LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

# VHEMBE WEST DISTRICT

## NATIONAL
## SENIOR CERTIFICATE

## GRADE 12

## PHYSICAL SCIENCES P1
## PRE-J UNE EXAMINATION
## 15/05/2025

**MARKS: 150**
**TIME: 3 HOURS**

**This question paper consists of 19 pages.**

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## INSTRUCTIONS AND INFORMATION

1 Write your name and grade on the ANSWER SHEET provided.
2 This question paper consists of 9 questions. Answer ALL the questions.
3 Start EACH question on a NEW page in the ANSWER SHEET.
4 Number the answers correctly according to the numbering system used in this question paper.
5 Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6 You may use a no-programmable calculator.
7 You may use appropriate mathematical instruments.
8 Show ALL formulae and substitutions in ALL calculations.
9 Round off your final numerical answers to a minmum of TWO decimal places.
10 Give brief motivations, discussions, etc, where required.
11 You are advised to use the attached DATA SHEETS.
12 Write neatly and legibly

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## QUESTION 1 (MULTIPLE-CHOICE QUESTIONS)

Various options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question numbers (1.1 – 1,10) in the ANSWER SHEET provided.

1.1 Two forces, **$F_1$** and **$F_2$**, are applied on a box lying on a frictionless surface as shown below. The magnitude of $F_1$ is greater than that of $F_2$.




The box will ...

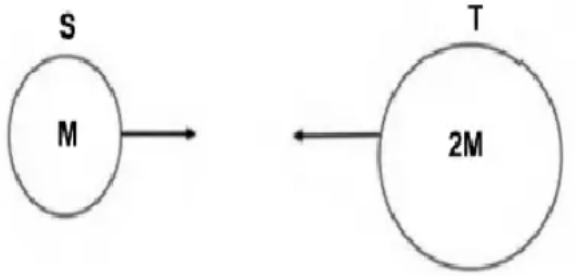
A accelerate towards the left.
B accelerate towards the right.
C move at a constant speed towards the right
D move at a constant speed towards the left. (2)

1.2 A 5 kg iron shot putt and a 10 kg shot putt, with the same diameter, fall freely from the shelf that is 12 m above the ground. Ignore the effects of air friction.

When the shot putts are 3 m above the ground, they have the same ...

A momentum
B acceleration
C potential energy
D kinetic energy (2)

1.3 Two asteroids, **S** and **T**, having masses of **M** and **2M** respectively, are on course for a collision.




If the magnitude of the acceleration on asteroid **S** is **a**, then the magnitude of the acceleration on asteroid **T** is:

A $\frac{1}{4}$ a

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B $\frac{1}{2}$ a
C a
D 2a

(2)

1.4 A sound source approaches a stationary observer at a CONSTANT VELOCITY. Which of the following describes the observed wavelength and frequency from the sound source as it approaches?

| | OBSERVED WAVELENGTH | OBSERVED FREQUENCY |
|---|---|---|
| A | Greater than | Greater than |
| B | Less than | Less than |
| C | Greater than | Less Than |
| D | Less than | Greater than |

(2)

1.5 Two objects, $m_1$ and $m_2$ a distance **r** apart, experiences a gravitational force F. The mass of $m_1$ is now doubled and the distance is halved. The gravitational force between $m_1$ and $m_2$ is now:

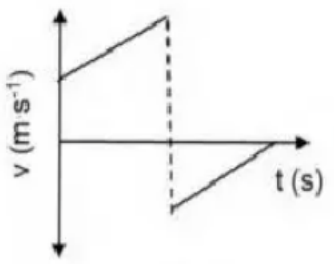
A $\frac{1}{8}$ F
B $\frac{1}{2}$ F
C F
D 8F

(2)

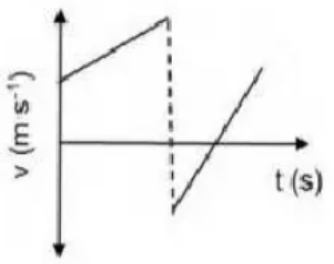
1.6 An object is thrown vertically downwards towards the ground from a height **h**, with a velocity **v**. The object strikes the ground and bounces upwards. It is caught when it reaches its maximum height after the bounce.

Which of the following graphs for velocity versus time best represents the motion of the object?

