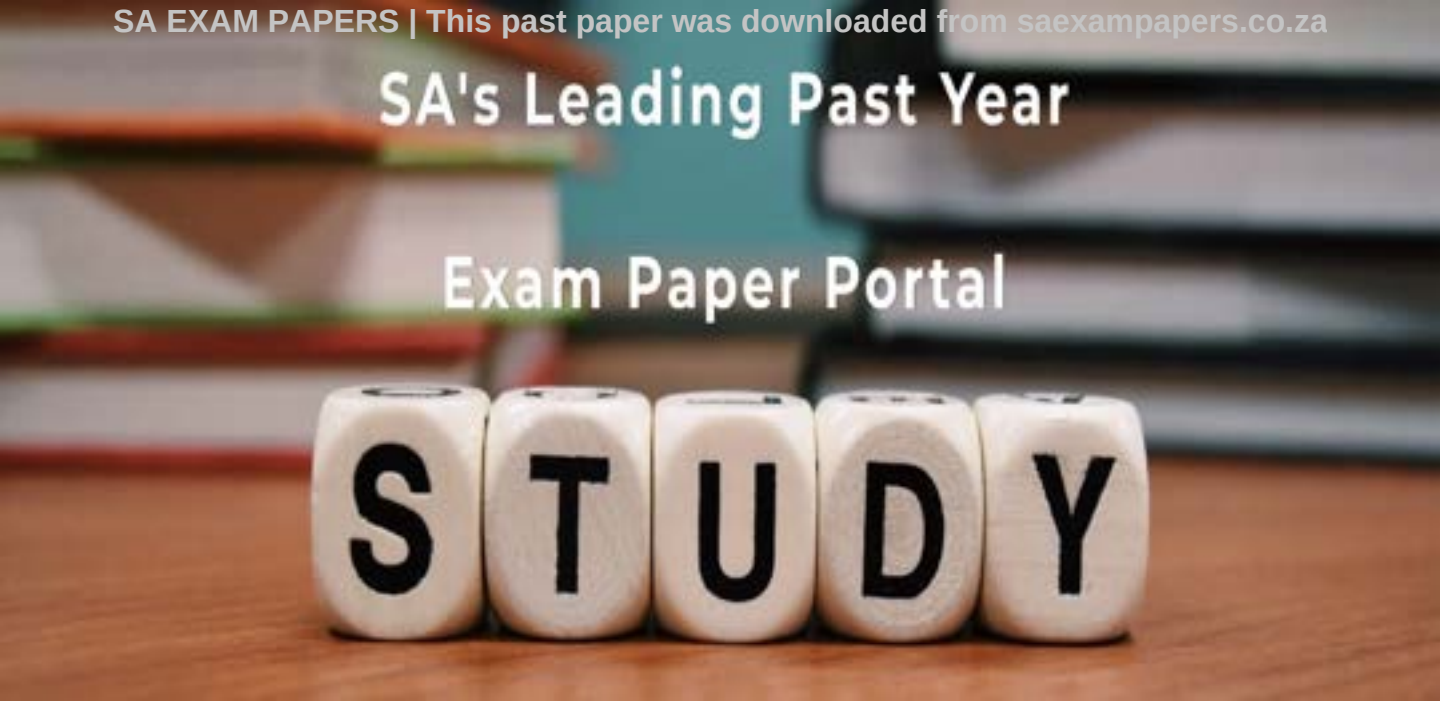


LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES
PHYSICS (P1)
PRE-TRIAL EXAMINATION
02 AUGUST 2024

MARKS: 150

TIME: 3 hours

This question paper consists of 20 pages including data sheet

INSTRUCTIONS

1. Answer ALL questions.
2. Non-programmable instruments may be used.
3. Appropriate mathematical instruments may be used.
4. You are advised to use the attached DATA SHEETS.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
7. Be brief whenever justifications, discussions, explanations, et cetera, are required.
8. Show the **formulae** and **substitutions** in ALL calculations.
9. Round off your final answers to a **minimum** of two (2) decimal places, unless stated otherwise.
10. Write neatly and legibly.

SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 The impulse delivered by a net force acting on an object is equal to the …

A initial momentum of the object.

