Education and Sport Development

Department of Education and Sport Development
Departement van Onderwys en Sportontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko
NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES:PHYSICS (P1)

JUNE 2018

MARKS: 150

TIME: 3 hours

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

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 9 questions. Answer ALL the questions in the ANSWER BOOK.

2. Start EACH question on a NEW page.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line open between sub-questions, for example, between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. You are advised to use the attached DATA SHEETS.

8. Show ALL formulae and substitutions in ALL calculations.

9. Round-off your final numerical answers to a minimum of TWO decimal places.

10. Give brief discussions, et cetera where required.

11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given 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, e.g. 1.11 D.

1.1 Two balls of different masses are released from rest from the same height above the ground. During their fall the balls will have the same:

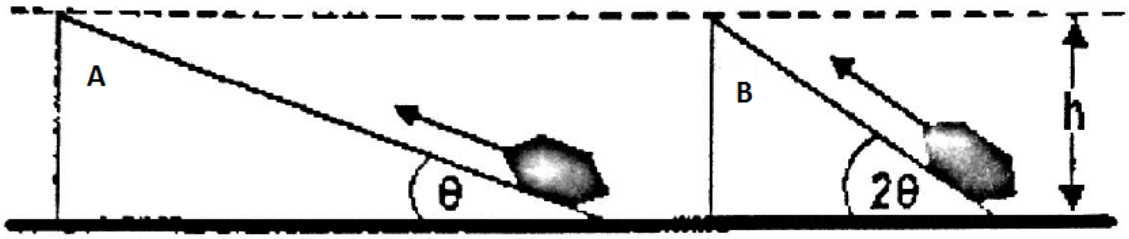
A Momentum

B Acceleration

C Kinetic energy

D Gravitational potential energy (2)

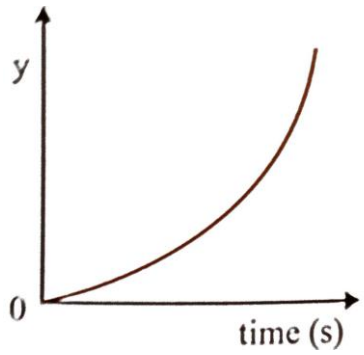
1.2 Two boys are pulling two identical objects at the same uniform speed on to different inclines, **A** and **B** of equal height. Friction can be ignored.



The magnitude of the FORCE exerted by each of the boys and the WORK DONE can be compared as follows:

	Magnitude of the force	**Work done**
A	$F_A < F_B$	$W_A < W_B$
B	$F_A > F_B$	$W_A > W_B$
C	$F_A < F_B$	$W_A = W_B$
D	$F_A > F_B$	$W_A = W_B$ (2)

1.3 A stone falls freely from rest from a certain height. Which one of the following quantities could be represented on the y-axis of the graph?



A Velocity
B Acceleration
C Momentum
D Position (2)

1.4 Thato exercises in a gymnasium. In which of the following cases would his power output be the greatest?

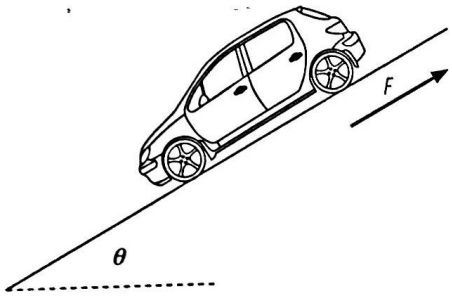
A 10 J work in 10 s

B 80 J work in 30 s

C 60 J work in 20 s

D 100 J work in 40 s (2)

1.5 A car of mass **'m'** applies a breaking force enabling it to travel at a constant speed down a slope of θ inclined with the horizontal. The car experiences a resistive force of **F.** Ignore effect of air resistance.



The breaking force needed to propel the car down the slope at constant speed is:

A mg cosθ

B mg sinθ - F

C mg cosθ - F

D mg sinθ (2)

1.6 For which of the following wave types does the Doppler effect occur?

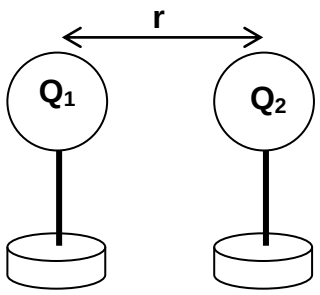
A Sound waves

B Ultrasound waves

C Light waves

D All of the above (2)

1.7 Two positive charges $\mathbf{Q_1}$ and $\mathbf{Q_2}$ are placed at a distance **r** apart. The charges experience an electrostatic force **F**.