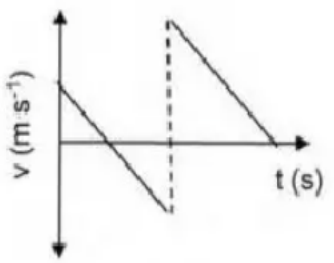
A



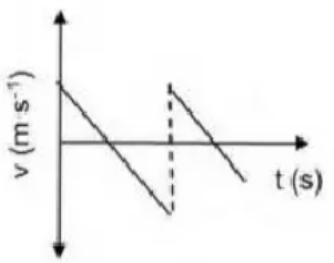

B




C




D




(2)

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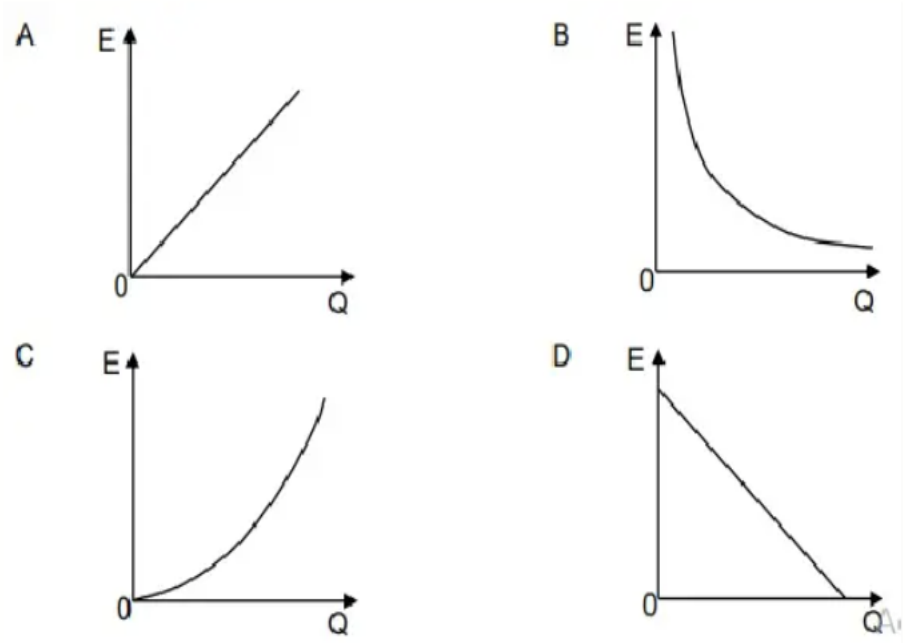
1.7 A crate is pulled up a slope.

Which of the forces will do zero work on the crate?

A pulling force.
B Normal force
C Frictional force
D Gravitational force (2)

1.8 The magnitudes of electric fields generated by different point charges are measured at a fixed point. For each measurement, the distance between this fixed point and the charges are the same.

Which ONE of the following sketch graphs CORRECTLY shows the relationship between the magnitude of the electric field (**E**) and the magnitude of the charge (**Q**)?



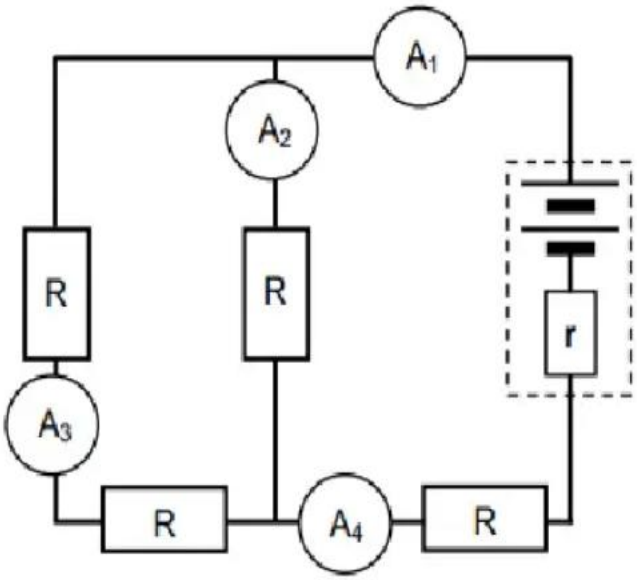

(2)

1.9 A positively charged object has ...

A fewer electrons than neutrons.
B fewer protons than neutrons.
C fewer electrons than protons.
D more protons than neutrons (2)

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1.10 The diagram below represents a circuit in which all the external resistors have the same resistance.