B final momentum of the object.

C change in momentum of the object.

D rate of change in momentum of the object. (2)

1.2 A person on planet A, having radius ***R***, experiences a gravitational force **F**. When the person is on planet B having a radius **5*R***, the gravitational force experienced will be:

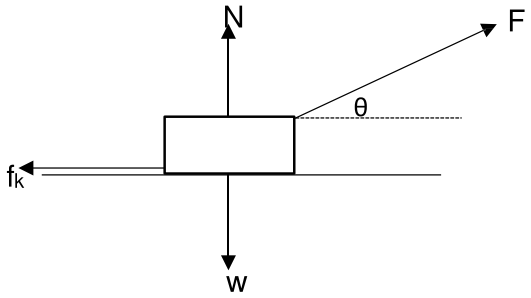
A $\frac{1}{25}$ **F**

B $\frac{1}{5}$ **F**

C 5 **F**

D 25 **F** (2)

1.3 The diagram below shows all the forces acting on an object being pulled to the right by a force **F** acting at an angle θ to the horizontal.



Which ONE of the following expressions can be used to determine the magnitude of the kinetic frictional force (f_k) acting on the object?

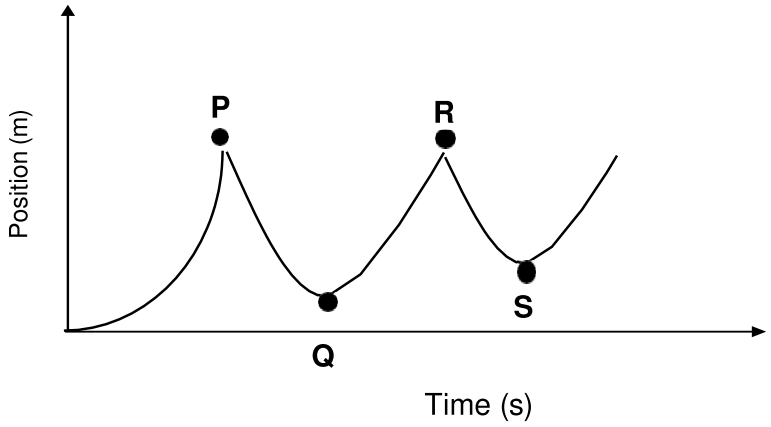
A $\mu(w + F\sin\theta)$

B $\mu(w - F\sin\theta)$

C $\mu(N - w)$

D μw (2)

1.4 The position-time graph below represents the motion of a ball from the instant it is released from rest from a certain height above the floor and bounces off the floor a number of times. Ignore the effects of air resistance.



Which point (**P**, **Q**, **R** or **S**) on the graph represents the position-time coordinates of the maximum height reached by the ball after the SECOND bounce?

A **P**

B **Q**

C **R**

D **S** (2)

1.5 The kinetic energy of a car moving at velocity **v** is **K**. The velocity of the car changes to **2v**. What is the new kinetic energy of the car?

A ¼**K**

B ½**K**

C 2**K**

D 4**K** (2)

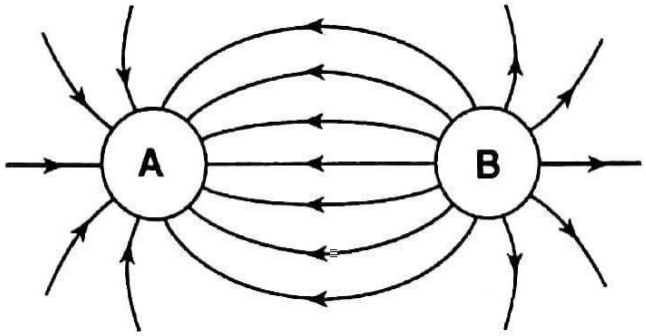
1.6 A sound source approaches a stationary observer at constant velocity.

Which ONE of the following describes how the observed frequency and wavelength differ from that of the sound source?

	Observed wavelength	**Observed frequency**	
A	Greater than	Greater than	
B	Less than	Less than	
C	Less than	Greater than	
D	Greater than	Less than	

(2)

1.7 The electric field pattern between two charged spheres, **A** and **B**, is shown below.



Which ONE of the following statements regarding the charge on spheres **A** and **B** is CORRECT?