Which ONE of the following explains a decrease in the magnitude of **F**?

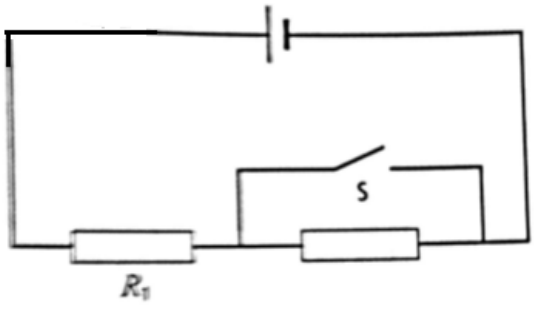
A A decrease in distance between them

B Q_1 and Q_2 change places

C Electrons are added to Q_1

D Electrons are removed from Q_2 (2)

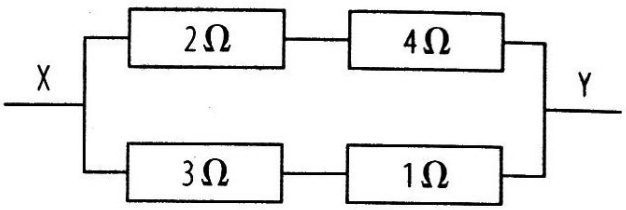
1.8 In the circuit below, the internal resistance of the battery can be ignored. Which one of the following combinations correctly represents the change in effective resistance and current through resistor R_1 when switch S is closed?



	Effective resistance	**Current through R_1**
A	Decreases	Increases
B	Increases	Decreases
C	Decreases	Decreases
D	Increases	Increases

(2)

1.9 The diagram below represents part of a circuit. The potential difference across X and Y is V



Which one of the following gives the current (in A) through 3 Ω resistor?

A $\frac{V}{6}$

B $\frac{V}{3}$

C $\frac{V}{10}$

D $\frac{V}{4}$ (2)

1.10 Which one of the following units is NOT the same as the 'watt"?

A Amperes per volt

B Joules per second

C Amperes X volts

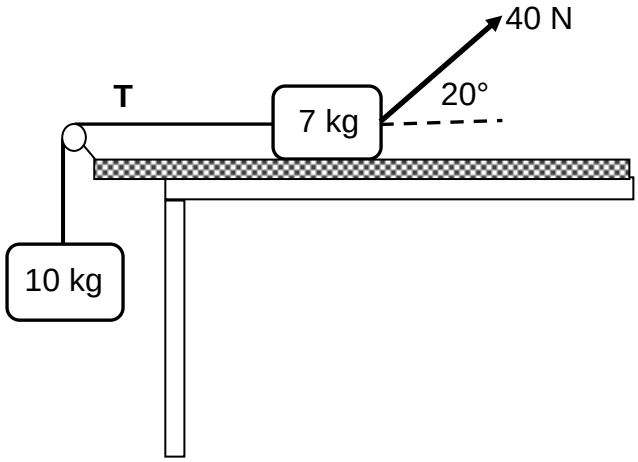
D $(\text{Amperes})^2$ X ohms (2)

[20]

QUESTION 2 (Start on a new page)

A block of mass 7 kg rests on a rough horizontal table. It is connected by a light inextensible string **T** which passes over a light frictionless pulley to another block of mass 10 kg hanging vertically as shown the sketch below.

When a 40 N force is applied to the 7 kg block at an angle of 20° to the horizontal, the 7 kg block accelerates at 3,35 $m \cdot s^{-2}$ TO THE LEFT.



The coefficient of kinetic friction between the 7 kg block and the surface of the table is μ_k. Ignore the effects of air friction.

