



**basic education**

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**PHYSICAL SCIENCES: PHYSICS (P1)**

**NOVEMBER 2018**

**MARKS: 150**

**TIME: 3 hours**

This question paper consists of 15 pages and 2 data sheets.

**INSTRUCTIONS AND INFORMATION**

1. Write your name and class (e.g. 11A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 12 questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
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 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.



**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

- 1.1 Two forces,  $F_1$  and  $F_2$ , act on a point. If  $F_1$  and  $F_2$  act in the same direction the maximum resultant has a magnitude of 13 N. If forces  $F_1$  and  $F_2$  act in opposite directions the magnitude of the minimum resultant is 3 N. The magnitude of the two forces, in newton, is ...

- A 8 and 5.
- B 16 and 10.
- C 3 and 10.
- D 10 and 7.

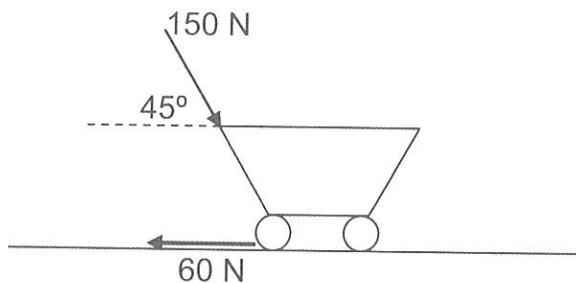
(2)

- 1.2 A free-moving block slides down an inclined plane at a CONSTANT VELOCITY. This means that the ...

- A frictional force acting on the block is zero.
- B net force acting on the block is in the direction down the slope of the plane.
- C net force acting on the block is zero.
- D component of weight parallel to the plane is greater than the frictional force.

(2)

- 1.3 A trolley is pushed along a horizontal surface with a force of 150 N at an angle of  $45^\circ$  to the horizontal. The trolley experiences a constant frictional force of 60 N.

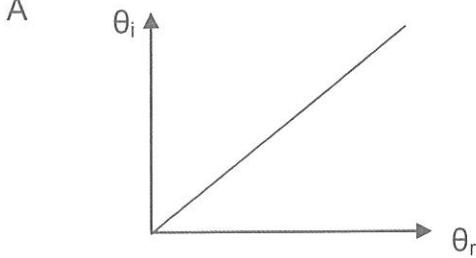
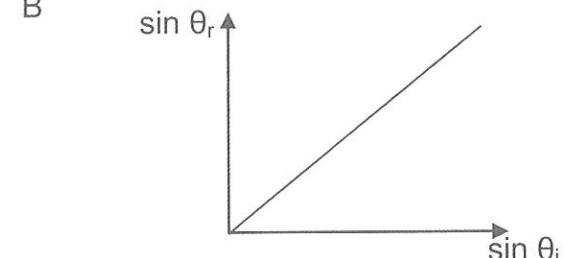
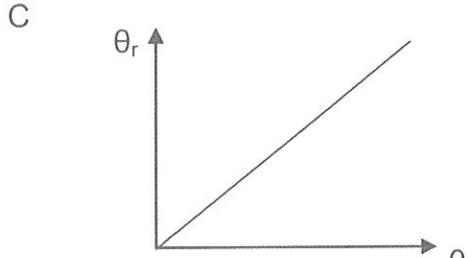
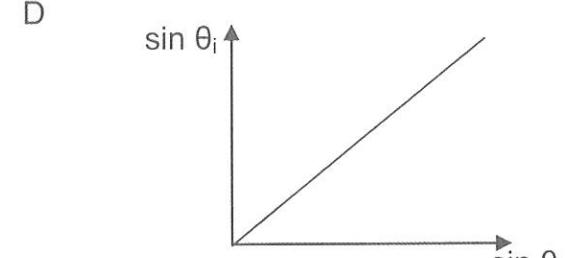


The NET FORCE acting on the trolley:

- (i) Causes the trolley to accelerate horizontally
- (ii) Is equal to the applied force
- (iii) Is horizontally forward

Which of the statements above are CORRECT?

