

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2015**

**PHYSICAL SCIENCES P1**

**MARKS: 150**

**TIME: 3 hours**



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

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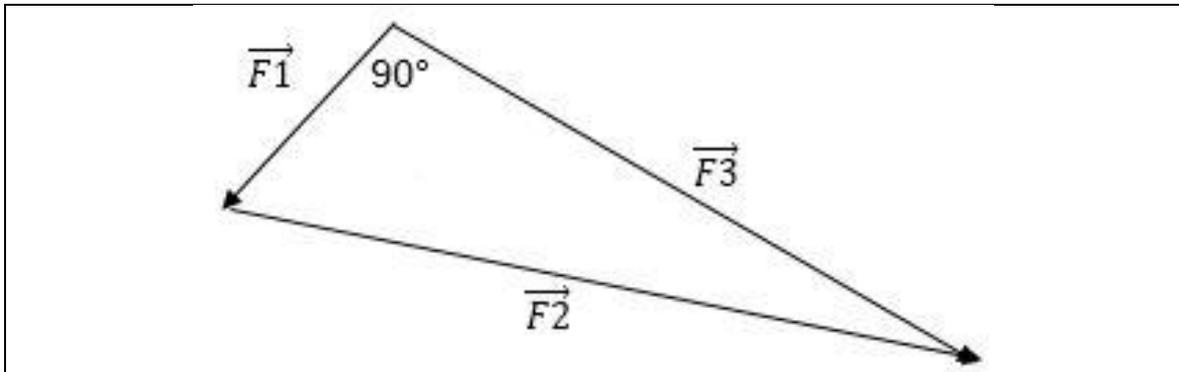
**INSTRUCTIONS AND INFORMATION**

1. Write your FULL NAME and SURNAME on your ANSWER SHEET or ANSWER BOOK.
2. This question paper consists of THIRTEEN questions. Answer ALL the questions.
3. Start EACH question on a new page in the ANSWER BOOK.
4. Number the answer 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 substitution in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legible.

**QUESTION 1: MULTIPLE CHOICE QUESTIONS**

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write the letter (A–D) next to the question number (1.1–1.10) on your answer sheet.

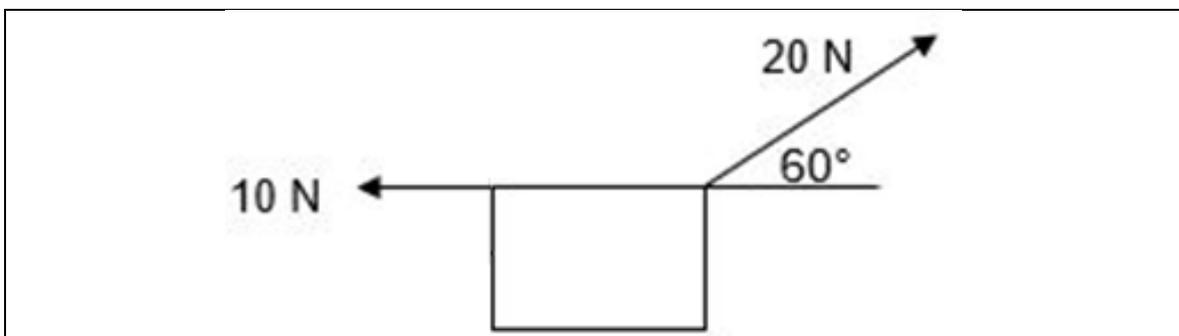
1.1 Which of the following is true for the given sketch?



- A  $\vec{F}_1 + \vec{F}_2 = \vec{F}_3$   
 B  $\vec{F}_1 + \vec{F}_3 = \vec{F}_2$   
 C  $\vec{F}_3 + \vec{F}_2 = \vec{F}_1$   
 D  $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$

(2)

1.2 Two forces are acting on a block as shown in the diagram. The resultant force in the horizontal direction is:



- A zero  
 B 10 N to the right  
 C 10 N to the left  
 D 20 N to the right

(2)

1.3 Mary has a mass of 50 kg and is standing on a scale in a lift. The reading on the scale is 555 N. The lift is ...

- A accelerating upwards.  
 B moving downwards at constant velocity.  
 C moving upwards at a constant velocity.  
 D accelerating downwards.

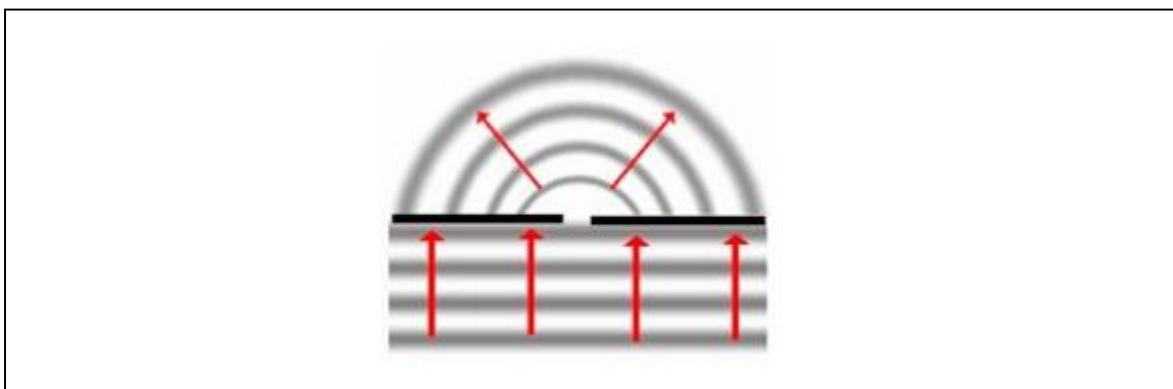
(2)

1.4 Which one of the following is an example of a contact force?

- A Electrostatic force
- B Magnetic force
- C Gravitational force
- D Frictional force

(2)

1.5 The diagram below shows water waves that spread out after passing through a single slit.



The wave phenomenon observed after the water waves pass through the slit is ...

