Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2010

PHYSICAL SCIENCES P1

MARKS: 150

TIME: 3 hours

This question paper consists of 22 pages, a data sheet, a formula sheet, graph paper and an answer sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Write your name and/or examination number (and centre number if applicable) in the appropriate spaces on the ANSWER SHEET, GRAPH PAPER and ANSWER BOOK.

2. Answer ALL the questions.

3. The question paper consists of TWO sections.
   SECTION A: [25 MARKS]
   SECTION B: [125 MARKS]

4. Answer SECTION A on the ANSWER SHEET and SECTION B in the ANSWER BOOK.

5. Non-programmable calculators may be used.

6. Appropriate mathematical instruments may be used.

7. Number the questions correctly according to the numbering system used in this question paper.

8. Information sheets are attached for your use.

9. Give brief motivations, discussions, etcetera where required.

SECTION A

Answer this section on the ANSWER SHEET.

QUESTION 1 ONE-WORD ITEMS

Give ONE word/term for EACH of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the ANSWER SHEET.

1.1 Waves in which the vibration of the medium is perpendicular to the direction of the motion of the wave (1)

1.2 The part of the eye that controls the amount of light entering the eye (1)

1.3 The quantity, other than mass, which remains constant during free fall (1)

1.4 The insulating material found in the space between the conducting plates of a capacitor (1)

1.5 The process whereby atoms are added to a semi-conductor to improve conduction (1)

[5]

QUESTION 2 MULTIPLE-CHOICE QUESTIONS

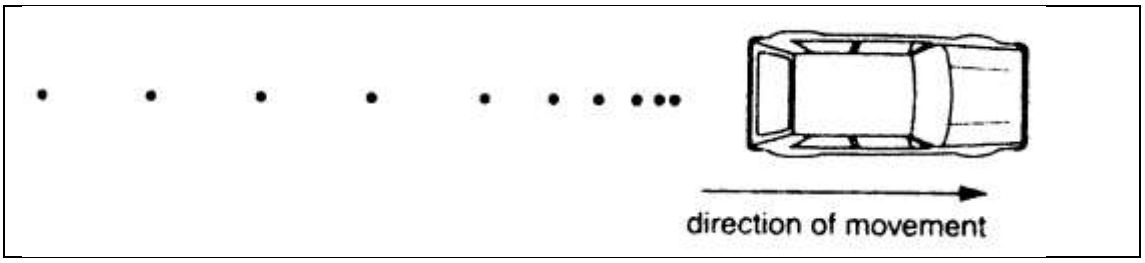
Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and mark the correct letter (A – D) next to the question number (2.1 – 2.10) with a cross (X) on your ANSWER SHEET.

2.1 The driver of a motor car places a book on the level dashboard of his car in front of him. He observes that the book slides towards the windscreen when the brakes are applied.

Which of Newton's Laws best explains this motion of the book?

A. First Law
B. Second Law
C. Third Law
D. Law of Universal Gravitation (2)

2.2 Oil drips at a constant rate from a moving car. The diagram shows the pattern of the drips on a road.

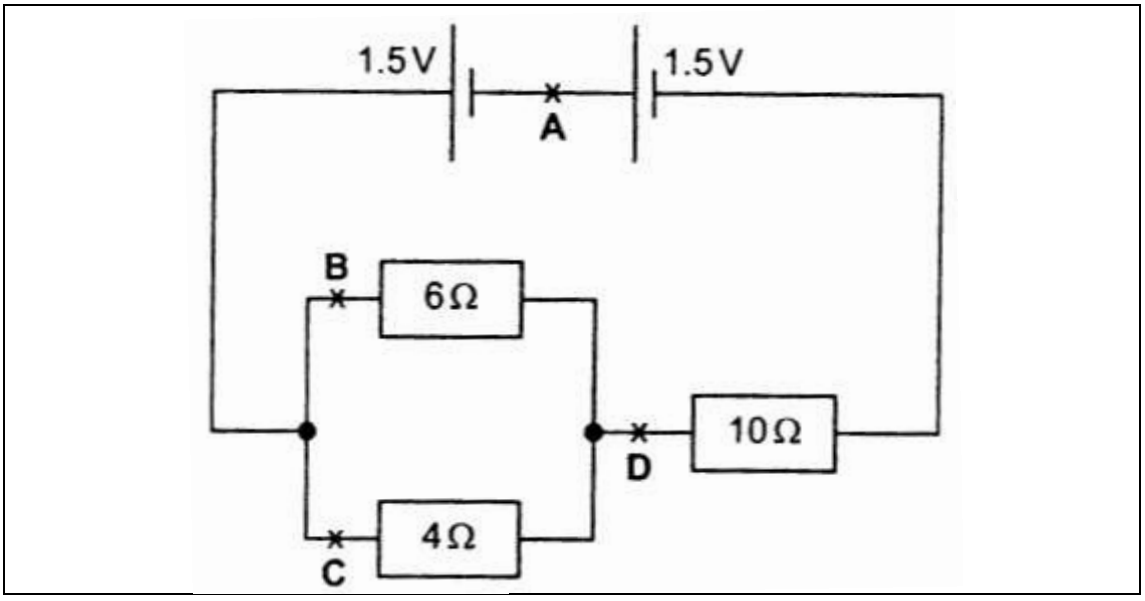


Which statement describes the motion of the car?

The car moved …

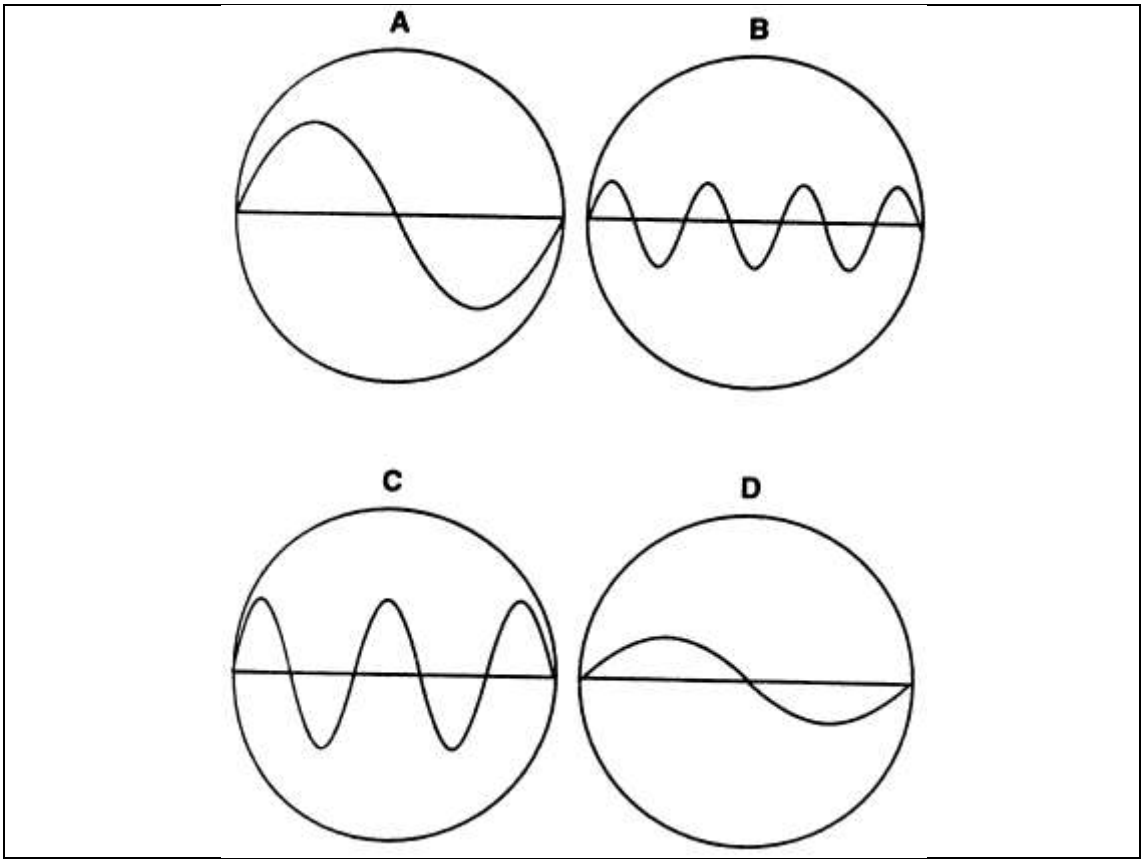
A. faster and then moved at a constant speed.
B. faster and then slowed down.
C. at a constant speed and then slowed down.
D. at a constant speed and then moved faster. (2)