- A (i) and (ii)
- B (ii) and (iii)
- C (i) and (iii)
- D (i), (ii) and (iii)

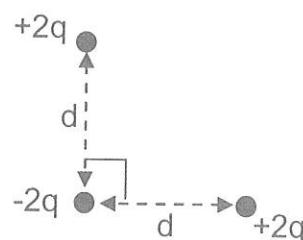
- 1.4 A man in a lift is moving upwards at a CONSTANT SPEED. The weight of the man is **W**. According to Newton's Third Law, the reaction force of the weight **W** is the force of ...
- A the floor on the man.  
B Earth on the man.  
C the man on the floor.  
D the man on Earth. (2)
- 1.5 The optical density of a medium ...
- A will be high if the refraction of light is less.  
B is a measure of the refracting power of the medium.  
C is less when light bends towards the normal when entering the medium.  
D will be high if light moves faster through the medium. (2)
- 1.6 In which ONE of the graphs below will the gradient represent the refractive index of a material when light passes from the air through the material?
- A  B 
- C  D  (2)

1.7 Every point on a wave front acts as a point source of spherical, secondary waves that move forward at the same speed as the wave. This statement represents ...

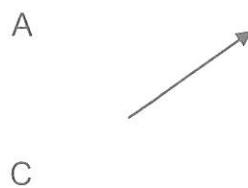
- A Snell's law.
- B Huygens' principle.
- C refraction.
- D the law of reflection.

(2)

1.8 Three charges of magnitudes  $+2q$ ,  $+2q$  and  $-2q$  are shown in the sketch below.

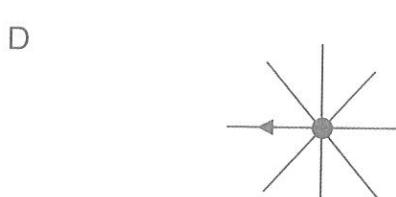
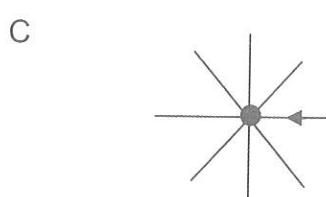
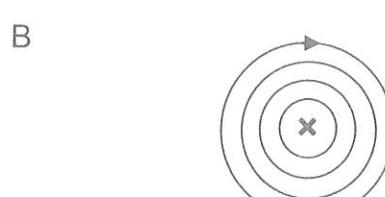
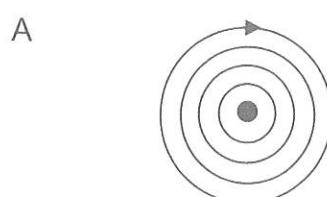


Which arrow CORRECTLY indicates the direction of the NET FORCE acting on the  $-2q$  charge?



(2)

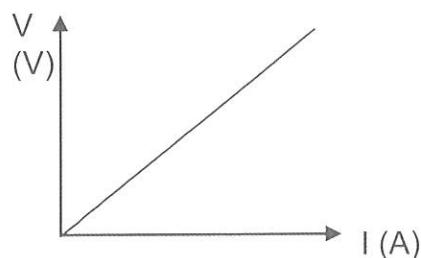
1.9 Which ONE of the sketches below represents the CORRECT magnetic field pattern around a straight current-carrying conductor?



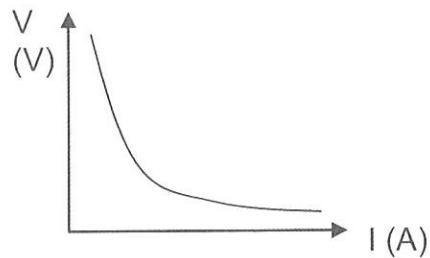
(2)

1.10 Which ONE of the graphs below CORRECTLY represents the relationship between potential difference and current in a non-ohmic resistor?

