LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2025

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)

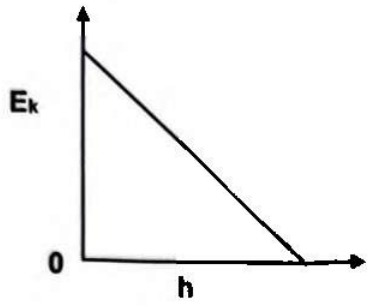
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1.3 An object is dropped from a height **h** above the ground.

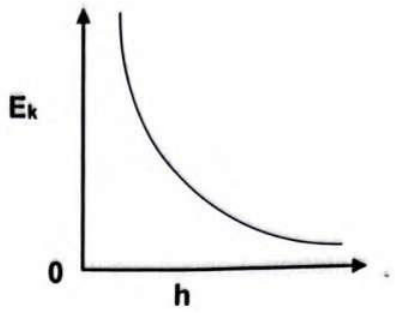
Neglect the effects of air resistance.

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

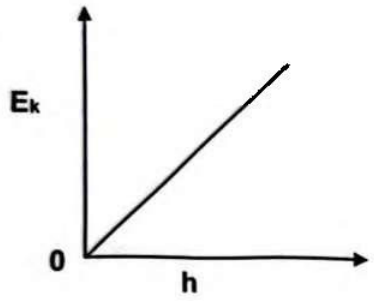
A



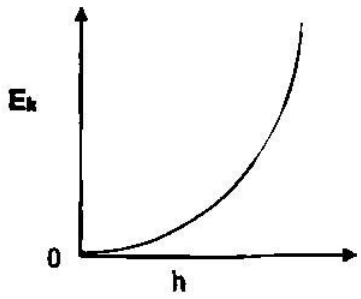
B



C

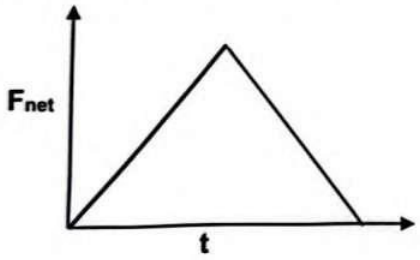


D



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

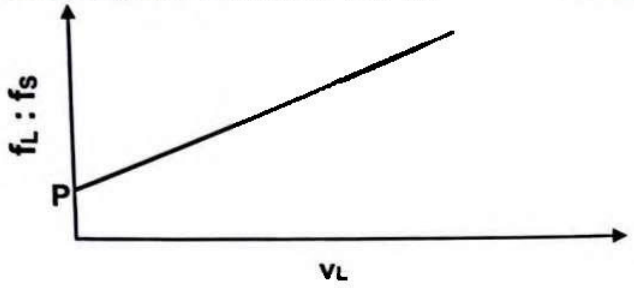
B $\frac{g}{v^2}$.

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...

A R 1,02

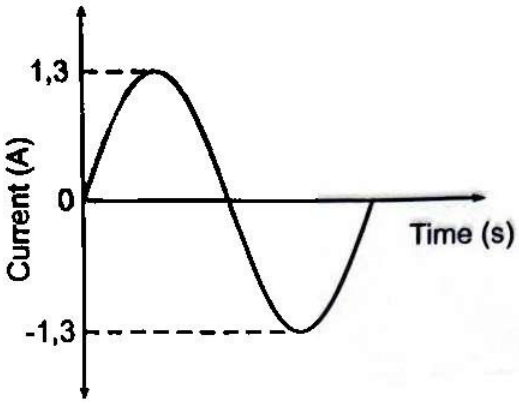
B R 6,12

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.



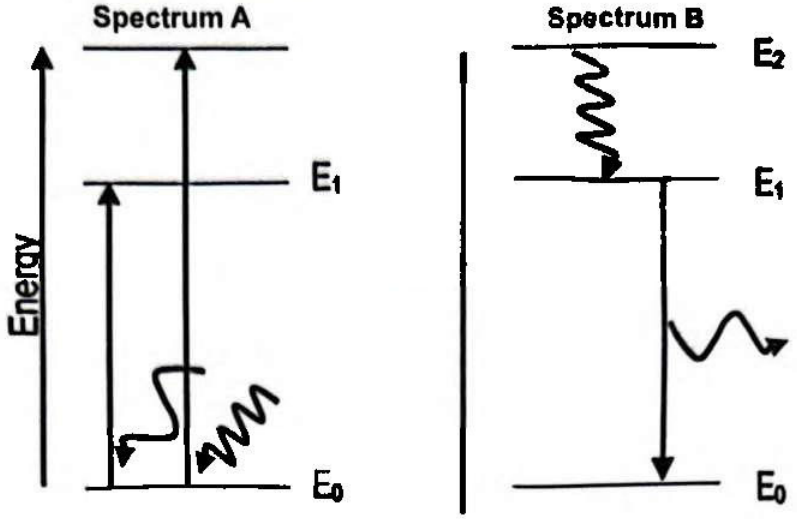
Which ONE of the following combinations of statements correctly describes the generator?

