Western Cape Government

METRO NORTH EDUCATION DISTRICT

SCHOOL-BASED ASSESSMENT

SEPTEMBER TRIAL COMMON EXAMINATION

PHYSICAL SCIENCES P1

TASK NO.: 5

SEPTEMBER 2025

TOTAL: 150
DURATION: 3 hours

This question paper consists of 19 pages and 3 data sheets

1. Write your name in the space below and submit the question paper with your answer sheets.

   NAME AND SURNAME: _____

   GRADE: **12** _____

2. This question paper consists of **TEN QUESTIONS**. Answer ALL the questions on your ANSWER SHEETS.

3. Start EACH question on a NEW page on your ANSWER SHEETS.

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

5. Leave ONE line between two sub questions, for example 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.

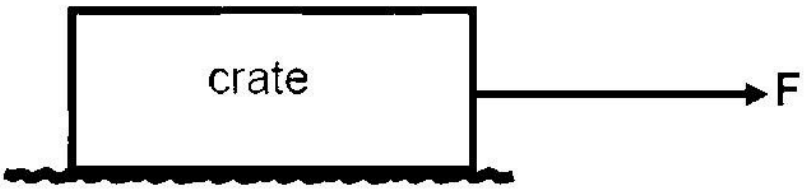
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.

11. Give brief motivations, discussions etc. where required.

12. Write neatly and legibly.

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 numbers (1.1 to 1.10) on your ANSWER SHEETS, e.g. 1.11 E.

1.1 A horizontal force **F** is applied to a crate, causing it to move over a rough, horizontal surface as shown below.



The kinetic frictional force between the crate and the surface on which it is moving depends on …

A the applied force **F**.
B the surface area of the crate in contact with the floor.
C how quickly the crate moves along the surface.
D the upward force exerted by the surface on the crate. (2)

1.2 A person stands on a bathroom scale that is calibrated in newton, in a stationary elevator. The reading on the bathroom scale is **w**.

The elevator now moves with a constant upward acceleration of ¼ **g**, where **g** is the gravitational acceleration.

What will the reading on the bathroom scale be now?

A ¼ **w**

B ¾ **w**

C **w**

D $^{5}/_{4}$ **w** (2)

1.3 A hot air ballon is moving upwards at a constant velocity **v**. A cellphone is dropped from the hot air balloon. What is the velocity of the cellphone at the instant it is dropped from the balloon?

A **v** downwards.
B **v** upwards.
C Zero.
D 2**v** downwards. (2)

1.4 Which one of the following best describes an inelastic collision?

A Neither kinetic energy nor momentum are conserved.
B Both momentum and kinetic energy are conserved.
C Kinetic energy is conserved but total linear momentum is not conserved.
D Kinetic energy is not conserved but total linear momentum is conserved. (2)

1.5 A 1000 W motor lifts a 100 kg mass to a height of 5 meters in 10 seconds at a constant speed. What is the **power** output of the motor in this situation?

A 490 W
B 500 W
C 1 000 W
D 5 000 W (2)

1.6 An astronomer at SALT observes that the light spectrum of a star has been red shifted. How have the observed frequency of light from the star and the distance between the star and Earth changed?

	OBSERVED FREQUENCY OF LIGHT	**DISTANCE BETWEEN THE STAR AND EARTH**
A	Increased	Decreased
B	Decreased	Increased
C	Increased	Increased
D	Decreased	Decreased

(2)

1.7 Two point charges each having a charge of ? are placed at a distance, **d** meters apart. If the distance between them is doubled, by what factor does the force between them change?

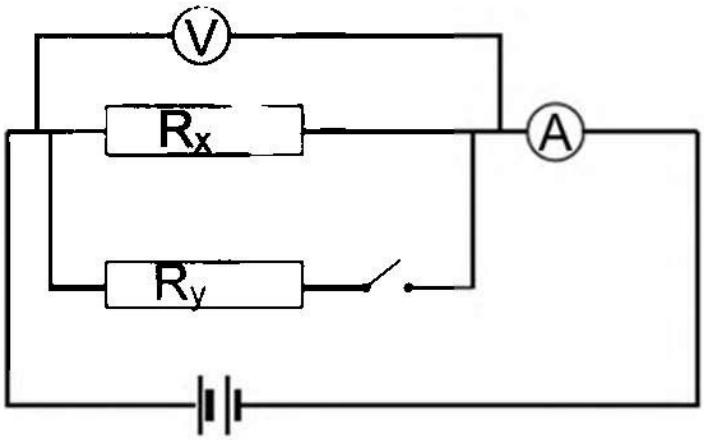
A 2

B 4

C ½

D ¼ (2)

1.8 In the circuit diagram below, R_x and R_y are identical ohmic resistors connected in parallel. When the switch is open, the ammeter reading is 0,1 A and the voltmeter reading is 3 V. Ignore the internal resistance of the battery.



