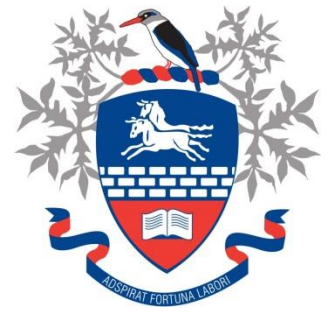


HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 1- Physics



TRIALS 2022
TIME: 3 HRS

Total 150

Instructions

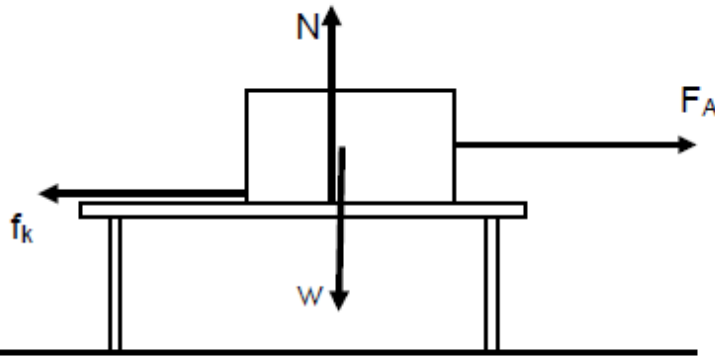
1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
SECTION B (130)

Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places

SECTION A
QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only one correct answer. Write only the letter (A-D) next to the question number (1.1-1.10) in the answer book.

- 1.1 The diagram below shows a box being pulled by force F_A along a horizontal surface. The box slides towards the right at constant velocity.



Which ONE of the following statements about the forces acting on the box is correct?

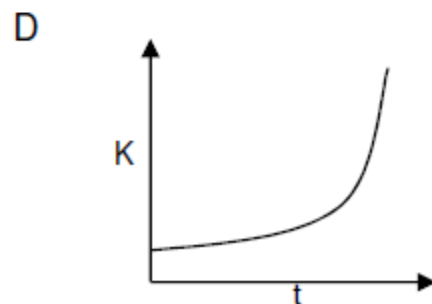
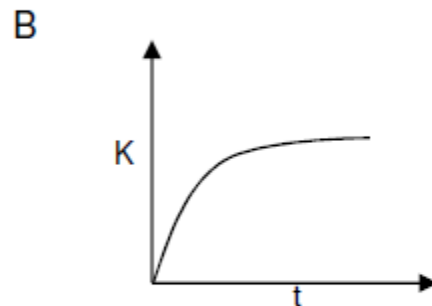
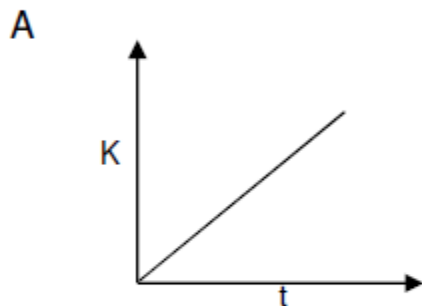
- A N is greater than w .
 - B w is greater than N .
 - C F_A is greater than f_k .
 - D F_A is equal to f_k .
- 1.2 A cricketer hits an approaching ball back in the opposite direction to its original direction.
- Which ONE of the following statements regarding this collision between the bat and the ball is TRUE?
- A The collision is perfectly elastic.
 - B The momentum of the ball stays the same before and after the collision.
 - C The magnitude of the net force of the ball on the bat is equal to the magnitude of the net force of the bat on the ball.
 - D The magnitude of the net force of the bat on the ball is greater than the magnitude of the net force of the ball on the bat.

1.3 A ball with mass m , travelling west, hits a wall with a velocity of \vec{v} . It bounces back with a velocity $0,75v$ in an easterly direction. The change in momentum of the ball will be ...

- A $0,25 mv$ east
- B $0,25 mv$ west
- C $1,75 mv$ east
- D $1,75 mv$ west

1.4 A ball is dropped from the edge of a cliff.

Which ONE of the graphs below shows the correct relationship between the kinetic energy of the ball and the time taken by the ball to hit the ground? Ignore the effects of air resistance.

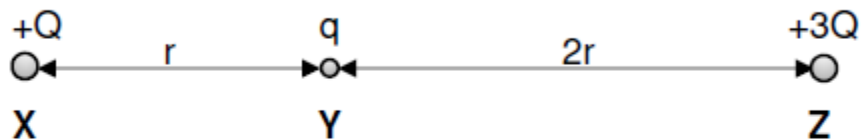


- 1.5 An applied force F acting on a block, causes the block to move across a rough horizontal surface. While moving, the applied force F is gradually changed to a force that has a magnitude less than the frictional force f .