Which ONE of the ammeters in the circuit will have the LOWEST reading?

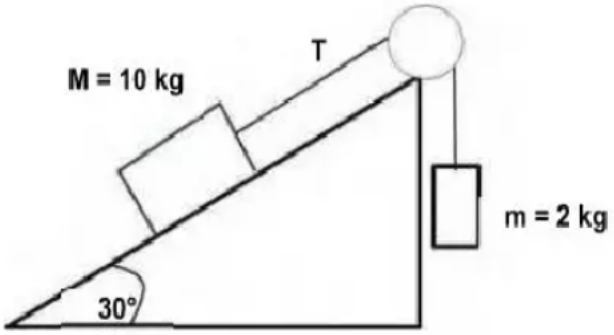
A $A_1$
B $A_2$
C $A_3$
D $A_4$

(2)
**[20]**

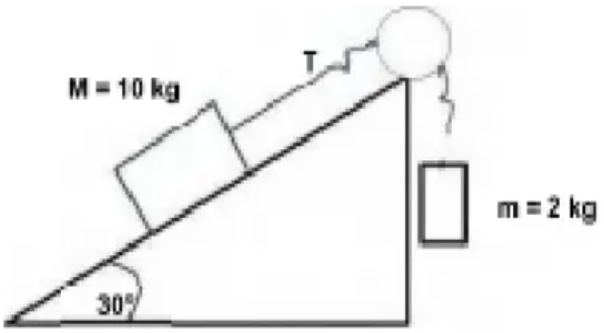
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**QUESTION 2 (FORCES) (Start on a NEW page)**

2 Block **M**, 10 kg, is connected to block m, 2 kg, with a rope, **T**, of negligible mass, over a frictionless pulley. Both blpcks are at rest. The slope makes an angle of 30º with the horizontal. Friction on the slope cannot be ignored.




2.1 Define the term *normal force*. (2)
2.2 Draw a labelled free-body diagram of all forces acting on the 2 kg mass. (2)
2.3 Calculate the frictional force needed to keep the blocks at rest. (5)
2.4 The rope snaps above mass **m**, causing block **M** to slide down the slope, and block m to fall to the ground. The kinetic frictional force between the block and the slope is 25 N. Ignore the mass of the rope **T**.

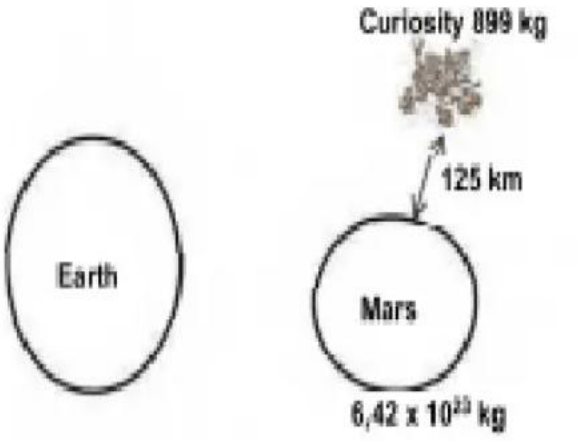



2.4.1 Draw a free-body diagram of all the forces acting on the mass **M**. (3)
2.4.2 Calculate the magnitude of acceleration of mass **M** (4)
2.5 Block m takes 0,5 s to reach the ground.
2.5.1 Calculate the final velocity of block **m**. (3)
2.5.2 How would the final velocity of m be affected if the mass was doubled and it is dropped from the same height? Write only INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (3)
**[22]**

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**QUESTION 3 (FORCES) (Start on a NEW page)**

3 The Curiosity rover dropped from 125 km above the surface of Mars. The mass of the Curiosity rover is 899 kg and the mass of Mars is 6,42 x $10^{23}$ kg. The radius of mass is 53,25% that of the Earth.