	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

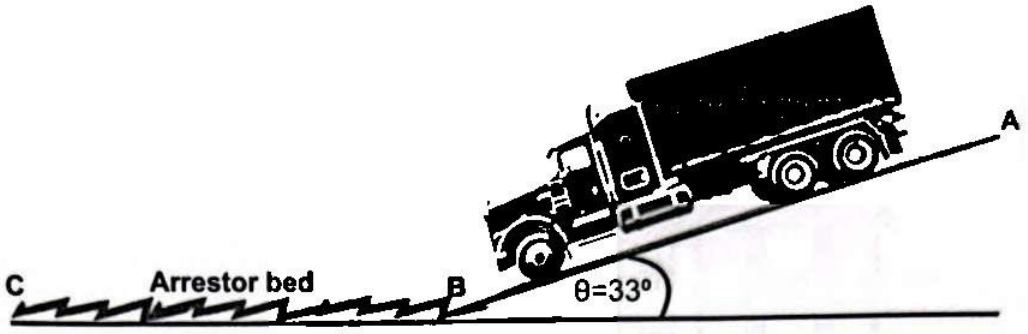
(2)

[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·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 $m \cdot s^{-1}$.

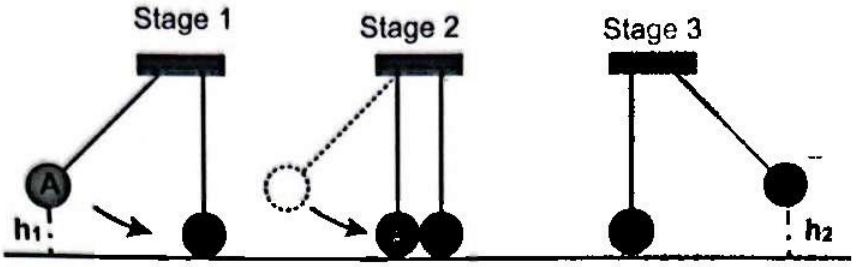
Calculate the time the ball takes from **B** to **C**. **(5)**

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)

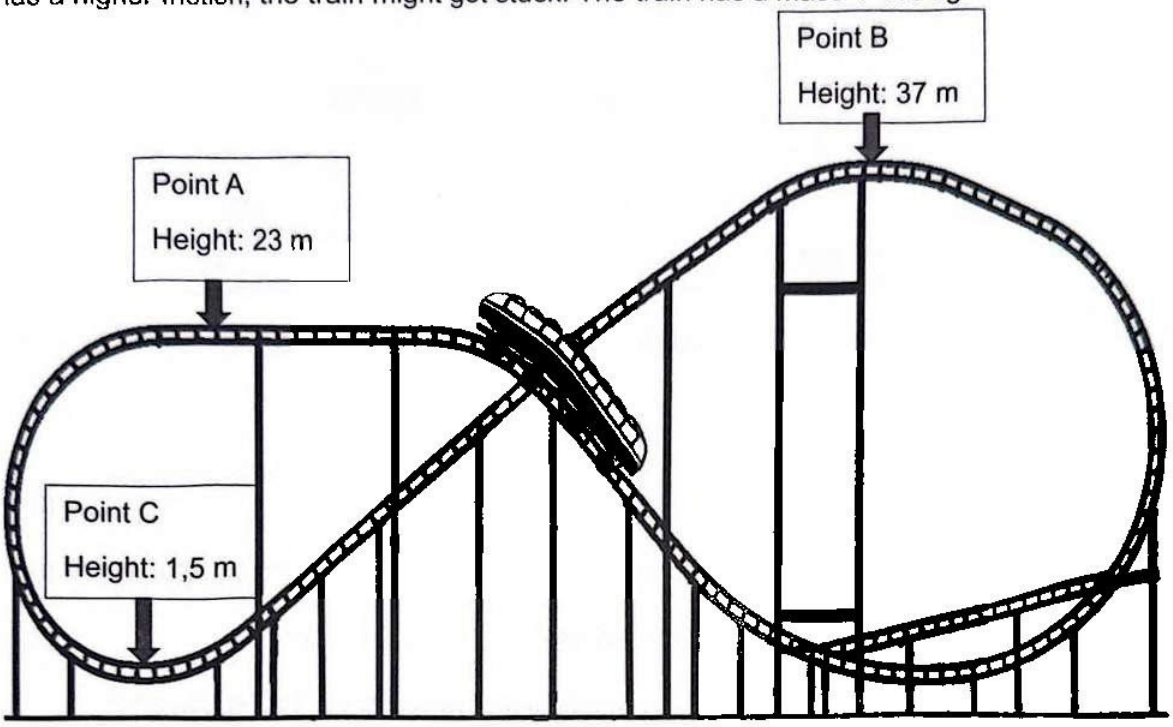
4.4 Use the principle in **QUESTION 4.3** to calculate the velocity of ball **B** just after the collision (**STAGE 3**) (4)

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.