Which ONE of the following statements is NOT TRUE for the second part of the movement of the block?

- A The work done by the applied force is negative.
- B The net work done on the block is negative.
- C The block is slowing down.
- D The net work done on the block decreases its kinetic energy.

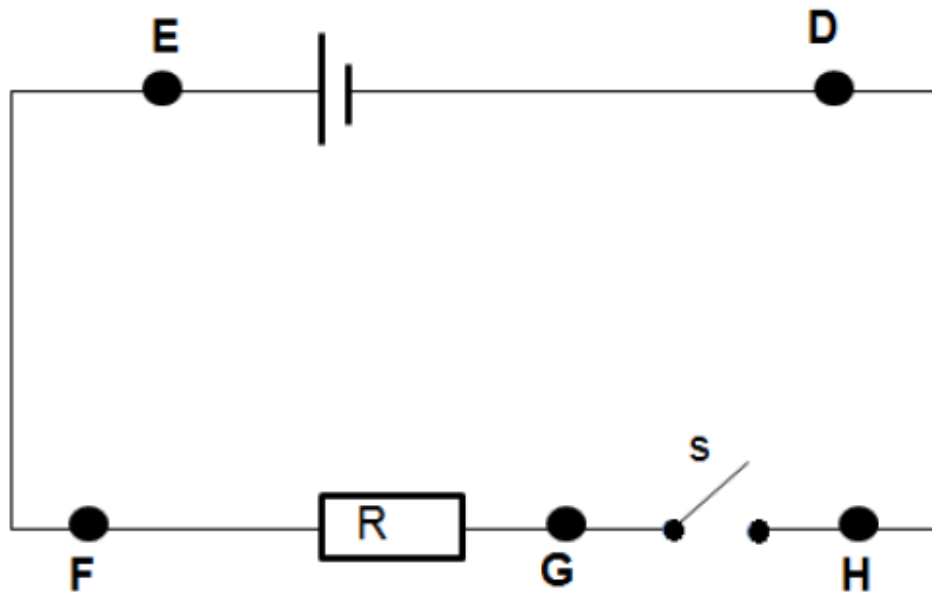
- 1.6 A positive test charge q is held at Y between two positive charges $+Q$ and $+3Q$ as shown below.



When released, q will ...

- A remain at Y .
- B move towards Z .
- C move towards X .
- D move vertically downwards.

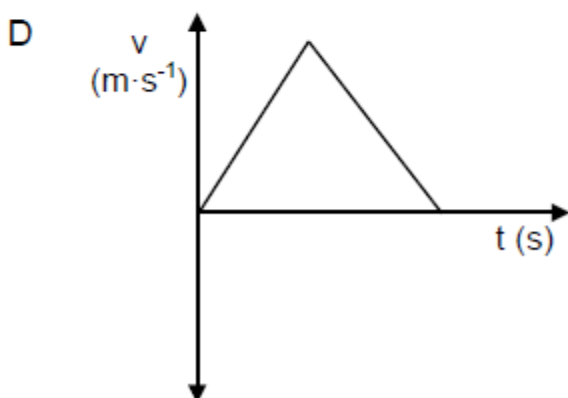
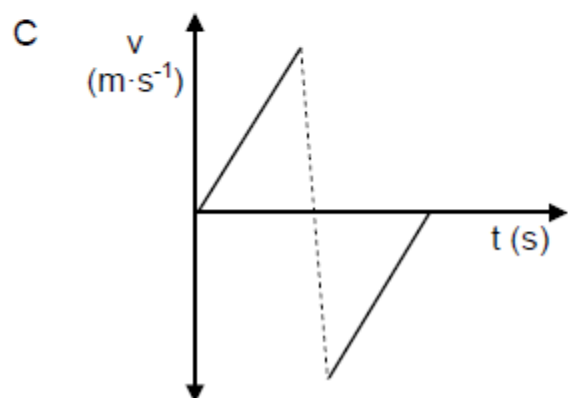
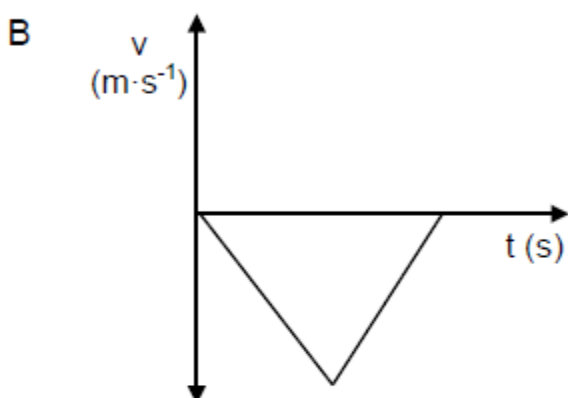
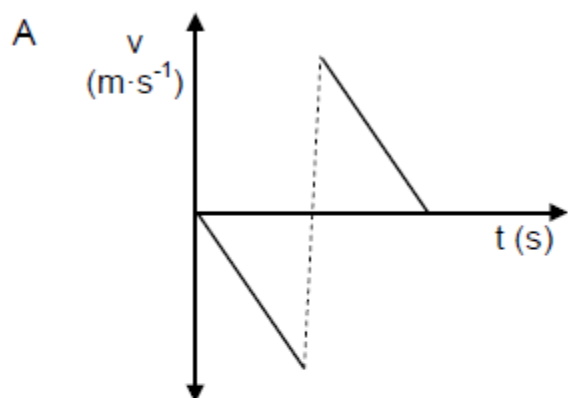
- 1.7 A cell is connected to a resistor and an open switch. Five points are labelled D, E, F, G and H respectively.