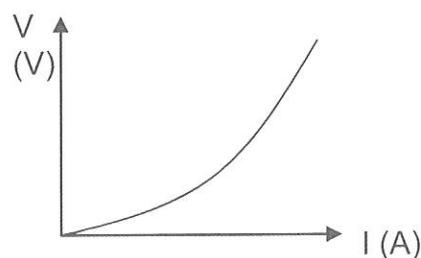
A



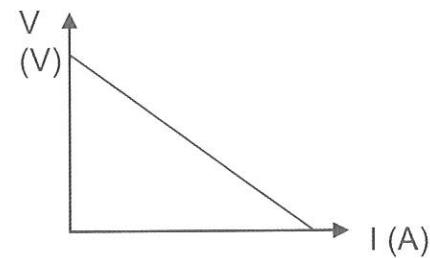
B



C

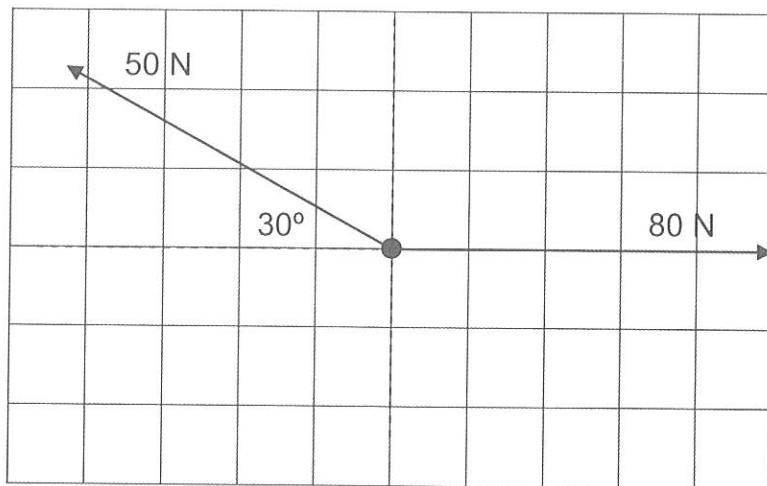


D

(2)  
[20]

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

Two forces, of magnitudes 50 N and 80 N, act at a point on a Cartesian plane in the directions shown in the sketch below.



2.1 Give the correct term for the following description:

A single vector having the same effect as two or more vectors together (1)

2.2 Calculate the:

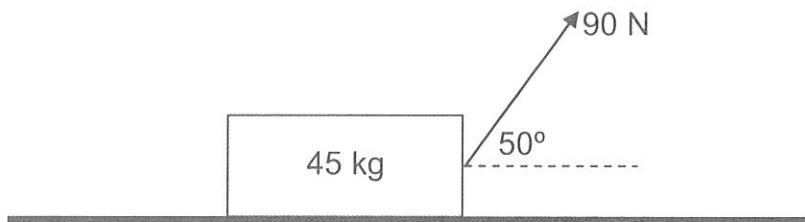
2.2.1 Magnitude of the vertical component of the 50 N (2)