2.1 Draw a labelled free-body diagram that shows ALL the forces acting on the 7 kg block. (5)

2.2 Write down Newton's SECOND law in words. (2)

Calculate the:

2.3 Normal force on the 7 kg block. (3)

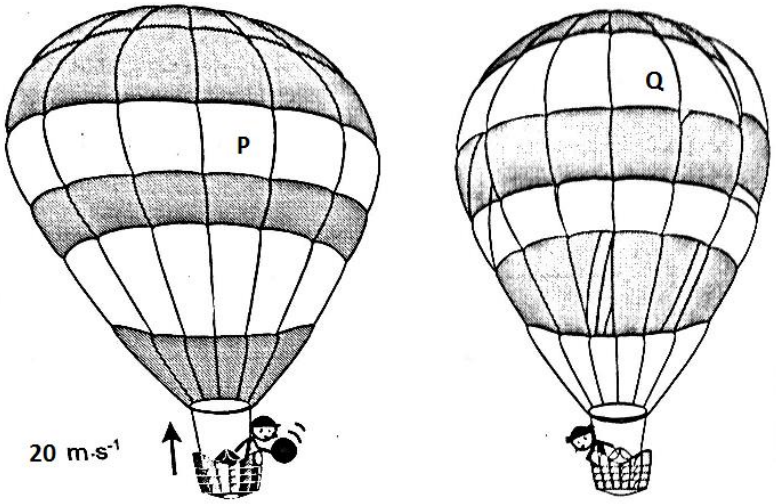
2.4 Tension in string **T**. (2)

2.5 Coefficient of kinetic friction (μ_k) between the 7 kg block and the table. (5)

[17]

QUESTION 3 (Start on a new page)

A hot air balloon **P** is rising at a constant speed of 20 $m \cdot s^{-1}$. At a height of 400 m it passes a stationery balloon **Q**, a person in balloon **P** releases a stone from his hand.(assume that the balloon keeps moving with the same constant speed.)



3.1 Describe the motion of the stone when it is released as seen by a man in balloon **Q**. (1)

3.2 What is the magnitude and direction of the stone's displacement after 2 s? (3)

3.3 What is the magnitude and direction of the balloon **P**'s displacement after 2 s? (2)

3.4 How far apart will balloon **P** and the stone be after 2 s? (2)

3.5 Calculate the stone's velocity after 6 s? (2)

3.6 Calculate the time taken for the stone to reach the ground? (4)

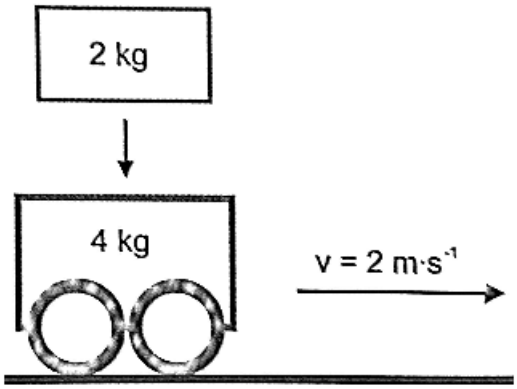
3.7 Draw a velocity time graph for the total motion of the stone. (3)
Show the following clearly on the graph:

a) The initial velocity of the ball.
b) The time taken to reach the ground.

[17]

QUESTION 4 (Start on a new page)

4.1 A trolley with a mass of 4 kg moves horizontally at a velocity of 2 $m \cdot s^{-1}$, as shown in the diagram. A brick with a mass of 2 kg, that is held just above the moving trolley is dropped on the trolley perpendicularly from above as shown in the sketch below:



4.1.1 Calculate the velocity of the trolley and brick after the brick has fallen on the trolley. (3)

4.1.2 Is this an example of an elastic or inelastic collision? (1)

4.1.3 Support your answer 4.1.2 with a calculation. (5)

4.2

4.2.1 State the impulse momentum theorem in words. (2)

4.2.2 A billiard ball of mass 200 g is moving at 6 $m \cdot s^{-1}$. It collides in a straight line with a cushion and bounces back at 4,2 $m \cdot s^{-1}$.

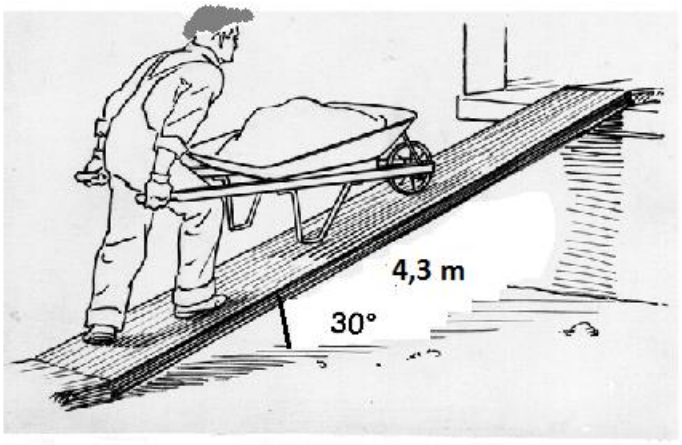
Determine the impulse exerted by the ball on the cushion. (3)