A voltmeter has a zero reading if it is connected across points ...

- A ED
 - B FH
 - C FG
 - D GH
- 1.8 The Doppler Effect is the (apparent) change in the ... of sound detected by a listener.
- A frequency
 - B amplitude
 - C loudness
 - D softness

- 1.9 A ball is dropped to the ground from a certain height and bounces back to the same height. Which ONE of the following velocity versus time graphs represents the motion of the ball if downwards is taken as positive.

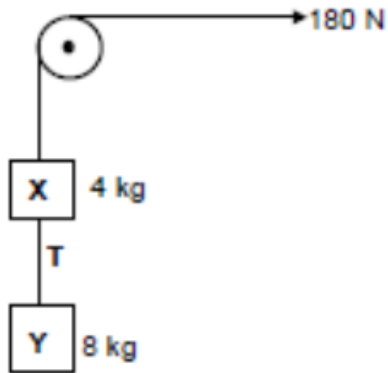


- 1.10 A large voltage is applied across a neon gas discharge tube. What type of spectrum will be observed when the gas inside the tube is viewed through a diffraction grating?

- A Line absorption spectrum
- B Line emission spectrum
- C Continuous emission spectrum
- D Absorption spectrum

Question 2

Block **X** of mass 4 kg is connected to block **Y** of mass 8 kg by a light, inextensible string. Another light, inextensible string attached to block **X** runs over a frictionless pulley. The system is pulled by means of a constant force of 180 N as shown in the diagram below. The magnitude of the tension between the two blocks is **T**. Ignore the effects of air resistance.



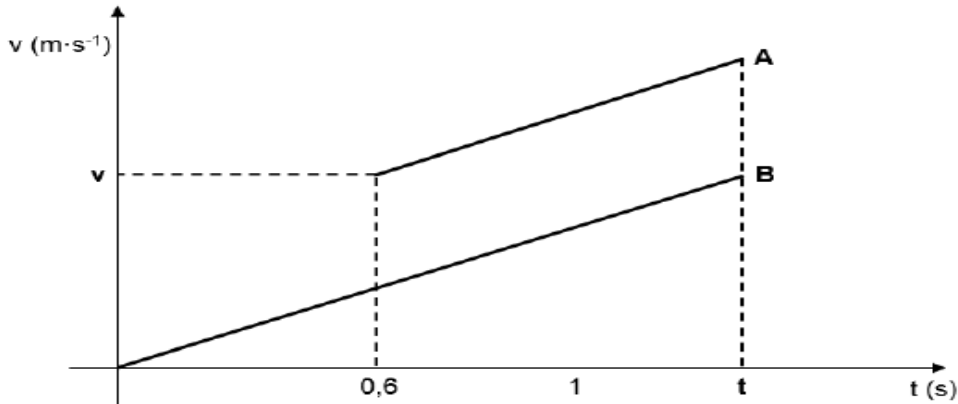
2.1 Draw a labelled free body diagram showing ALL the forces acting on object **X**. (3)

2.2 Calculate the:
tension **T** in the string connecting the two blocks. (5)

[8]

Question 3

The two velocity-time graphs below, are for two objects **A** and **B** falling vertically towards the ground. Both objects start from a height of 8 m and strike the ground at the same time **t**. Ignore the effects of friction.