2.2.2 Magnitude of the resultant (net) force (5)

2.2.3 Direction of the resultant (net) force (2)  
[10]

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

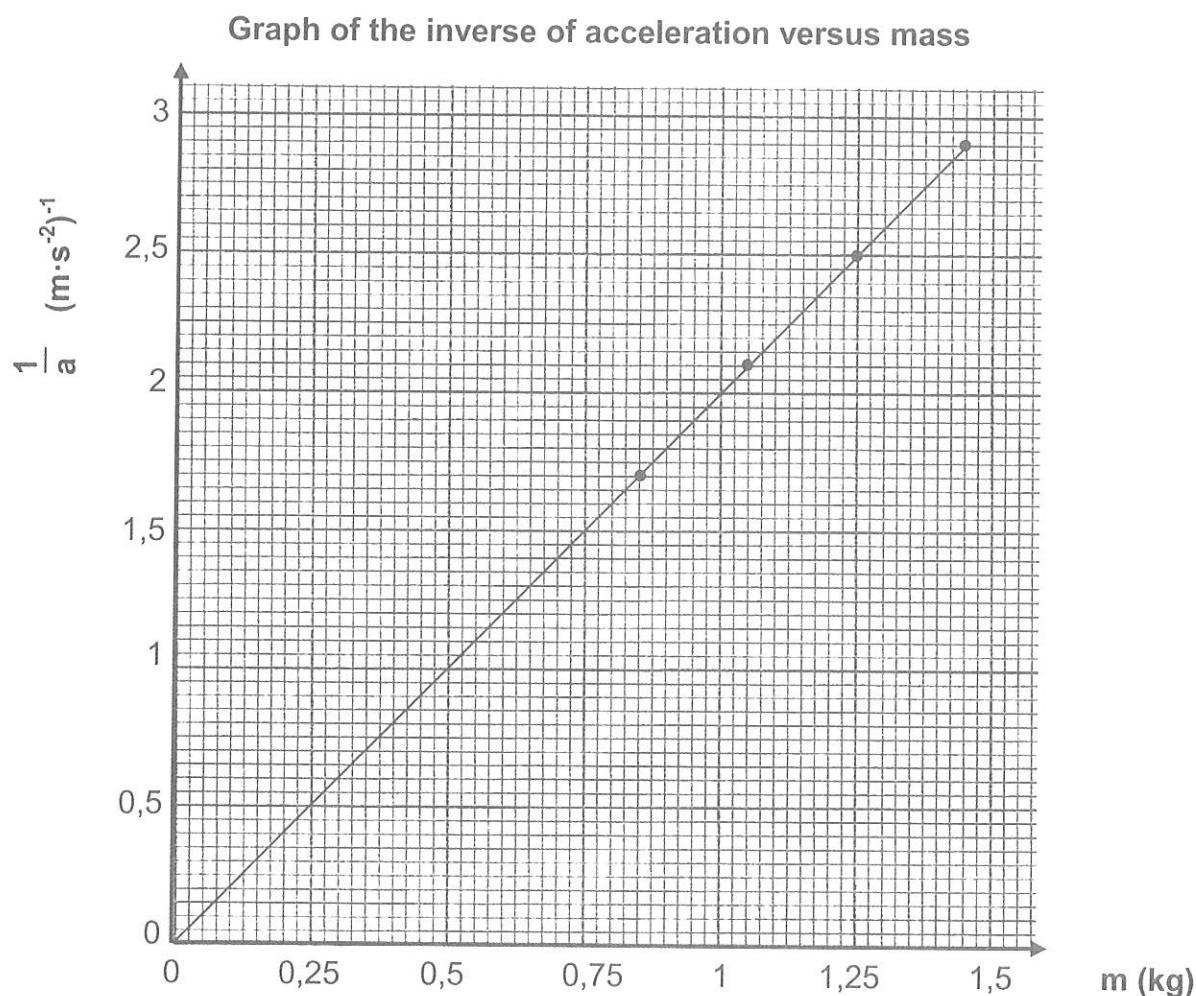
A box, with a mass of 45 kg, is pulled with a force of 90 N at an angle of  $50^\circ$  to the horizontal. The box moves at a CONSTANT VELOCITY.



- 3.1 Define the term *kinetic frictional force*. (2)
- 3.2 State *Newton's First Law of Motion* in words. (2)
- 3.3 Calculate the magnitude of the horizontal component of the applied force. (2)
- 3.4 Calculate the magnitude of the normal force. (4)
- 3.5 Calculate the coefficient of kinetic friction. (4)
- 3.6 Will the coefficient of kinetic friction change if the angle of the applied force is decreased? Write only YES or NO and give a reason. (2)  
[16]

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

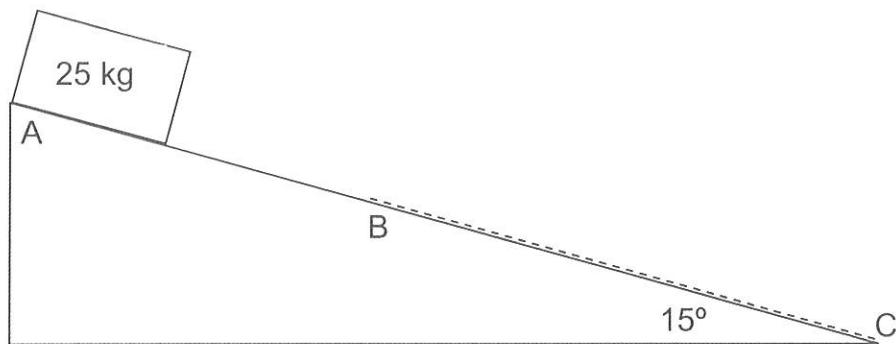
Learners investigate the relationship between the mass of an object and the acceleration it experiences when a constant net force is applied on the object. They use their results to draw the graph below.



- 4.1 State *Newton's Second Law of Motion* in words. (2)
- 4.2 Calculate the gradient of the graph. (3)
- 4.3 Hence, determine the net force applied on the object during the experiment. (2)
- 4.4 Write down a conclusion for this experiment. (2)  
**[9]**

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

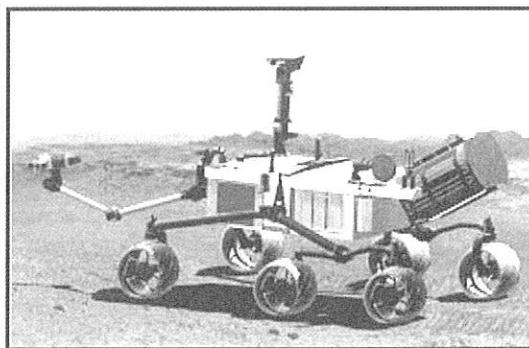
A crate, with a mass of 25 kg, slides down a plane which is inclined at  $15^\circ$  to the horizontal. During the first part of the motion, from A to B, there is no friction between the crate and the plane, but part BC has a rough surface.