A Sphere **A** is negatively charged, and sphere **B** is positively charged.

B Sphere **A** is positively charged, and sphere **B** is negatively charged.

C Spheres **A** and **B** are both positively charged.

D Spheres **A** and **B** are both negatively charged. (2)

1.8 The SI unit of measurement of the RATE OF FLOW OF CHARGE in a conductor is …

A watt.

B volt.

C ampere.

D coulomb. (2)

1.9 Which ONE of the following changes to the design of an AC generator will increase its maximum emf output?

A Change the polarity of the magnets

B Use larger slip rings

C Use larger brushes

D Increase the number of turns on the coil (2)

1.10 A line emission spectrum is formed when …

A electrons in the ground state move to a higher energy state.

B electrons in the higher energy state move to a lower energy state.

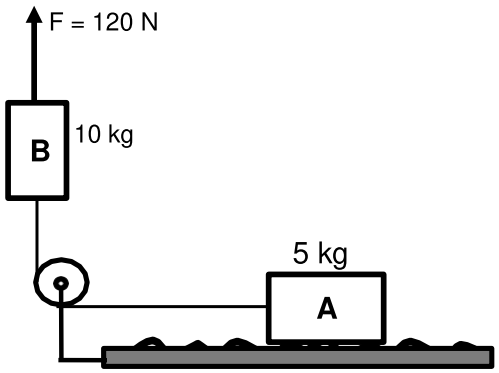
C white light passes through a cold gas.

D white light passes through a triangular prism. (2)

[20]

QUESTION 2 (Start on a new page.)

A block **A** of mass 5 kg, at rest on a rough horizontal table, is connected to another block **B** of mass 10 kg by means of a light inextensible string which passes over a light frictionless pulley. A force of 120 N is applied vertically upwards on block **B** as shown in the diagram below.



The coefficient of kinetic friction between the surface and block **A** is 0,3. Ignore the effects of air friction.

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

2.2 Draw a labelled free-body diagram for block **B**. (3)

2.3 Calculate the magnitude of the:

2.3.1 Friction force acting on block **A** (3)

2.3.2 Tension force acting on block **B** (6)

2.4 A man on the surface of planet **Y** weighs HALF his weight compared to his weight on the surface of the Earth. The mass of planet **Y** is TWICE that of the Earth.

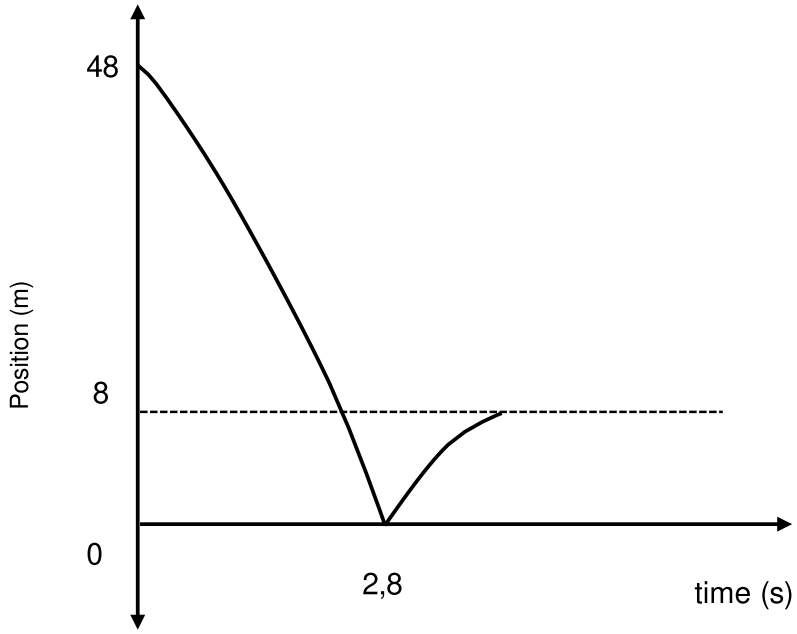
2.4.1 State Newton's *universal gravitational law*, in words (2)

2.4.2 Calculate the radius of planet Y in terms of the radius of the Earth. (4)

[20]

QUESTION 3 (Start on a NEW page.)