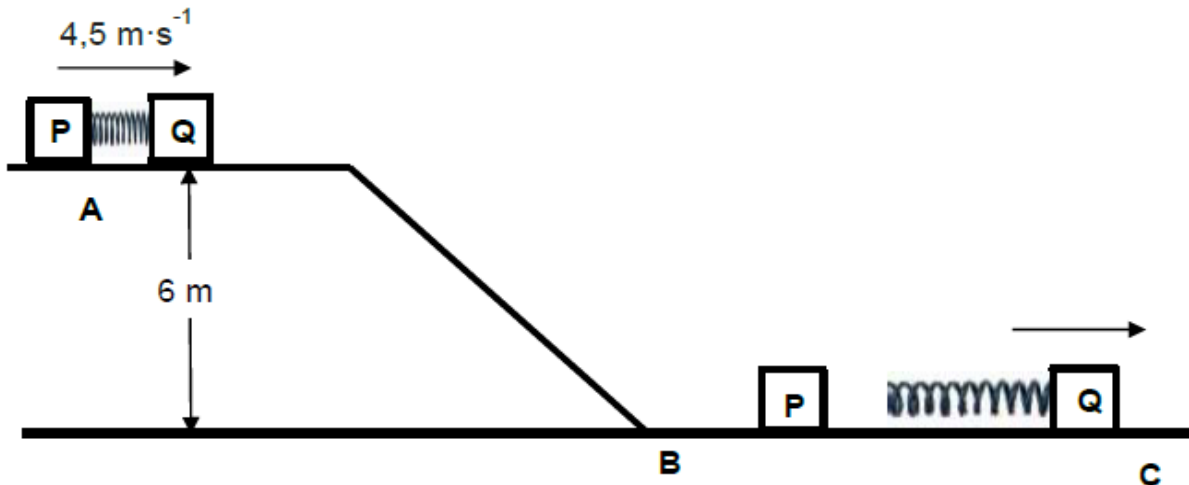


- 3.1 Explain the term *projectile*. (2)
- 3.2 3.2.1 Which ONE of the objects, **A** or **B**, was projected (thrown) downwards?
Choose from **A** or **B**. (1)
- 3.2.2 Give a reason for your answer to QUESTION 3.2.1 (1)
- 3.3 Calculate the following values on the graph.
- 3.3.1 Time **t** (4)
- 3.3.2 Velocity **v** of object **A** (4)
- 3.4 How does the area under graph **A** compare with that of graph **B**?
Choose from: SAME AS, GREATER, LESS THAN.
Give a reason for your answer. (2)
- 3.5 Write the magnitude and direction of the vector represented by the gradient. (2)

(16)

Question 4

ABC is a frictionless track. **A** is a point 6 m above the ground. Blocks **P** and **Q** have masses of 4 kg and 6 kg respectively, and a spring of negligible mass clamped together so that the fully compressed spring is aligned between blocks **P** and **Q**. At position **A** the system moves as a whole at a speed of $4,5 \text{ m}\cdot\text{s}^{-1}$. The system slides down and reaches point **B** at the bottom of the ramp as shown in the diagram below. Ignore air friction.



- 4.1 State the *law of conservation of mechanical energy* in words. (2)
- 4.2 Use the law of conservation of mechanical energy to calculate the speed of the blocks at the bottom of the ramp. (4)

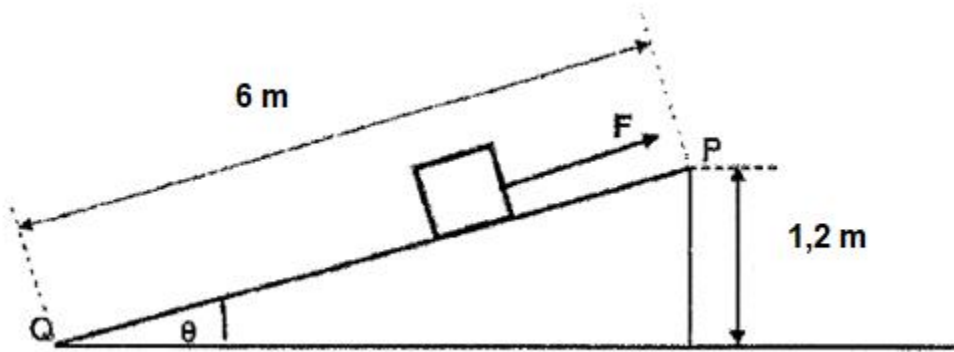
At the bottom of the ramp the clamp is released (by remote control so that the motion of the system as a whole is not affected in any way). As the spring expands (stretches), the blocks move apart. The speed of block **Q** is now increased 10%.