- A reflection.
- B diffraction.
- C dispersion.
- D total internal reflection.

(2)

1.6 A ray of light moves from glass to air. The angle of incidence in glass is  $30^\circ$  and refraction takes place.

Which combination for speed and frequency of the refracted wave is correct?

	<b>Speed</b>	<b>Frequency</b>
A	Increases	Remains constant
B	Decreases	Remains constant
C	Increases	Increases
D	Decrease	Increases

(2)

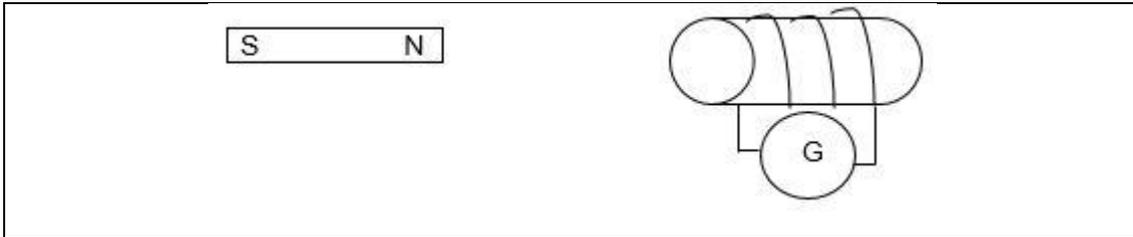
1.7 A central bright band is observed when light of wavelength  $\lambda$  passes through a single slit of width  $a$ .

Light of wavelength  $3\lambda$  is now used. Which ONE of the following slit widths would produce a central bright band of the same broadness?

- A  $\frac{1}{6} a$
- B  $\frac{1}{3} a$
- C  $a$
- D  $3 a$

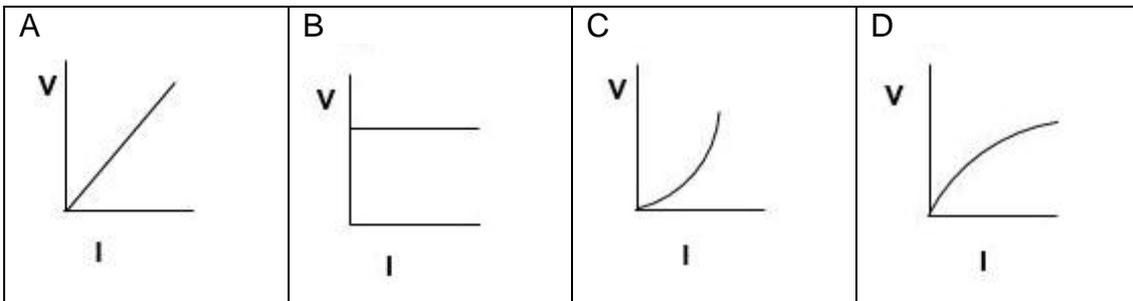
(2)

1.8 A bar magnet can be moved towards or away from a solenoid. Which ONE of the following factors/actions will increase the deviation on the galvanometer?



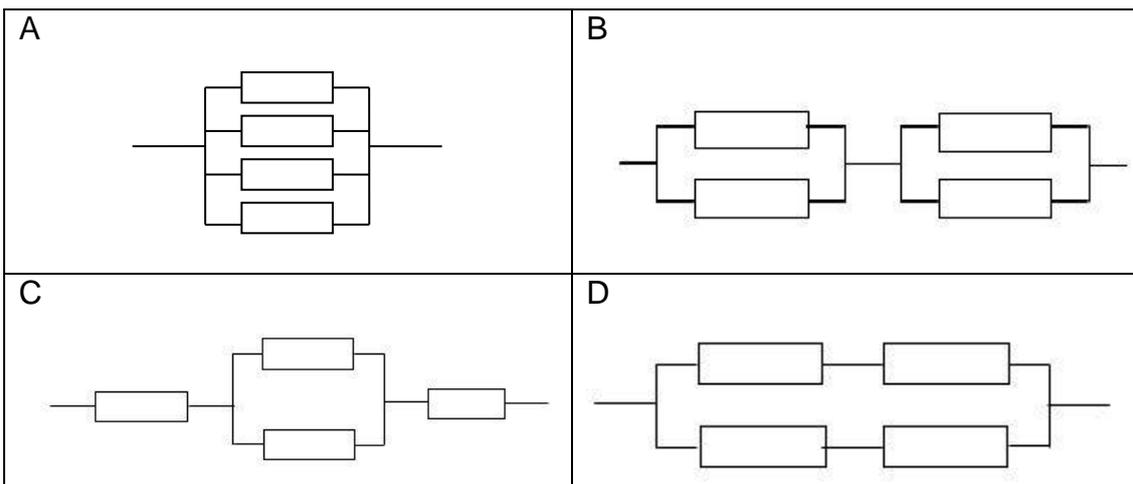
- A Use a solenoid with a smaller diameter.
- B Use a solenoid with fewer turns.
- C Use a weaker magnet.
- D Move the magnet faster towards and away from the solenoid. (2)

1.9 Which one of the following graphs correctly represents the relationship between potential difference (V) and current (I) for an ohmic conductor?