- 5.1 Draw a free-body diagram of ALL the forces acting on the crate while it moves from B to C. (3)
- 5.2 Calculate the magnitude of the acceleration of the crate while it moves from A to B. (4)
- 5.3 Write down the direction of the acceleration of the crate while it slows down from B to C. Write only UP THE SLOPE or DOWN THE SLOPE. (1)
- 5.4 The magnitude of the net acceleration from B to C is  $1,2 \text{ m}\cdot\text{s}^{-2}$ . Calculate the magnitude of the frictional force acting on the crate. (4)  
**[12]**

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

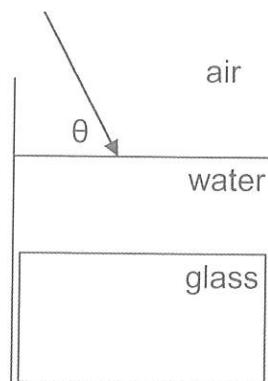
The gravitational force on a probe, called Curiosity, on the surface of Mars is 3 338 N. The radius of Mars is 3 390 km and the mass of the planet is  $6,39 \times 10^{23}$  kg.



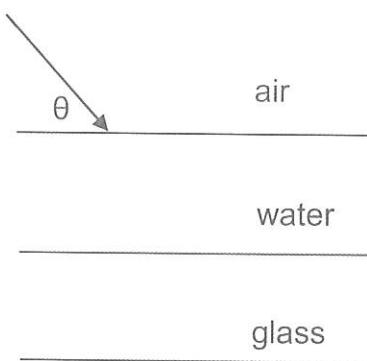
- 6.1 State Newton's Law of Universal Gravitation in words. (2)
- 6.2 Calculate the mass of the probe. (4)
- 6.3 Calculate the weight of the probe on Earth. (2)  
**[8]**

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

A glass prism is placed at the bottom of a container filled with water. A light ray passes from the air through the water into the glass prism. The light ray changes direction every time it passes into a new medium.



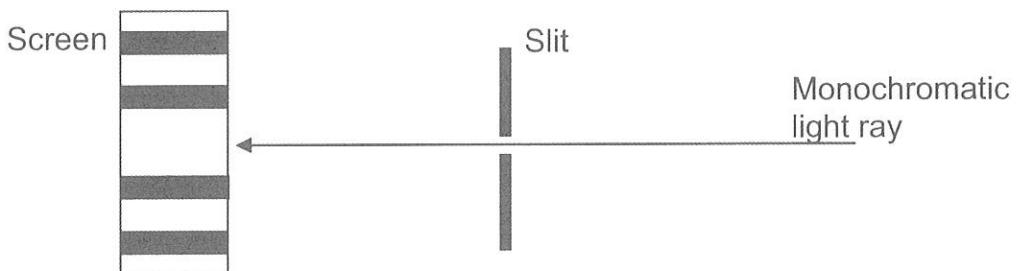
- 7.1 Name the phenomenon described by the underlined words above. (1)
- 7.2 If the refractive index of water and air is 1,33 and 1 respectively, calculate the angle  $\theta$  between the light ray and the SURFACE OF THE WATER if the angle of refraction in the water is  $40^\circ$ . (4)
- 7.3 The angle of refraction in the glass is  $35^\circ$ . Calculate the refractive index of glass. (3)
- 7.4 Draw the sketch below and complete the diagram of the path of the light ray from the air to the water to the glass. Show ALL the values of the angles of incidence, angles of refraction and normal in EACH medium. (3)



- 7.5 Calculate the speed of light through the glass prism if the refractive index of glass is 1,5. (3)
- 7.6 Is it possible that total internal reflection of the light ray can occur in the above situation? Write only YES or NO. (1)
- [17]