- 4.3 Use the *law of conservation of linear momentum* to calculate the velocity of block **P** after the spring has been expanded. (4)
- 4.4 Calculate the magnitude of the impulse which block **Q** exerts on block **P**. (3)

[13]

Question 5

A 100 kg box slides down a rough inclined plane from P to Q. A man applies a constant force F on the box such that it slides down the inclined plane at constant velocity. The slope provides a frictional force of 60 N.

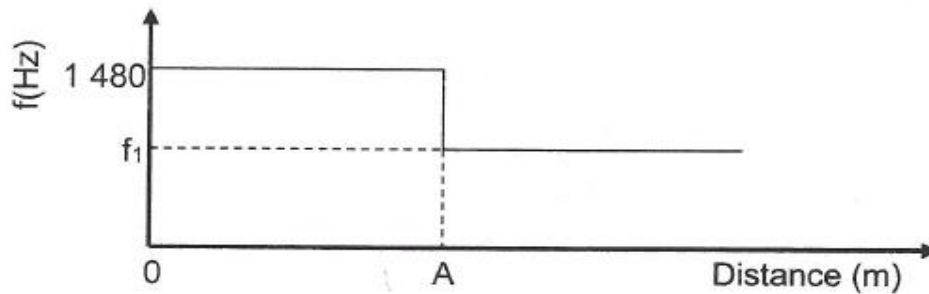


5.1 Use the work energy theorem to calculate the magnitude of force F exerted by the man on the box.

(9)

Question 6

A bird watcher finds himself/herself at position **A** with regard to a reference point. The accompanying graph illustrates how the frequency of the bird's tweets being observed by the bird watcher changes as the bird flies closer to him/her, passes over his/her head, and flies away.



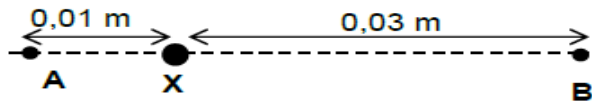
The wavelength of the sound wave the bird emits is 0,25 m. Take the speed of sound in air as $340 \text{ m}\cdot\text{s}^{-1}$.

- 6.1 State the *Doppler effect* in words. (2)
- 6.2 Calculate the:
- 6.2.1 Speed at which the bird flies (6)
- 6.2.2 Value of f_1 , shown on the graph (4)
- 6.3 Spectral lines of star Y at an observatory are observed to be *red shifted*. Explain the term red shifted in terms of **frequency**. (2)

[14]

Question 7

The diagram below shows a small sphere **X** from which 938 electrons were removed and two points **A** and **B** at different distances from the sphere **X**.