(2)

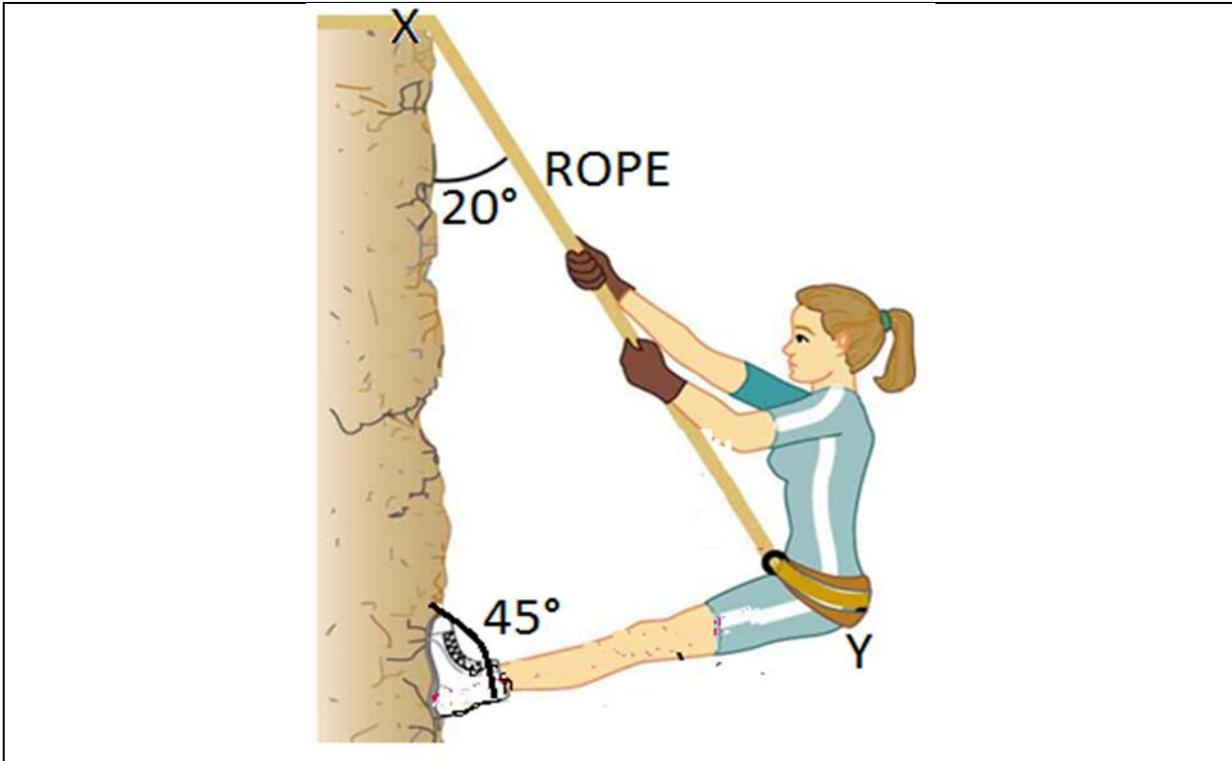
1.10 Each of the four identical resistors is connected to the same emf. Which ONE of the following circuits will have the highest resistance?



(2)  
[20]

**QUESTION 2 (Start on a new page.)**

During a mountain climbing exercise, Ferial, mass 50 kg, is suspended from an inelastic piece of nylon rope, fixed to a vertical cliff at X on the cliff. She pushes her legs against the cliff so that they make an angle of  $45^\circ$  with the cliff, as indicated in figure. The angle that the rope makes with the cliff is  $20^\circ$ .

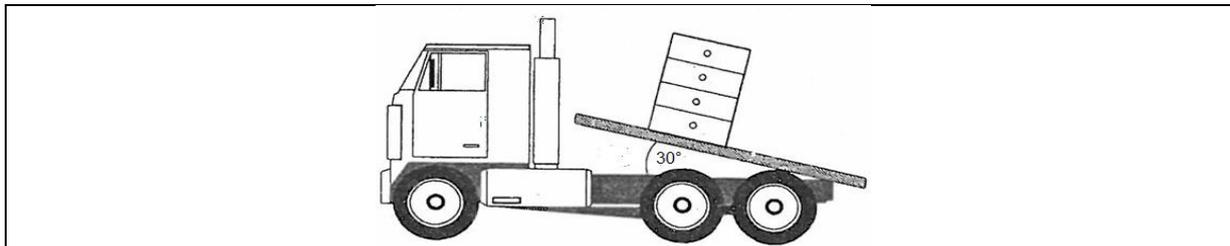


Point Y is in equilibrium.

- 2.1 Explain what is meant by Point Y *is in equilibrium*. (1)
- 2.2 Draw a FORCE DIAGRAM showing all the forces acting on point Y. (3)
- 2.3 Determine by means of ACCURATE CONSTRUCTION and MEASUREMENT. (use the scale 10 mm: 50 N and indicate at least TWO angles):
- 2.3.1 The magnitude of the force which the rope exerts on her.
- 2.3.2 The magnitude of the force exerted by her legs. (8)
- [12]

**QUESTION 3 (Start on a new page.)**

A wooden cabinet of 60 kg rests on the back of a tip-up truck. The back tilts slowly, until it makes an angle of  $30^\circ$  with the horizontal. The cabinet does NOT move.