4.2.3 The ball is in contact with the cushion for 0,02 s. Calculate the force exerted by the cushion on the ball. (2)

[16]

QUESTION 5 (Start on a new page)

Sibsu is pushing a load in a wheel barrow. The total mass of the wheel barrow and load is 280 kg. At the top of the 30˚ slope the wheel barrow starts to slide downwards for 4,3 m. To stop the wheel barrow accelerating any further down the slope, Sibsu applies a force on the wheel barrow that is parallel to the slope. The kinetic frictional force between the wheel barrow and slope is 950 N.



5.1 Draw a labelled free body diagram to indicate all the forces acting on the wheel barrow. (4)

5.2 Calculate the force exerted on wheel barrow by Sibsu to prevent it from accelerating down the slope. (4)

5.3 Calculate the work done on the wheel barrow by the gravitational force. (3)

5.4 Determine the work done on the wheel barrow by friction (2)

5.5 Define conservative forces and write an example of a conservative force. (3)
[16]

QUESTION 6 (Start on a new page)

During an experiment to determine the speed of sound, learners are given a siren that sounds a single note of frequency 426 Hz. They attach it to a remote controlled car and move it at a constant speed past a stationery tape recorder next to the runway. Ignore the effects of friction. The tape recorder records the sound of the siren.

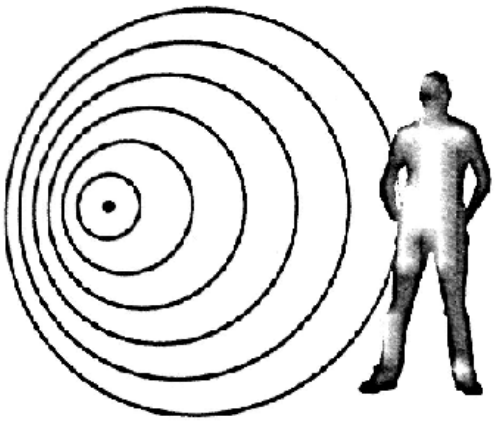
6.1 State the Doppler effect in words. (2)

6.2 The speed of the remote controlled car was noted as 31,9 $m \cdot s^{-1}$. The frequencies of two notes were recorded. One note had the frequency of 467 Hz and the other had a frequency **lower** than 426 Hz.

6.2.1 Determine the speed of sound in air. (4)

6.2.2 Give a reason why observed frequencies are respectively
(a) higher
(b) lower than the frequency of the source. (2)

6.3

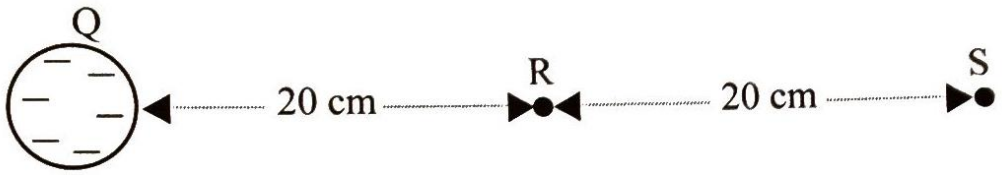


In the diagram above, the observer is stationery. Is the observer going to experience a higher or lower pitch than the actual sound emitted? Explain your answer. (3)

[11]

QUESTION 7 (Start on a new page)

R and **S** are two points in the electric field of a small negatively charged sphere **Q,** as shown in the diagram below. The two points and the centre of the sphere all lie on the same straight line. The magnitude of the electric field of the sphere at **R** is 5,6 x 10^3 N·C^{-1}



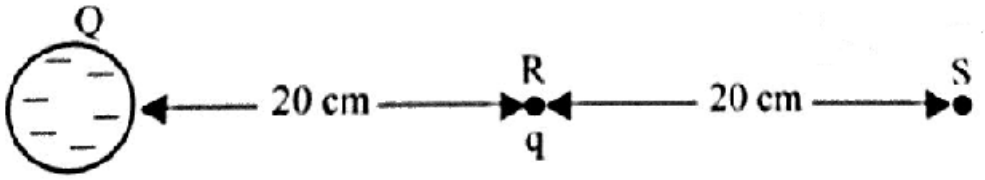
7.1 Define the term *electric field at a point*. (2)