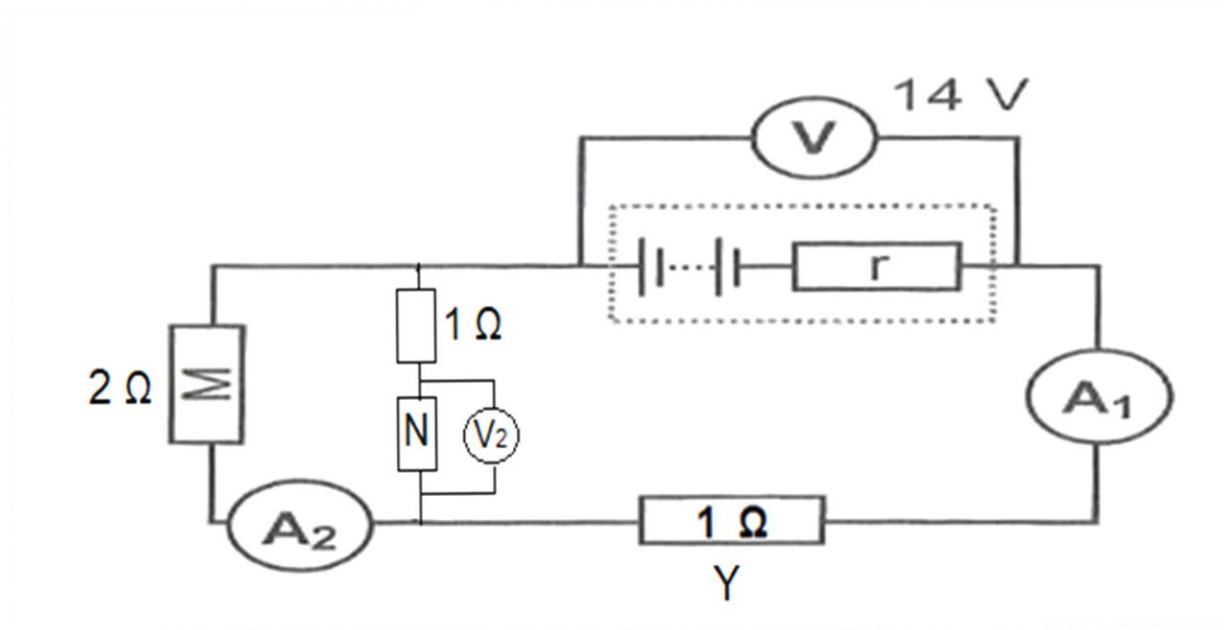


- 7.1 What is the nature of the charge on sphere **X**? Chose from POSITIVE or NEGATIVE. (1)
- 7.2 Calculate the magnitude of the charge on sphere **X**. (3)
- 7.3 Define *electric field at a point* in words. (2)
- 7.4 Draw the electric field pattern around sphere **X**. (2)
- 7.5 At what point, **A** or **B**, is the magnitude of the electric field due to the charged sphere **X** greater? Explain the answer. (3)
- 7.6 A negative point charge **Y** with charge $-2,8 \times 10^{-16}$ C is NOW placed at point **B** and a point charge **Z** with charge $+3,2 \times 10^{-16}$ C is placed at point **A**.
- 7.6.1 State *Coulomb's law* in words. (2)
- 7.6.2 Calculate the net electrostatic force on sphere **X**. (5)

[18]

Question 8

The circuit diagram shows a battery with an internal resistance $0,5 \Omega$. The resistance of **Y** is 1Ω and the reading on voltmeter **V** is 14 V . The resistance of the ammeters and connecting wire may be ignored.



8.1 If the emf of the battery is 17 V , calculate the reading on **A**₁.

(4)

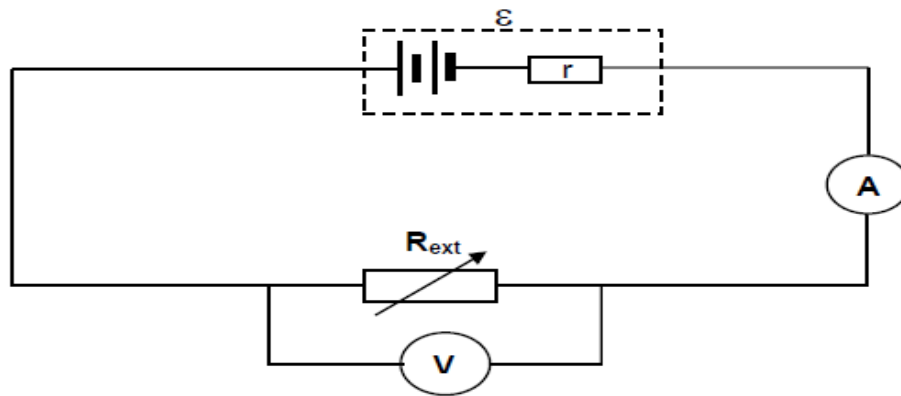
8.2 Calculate the resistance of **N**.

(7)