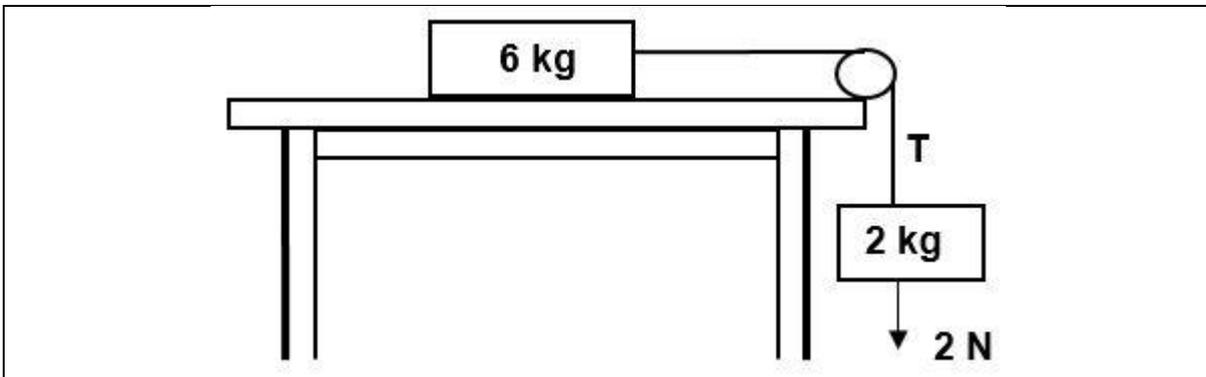


- 3.1 Calculate the magnitude of the frictional force. (3)
- 3.2 Calculate the coefficient of static friction. (3)
- 3.3 The angle of  $30^\circ$  is now increased. How will this change affect the following:  
(Write down only INCREASES, DECREASES or REMAINS THE SAME)
- 3.3.1 The coefficient in QUESTION 3.2? (1)
- 3.3.2 The frictional force? Explain your answer. (3)

**[10]**

**QUESTION 4 (Start on a new page.)**

A 6 kg block on a horizontal rough surface is joined to a 2 kg block by a light, inelastic string running over a frictionless pulley. The frictional force between the 6 kg block and the table is 11,76 N. A downwards force of 2 N is applied to the 2 kg block as indicated in the diagram below.

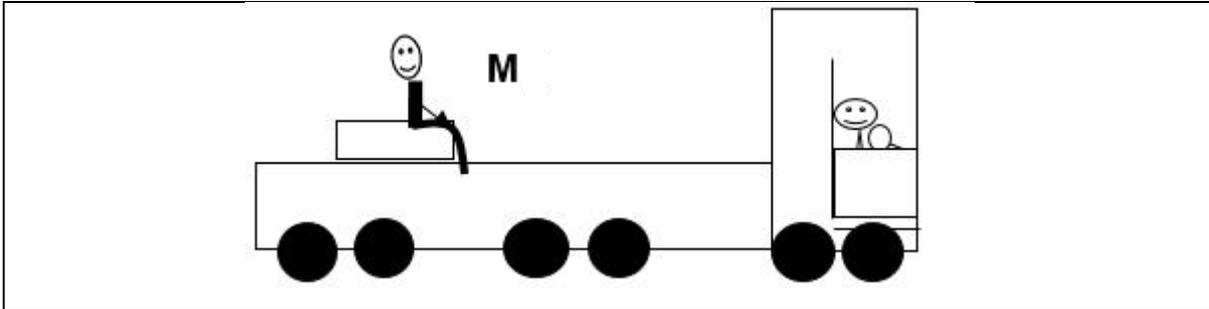


- 4.1 State Newton's Second Law of motion in words. (2)
- 4.2 Draw a free-body diagram showing ALL the forces acting on the 6 kg block. (4)
- 4.3 Calculate:
- 4.3.1 The magnitude of the acceleration of the 6 kg block. (5)
- 4.3.2 The magnitude of the tension (T) in the string connecting the two blocks. (2)
- 4.4 The rough surface is replaced by a smooth frictionless surface. How will this change affect the answer in QUESTION 4.3.1? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

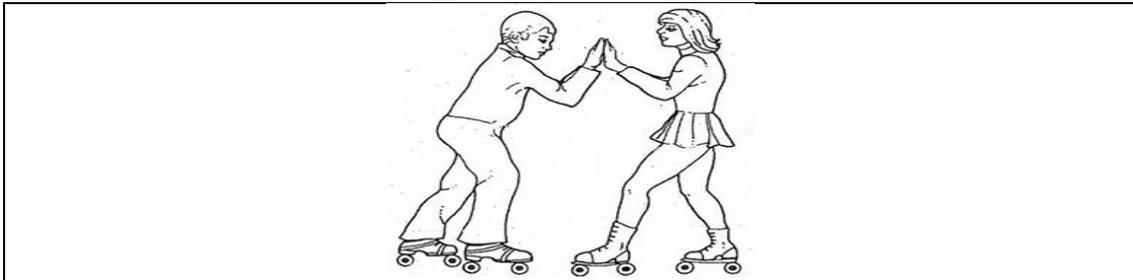
**[14]**

**QUESTION 5 (Start on a new page.)**

A truck is moving at a constant velocity and is suddenly hit from the rear (back) by a fast-moving bus. A loose-standing crate is placed on the back of the truck and a man, **M**, is sitting on the crate.