What will be the reading on the AMMETER and VOLTMETER when the switch is closed?

	READING ON AMMETER	**READING ON VOLTMETER**
A	Equal to 0,1 A	Equal to 3 V
B	Greater than 0,1 A	Equal to 3 V
C	Less than 0,1 A	Less than 3 V
D	Greater than 0,1 A	Greater than 3 V

(2)

1.9 A group of leaners built an electric generator. They then used this generator to investigate how the magnitude of the induced emf would change as the magnetic field strength changed.

Which ONE of the following is CORRECT regarding the variables for the investigation?

	DEPENDENT VARIABLE	**INDEPENDENT VARIABLE**	**CONTROL VARIABLE**
A	Magnetic field strength	Number of turns of coil of generator	Magnitude of induced emf
B	Magnitude of induced emf	Number of turns of coil of generator	Magnetic field strength
C	Magnitude of induced emf	Magnetic field strength	Number of turns of coil of generator
D	Number of turns of coil of generator	Magnitude of induced emf	Magnetic field strength

(2)

1.10 To see an absorption spectrum, dispersed light must …

A Have passed through a gas that is at the same temperature as the source of light.

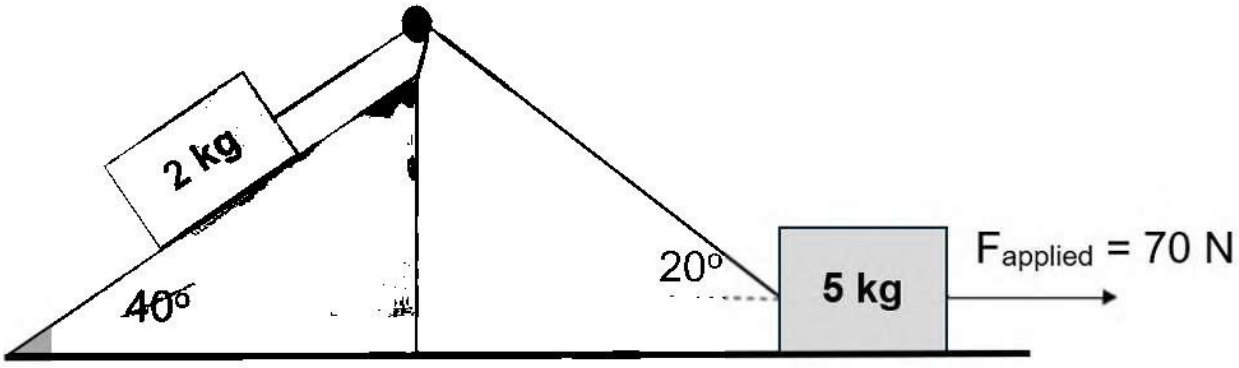
B Have passed through a gas that is substantially cooler than the source of light.

C Have passed through a gas that is substantially hotter than the source of light.

D Come straight out of a white-hot filament. (2)

[20]

The sketch below shows a 2 kg block on an incline with an angle of 40° and is attached to a 5 kg block on the ground by an inelastic rope. The coefficient of kinetic friction on the incline is 0,2. A force of 70 N is applied to the 5 kg block **at the moment** when the rope attached to the 5 kg block is at an angle of 20°, a kinetic frictional force of 17,15 N is measured for the 5 kg block.



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

2.2 Draw a free-body diagram showing ALL forces acting on the 5 kg block. (5)

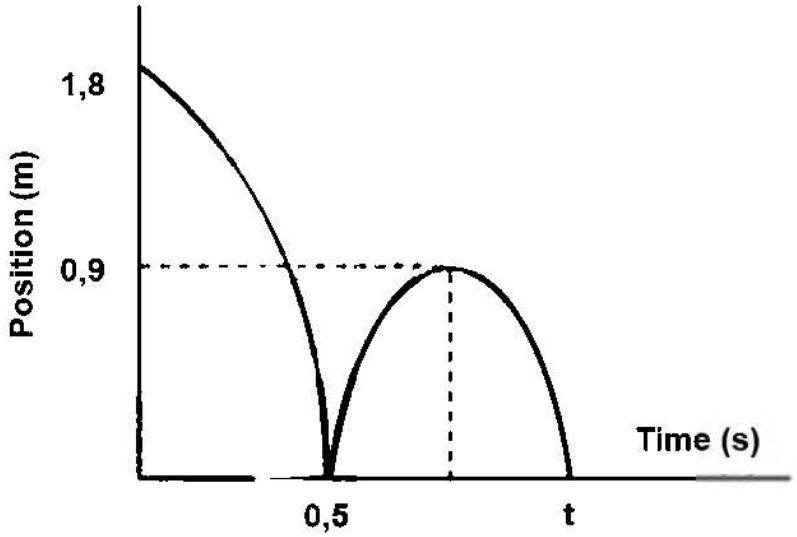
2.3 Calculate the kinetic frictional force on the 2 kg block. (3)