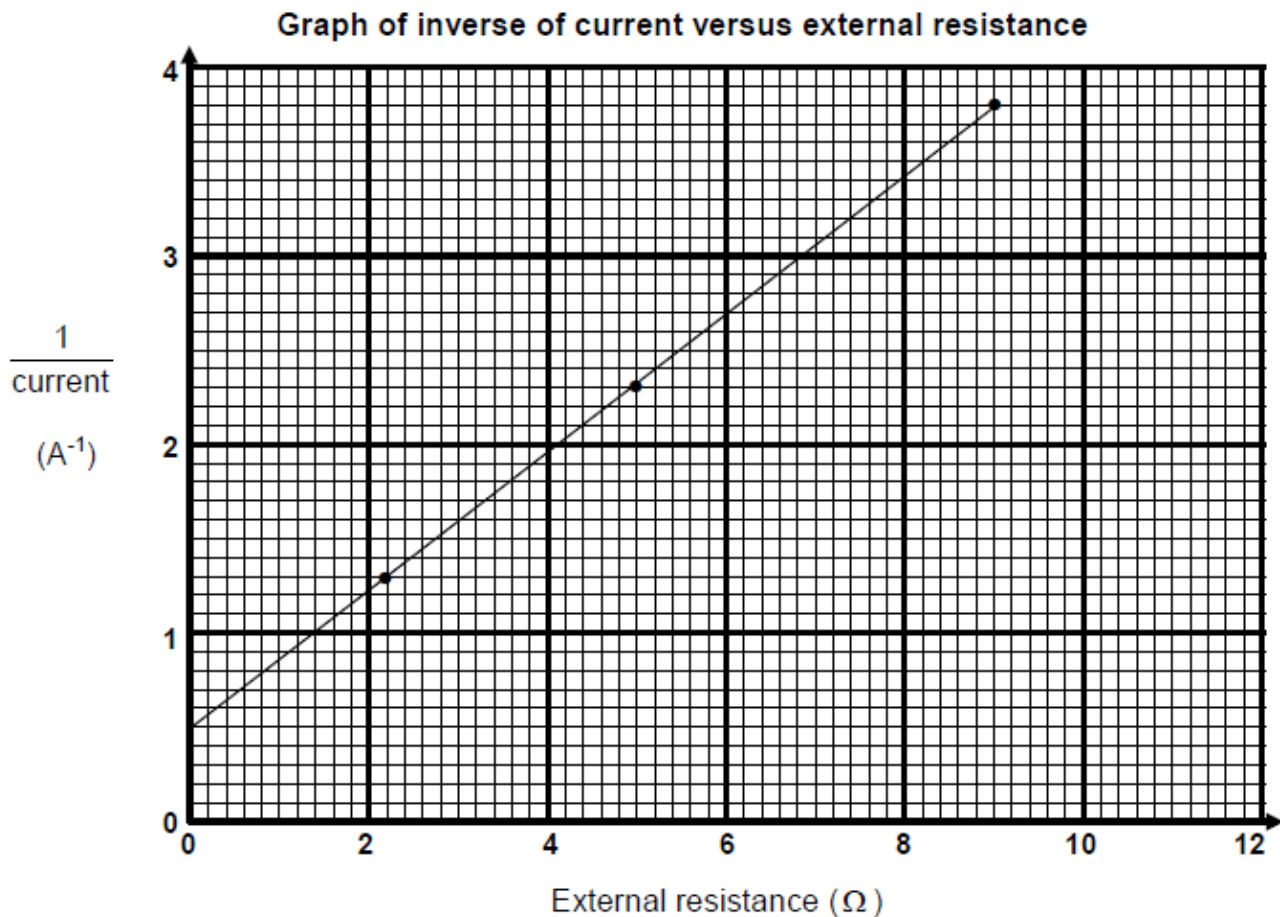
[11]

Question 9

A learner set up the circuit shown below to measure the internal resistance of a battery.



She records the readings on the voltmeter and ammeter for different resistances of the rheostat. The graph below was obtained from the results.



9.1 Define the term *emf*. (2)

9.2 Calculate the gradient of the above graph. (3)

9.3 What is represented by the gradient in QUESTION 9.2? (1)

9.4 Use the information on the graph to calculate the:

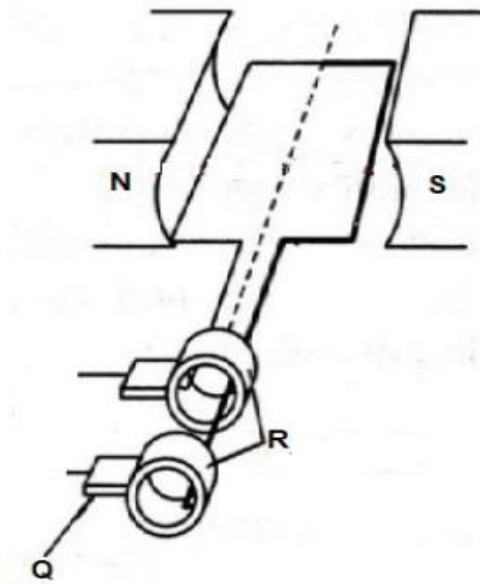
9.4.1 emf of the battery. (2)