7.2 What will be the direction of the electric field at point **R**. (2)

7.3 What will be the magnitude of the electric field at **S.** (3)

7.4 What is the magnitude of the charge on sphere **Q**. (4)

7.5 A point charge **q** of +15 nC is now placed at point **R.**



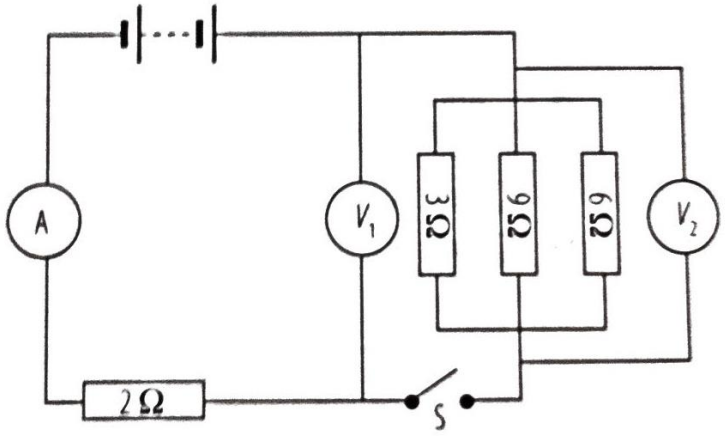
7.5.1 Determine the force that the sphere **Q** exerts on this point charge **q.** (3)

7.5.2 Calculate the magnitude and direction of the net electric field at point **S** (4)

[18]

QUESTION 8 (Start on a new page)

A battery with an internal resistance of 2 Ω and an emf (ε) of 24 V is connected in a circuit, as shown below.



8.1 When the switch S is open, What is the reading on:

8.1.1 V_1? (1)

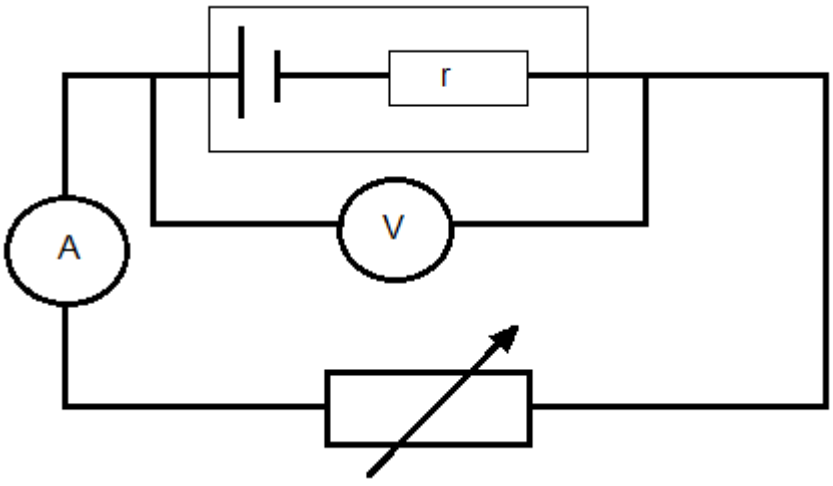
8.1.1 V_2? (1)

8.2 Switch **S** is now closed:

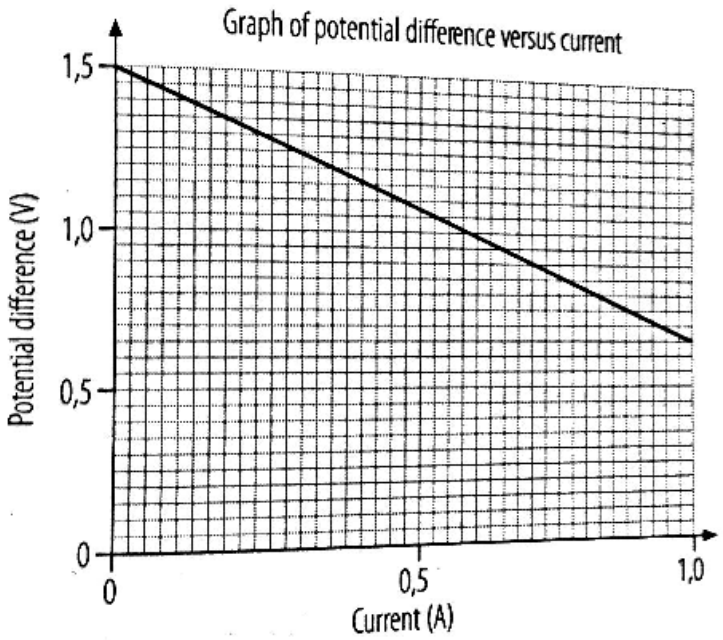
8.2.1 Calculate the total resistance of the entire circuit. (3)

8.2.2 Determine the reading on the ammeter **A** (3)

8.3 Learners set up an investigation to determine the 'emf' and the internal resistance of a battery. They set up the circuit as shown in the diagram. They vary the resistance using a rheostat and take voltmeter readings for different current readings.