2.4 Calculate the magnitude of the 5 kg block's acceleration at the instant when the angle of the rope on the 5 kg block is 20°. (6)

[16]

The position-time graph is given for a ball which is thrown down from a vertical height of 1,8 m. The ball bounces on reaching the ground. The contact time between the ball and the floor can be ignored.

Ignore air resistance.



3.1 Define the term *projectile*. (2)

3.2 Calculate the initial speed at which the ball was thrown. (3)

3.3 Determine the velocity of the ball as it leaves the ground following the bounce. (3)

3.4 Calculate the value of time **t**. (4)

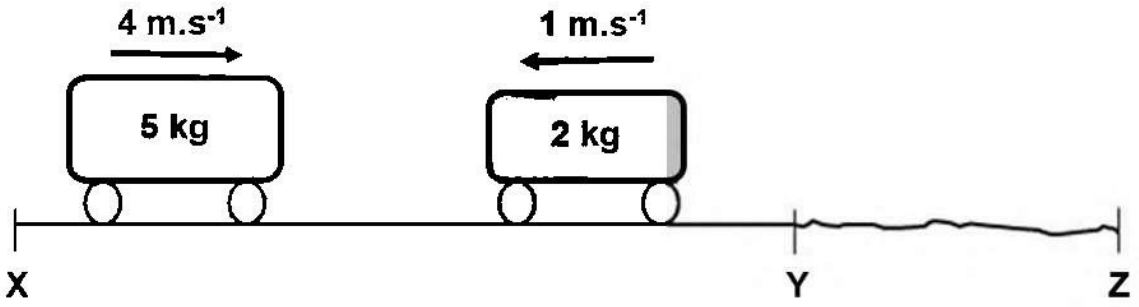
3.5 Sketch the *velocity-time* graph to represent the motion of the ball. Indicate the following on the graph:

- The initial velocity at which the object was thrown.
- The velocity at which the ball bounces off the ground.
- The time of the first ball bounce. (4)

[16]

The diagram below shows two sections, **XY** and **YZ**, of a horizontal, flat surface. Section **XY** is frictionless, while section **YZ** is rough.

A 5 kg trolley, moving with a velocity of 4 $m.s^{-1}$ to the right, collides head-on with a 2 kg trolley moving with a velocity of 1 $m.s^{-1}$ towards the 5 kg trolley. After the collision, the two trolleys stick together and move to the right pass point **Y**.



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

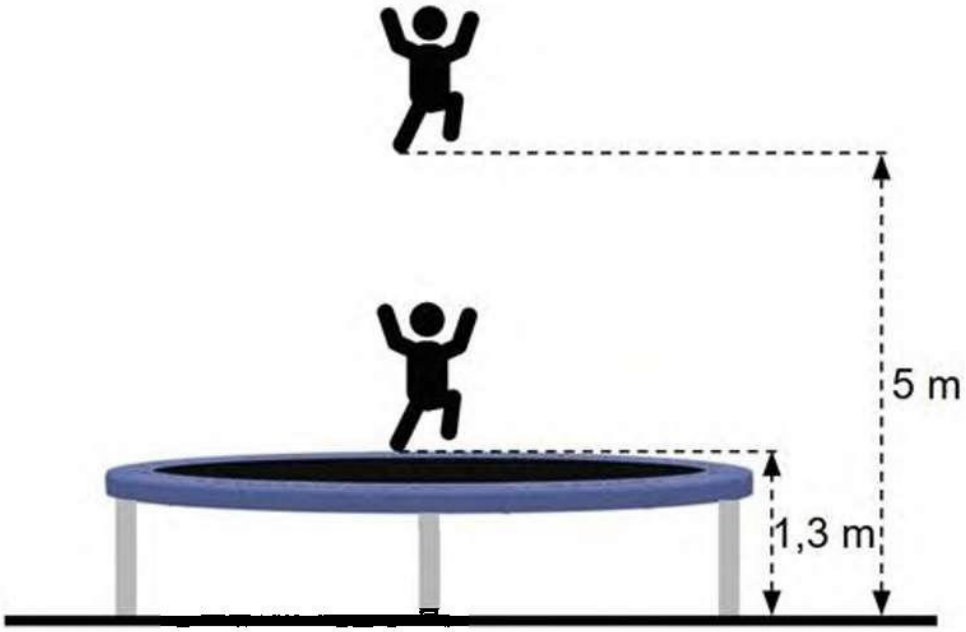
4.2 Calculate the magnitude of the velocity of the combined trolleys at point **Y**. (4)

