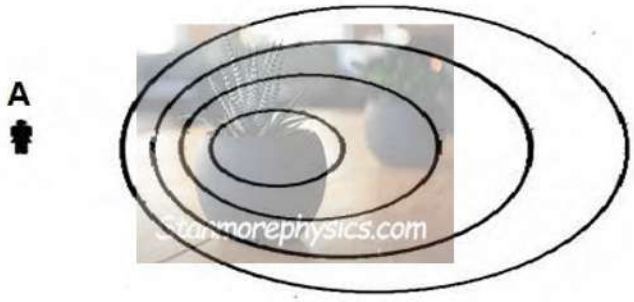


Stationary source

6.1 Calculate the wavelength of the sound wave. (3)

6.2 What is the frequency of the note as heard by an observer at point **A**? (1)

The car now moves at a constant speed of 8 $m \cdot s^{-1}$. The wave fronts reach the stationary observer at **A** as shown in the diagram below.



Moving source

6.3 State the Doppler effect in words. (2)

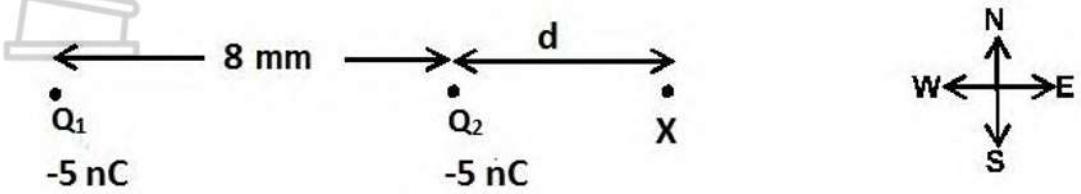
6.4 At what speed are the wave fronts progressing towards the observer? (1)

6.5 Calculate the frequency of the note as heard by the observer at point **A**. (5)
[12]

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QUESTION 7 (Start on a NEW page.)

In the diagram below, a point charge, Q_2, with a charge of -5 nC is placed 8 mm east of an identical point charge Q_1. Point **X** is a distance **d** east of Q_2.

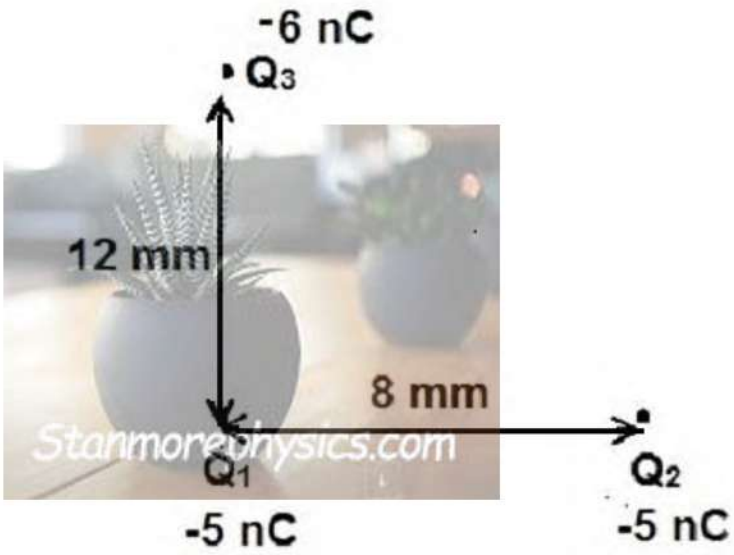


7.1 Define the term *electric field at a point* in words. (2)

7.2 Draw an electric field pattern between Q_1 and Q_2. (3)

7.3 The electric field at point **X**, due to ONLY Q_1, is $5{,}22 \times 10^5\ N \cdot C^{-1}$ west. Calculate the distance **d**. (4)

A third charge Q_3 of -6 nC is now placed 12 mm due north of charge Q_1 as shown in the diagram below.



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

7.5 Calculate the magnitude of the net electrostatic force experienced by charge, Q_1 due to the presence of the other two charges Q_2 and Q_3. (6)