The position-time graph for a ball thrown vertically downwards from the top of a 48 m tall building is shown below. The graph is not drawn to scale. The ball bounces off the ground, reaching a maximum height of 8 m. Ignore the effect of air resistance.



3.1 Calculate the speed at which the ball:

3.1.1 Is thrown downwards (4)

3.1.2 Hits the ground (3)

3.1.3 Bounces off the ground (3)

3.2 Draw a velocity-time graph (not to scale) for the entire motion of the ball.

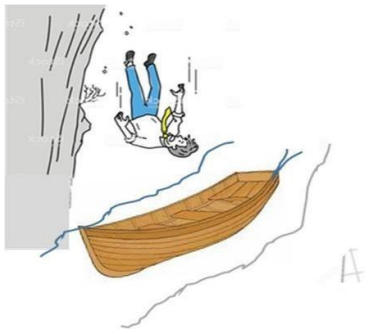
Indicate the following on your graph:

(i) Initial velocity with which the ball was thrown
(ii) Velocity with which the ball hit the ground
(iii) Time taken to attain this velocity
(iv) The velocity with which the ball bounces off the ground (4)

[14]

QUESTION 4(Start on a new page.)

Tom, with a mass of 65 kg, slips on a mountain path and falls 5 m vertically downwards. Luckily, he lands on a 100 kg boat which is moving along a river directly below the path.



4.1 Define impulse. (2)

4.2 The boat was moving at a constant velocity of 5 $m \cdot s^{-1}$ when Tom fell on it. Calculate the velocity of the boat and Tom directly after Tom fell on it. (5)

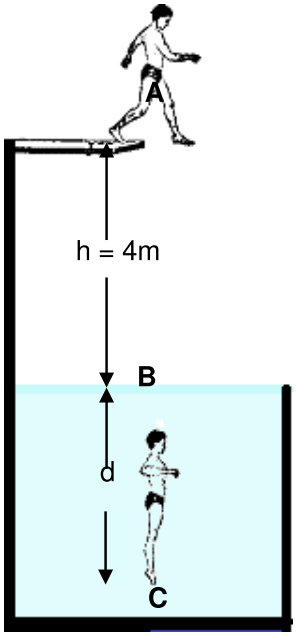
The boat collides with a rock in the river just after Tom fell into the boat. The boat comes to rest in 0,2 s.

4.3 Calculate the average force that the rock exerts on the boat. (4)

[11]

QUESTION 5 (Start on a NEW page.)

A diver of mass 80 kg, steps off a diving board at point **A**, 4,0 m above the level of the water of a swimming pool. The diver enters the water at point **B** and comes to rest at point **C.** While the diver falls through the air, an average frictional force of magnitude 172 N acts on the diver. The total work done on the diver while he movesfrom **A** to **C** is -6240J.



5.1 State the work-energy theorem in words. (2)

5.2 Use the work-energy theorem to calculate the speed of the diver at point B. (4)

5.3 Is the mechanical energy of the diver conserved? Choose from YES or NO. Give a reason for the answer. (2)

5.4 Using energy principles ONLY, calculate the distance from B to C. (4)

[12]

QUESTION 6 (Start on a new page.)

The driver of a car pulls over to the side of a straight road and stops when he hears the siren of an approaching fire truck. As the fire truck approaches, the person hears a frequency of 460 Hz; as the fire truck moves away, the person hears a frequency of 410 Hz. Consider the speed of sound in air as 340 $m \cdot s^{-1}$.

6.1 State *the Doppler effect* in words. (2)

6.2 Does the stationary person detect a longer or shorter wavelength as the fire truck moves away? Explain your answer. (3)

6.3 Calculate the frequency of the sound of the siren. (6)

6.4 A study of spectral lines obtained from various stars can provide valuable information about the movement of the stars.

The two diagrams below represents different spectral lines of an element.

Diagram 1 represents the spectrum of the element in a laboratory on Earth.

Diagram 2 represents the spectrum of the same element from a distant star.