2.3 At which point is the current the smallest in the circuit shown below?



(2)

2.4 The diagrams represent sound waves displayed on a monitor (TV screen). Assuming that all settings remain the same, which diagram represents the softest sound with the highest frequency?



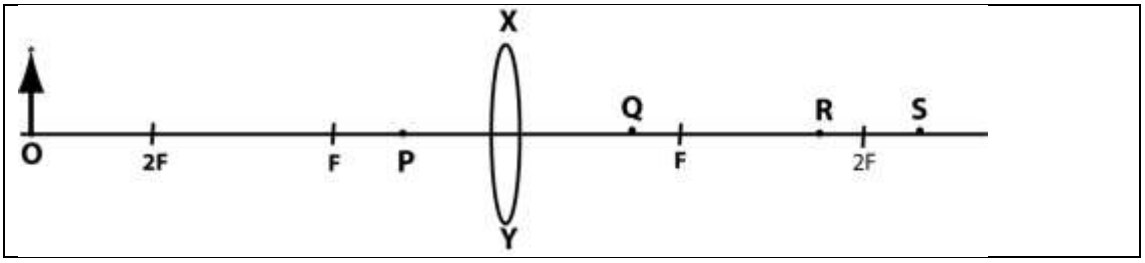
(2)

2.5 What is the correct order for the speed of sound in air, steel and water?

	Slowest ⟶		Fastest
A.	Air	Steel	Water
B.	Air	Water	Steel
C.	Water	Air	Steel
D.	Water	Steel	Air

(2)

2.6 In the diagram, XY represents a convex lens. Points labelled F are one focal length from the lens and points labelled 2F are two focal lengths from the lens. If an object is placed at O, at which point is the image formed?



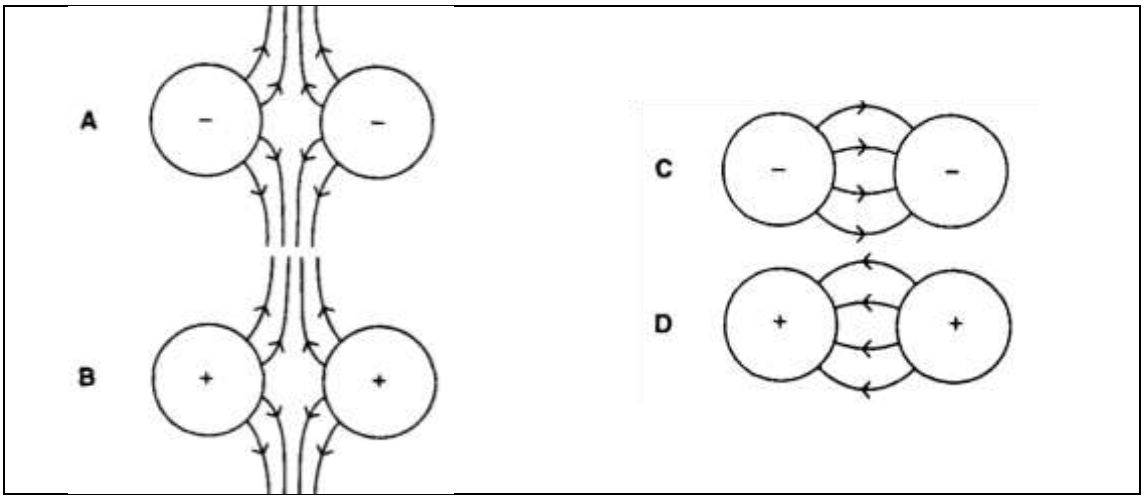
A. P
B. Q
C. R
D. S (2)

2.7 Refer to the diagram in QUESTION 2.6.

An optical instrument which uses this arrangement is a …

A. camera.
B. magnifying glass.
C. photographic enlarger.
D. projector. (2)

2.8 Which diagram correctly shows the electric field between two charged spheres?

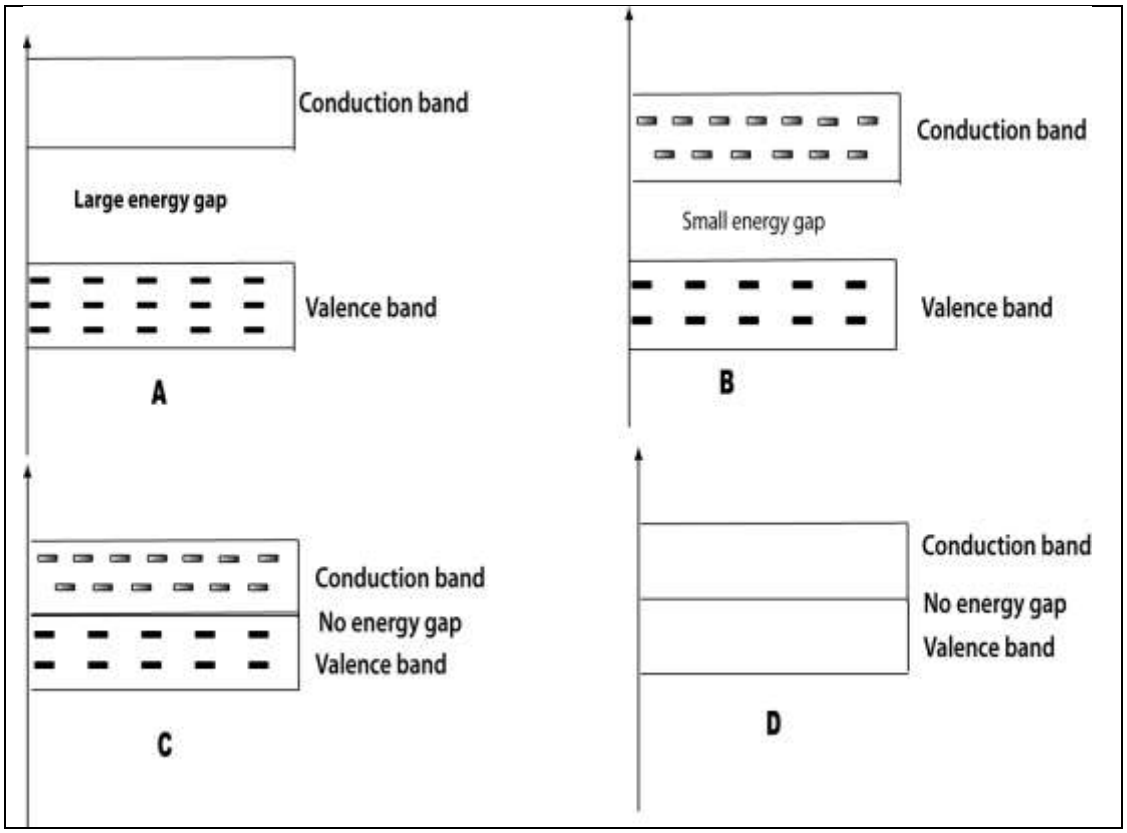


(2)