The combined trolleys travel for 0,3 s from point **Y** before coming to a stop at point **Z**.

4.3 Calculate the magnitude of the net force acting on the combined trolleys while they move through section **YZ**. (4)

[10]

5.1 A gymnast, with an unknown mass **m**, jumps vertically upwards from a trampoline as shown below.



The gymnast loses contact with the trampoline at a height of 1,3 m above the ground and reaches a maximum height of 5 m above the ground. Ignore all effects of friction.

5.1.1 State the *law of conservation of mechanical energy* in words. (2)

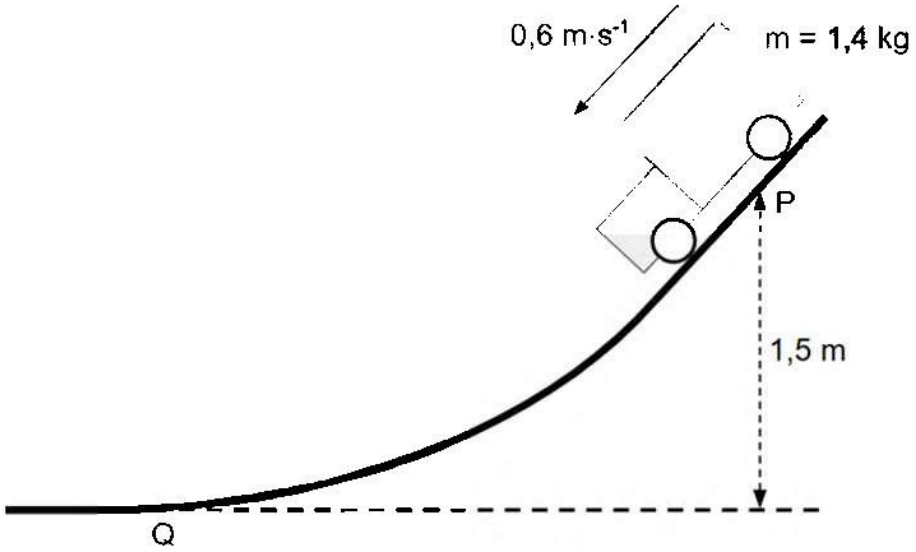
5.1.2 Use **ENERGY PRINCIPLES** to calculate the velocity with which the gymnast leaves the trampoline. (4)

5.1.3 If the effects of friction were NOT ignored, how would the maximum height reached be affected? Write only INCREASE, DECREASE or REMAIN THE SAME.

Explain your answer. (2)

5.2 A toy train with a mass of 1,4kg is released from rest and moves along a track down an incline as shown below. It has a speed of 0,6 $m \cdot s^{-1}$ at point **P,** which is at a vertical height of 1,5 m above the ground. The curved part of the track, **PQ**, is 1,8 m in length. The toy truck's speed at point **Q** is 3 $m \cdot s^{-1}$.

There is a constant frictional force acting on the toy truck from **P** to **Q**.



5.2.1 Is frictional force a *conservative* or *non-conservative force*? Explain your answer. (2)

5.2.2 Calculate the magnitude of the average frictional force experienced by the toy truck. (6)

[16]

A car moves at a constant velocity along a straight, horizontal road towards a device which is capable of emitting and detecting sound waves. The device emits sound waves with a wavelength of 0,013 m. The sound waves are reflected off the surface of the car and the device detects sound waves with a frequency of 31 500 Hz. Assume that the speed of sound in air is 340 $m.s^{-1}$.