Diagram

Diagram 2

Is the star moving *towards* or *away* from the Earth? Explain the answers by referring to the shift in the spectral lines.

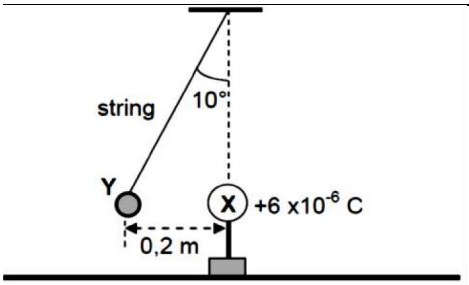
(3)

6.5 Write down ONE application of *Doppler effect*. (1)

[15]

QUESTION 7

7.1 A small sphere, **Y**, carrying an unknown charge, is suspended at the end of a light inextensible string which is attached to a fixed point. Another sphere, **X**, carrying a charge of +6 x10-6 C, on an insulatedstand is brought close to sphere **Y**. Sphere **Y** experiences an electrostatic force and comes torest 0,2 m away from sphere **X**, with the string at an angleof 10° with the vertical, as shown in the diagram



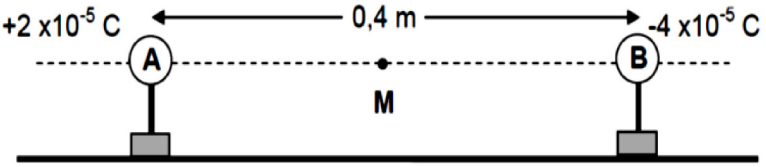
7.1.1 What is the nature of the charge on sphere **Y**? Choose from POSITIVE or NEGATIVE. (1)

7.1.2 Calculate the magnitude of the charge on sphere **Y** if the magnitude of the electrostatic force acting on it is 3,05 N. (3)

7.1.3 Draw a labelled free-body diagram for sphere **Y**. (3)

7.1.4 Calculate the magnitude of the tension in the string. (3)

7.2 Two small charged spheres, **A** and **B**, on insulated stands, with charges +2 x10-5 C and -4 x10-5 Crespectively, are placed 0,4 m apart, as shown in the diagram below. **M** is the midpoint between spheres **A** and **B**



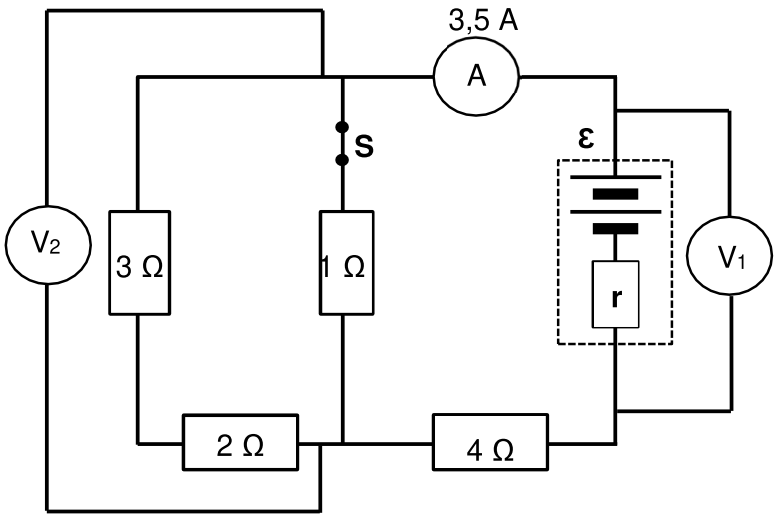
7.2.1 Define the term *electric field at a point*. (2)

7.2.2 Calculate the net electric field at point **M**. (6)

[18]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows four resistors connected to a battery of emf **ε** and internal resistance **r**. The resistances of the ammeter and the connecting wires are negligible, while the voltmeters have very high resistances.



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

Switch **S** is CLOSED.