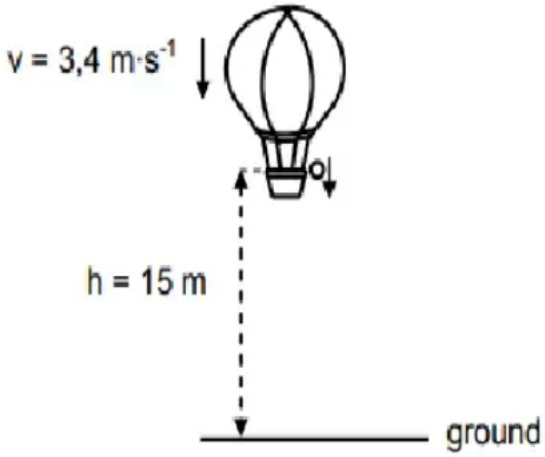

3.1 *State Newton's Law of Universal Gravitation* in words. (2)
3.2 Calculate the weight of the Curiosity on Earth. (2)
3.3 Calculate the gravitational acceleration on Mars. (4)
3.4 Would the mass of the Curiosity be different on Mars than on Earth? Choose from YES or NO.

Give a reason for the answer. (2)
**[10]**

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**QUESTION 4 (VERTICAL PROJ ECTILE MOTION) (Start on NEW page)**

A hot-air balloon moves vertically downwards at a constant velocity of 3,4 $m.s^{-1}$. When the balloon is 15 m above the ground, a small ball is dropped from balloon. Refer to the diagram below.

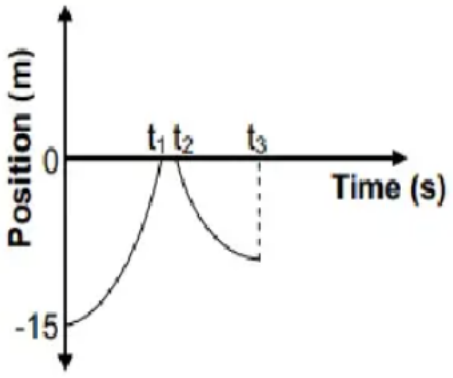



The ball strikes the ground and bounces vertically upwards. The hot-air balloon continues to move downwards at the same constant velocity.

Ignore the effects of air friction acting on the ball.

4.1 Define the term *free fall* in words. (2)

The sketch graph below (not drawn to scale) represents the positions of the ball relative to the ground from the time the ball is dropped until the time it reaches its maximum height after the first bounce.




4.2 Was the ball in free fall between $t_1$ and $t_2$ seconds? Write down either YES or NO. (1)

4.3 Use only EQUATIONS OF MOTION to calculate:

4.3.1 The value of $t_1$ indicated on the graph. (3)

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4.3.2 The value of the hot-air balloon above the at the instant when the ball struck the ground. (4)

4.4 The ball was in contact with the ground for 0,2 s and left the ground with a vertical upward velocity of 7,2 $m.s^{-1}$.

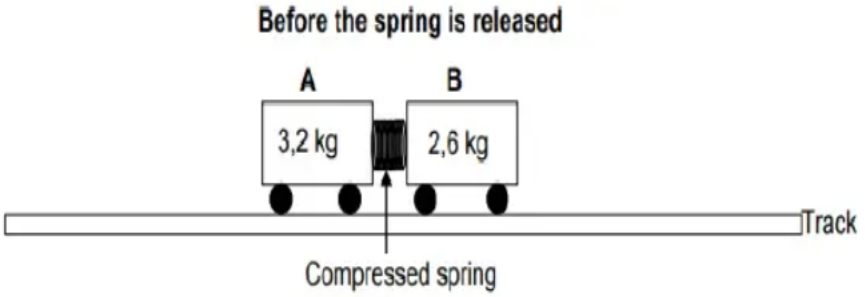
Use only EQUATIONS OF MOTION to calculate the value of $t_3$ indicated on the graph. (4)

**[14]**

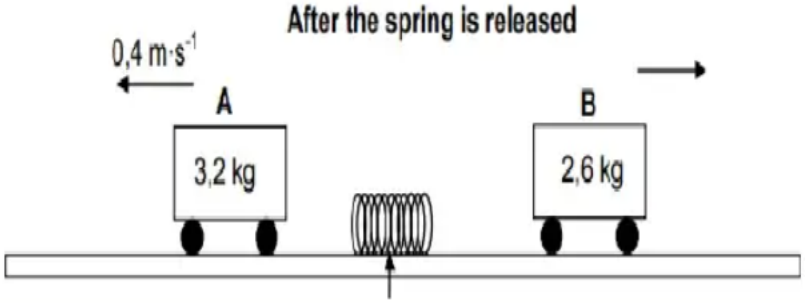
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## QUESTION 5 (MOMENTUM AND IMPULSE) (Start on a NEW page)

Two trolleys **A** and **B** of mass 3,2 kg and 2,6 kg respectively are held at rest on a straight horizontal, frictionless track, with a compressed spring between them, as shown in the diagram below.