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

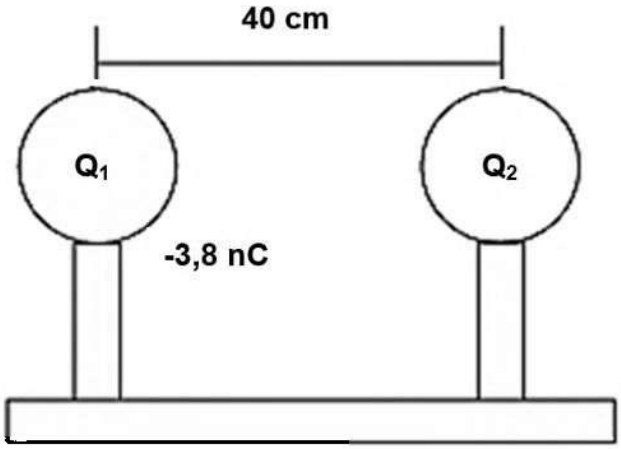
6.2 Determine the frequency of the emitted waves. (3)

The speed limit on this road is 100 $km.h^{-1}$.

6.3 Determine if the vehicle was driving over the speed limit using an appropriate calculation. (6)

[11]

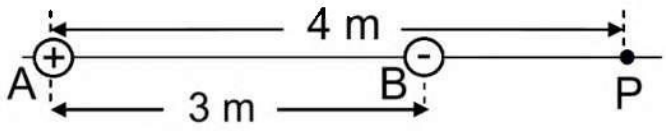
7.1 Two identical charged metal spheres Q_1 and Q_2 are placed on insulated stands with their centres 40 cm apart. The charge on Q_1 is -3,8 nC. The electrostatic force of attraction between the two spheres is $8,54 \times 10^{-7}$ N.



7.1.1 State *Coloumb's law* in words. (2)

7.1.2 Calculate the charge on Q_2. (3)

7.2 Two-point charges, **A** and **B**, are placed 3 m apart. The charge on **A** is $+6 \times 10^{-6}$ C and the charge on **B** is -3×10^{-6} C. **P** is a point 4 m to the right of charge **A**.



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

7.2.2 Calculate the net electric field at point **P**. (4)

7.2.3 A proton is placed at point **P**.
Calculate the magnitude of the initial acceleration of the proton if the mass of a proton is $1,67 \times 10^{-27}$ kg. (4)

7.2.4 If an electron was placed at point **P** instead of a proton, how would the acceleration of the electron compare to that of the proton?
Write only GREATER THAN, SMALLER THAN or EQUAL TO. (1)

[16]

8.1 In **diagram 1**, when two NON-IDENTICAL resistors **X** and **Y** are connected in parallel across a 6 V battery, the current through A_1 is found to be 2 A. In **diagram 2**, when the two resistors are connected in series to a 6 V battery, V_2 reads 4 V. The internal resistance of the battery and the resistance of the conducting wires may be ignored.

Diagram 1

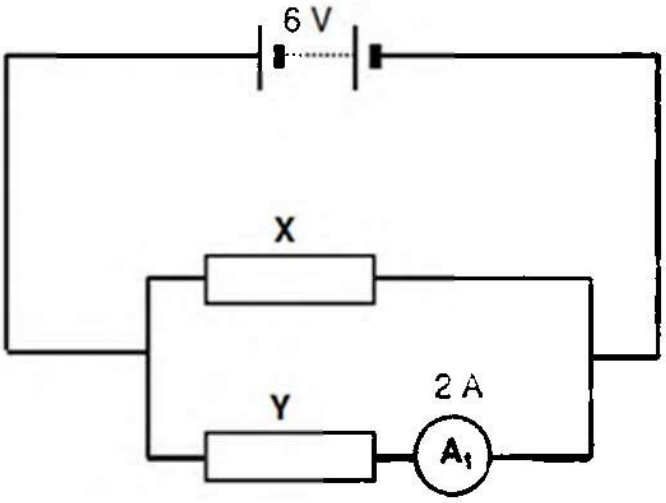
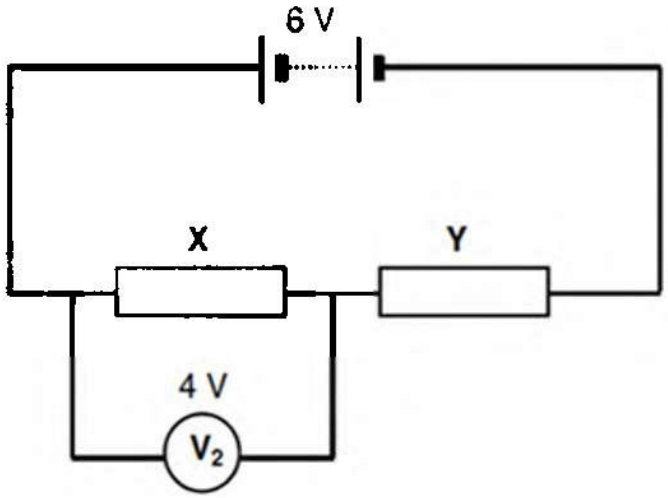