8.2 The reading on the ammeter is 3,5 A.

8.2.1 Calculate the total external resistance of the circuit. (4)

8.2.2 Calculate the reading on voltmeter V_1. (3)

8.2.3 How does the reading on voltmeter V_2 compare to the reading on voltmeter V_1? Choose from SMALLER THAN, EQUAL TO or GREATER THAN. (1)

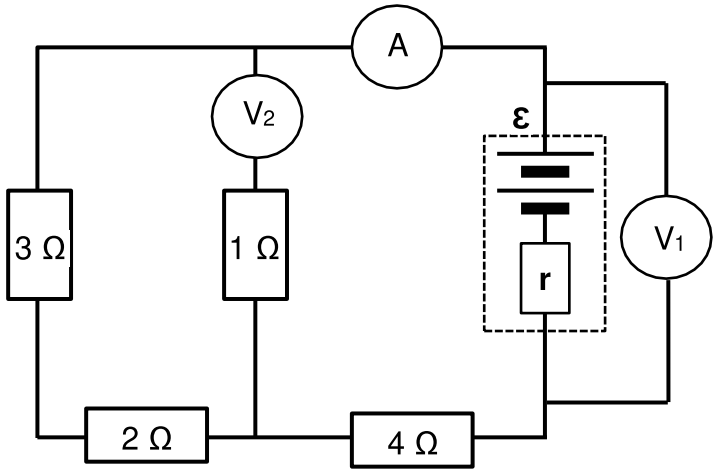
8.3 A learner concludes that the emf of the battery is equal to the reading on voltmeter V_1.

8.3.1 Define the term *emf*. (2)

8.3.2 Is the learner's conclusion CORRECT? Choose from YES or NO. (1)

8.3.3 Give a reason for the answer to QUESTION 8.3.2. (1)

Switch **S** is now removed and replaced by voltmeter V_2, as shown in the circuit diagram below.



8.4 How will EACH of the following change?

(Choose from INCREASES, DECREASES or REMAINS THE SAME.)

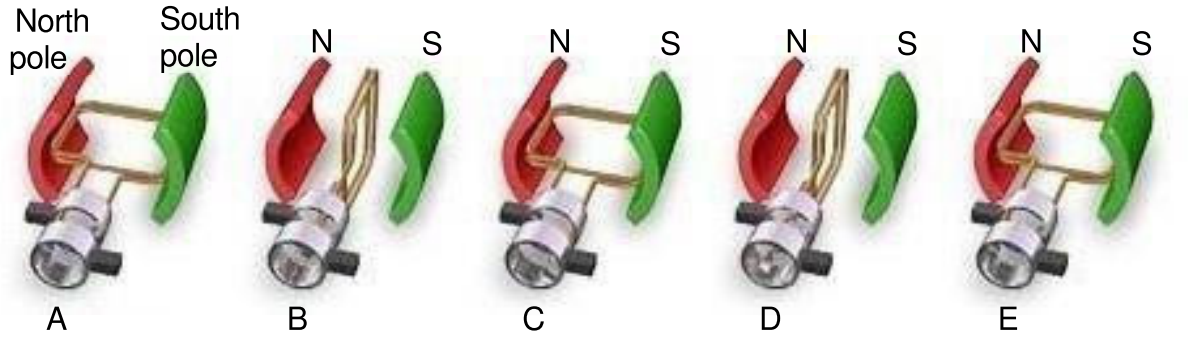
8.4.1 The power dissipated by the 4 Ω resistor (1)

8.4.2 The reading on voltmeter V_1 (1)

[16]

QUESTION 9 (Start on a new page.)

9.1 The diagrams below illustrate a generator with a rotating coil, between magnetic poles, shown in a number of different positions labelled **A – E**. The coil is rotated clockwise at constant speed in a uniform magnetic field.



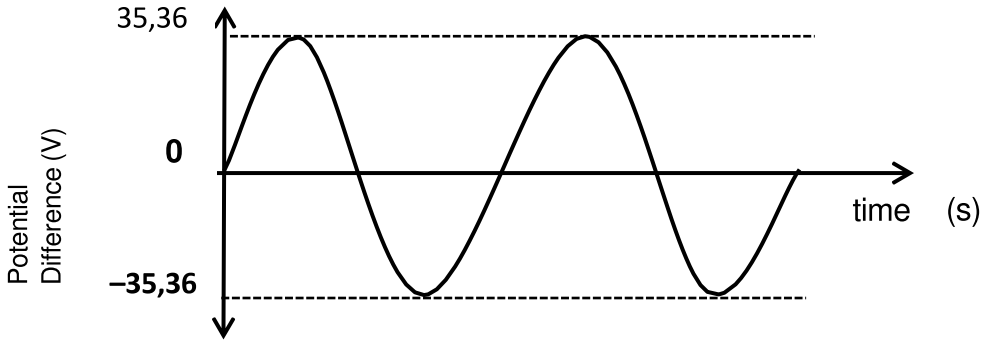
9.1.1 On which principle is the working of the generator based? (1)