9.4.2 internal resistance of the battery. (3)

[11]

Question 10

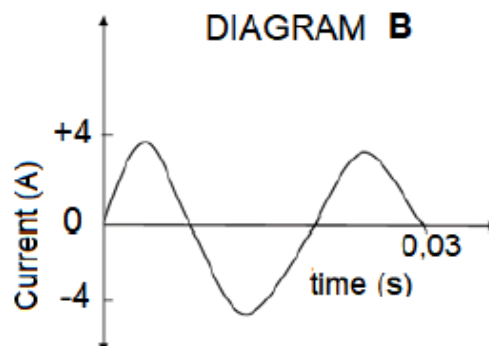
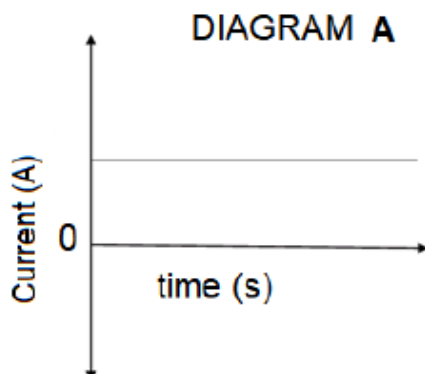
10.1 A simplified diagram of an electric generator is given below.



10.1.1 Is this an AC or a DC generator? (1)

10.1.2 Name the parts labelled **Q** and **R**. (2)

10.2 Current-time graphs from two different sources are shown in the following diagrams **A** and **B**.

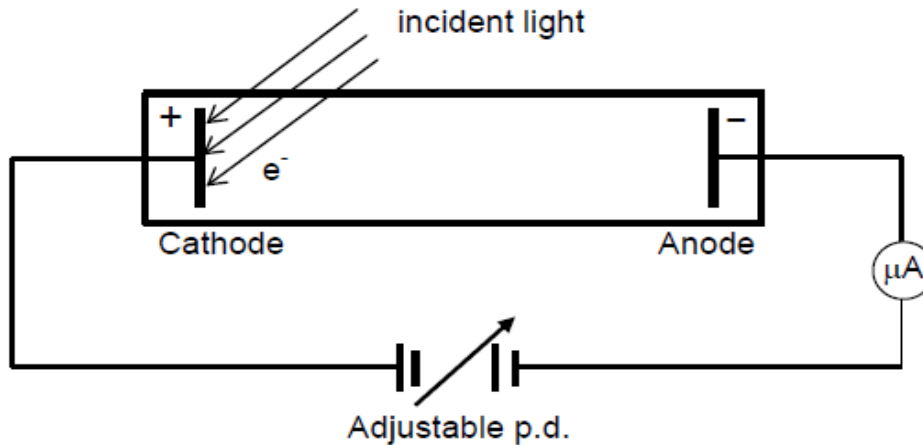


- 10.2.1 Name the types of CURRENT shown by diagrams **A** and **B**. (2)
- 10.2.2 Calculate the frequency of the current shown in diagram **B**? (2)
- 10.3 The rms voltage of 200 V is applied to an electric kettle of resistance 10 Ω .
- 10.3.1 Calculate the peak voltage. (3)
- 10.3.2 Calculate the rms value of the current. (3)
- 10.3.3 Calculate the average power dissipated by the kettle. (3)

[16]

Question 11

Incident light of different wavelengths was shone on a metal cathode in an evacuated tube as shown in the diagram below.



It was found that light of 500 nm releases electrons with zero kinetic energy. The micro-ammeter gives a zero reading.

11.1 Define the term *work function*. (2)

11.2 Calculate the work function of the metal used as cathode. (5)

The metal cathode is now irradiated with light of wavelength 400 nm.

11.3 Calculate the maximum kinetic energy of an emitted photo-electron. (5)

11.4 How will each of the following affect the reading on the micro-ammeter?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

11.4.1 The intensity of the light is increased. (1)

11.4.2 Light with a wavelength of 450 nm is used. (1)

[14]

Total 150

**DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 12
VRAESTEL 1 (FISIKA)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

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

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

$F_{\text{net}} = ma$	$p = mv$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$

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 $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{ave}} = F v_{\text{ave}}$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/of $E = h \frac{c}{\lambda}$
$E = W_o + E_k$ where/waar	
$E = hf$ and/en $W_o = hf_o$ and/en $E_k = \frac{1}{2} mv^2$	

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ 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)
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/WISSELSTROOM

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