After the trolleys are released, the spring extends to its natural length and the falls onto the track. Trolley A now moves with a constant velocity of 0,4 $m.s^{-1}$ to the left, while trolley **B** moves with a constant unknown velocity to the right. Trolley **B** reaches the end of the track after 1,3 s.




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

5.2 Calculate the distance travelled by the trolley **B** in 1,3 s. (5)

The average force exerted by the extended spring on each trolley while they were in contact with the spring was 4,2 N.

5.3 Calculate the time it took the spring to extend to ist natural length. (3)

5.4 Trolley B is now replaced by trolley **C**, which has a larger mass. The same compressed spring is placed between trolleys **A** and **C**. The trolleys are then rekeased. The average force exerted by the extended spring on the trolleys remains 2,4 N for the same period of time as calculated in QUESTION 5.3.

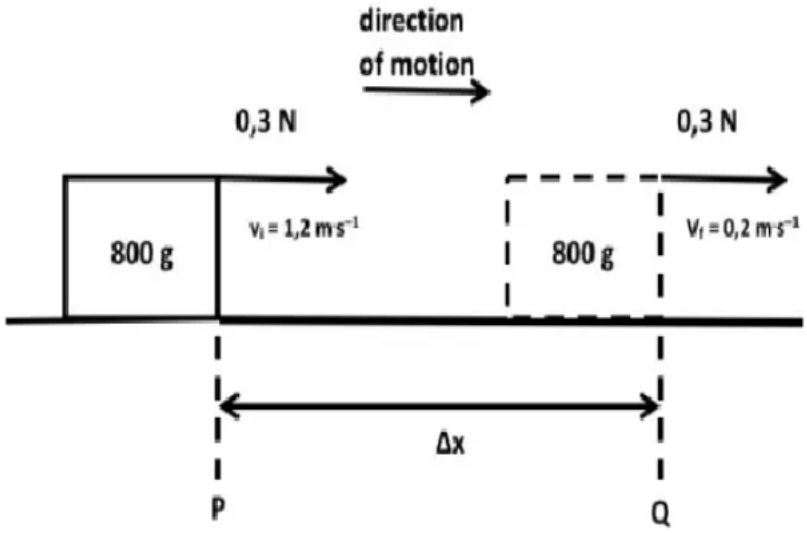
How does the magnitude of the average velocity of trolley **C** compare to the magnitude of the velocity of trolley **B** after the spring has fallen to the track? Write only GREATER THAN, LESS THAN or EQUAL TO. (3)
Explain the answer

**[13]**

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## QUESTION 6 (WORK, ENERGY AND POWER) (Start on a NEW page)

A block of mass 800 gmoves under the influence of a force of 0,30 N. Whem the block reaches a velocity of 1,2 $m.s^{-1}$, it eneters a rough surface. The block experiences a constant frictional force of 0,86 N as it moves from point **P** to point Q as shown below causing its speed to decrease to 0,2 $m.s^{-1}$ after a displacement, $\Delta x$.




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

6.2 Draw a labelled free-body diagram showing all the forces acting on the block as it moves across the rough surface. (4)

6.3 Determine the net force acting on the block as it moves across the surface. (3)

6.4 Use Energy Principles to calculate the displacement, $\Delta$**x**, of the block. (4)

6.5 NAME ONE non-conservative force acting on the block as it moves across the surface. (1)

**[14]**

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## QUESTION 7 (DOPPLER EFFECT) (Start on a NEW page)

An observer walks at a constant velocity towards a stationary sound source that emits sound at a frequency of 2 450 Hz. The frequency detected by the observer as she approaches the sound source is 2 500 Hz.