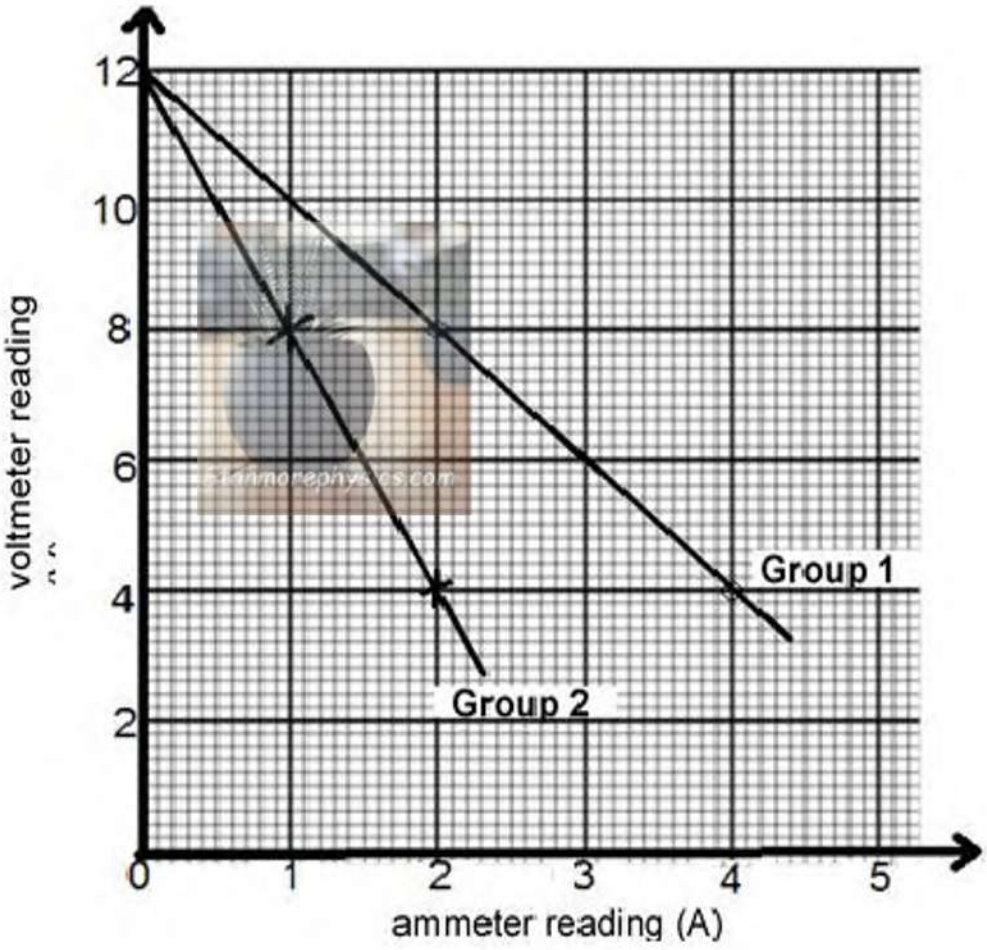
[17]

QUESTION 8 (Start on a NEW page.)

Grade 12 learners conducted an experiment to determine the INTERNAL RESISTANCE of a battery. The learners were divided into two groups:

Group 1 used battery 1 with an internal resistance r_1.
Group 2 used battery 2 with an internal resistance r_2.

The results of each group are shown in the graph below:



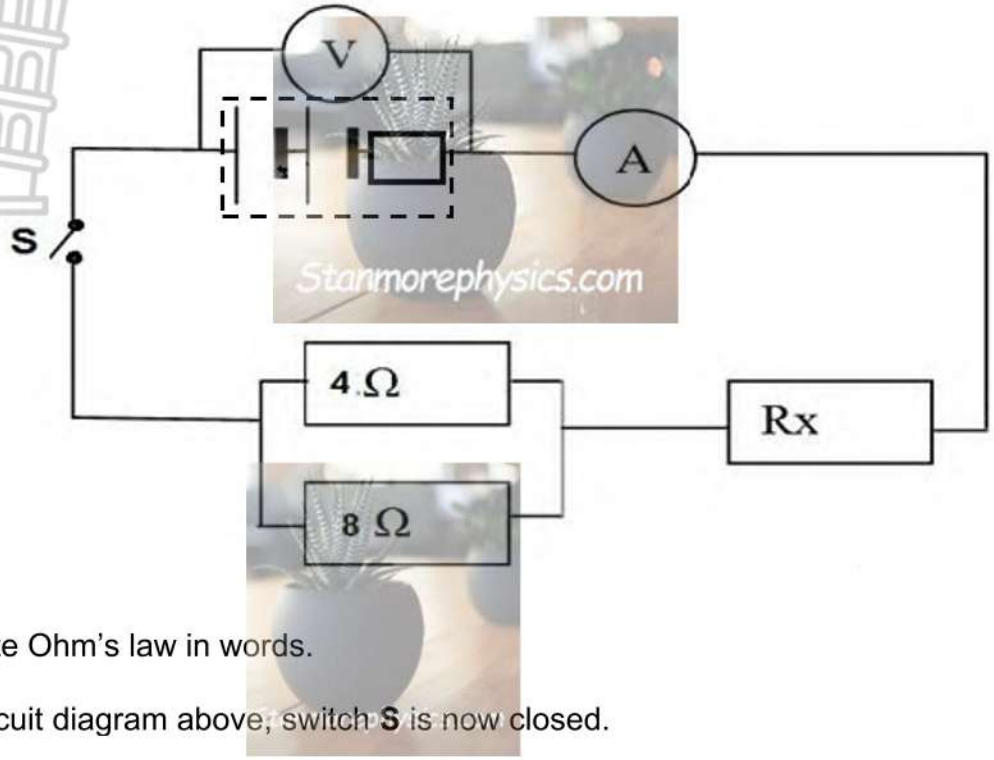
8.1 Explain why the voltmeter reading across the battery decreases as the current increases. Use appropriate equation(s) in Physics in your explanation. (4)

8.2. Which group, **1** or **2**, used a battery with greater internal resistance? (1)

8.3 Use the graph to determine the internal resistance of the battery used by learners in **group 1**. (3)

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Three resistors, 4 Ω, 8 Ω and R_x are connected to a battery as shown in the circuit diagram below. When switch S is open the reading on the voltmeter is 12 V. When switch S is closed the reading on the voltmeter is 10 V and the reading on the ammeter is 1,5 A.