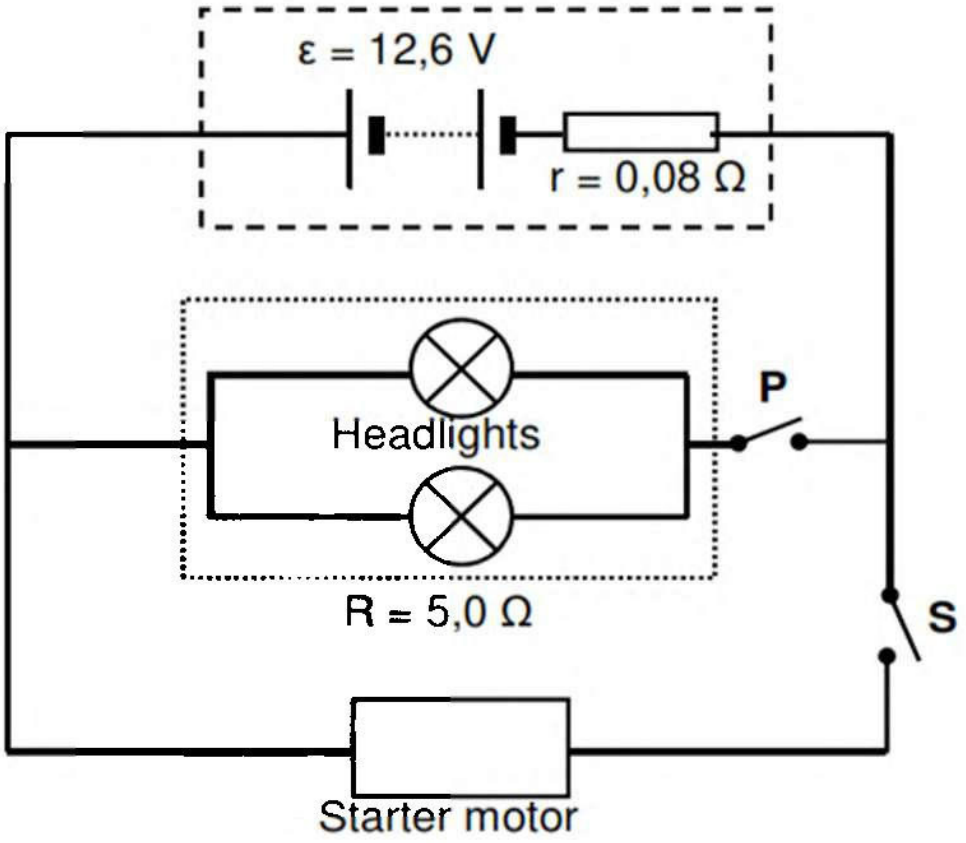
Diagram 2



8.1.1 State *Ohm's law* in words. (2)

8.1.2 Calculate the resistance of **X** and **Y** respectively. (6)

8.2 An car battery has en emf of 12,6 V and an internal resistance of 0,08 Ω. The two headlights have a total external resistance of 5,0 Ω. The starter motor is connected in parallel with the headlights as shown in the diagram below. Assume the headlights are ohmic resistors.



8.2.1 Write down the magnitude of the potential difference across switch **S** when both switches are open. (1)

Switch **P** is now CLOSED but **S** is still OPEN.