2.9 To make n-type material from silicon, small amounts of an impurity must be added to the pure silicon. The impurity that can be added is …

A. antimony.
B. indium.
C. gallium.
D. aluminium. (2)

2.10 Which of the following is a correct representation of an insulator according to the band theory?



(2)
[20]

TOTAL SECTION A: 25

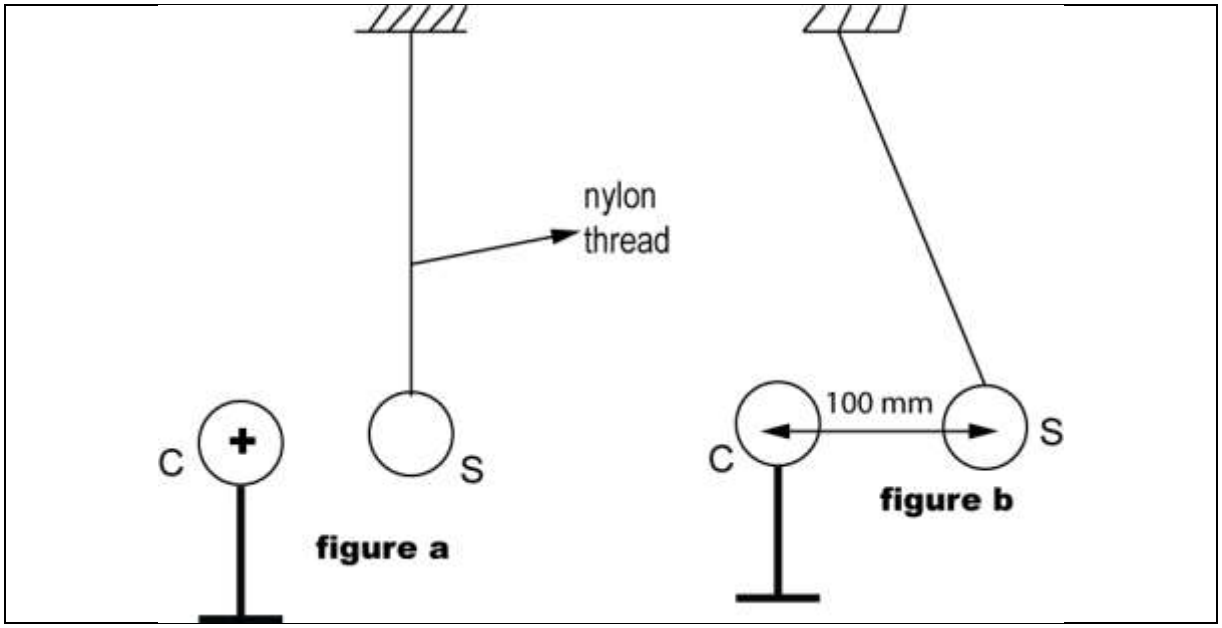
SECTION B

INSTRUCTIONS AND INFORMATION

1. Start each QUESTION on a NEW page.
2. Leave one line between two subquestions, for example between QUESTIONS 3.1 and 3.2.
3. The formulae and substitutions must be shown in ALL calculations.
4. Round off your answers to TWO decimal places.

QUESTION 3 (Start on a new page)

An electrically charged sphere, C, with a charge of 4×10^{-6} C is brought closer to a small identically, uncharged conducting sphere, S, suspended as shown in **figure a**. S is first attracted towards **C** until it touches the surface of C and is then repelled to the position shown in **figure b.**



3.1 Give a reason why S is first attracted towards C. (2)

3.2 Calculate the new charge on each sphere in **figure b**. (2)

3.3 Calculate the magnitude and give the direction of the electrostatic force that sphere C exerts on S in **figure b**. (6)

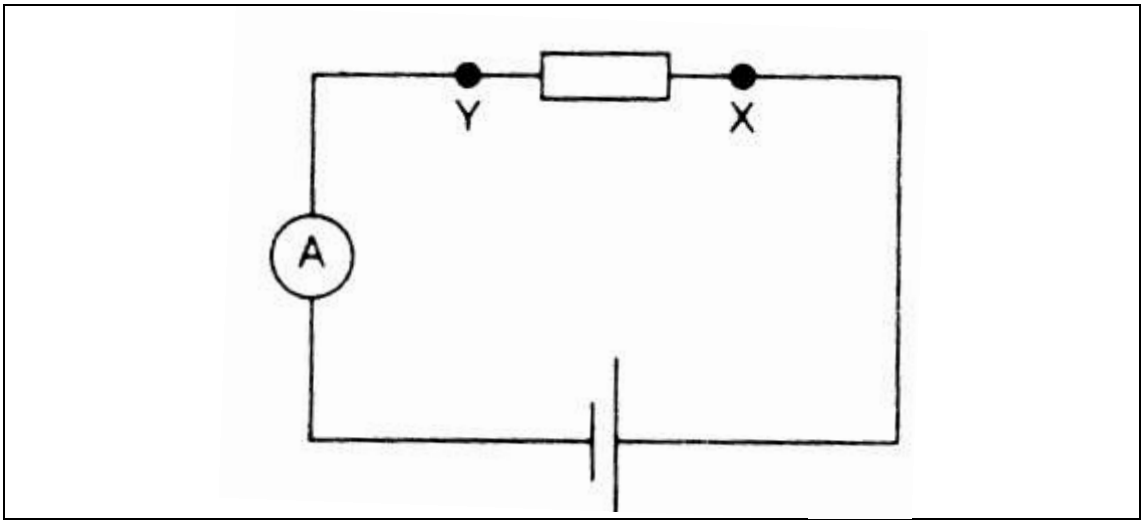
3.4 Draw a force diagram with labels of all the forces acting on S in **figure b**. (3)

3.5 Name the natural effect caused by the build-up of charges between clouds. (1)

[14]

QUESTION 4 (Start on a new page)

4.1 The diagram below shows a circuit setup to test the effect of temperature on resistance.



Two components, a length of metal wire and a semi-conductor (thermistor) are tested. They are each tested in turn connecting them between the terminals X and Y. As the temperature changes, the current readings on the ammeter are noted. The results are recorded in the table below.