8.4 State Ohm's law in words. (2)

In the circuit diagram above, switch **S** is now closed.

8.5 Calculate the resistance of the unknown resistor $\mathbf{R_x}$. (6)

8.6 Calculate the internal resistance of the battery.

After a while, the 4 Ω resistor gets hotter than the 8 Ω resistor. (3)

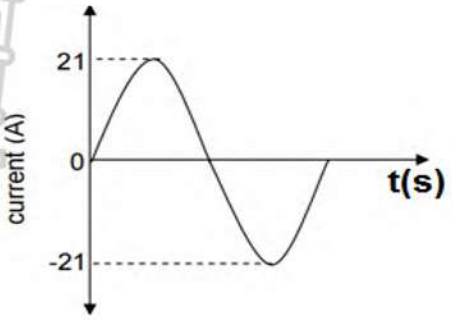
8.7 Fully explain this observation. (3)

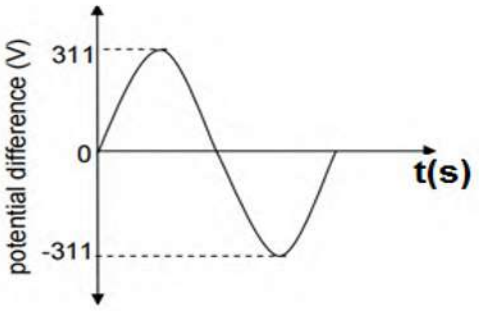
[22]

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QUESTION 9 (Start on a NEW page.)

Graphs of the current and potential difference outputs of an AC generator are shown below.





9.1 Define the term *root mean square value* (**rms**) of an AC voltage. (2)

9.2 Write down the energy conversion that takes place in an AC generator. (1)

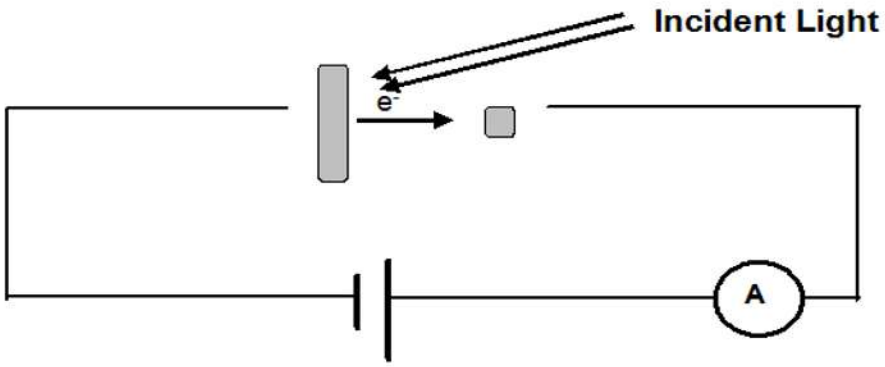
9.3 Give ONE reason why AC voltage is preferred to DC voltage for everyday use. (1)

9.4 Calculate the average power output of this generator. (6)
[10]

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QUESTION 10 (Start on a NEW page.)

The diagram below shows a circuit in which a photocell is irradiated alternately with red and blue light to demonstrate the photo-electric effect.



10.1 An ammeter reading is recorded when the photocell is irradiated with red light. Give an explanation for this observation. (2)

Blue light with the same intensity as the red light is now used to irradiate the metal in the photocell. How will this affect the following?

10.2 The kinetic energy of the photo-electrons (Write down only INCREASE, DECREASE or STAYS THE SAME.) (1)

10.3 The ammeter reading. (Write down only INCREASE, DECREASE or STAYS THE SAME.)

Fully explain your answer. (4)

10.4 The wavelength of the blue light used in the demonstration is $4,5 \times 10^{-7}$ m. Calculate the threshold frequency (cut-off frequency) of the metal used in the photo cell if the average speed of an emitted photo-electron is equal to $4,78 \times 10^{5}$ m·s^{-1}. (6)

[13]

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 / *Universelegravitasiekonstant*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Mass of earth / *Massa op aarde*	M	$5,98 \times 10^{24}$ kg
Radius of earth / *Radius van aarde*	R_E	$6,38 \times 10^{6}$ m
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant / *Planck se konstante*	h	$6,63 \times 10^{-34}$ J•s
Coulomb's constant / *Coulomb se konstante*	k	$9,0 \times 10^{9}$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron / *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass / *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

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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*

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

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

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

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s}f_s$ $\quad f_L = \frac{v \pm v_L}{v \pm v_b}f_b$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ 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*

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

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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 = VIΔt 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*

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

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