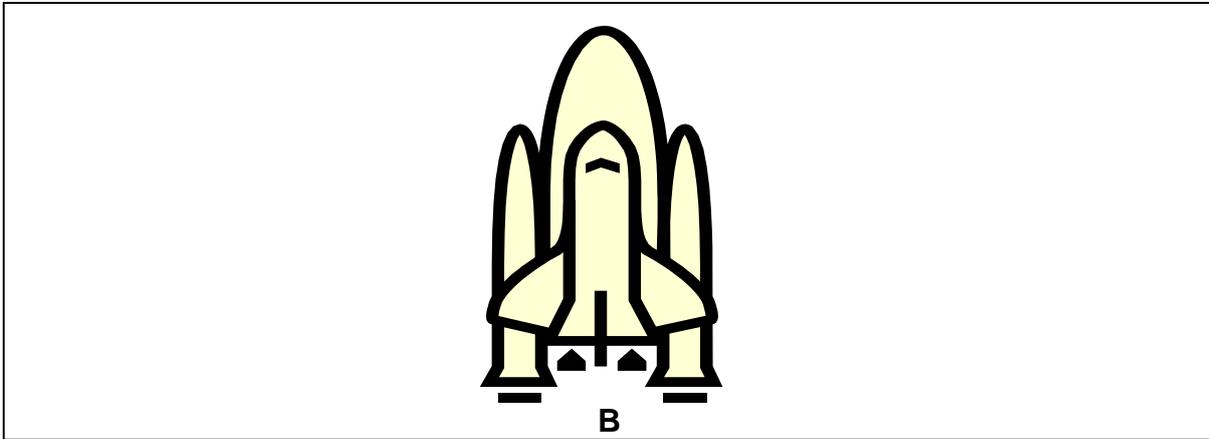
- 5.1 In which direction does the man, **M**, fall?  
Write down only BACKWARDS or FORWARDS. (1)
- 5.2 State in words Newton's laws of motion you used to answer QUESTION 5.1. (2)
- 5.3 Luxolo and Kay with masses 80 kg and 50 kg respectively are standing on roller-skates facing each other. Initially they are at rest. They push against each other and both move away in opposite directions. (IGNORE FRICTION)



- 5.3.1 How does the force exerted on Kay compare to the force exerted on Luxolo?  
Write only GREATER, SMALLER or EQUAL TO. (1)
- 5.3.2 Explain how their accelerations compare. (2)
- [6]**

**QUESTION 6 (Start on a new page.)**

NASA fires a space shuttle off the ground and into space. It accelerates from rest to  $160 \text{ m}\cdot\text{s}^{-1}$  in the first 400s of its journey. The total mass of the space shuttle and its fuel tanks is 2 600 tons ( $2,6 \times 10^6 \text{ kg}$ ). The space shuttle's propulsion system consists of exhaust gases, which are pushed out of an outlet in its base, **B**.



- 6.1 Name an action-reaction pair of forces acting on the astronaut as the space shuttle accelerates upwards. (2)
- 6.2 Calculate the resultant force on the space shuttle during the first 400 s of its flight. (5)
- 6.3 Give TWO reasons why the space shuttle's acceleration increases as it moves away from the surface of the earth. (2)
- [9]**

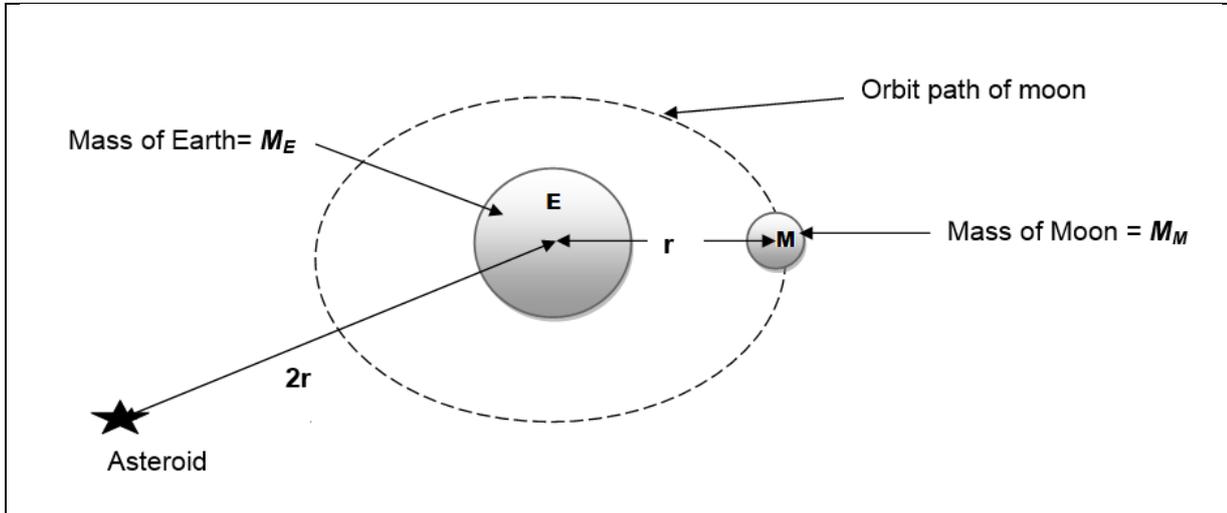
**QUESTION 7 (Start on a new page.)**

The diagram below shows the earth (E) and the moon (M) a distance 'r' apart.

The dotted line shows the path of the moon's orbit around the earth.

The mass of the moon ( $M_M$ ) is  $7,35 \times 10^{22}$  kg and the mass of the earth ( $M_E$ ) is  $6 \times 10^{24}$  kg.