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

7.2 Explain in terms of wave motion why the detected frequency is higher than the emitted frequency. (3)

7.3 Calculate the speed of the observeras it approaches the sound source. Take the speed of sound in air as 340 $m.s^{-1}$. (5)

7.4 How would the wavelength of the sound wave emitted by the source change in the following scenarios?

Write down only INCREASE, DECREASE or STAY THE SAME.

When the observer:

7.4.1 Stands next to the sound source. (1)

7.4.2 Moves away from the sound source. (1)

7.5 The observer decides to run towards the direction of the sound source at a higher constant speed than the speed calculated in QUESTION 7.3. How will this affect the following?

Write down only INCREASES, DECREASES or STAYS THE SAME.

7.5.1 Detected frequency. (1)

7.5.2 The speed of sound. (1)

7.5.3 The emitted frequency from the sound source. (1)

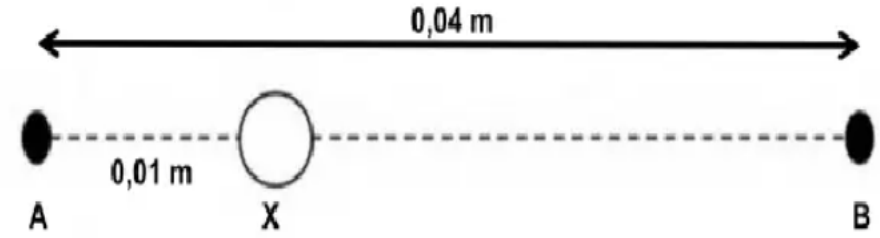
7.6 Give TWO applications of the Doppler effect in the medical field. (2)

**[17]**

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**QUESTION 8 (ELECTROSTATICS) (Start on a NEW page)**

Point **A** and point **B** are 0,04 m apart, as shown below. (the sketch is not drawn to scale). Sphere **X** lies 0,01 m from point **A**. Sphere **X** has 1 238 electrons removed from the surface.




8.1 What is the nature of the charge on sphere **X**? Choose either POSITIVE or NEGATIVE. (1)

8.2 Calculate the magnitude of the charge on sphere **X**. (3)

8.3 Define the term electric field. (2)

8.4 Draw the net electric field pattern for two identical spheres with opposite charge. (3)

8.5 At what point, **A** or **B**, is the magnitude of the electric field, due to charged sphere **X**, is greater? Explain the answer. (3)

8.6 Calculate the electri fiwld of sphere **X** at point **B** if sphere **X** is replaced with a charge of $-2 \times 10^{-9}$ C. (3)

8.7 A negative point charge **Y** with a charge of -2,8 nC is NOW placed at point **B**, and a point charge **Z** with a charge of +3,2 nC is placed at point **A**.

8.7.1 Draw a vector diagram to show the direction of the forceon charge X because of charges **Y** and **Z**. (2)

8.7.2 Calculate the net electrostatic force on shpere **X** because of charges **Y** and **Z**. (5)

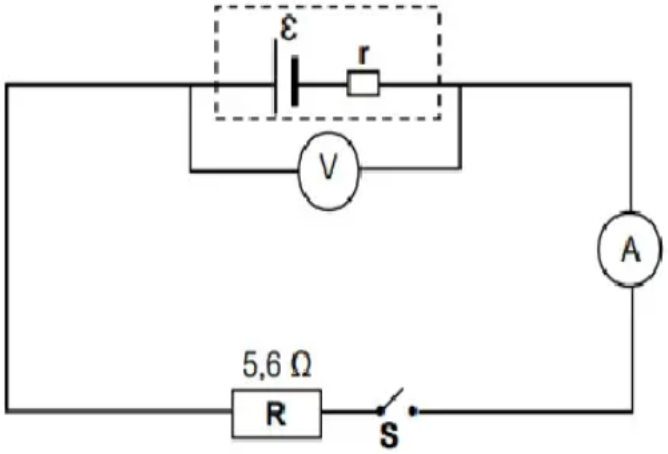
[22]

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**QUESTION 9 (ELECTRIC CIRCUITS) (Start on a NEW page)**