Component under test	**Current at 0 °C** **A**	**Current at 50 °C** **A**	**Current at 100 °C** **A**
Metal wire	0,100	0,090	0,080
Semi-conductor	0,002	0,004	0,080

4.1.1 Redraw the given diagram in QUESTION 4.1 in your answer book and draw a voltmeter to show how it is connected to measure the potential difference across XY. (1)

4.1.2 State how you would use the voltmeter reading to obtain a value for the resistance of the component. (1)

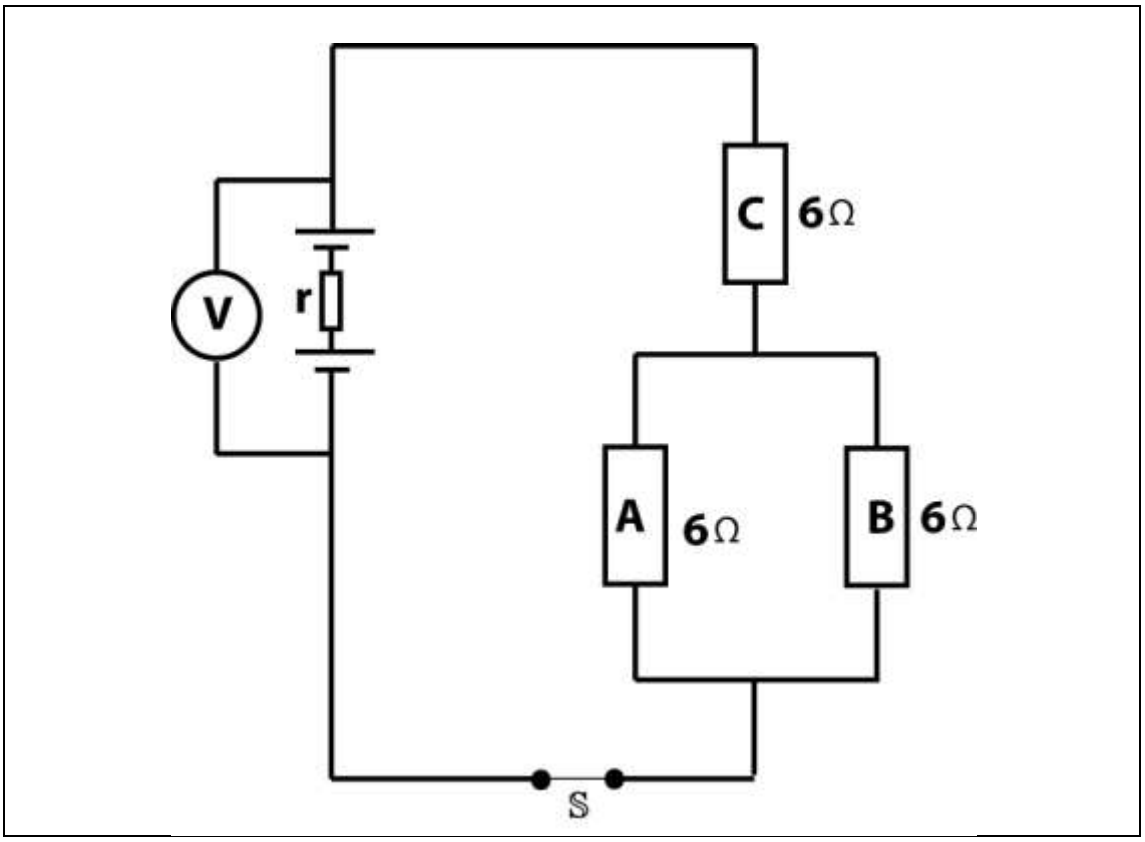
4.1.3 Write an investigative question for this experiment. (2)

4.1.4 State whether the resistance of each of the components **increases** or **decreases** as it is heated. Give a reason for your answer.

(a) Metal wire (2)

(b) Semi-conductor (2)

4.2 A battery with an emf of 24 V and an internal resistance of **r** is connected to an external circuit with three equal resistors of 6 Ω each as shown below.



4.2.1 Calculate the total resistance of the external circuit. (3)

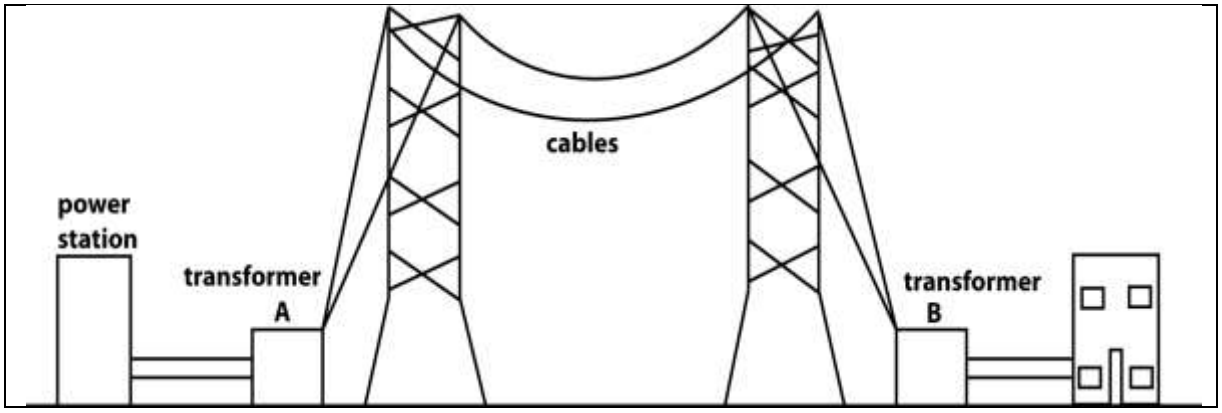
4.2.2 When switch S is closed the current passing through the resistance **C** is 2 A. Find the reading on voltmeter **V**. (3)

4.2.3 Calculate the internal resistance **r** of the battery. (3)

[17]

QUESTION 5 (Start on a new page)

Eskom uses high voltage cables to transmit electrical energy over long distances. The diagram below is adapted from the Eskom Journal 1991.



5.1 What is the purpose of transformer B in this setup? (2)

5.2 Explain why high voltages are used to transmit electricity. (2)

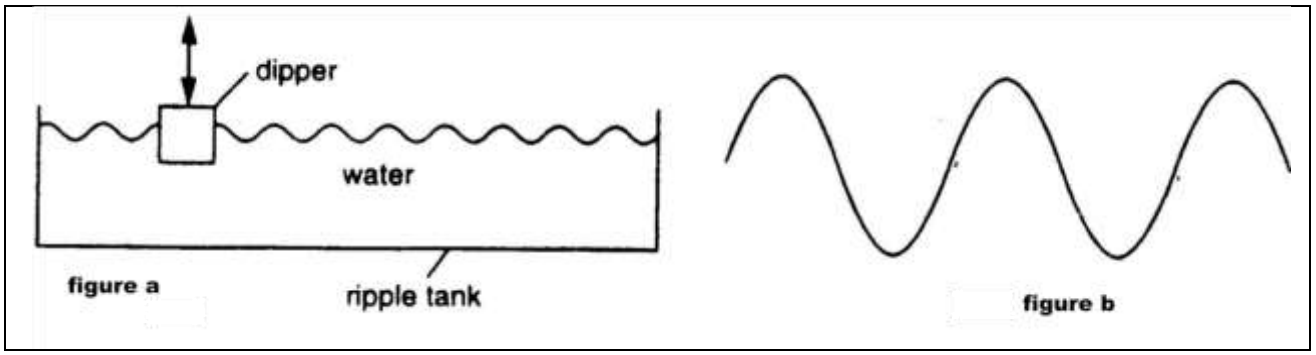
5.3 Give a reason why thick cables are used to transmit electrical energy. (2)

5.4 The power station produces electricity at a voltage of 20 kV. Transformer A in the diagram in QUESTION 5 has 48 000 turns in its secondary coil and produces an output voltage of 275 kV. Calculate the number of turns in the primary coil of transformer A. (4)

[10]

QUESTION 6 (Start on a new page)

A ripple tank is used to investigate waves on water. The dipper moves up and down 20 times in one second. **Figure b** shows, to full scale, a sideways view of the wave on the surface of the water at one instant.