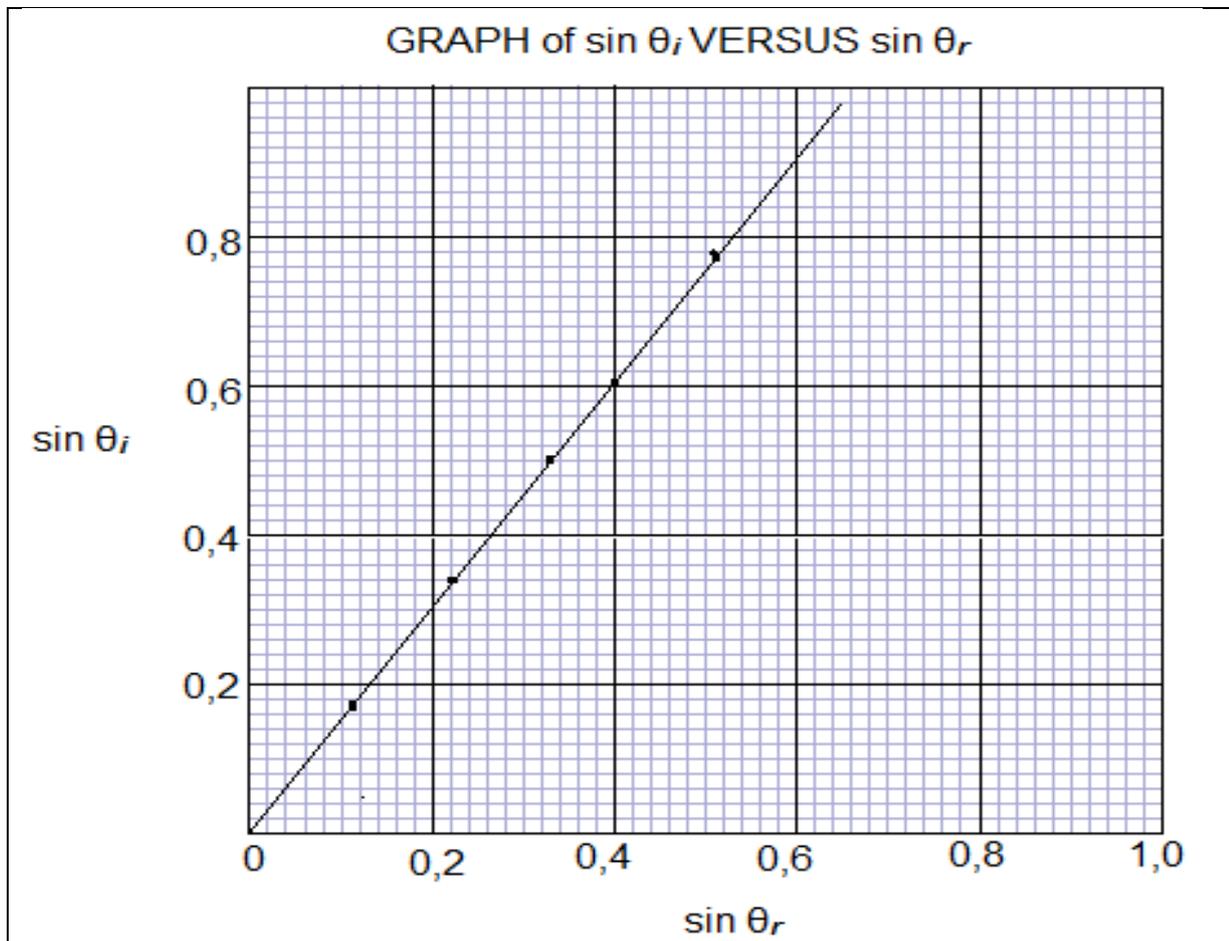
The distance  $r$  between their centres is  $3,84 \times 10^9$  m.



- 7.1 Calculate the gravitational force,  $F_{EM}$ , between the moon and the earth when their centres are a distance  $r$  apart. (4)
- 7.2 Name Newton's law that you applied in QUESTION 7.1. (1)
- 7.3 Give a reason why the gravitational force exerted by the earth on the moon does not stay constant as the moon orbits the earth. (1)
- 7.4 An asteroid with a mass of  $\frac{1}{4} M_M$  moves at a distance of  $2r$  from the centre of the earth. Without using any of the values provided, determine the force between the earth and the asteroid in terms of  $F_{EM}$ . (3)
- [9]**

**QUESTION 8 (Start on a new page.)**

Learners passed light from a ray box through a rectangular glass block to verify Snell's law. The results obtained are used to draw the graph below.

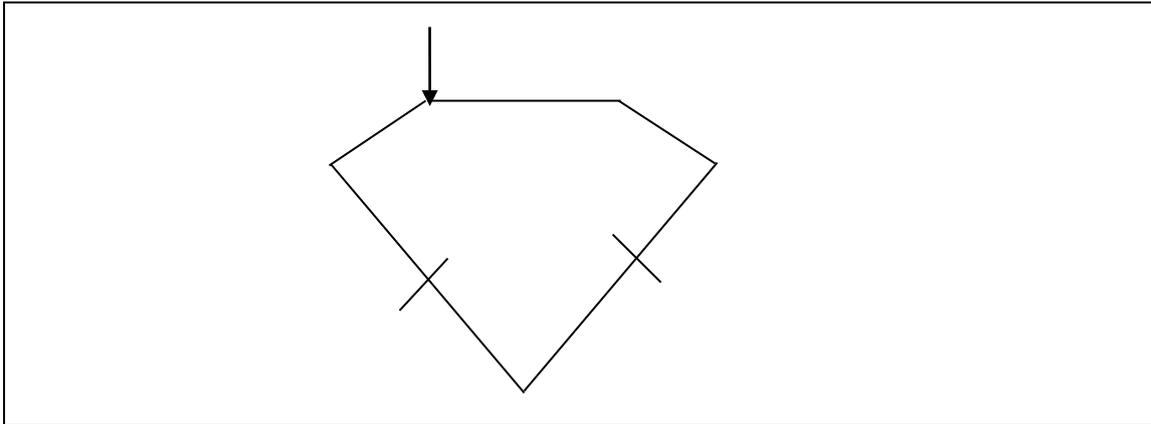


- 8.1 Write down the independent variable. (1)
- 8.2 Write down the variable that must be controlled. (1)
- 8.3 Write down the conclusion that can be obtained from the graph. (2)
- 8.4 USE THE GRAPH to determine the refraction index of the glass block. (4)
- [8]**

**QUESTION 9 (Start on a new page.)**

A diamond glitters in light because of its high refraction index of 2,42 and the small critical angle of the diamond-air boundary.

- 9.1 Calculate the critical angle of a diamond-air interface.  
Take the refraction index of air as 1. (4)
- 9.2 The angle of incidence of light at the diamond-air interface is increased to  $30^\circ$ .  
Redraw the diagram and complete the path of ray of light.