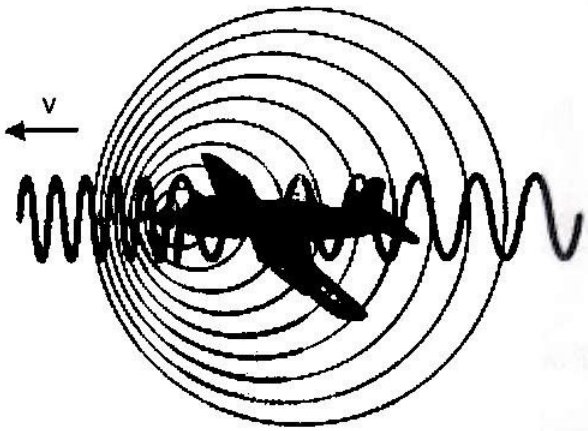
Suggest a reason for the answer. (2)

[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.

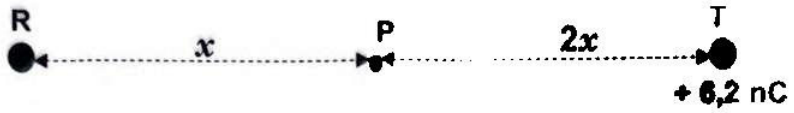
Justify the answer with reference to the OBSERVED WAVELENGTH. (2)

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)

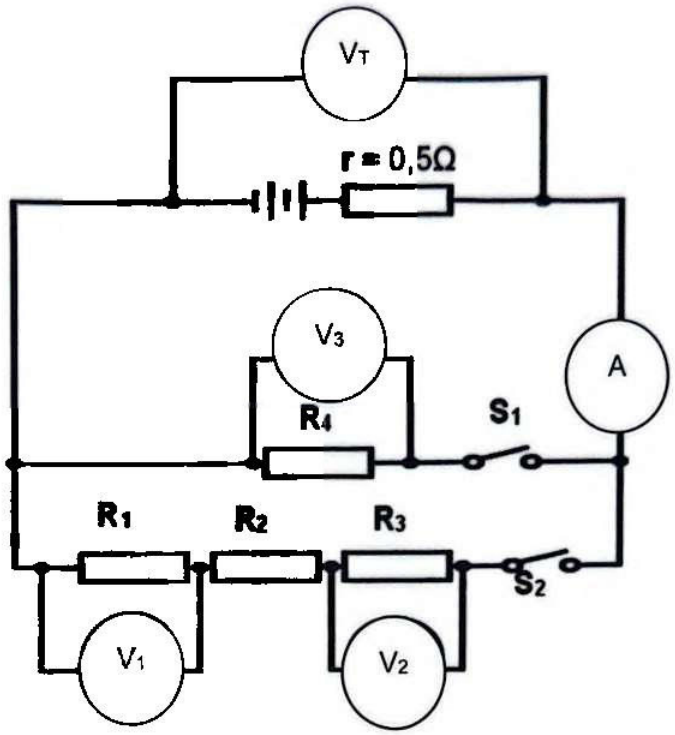
[16]

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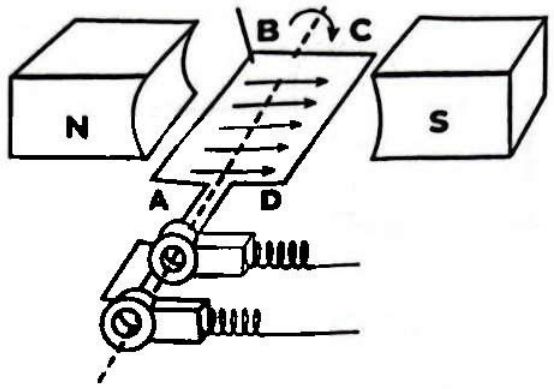
The reading on V_3 is 11,10 V.
Calculate the:

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**.



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:

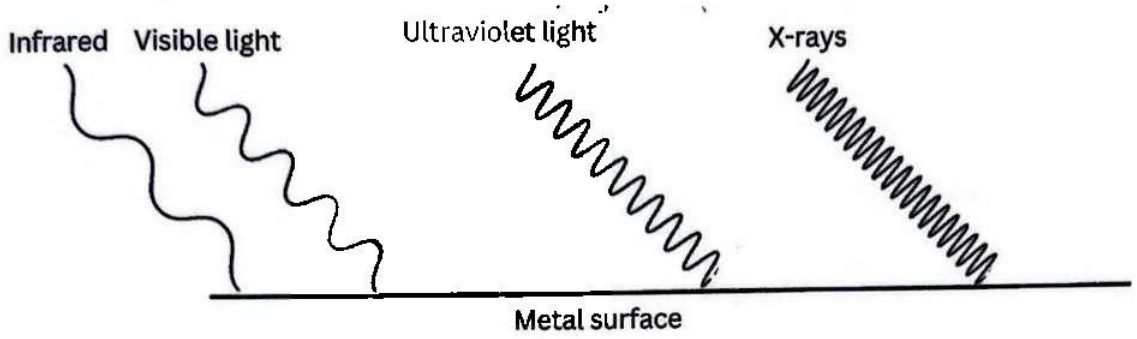
- Period of the full rotation (1 cycle)
- V_{max} (3)

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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]

Grand Total: 150

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

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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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

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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