6.1 Determine the wave length of the wave in **figure b** if its total length is 53 mm. (2)

6.2 Calculate the speed of the water wave. (3)

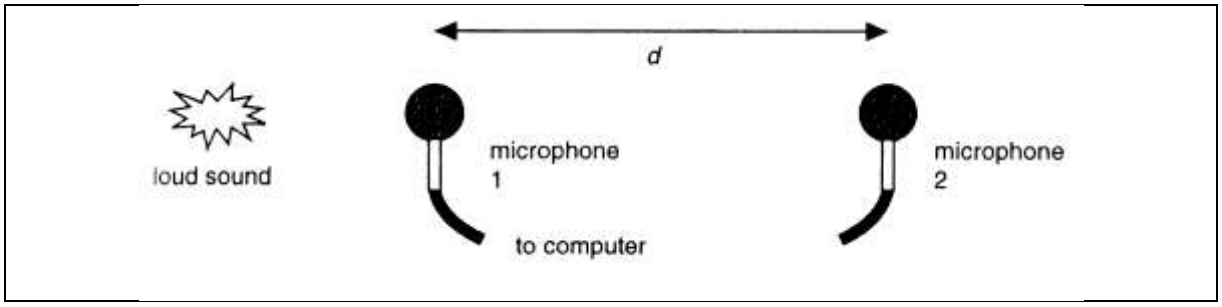
6.3 The dipper is now made to move up and down 40 times in one second. The speed of the water wave is unchanged.

6.3.1 Redraw **figure b** as it is in your answer book and then draw the sideways view of the new wave on it. (2)

6.3.2 What is the new value of the wavelength of the wave? (1)
[8]

QUESTION 7 (Start on a new page)

A learner measures the speed of sound in a laboratory using an experimental setup as shown in the diagram below.



The sound is received by two microphones placed a distance **d** apart. The time interval, **t**, between the sound arriving at microphone 1 and microphone 2 is recorded.

The signals from the microphones are fed into a computer, which displays the value of **t**.

7.1 Table 7.1 shows the average value for **t** as **d** is changed.

d in m	1,00	2,00	3,00	4,00
t in s	0,0031	0,0060	0,0092	0,0121

7.1.1 Draw a distance-time graph of the results given in table 7.1 on the graph paper provided. (5)

7.1.2 Use your graph to calculate the speed of sound in air. (3)

7.1.3 Give ONE reason why it is difficult to measure the speed of sound inside a building using only a stopwatch and a metre rule. (1)

7.2 The experiment is repeated under water. The microphones can still detect the sound.

7.2.1 State what happens to the time interval between the two microphones during each measurement. Write only **INCREASES**, **DECREASES** or **REMAINS THE SAME**. (1)

7.2.2 Give a reason for your answer in QUESTION 7.2.1. (1)

7.3 Deafness is usually caused by damage or infection to the eardrum or cochlea or a birth defect. Other factors can also cause loss of hearing. People who have difficulty in hearing can use an instrument called a hearing-aid so that they can hear better.

7.3.1 Name ONE other factor which can cause hearing loss. (1)

7.3.2 Hearing aids have a microphone which is implanted into the ear. Name ONE part of this microphone which is comparable to the eardrum in the ear. (1)

7.3.3 Usually human beings have difficulty in hearing sound having a frequency above 20 000 Hz, but animals can. What is this sound called? (1)

7.3.4 State ONE medical use of the sound referred to in QUESTION 7.3.3. (1)

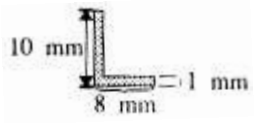
[15]

QUESTION 8 (Start on a new page)

8.1 A stamp collector views a postage stamp of height 2,0 cm through a hand lens placed 2,8 cm from the stamp. The image he sees is upright and magnified 3,0 times.

8.1.1 State the type of lens used for the hand lens. (2)

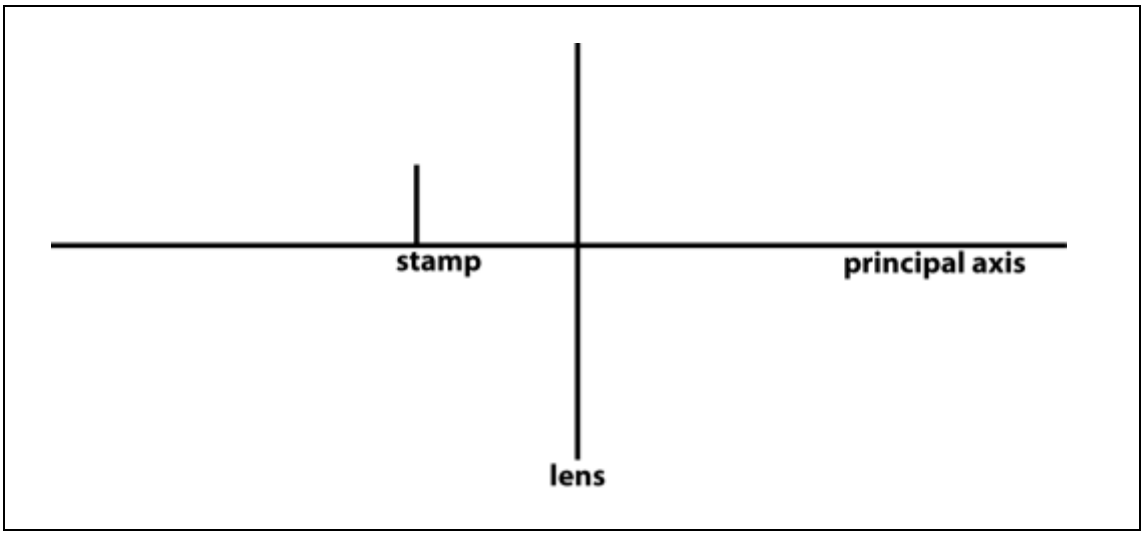
8.2 The stamp collector views the letter **L** on the stamp, shown actual size below.



8.2.1 Draw in your answer book a full sized, magnified image that will be seen using the hand lens. Indicate the dimensions of the image correctly on your sketch. (A ray diagram is not required only a sketch of the image.) (3)

8.3 In the diagram (not to scale) below the horizontal line represents the principal axis of the hand lens. The stamp and lens are represented by the vertical lines.

Remember that the image is upright and has a magnification of 3,0.



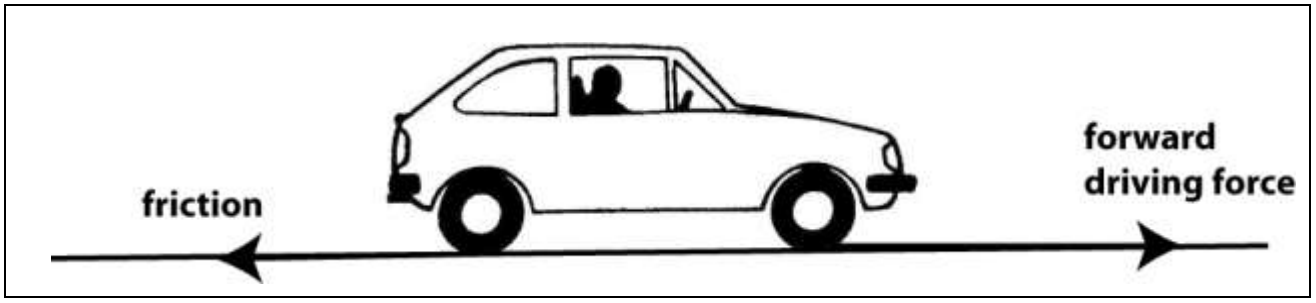
8.3.1 Construct an accurate ray diagram in your answer book to show the formation of the image of the stamp. Use the distance of 2,8 cm from the lens to the stamp. (4)

8.3.2 From the ray diagram, determine the focal length of the lens. (2)

[11]

QUESTION 9 (Start on a new page)

The diagram below shows a car moving along a horizontal road.