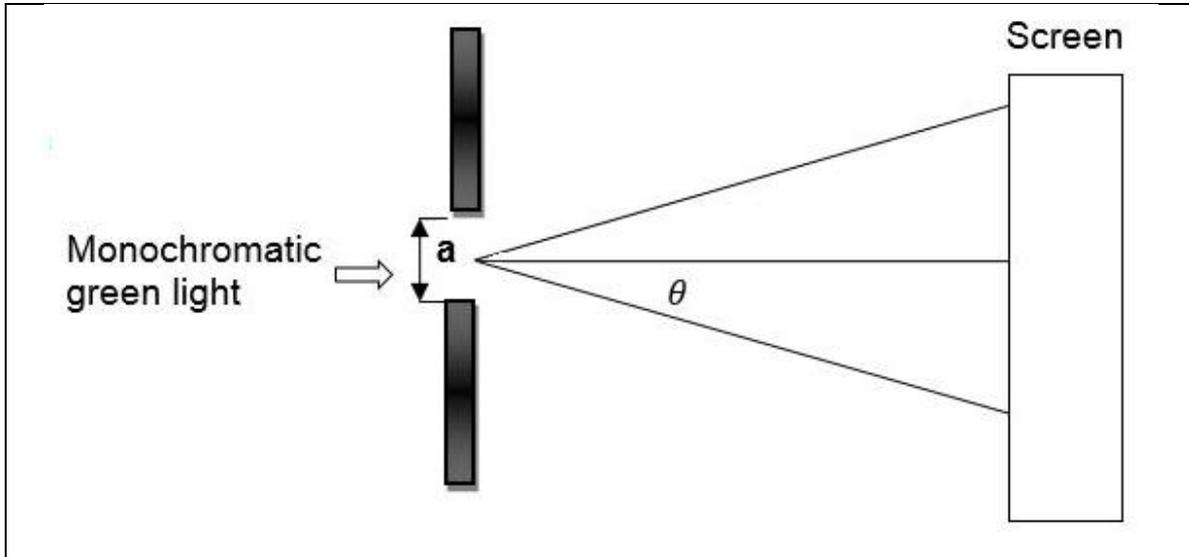
- (2)
- 9.3 Name the phenomenon that will now be observed at the diamond-air interface. (1)
- 9.4 What are the TWO CONDITIONS that are necessary for the phenomenon in QUESTION 9.3 to happen? (2)
- 9.5 Name the medical instrument used to examine internal parts of the body that makes use of the phenomenon in QUESTION 9.3. (1)

**[10]**

**QUESTION 10 (Start on a new page.)**

Learners pass a green light with wavelength 534 nm through a single slit of width  $1,8 \times 10^{-4}$  m and shines it on a screen.

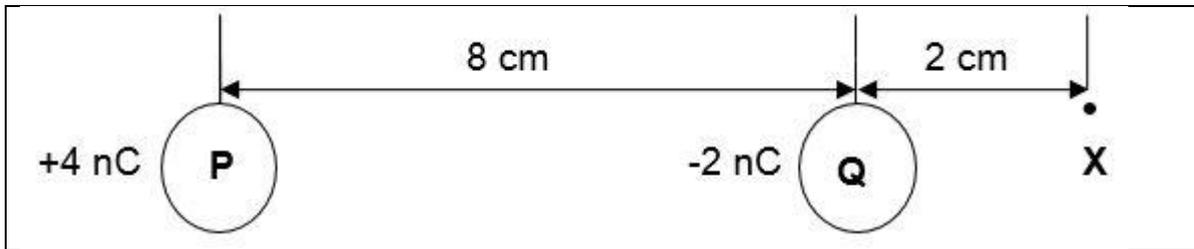
They set up the apparatus as shown in the diagram below.



- 10.1 Define the term *monochromatic light*. (1)
- 10.2 Draw the observed pattern and indicate the positions of constructive and destructive interferences. (4)
- 10.3 How will the broadness of the central band change if ...  
(Write only INCREASES, DECREASES or REMAINS THE SAME)
- 10.3.1 the green light is replaced by a red light? (1)
- 10.3.2 the slit width is smaller?  
Explain your answer. (2)
- [8]**

**QUESTION 11 (Start on a new page.)**

Two charges **P** and **Q** with charges  $+4 \text{ nC}$  and  $-2 \text{ nC}$  respectively, are placed  $8 \text{ cm}$  apart. A point charge **X** is placed  $2 \text{ cm}$  from **Q** as shown in the sketch below.



- 11.1 Define the term *electric field at a point*. (2)
- 11.2 Draw the electric field pattern between two oppositely charged particles. (3)
- 11.3 Calculate the net electric field strength at point **X** due to **P** and **Q**. (7)
- 11.4 Calculate the magnitude and direction of the electrostatic force on an electron if it is placed at point **X**. (3)