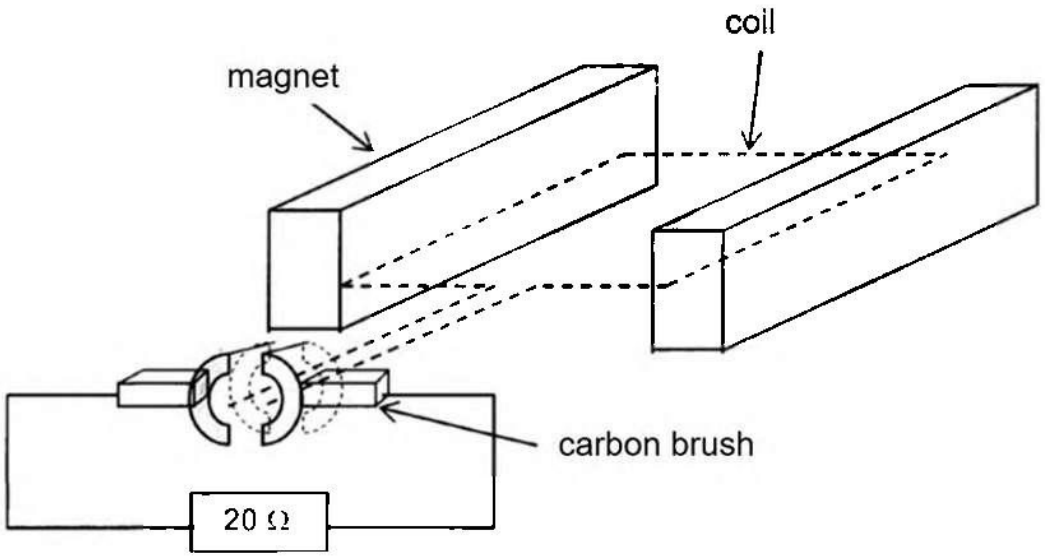
8.2.2 Calculate the potential difference across the headlights when switch **P** is closed. (5)

BOTH switches (**P** and **S**) are now CLOSED.

8.2.3 What will happen with the brightness of the headlights? Write down only INCREASE, DECREASE or REMAIN THE SAME. Explain your answer. (5)

[19]

9.1 The diagram below shows the essential parts of a generator.



The coil rotates within the magnetic field.

Write down the type of current (direct current (DC) or alternating current (AC)):

9.1.1 induced in the coil. (1)

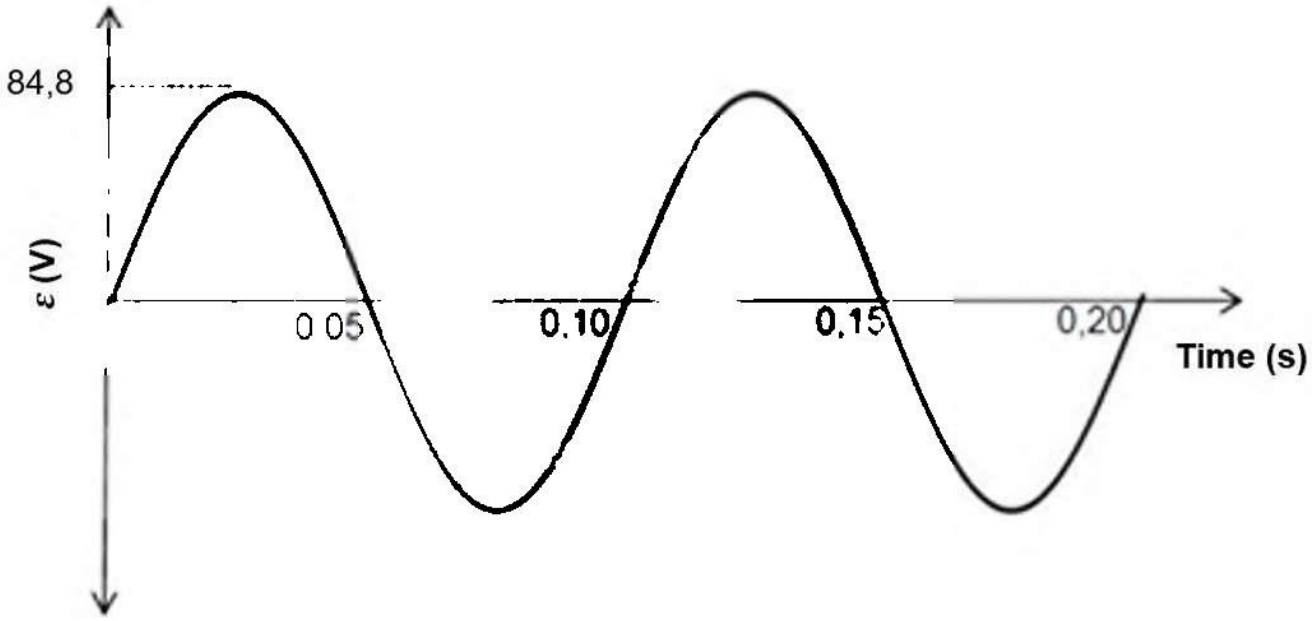
9.1.2 passing through the 20 Ω resistor. Give a reason for the answer. (2)

9.2 An alternating current generator is used in the commercial generation of electricity.

9.2.1 State ONE fundamental difference in the design of an alternating current generator and the direct current generator. (2)