The car has a mass of 800 kg and travels at a constant velocity initially and then accelerates. The forward driving force required to accelerate the car is 11 520 N.

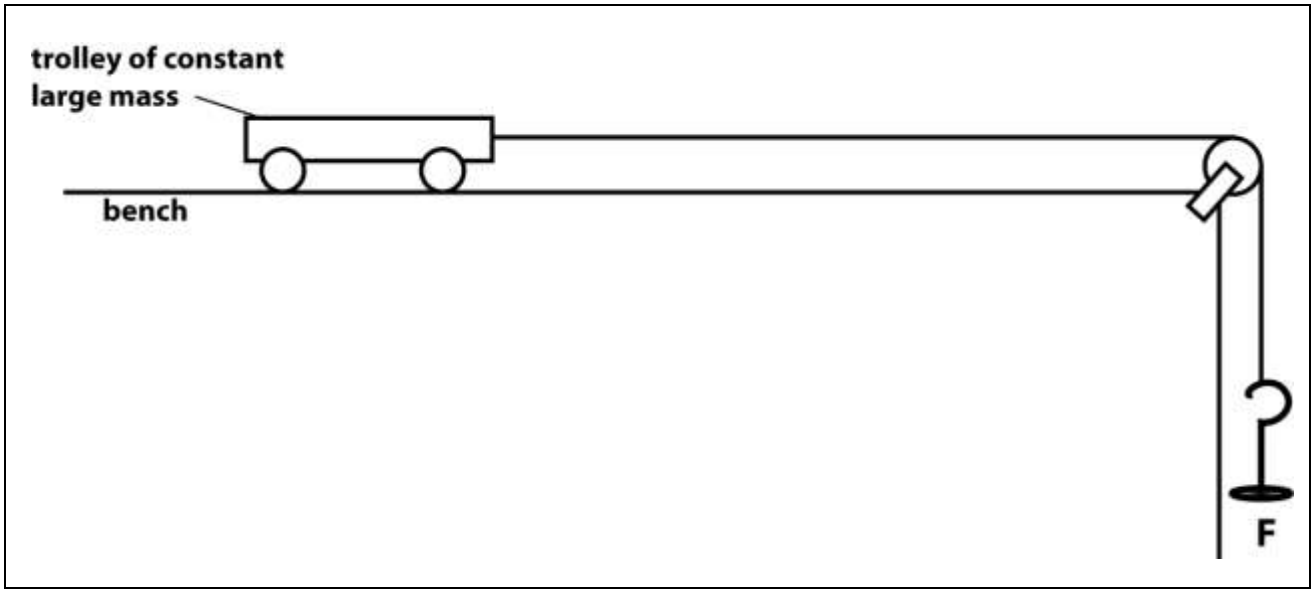
9.1 What is the net force acting on the car while the car is moving at constant velocity? (1)

9.2 Calculate the acceleration of the car if the coefficient of kinetic friction is 0,05. (6)

[7]

QUESTION 10 (Start on a new page)

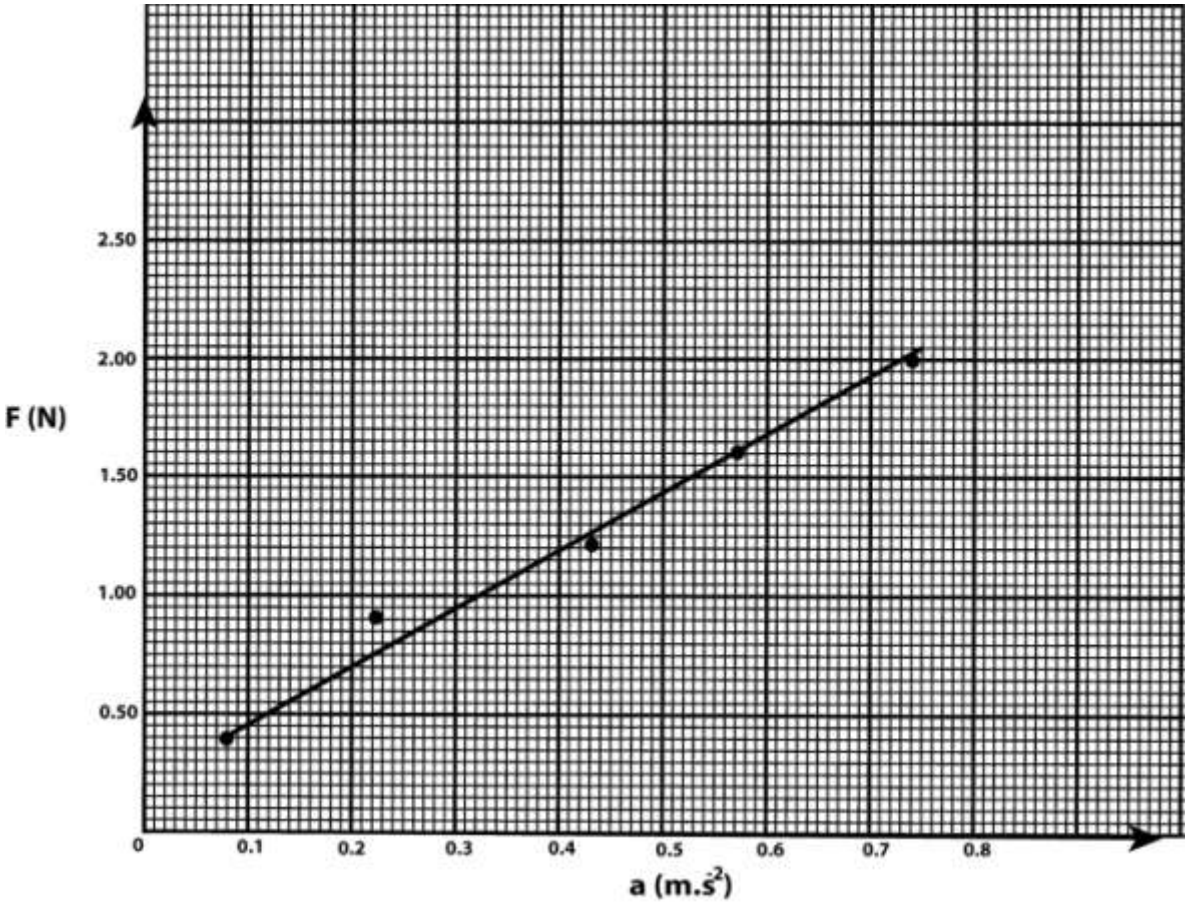
A group of learners set up an arrangement as shown in the diagram to investigate the relationship between force and acceleration.



They kept the mass of the trolley constant. The time, **t**, for the trolley to move a distance of 1 m from rest was determined for various values of the pulling force **F**. The acceleration is then calculated using the equation $s = ½ at^2$, where s = 1 m. The following values were obtained and are recorded in the table below.