**[15]****QUESTION 12 (Start on a new page.)**

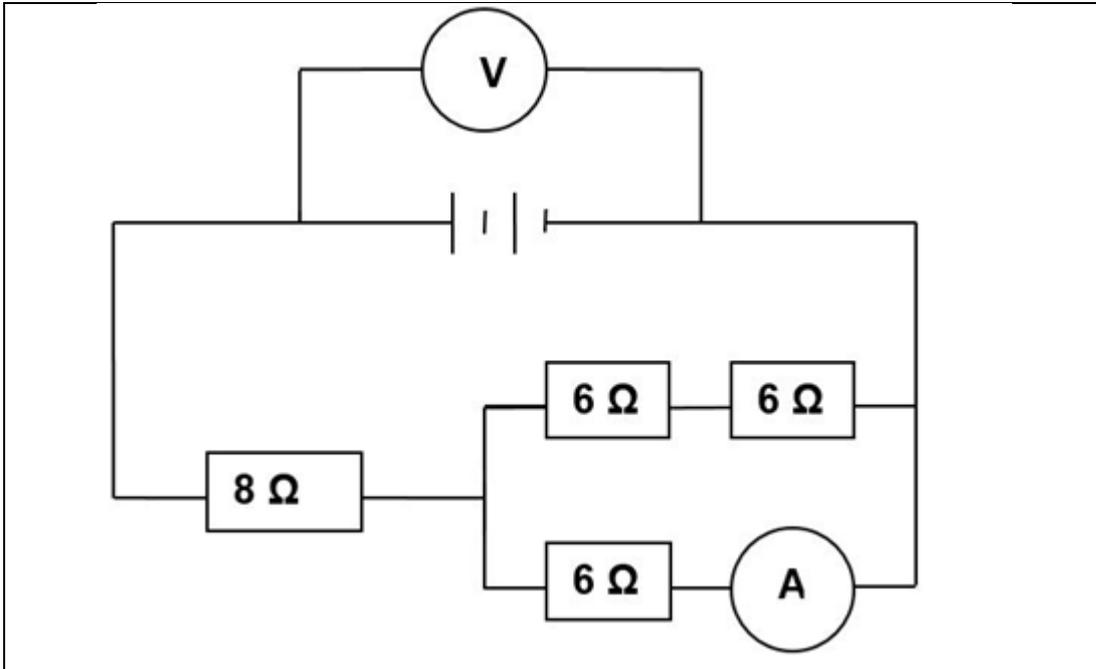
A single circular loop of wire,  $12 \text{ cm}$  in diameter, is placed in a  $0,6 \text{ T}$  magnetic field. It is removed from the magnetic field in  $0,04 \text{ s}$ .

- 12.1 Calculate:
- 12.1.1 The flux which is linked to this coil. (4)
- 12.1.2 The average induced emf. (4)
- 12.2 How does the *emf* change if ...
- (Write only INCREASES, DECREASES or REMAINS THE SAME)
- 12.2.1 the magnetic field strength changes to  $0,5 \text{ T}$ ? (1)
- 12.2.2 the coil is removed from the field in  $0,02 \text{ s}$ ? (1)

**[10]**

**QUESTION 13 (Start on a new page.)**

In the circuit below, the resistance of the battery, ammeter and connecting wires can be ignored.



The power of the  $8\ \Omega$  resistor is  $0,5\ \text{W}$ .

13.1 Calculate the reading on the:

13.1.1 voltmeter (V) (8)

13.1.2 ammeter (A) (4)

13.2 A television is labelled: **240 V; 750 W**.

13.2.1 Calculate the resistance of the television's resistor. (4)

13.2.2 Calculate the costs of using the television for 6 hours if electricity costs R1,04 per kWh. (3)

**[19]**

**TOTAL: 150**

**DATA FOR PHYSICAL SCIENCES GRADE 11**  
**GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 11**  
**PAPER 1 (PHYSICS) / 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 m.s <sup>-2</sup>
Universal Gravitational constant <i>Swaartekragkonstante</i>	G	6,67 x 10 <sup>-11</sup> N.m <sup>2</sup> .kg <sup>-2</sup>
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 x 10 <sup>9</sup> N.m <sup>2</sup> .C <sup>-2</sup>
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 x 10 <sup>8</sup> m.s <sup>-1</sup>
Charge on electron <i>Lading op elektron</i>	e <sup>-</sup>	-1,6 x 10 <sup>-19</sup> C
Electron mass <i>Electronmassa</i>	m <sub>e</sub>	9,11 x 10 <sup>-31</sup> kg
Charge on electron <i>Lading op elektron</i>	e <sup>-</sup>	-1,6 x 10 <sup>-19</sup> C
Radius of earth <i>Radius van aarde</i>	R <sub>E</sub>	6,38 x 10 <sup>6</sup> m
Mass of earth <i>Massa van aarde</i>	M <sub>g</sub>	5,98 x 10 <sup>24</sup> kg

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

**MOTION/BEWEGING**

$v_f = v_i + a\Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left[ \frac{v_f + v_i}{2} \right] \Delta t$

**FORCE/KRAG**

$F_{\text{net}} = ma$	$w = mg$
$F = \frac{GM_1M_2}{r^2}$	$f_{s(\text{max})} = \mu_s N$
$f_k = \mu_k N$	

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

$n = \frac{c}{v}$	$T = \frac{1}{f}$
$n_1 \sin \theta_1 = n_2 \sin \theta_2$	$v = f\lambda$



**ELECTROSTATICS/ELEKTROSTATIKA**

$F = \frac{k Q_1 Q_2}{r^2}$ (k = 9,0 x 10 <sup>9</sup> N.m <sup>2</sup> .C <sup>-2</sup> )	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ (k = 9,0 x 10 <sup>9</sup> N.m <sup>2</sup> .C <sup>-2</sup> )	$E = \frac{V}{d}$

**ELECTROMAGNETISM/ELEKTROMAGNETISME**

$\Phi = BA \cos \theta$	$\mathcal{E} = - \frac{N \Delta \Phi}{\Delta t}$
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**CURRENT ELECTRICITY/STROOMELEKTRISITEIT**

$R = \frac{V}{I}$	$R = R_1 + R_2 + \dots$
$I = \frac{Q}{\Delta t}$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
$W = Vq$	$P = \frac{W}{\Delta t}$
$W = VI\Delta t$	$P = VI$
$W = I^2 R \Delta t$	$P = I^2 R$
$W = \frac{V^2 \Delta t}{R}$	$P = \frac{V^2}{R}$