9.1.2 Write down the energy conversion that takes place while the generator is in operation. (1)

9.1.3 A student states that the diagrams illustrate an AC generator. Give a reason why this statement is correct. (1)

9.1.4 Sketch a graph to show how the induced emf of the generator varies with time. Clearly indicate positions A, B, C, D and E on the graph to correspond to the diagrams. (2)

9.2 The graph of potential difference and time for the generator in QUESTION 9.1 is shown below.

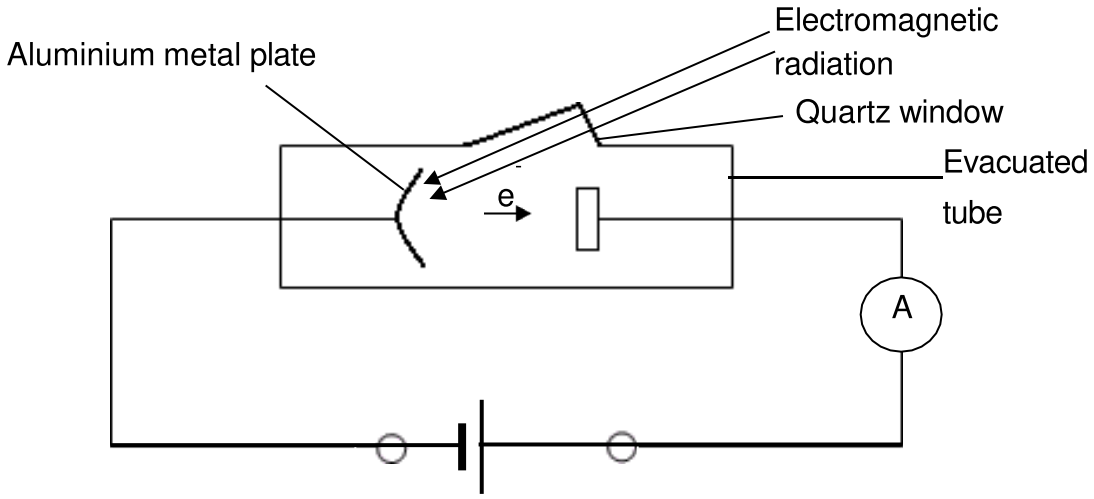


9.2.1 If an rms current of 1,22 A is produced, determine the rate at which the generator will transfer energy. (4)

[9]

QUESTION 10 (Start on a new page.)

The diagram below shows an aluminium metal plate that emits electrons when radiation of wavelength 200 nm is incident on it. The aluminium metal plate is connected to a source of potential difference and an ammeter that reads the saturated current as shown in the circuit below.



10.1 Name the phenomenon described above. (1)

10.2 State the significance of this phenomenon. (2)

The work function of aluminium is $6,7 \times 10^{-19}$ J.

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

10.4 Calculate the maximum kinetic energy of the ejected photoelectrons. (4)

10.5 How will the reading on the ammeter change if the intensity of the electromagnetic radiation is increased? Write down INCREASES, DECREASES or REMAINS THE SAME. Explain your answer. (3)

10.6 Incident radiation with a greater frequency is now used. How will the reading on the ammeter change? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

[13]

GRAND TOTAL: 150

DATA SHEET FOR PHYSICAL SCIENCES GRADE 12

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} $N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth	R_E	6,38 x 10^6 m
Mass of the Earth	M_E	5,98 x 10^{24} kg
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

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* $g = G\frac{M}{r^2}$

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 1	$W_{net} = \Delta K$ 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*

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

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)
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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