F in N	0,40	0,80	1,20	1,60	2,00
a in ($m.s^{-2}$)	0,08	0,22	0,43	0,57	0,74

The relation between force **F** (N) and acceleration **a** ($m.s^{-2}$) is shown in the graph below.



10.1 Give a suitable hypothesis for this investigation. (2)

10.2 What does the gradient of the graph represent? (You do not have to calculate the gradient). (1)

10.3 Draw a sketch of the trolley and draw arrows on your sketch to represent all the external forces acting on the trolley while it is accelerating along the bench. Label each force. (4)

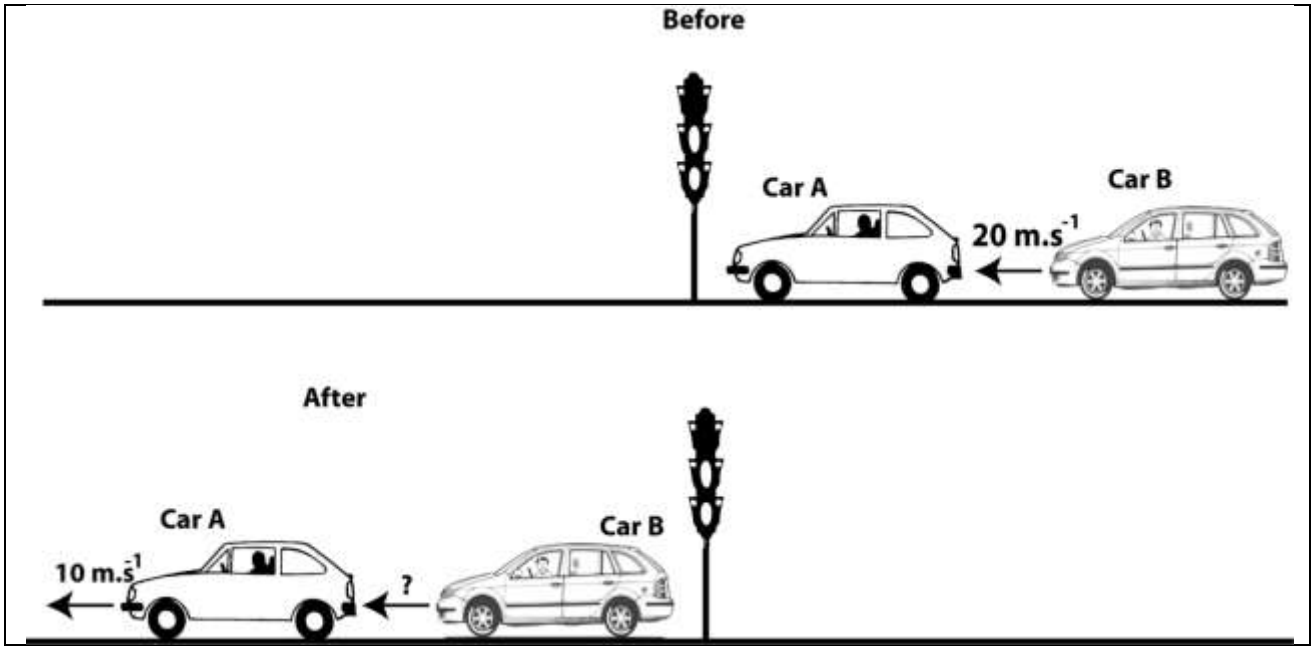
10.4 Name the law which is investigated by this experiment. (1)

10.5 The mass of the trolley is now doubled and the whole investigation is repeated. What is the effect of the increased mass on the gradient of the graph? (Use only **REMAINS THE SAME**, **INCREASES** or **DECREASES** as your answer). (1)

[9]

QUESTION 11 (Start on a new page)

Car accidents from the rear are common on our roads. The sketch below shows an example of such an accident. Car A, with a mass of 900 kg, waiting at a robot is hit from the rear by car B that has a mass of 1100 kg, travelling at a speed of 20 $m.s^{-1}$. Immediately after the collision car A moves forward at 10 $m.s^{-1}$.



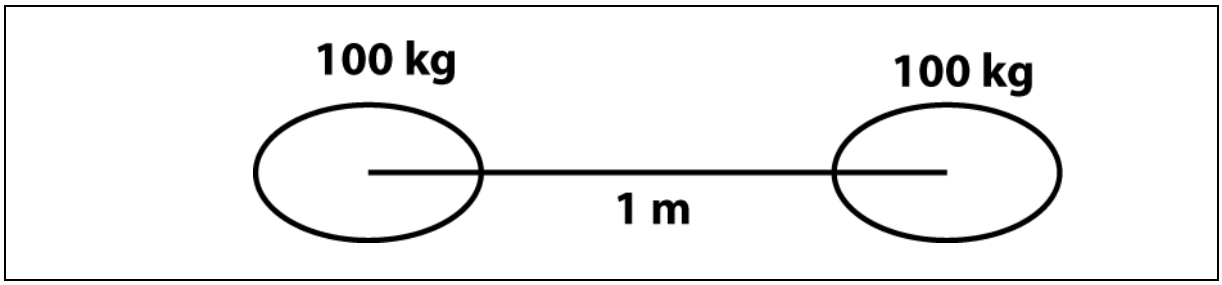
11.1 State in words the principle of conservation of linear momentum. (2)

11.2 Assume that the linear momentum is conserved during this collision. Calculate the velocity of car B directly after the collision. (5)

11.3 State TWO precautions that drivers can take to avoid collisions at the rear of another car. (2)
[9]

QUESTION 12 (Start on a new page)

The diagram shows two bodies, each with a mass of 100 kg on the surface of the earth.



12.1 State in words Newton's Law of Universal Gravitation. (2)

12.2 Calculate the magnitude of the force between the two bodies if they are 1 m apart. (4)

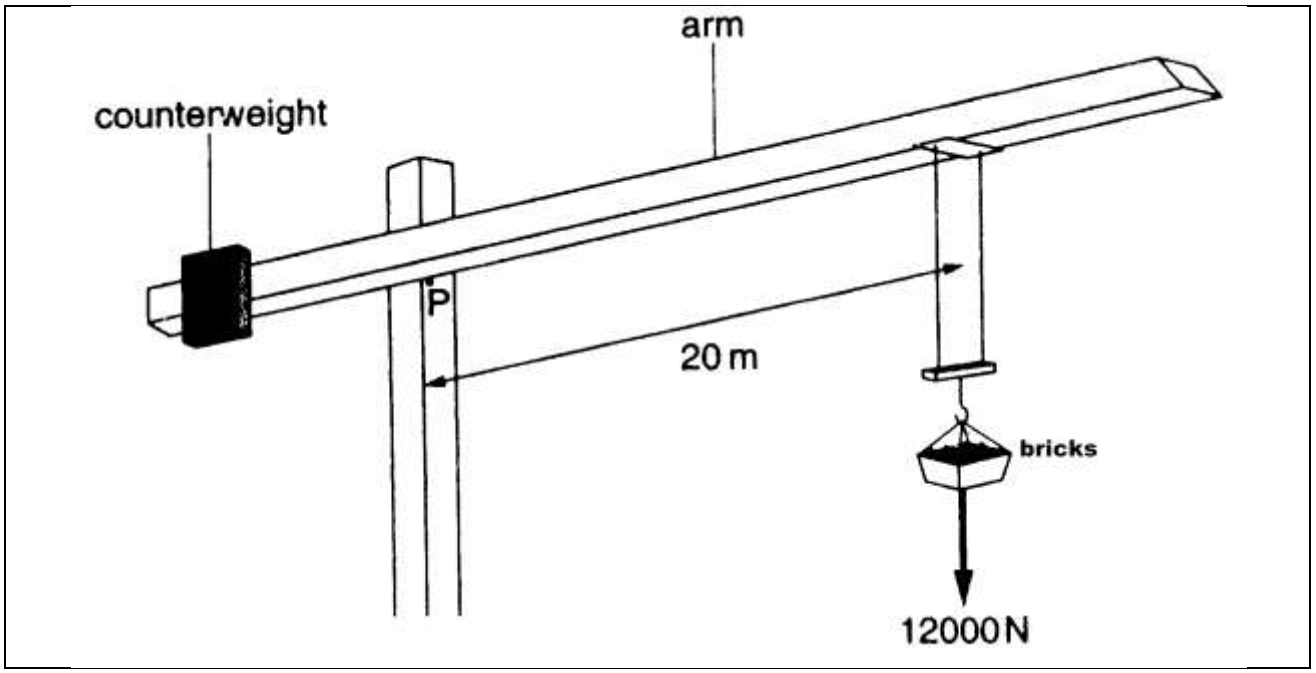
12.3 By what factor will the force change if the distance between the bodies is halved? **[Do not calculate the new value.]** (1)