They draw up the following graph



Answer the following questions based on the graph.

8.3.1 What is the emf of the battery? (1)

8.3.2 Determine the gradient of the graph. (2)

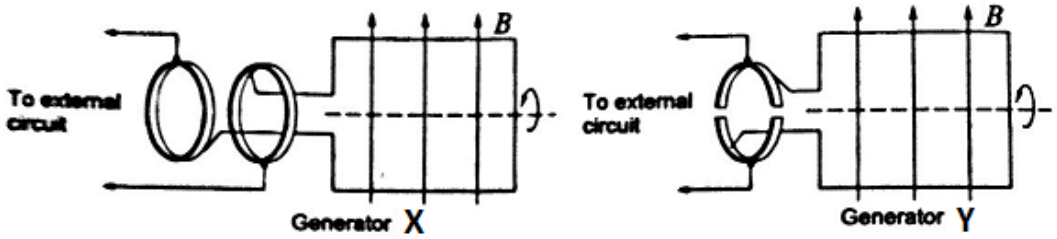
8.3.3 What physical quantity does the negative gradient of the graph represents? (1)

8.3.4 Determine the resistance of the rheostat when the current is 0,75 A. (3)

8.3.5 Explain why voltmeter readings decreased as the current increased. (3)
[18]

QUESTION 9 (Start on a new page)

9.1 Two types of generators are shown in the diagram below

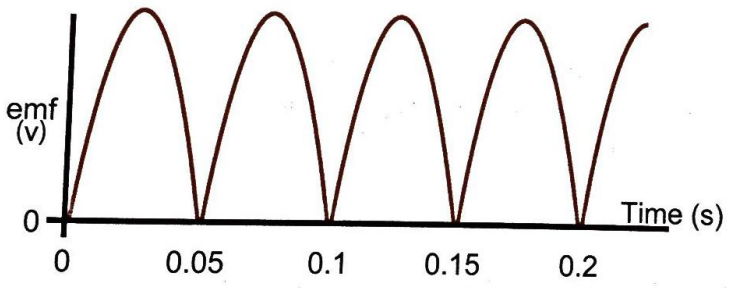


9.1.1 What is the function of the brushes in a generator? (2)

9.1.2 Which one of these generators is the direct current generator? Write down the reason for your choice.
Choose from **X** and **Y** (2)

9.1.3 Explain why alternating current generators are used in large-scale in production of electric power. (2)

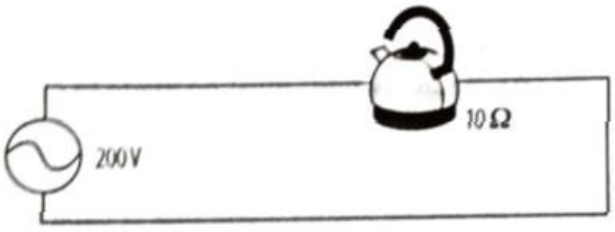
9.2 The graph below shows the induced emf vs time graph, for a generator.



9.2.1 Is the coil horizontal or vertical at 0,1 s ? (1)

9.2.2 Does the graph represent an AC generator or a DC generator? Explain. (1)

9.3 The rms voltage of 200 V is applied to an electric kettle of resistance 10 Ω



Calculate:

9.3.1 The peak voltage (3)

9.3.2 The rms value of the current (3)

9.3.3 The average power dissipated by the kettle (3)

[17]

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 gravitasiekonstante*	G	6,67 × 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·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 Earth *Massa van Aarde*	M_E	5,98 × 10^{24} kg
Radius of Earth *Radius van Aarde*	R_E	6,38 × 10^6 m

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 $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ 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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = F\cdot v_{ave}$ / $P_{gemid} = F\cdot v_{gemid}$	

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ 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 $W_o = hf_o$ 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

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