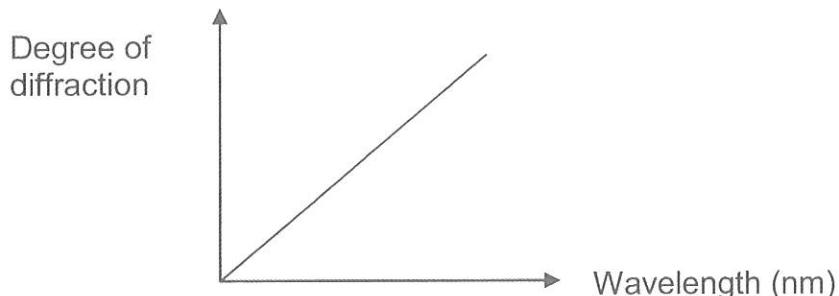
**QUESTION 8 (Start on a new page.)**

An experiment is performed to investigate the effect of wavelength on the degree of diffraction. Monochromatic light shines through a slit with a width of 0,002 mm and the pattern produced is shown on a screen.



- 8.1 Define the term *diffraction*. (2)
- 8.2 Write an investigative question for this experiment. (2)

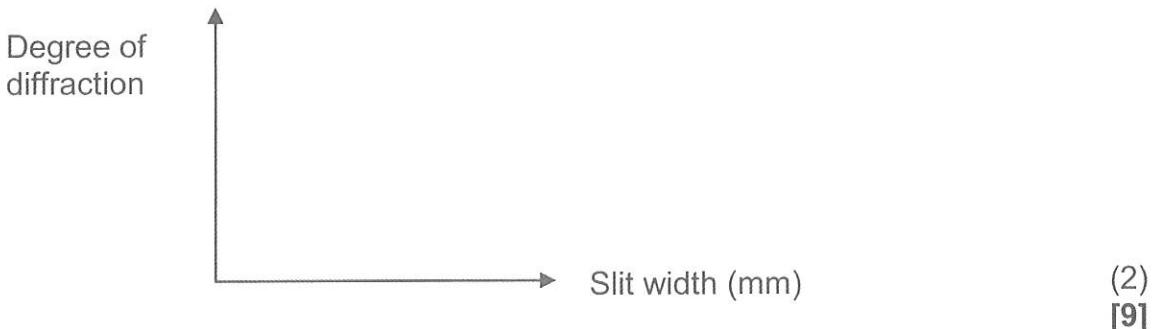
The degree of diffraction is recorded for different colours of monochromatic light and the results are shown on the graph below.



- 8.3 Write the mathematical relationship between wavelength and the degree of diffraction. (2)
- 8.4 Which colour of light, RED or GREEN, has the largest degree of diffraction? (1)

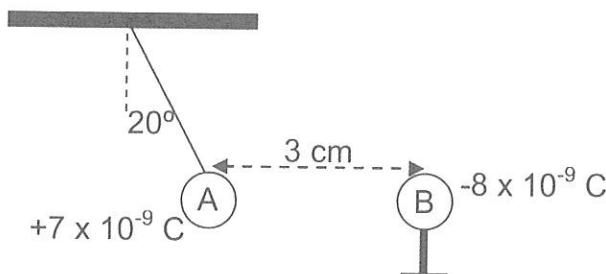
The experiment is repeated with only green light with a wavelength of 560 nm, but the slit width is changed and the degree of diffraction is recorded.

- 8.5 Copy the set of axes below into your ANSWER BOOK and draw a graph showing the relationship between slit width and degree of diffraction.



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

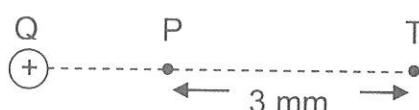
A small isolated sphere A, with a mass of  $0,2\text{ g}$ , carrying a charge of  $+7 \times 10^{-9}\text{ C}$ , is suspended from a horizontal surface by a string of negligible mass. A second sphere B, carrying a charge of  $-8 \times 10^{-9}\text{ C}$ , on an isolated stand, attracts sphere A so that the string forms an angle of  $20^\circ$  to the vertical. The horizontal distance between the centres of the two spheres is  $3\text{ cm}$ . Refer to the diagram below.



- 9.1 State Coulomb's law in words. (2)
  - 9.2 Draw a VECTOR DIAGRAM of the forces acting on sphere A. Indicate at least ONE angle. (4)
  - 9.3 Calculate the magnitude of the electrostatic force that sphere B exerts on sphere A. (4)
  - 9.4 Calculate the magnitude of the tension force in the string. (3)
- [13]**

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

Two points, P and T, are situated  $3\text{ mm}$  apart in the electric field of positive charge Q, as shown below.