9.2.2 Fully explain why alternating current is preferred over direct current for the transmission of electricity over long distances. (2)

9.3 A A3 generator produces the following graph on emf versus *time*.



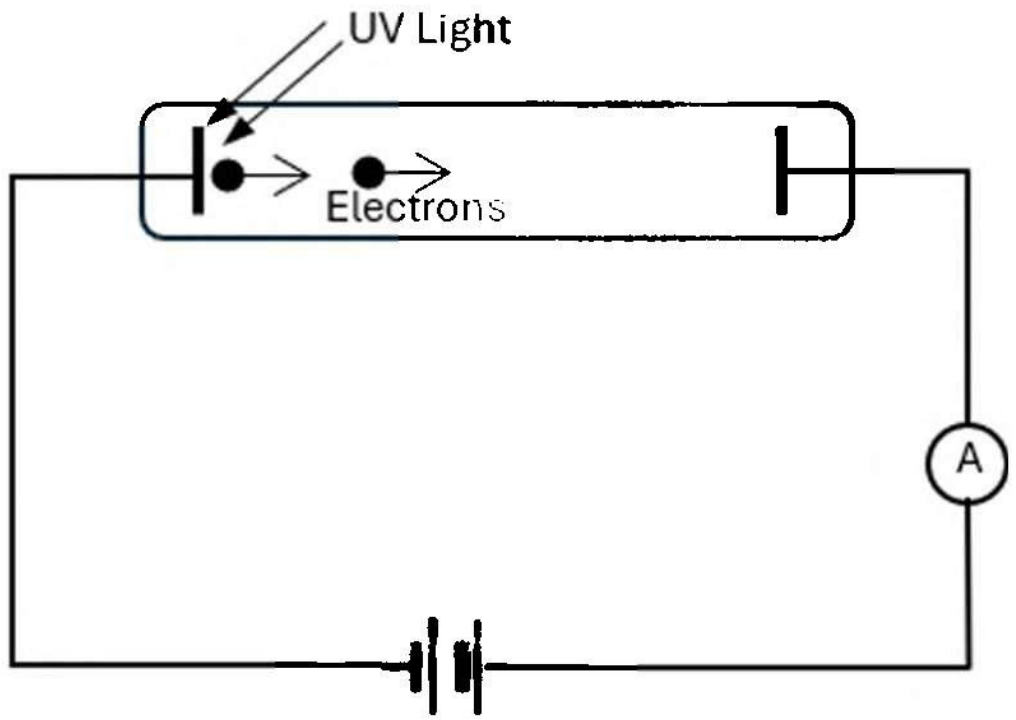
9.3.1 Write down the **period for one revolution** of the coil of the generator. (1)

9.3.2 Calculate the **root mean square voltage** (V_{rms}) for this generator. (2)

9.3.3 Calculate the **resistance of a** 40 W ohmic bulb connected to the generator. (3)

[13]

The photocell below demonstrates an ultraviolet (UV) source of light shone onto a metal plate. The UV light with a wavelength of 284 nm ejects electrons from the surface of the metal plate with an average speed of $1,48 \times 10^5$ $m.s^{-1}$.



10.1 Calculate the frequency of the UV light photons. (3)

Some metals and their corresponding work functions are listed in the table below.

Metal	Work function ($x10^{-19}$ J)
Gold	7,8
Zinc	6,9
Calcium	4,3
Potassium	3,2

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

10.3 By means of calculations, identify the metal that is used in this photocell from the table above. (5)

10.4 The metal as tried in Question 10.3 is now replaced with potassium.

State how this change will influence the following.

Choose from INCREASES, DECREASES or NO EFFECT.

10.4.1 the number of photoelectrons that will be ejected from the potassium metal surface. (1)

10.4.2 the ammeter reading. (1)

10.4.3 the kinetic energy of the photoelectrons. (1)
[13]

TOTAL: 150 MARKS

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/ *TABEL 1: FISIESE KONSTANTES*

NAME	SYMBOL	VALUE
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Mass of Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg
Speed of light in a vacuum *Spoed van lig in 'n vacuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se constant*	h	6,63 x 10^{-34} J·s
Coulomb's constant *Coulomb se konstant*	k	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op electron*	e	-1,6 x 10^{-19} C
Electron mass *Electronmassa*	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* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_k N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$	$E = hf$ 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 $K_{max} = \frac{1}{2}mv_{max}^2$	
$E = W_o + E_{k(max)}$ *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* $K_{max} = \frac{1}{2}mv_{max}^2$	

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	$emf(\mathcal{E}) = I(R + r)$
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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