12.4 The two bodies are now taken to the Moon. The distance between them remains 1 m. State what happens to the force between them? Write only **INCREASES**, **DECREASES** or **REMAINS THE SAME**. (1)

[8]

QUESTION 13 (Start on a new page)

Cranes are mainly used to lift heavy objects. They are very common at construction sites. The diagram shows a sketch of such a crane lifting bricks during the building of a tall building.



The weight of the bricks produces a turning effect on the arm of the crane about the point P. The combined weight of the bricks is 12 000 N.

13.1 Identify the class of lever in the above diagram. Give a reason for your answer. (2)

13.2 Calculate the moment of the force caused by the bricks about the point P. (4)

13.3 Cranes of this nature have a counterweight attached to one end. State ONE reason for the counterweight. (2)

[8]

QUESTION 14 (Start on a new page)

Semi-conductors are essential components of all electronic equipment ranging from radio's, televisions, calculators, iPods and computers to mention a few. One main advantage of using semi-conductors is that the equipment can be made smaller (miniaturized) and lighter.

14.1 Give ONE property of semi-conductors which makes it suitable for use in electronic equipment. (2)

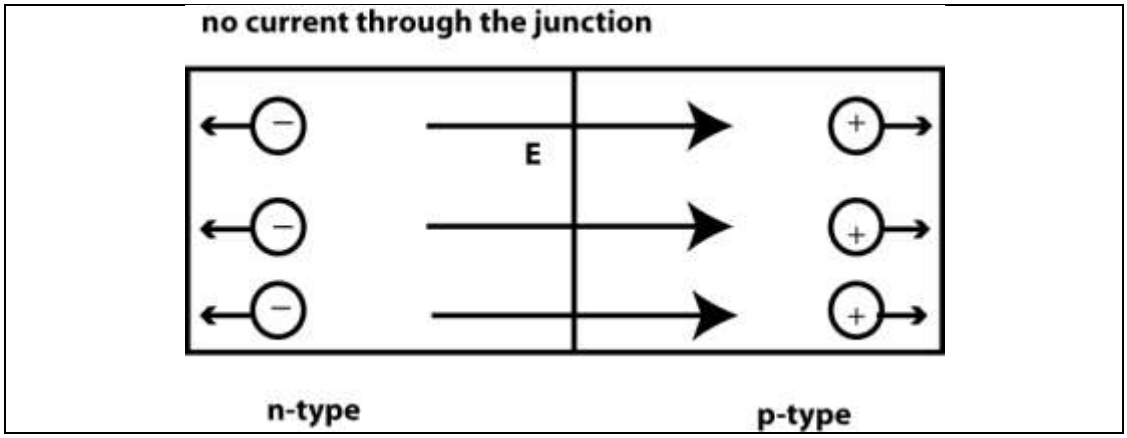
14.2 Give ONE example of a common semi-conductor material used in electronic devices. (1)

14.3 When a p-type semi-conductor material and n-type semi-conductor material are in contact they form a p-n junction.

14.3.1 Give the common name in the electronic industry for the device in which this junction is used. (1)

14.3.2 What is the main function of this device in QUESTION 14.3.1? (1)

14.4 The diagram shows a p-n-type junction.



14.4.1 Explain how you would make this junction a reverse bias. (2)

14.5 Electrical conduction can occur in solids as well as in liquids. Name the carriers of charges in a …

14.5.1 solid. (1)

14.5.2 liquid. (1)
[9]

TOTAL SECTION B: 125

GRAND TOTAL: 150

DATA/GEGEWENS

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}\ m{\cdot}s^{-1}$
Gravitational constant *Swaartekrgkonstante*	G	$6,67 \times 10^{-11}\ N{\cdot}m^{2}{\cdot}kg^{-2}$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}\ N{\cdot}m^{2}{\cdot}C^{-2}$
Charge on electron *Lading op elektron*	e^{-}	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$
Permittivity of free space *Permittiwiteit in 'n vakuum*	ε_0	$8,85 \times 10^{-12}\ F{\cdot}m^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$F = \frac{Gm_1m_2}{r^2}$	$F\Delta t = \Delta p = mv - mu$
$\mu_s = \frac{f_{s(max)}}{N}$	$\mu_k = \frac{f_k}{N}$
$\tau = F \perp r$	

WEIGHT AND MECHANICAL ENERGY/*GEWIG EN MEGANIESE ENERGIE*

$F_g = mg$	$U = E_P = mgh$
$K = E_k = \frac{1}{2}mv^2$	

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

$v = f\lambda$ or/*of* $v = \nu\lambda$	$T = \frac{1}{f}$ or/*of* $T = \frac{1}{\nu}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$(k = 9{,}0x10^9 N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$	$(k = 9{,}0x10^9 N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{V}{d}$
$V = \frac{W}{Q}$		$W = QEs$
$U = \frac{kQ_1Q_2}{r}$	$(k = 9{,}0x10^9 N{\cdot}m^2{\cdot}C^{-2})$	$C = \frac{Q}{V}$
$C = \frac{\varepsilon_0 A}{d}$		

TABLE 3: FORMULAE/*TABEL 3: FORMULES*

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA$
$\frac{V_S}{V_P} = \frac{N_S}{N_P}$	$F = qvB$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$emf / emk = I(R + r)$	$R = r_1 + r_2 + r_3 + ...$
$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + ...$	

NAME:……

SECTION A

QUESTION 1

1.1 _____ (1)

1.2 _____ (1)

1.3 _____ (1)

1.4 _____ (1)

1.5 _____ (1)

[5]

QUESTION 2

2.1	**A**	**B**	**C**	**D**
2.2	**A**	**B**	**C**	**D**
2.3	**A**	**B**	**C**	**D**
2.4	**A**	**B**	**C**	**D**
2.5	**A**	**B**	**C**	**D**
2.6	**A**	**B**	**C**	**D**
2.7	**A**	**B**	**C**	**D**
2.8	**A**	**B**	**C**	**D**
2.9	**A**	**B**	**C**	**D**
2.10	**A**	**B**	**C**	**D**

(10 x 2) **[20]**

TOTAL SECTION A: 25