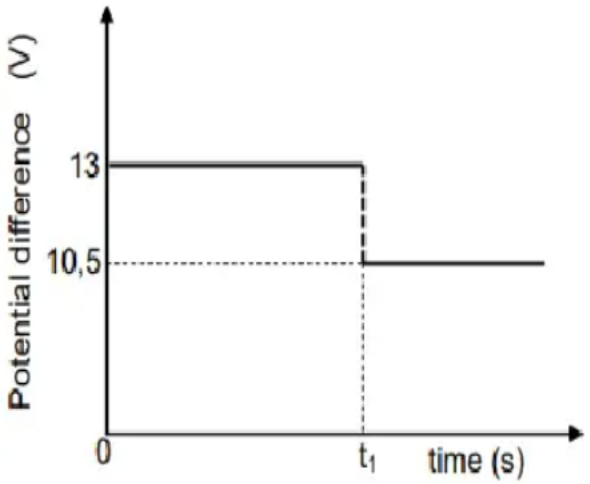
In the circuit diagram below, resistor **R**, with a resistance of 5,6 Ω, is connected, together with a switch, an ammeter and a high-resistance voltmeter, to a battery with an unknown internal resistance, *r*.

The resistance of the connecting wires and the ammeter may be ignored.




Thegraph below shows the potential difference across the terminals of the battery as a function of time .

At time $t_1$, switch **S** is closed.



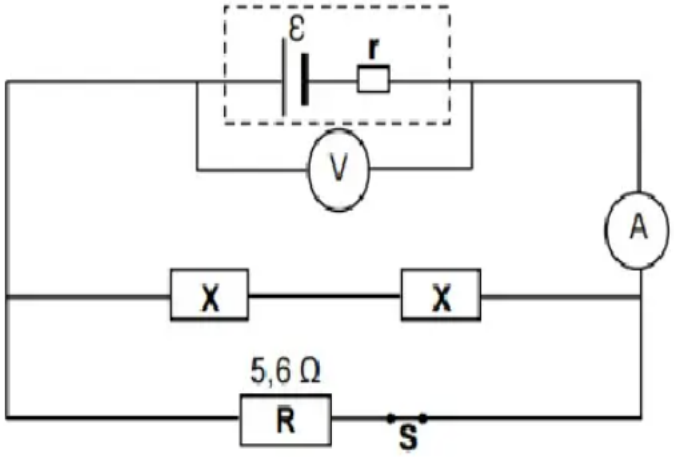

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9.1 Define the term *emf* of a battery. (2)
9.2 Write down the value of the emf of the battery/ (1)

9.3 When the switch **S** is CLOSED, calculate the:

9.3.1 Current through resistor R. (3)
9.3.2 Power dissipated in resistor R (3)
9.3.3 Internal resistance, r, of the battery (3)

9.4 Two IDENTICAL resistors, each with resistance **X**, are now connected in the same circuit with switch **S** closed, as shown below.




The ammeter reading now increases to 4 A.

9.4.1 How would the voltmeter reading change? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

9.4.2 Calculate resistance **X**. (5)

**[18]**

**TOTAL = 150**

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

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**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***

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $f_s^{max} = \mu_s N$ | $f_k = \mu_k N$ |
| $F_{net}\Delta t = \Delta p$<br>$\Delta p = mv_f - mv_i$ | $w = mg$ |
| $F = G\frac{m_1 m_2}{d^2}$ 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* $W_{net} = \Delta E_k$<br>$\Delta K = K_f - K_i$ 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***

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$ | $E = hf$ or/*of* $E = \frac{hc}{\lambda}$ |
| $E = W_0 + E_{k(max)}$ or/*of* $E = W_0 + K_{max}$ where/*waar*<br>$E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$ | |

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**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 ($\varepsilon$) = I(R + r)<br>emk ($\varepsilon$) = I(R + r) |
| $R_s = R_1 + R_2 + \ldots$<br>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ | $q = I\Delta t$ |
| $W = Vq$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |

**ALTERNATING CURRENT/*WISSELSTROOM***

| | |
|---|---|
| $I_{rms} = \frac{I_{maks}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ | $P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$<br>$P_{ave} = I^2_{rms}R$ / $P_{gemiddeld} = I^2_{wgk}R$ |
| $V_{rms} = \frac{V_{maks}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$ | $P_{ave} = \frac{V^2_{rms}}{R}$ / $P_{gemiddeld} = \frac{V^2_{wgk}}{R}$ |

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