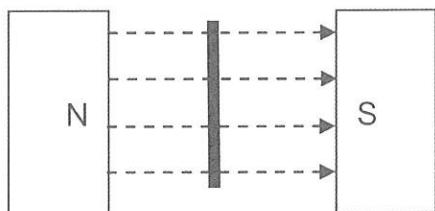
- 10.1 Draw the electric field pattern around charge Q. (2)

The magnitude of the electric field at point P is  $4 \times 10^6\text{ N}\cdot\text{C}^{-1}$  and at point T the magnitude is  $2,5 \times 10^5\text{ N}\cdot\text{C}^{-1}$ .

- 10.2 Calculate:
    - 10.2.1 The ratio of the electric field at point P to the electric field at point T. Write the answer as  $E_P : E_T$ . (1)
    - 10.2.2 The distance between charge Q and point P (4)
    - 10.2.3 The magnitude of charge Q (2)
- [9]**

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

A SQUARE induction coil with a side length 3 cm and 400 windings, is placed perpendicularly in a uniform magnetic field and then rotated through an angle of  $45^\circ$  in 0,08 s.



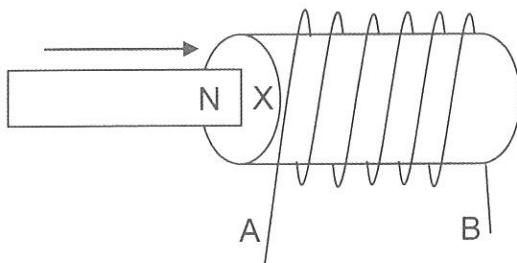
An emf of 7 V is induced in the coil.

- 11.1 State *Faraday's law of electromagnetic induction* in words. (2)
- 11.2 Calculate the change in the magnetic flux. (3)
- 11.3 Calculate the magnitude of the magnetic field. (4)

The coil is now rotated through an angle of  $45^\circ$  in 0,05 s.

- 11.4 How will the induced emf be affected? Write only INCREASE, DECREASE or STAY THE SAME. (1)
- 11.5 Explain the answer to QUESTION 11.4. (1)

The north pole of a bar magnet is pushed into a solenoid, as shown in the sketch below.

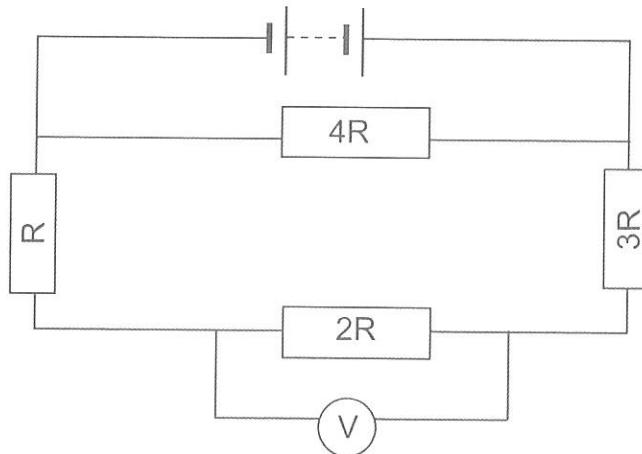


- 11.6 Which pole will be induced at point X? Write only NORTH or SOUTH. (1)
- 11.7 In which direction will the induced current flow? Write only FROM A TO B or FROM B TO A. (1)

[13]

**QUESTION 12 (Start on a new page.)**

Consider the circuit diagram below. The internal resistance of the battery and any resistance in the wires can be ignored.



- 12.1 Calculate the value of resistor  $R$  if the total resistance of the circuit is  $4,8 \Omega$ . (3)
- 12.2 Calculate the reading on the voltmeter if the current through the  $4R$  resistor is  $1,8 \text{ A}$ . (5)
- 12.3 Calculate the energy converted in resistor  $4R$  in 2 minutes. (3)

The  $4R$  resistor is replaced with an ammeter.

- 12.4 How will the reading on the voltmeter be influenced? Write only INCREASE, DECREASE or STAY THE SAME. (1)
- 12.5 Explain the answer to QUESTION 12.4. (2)  
[14]

**TOTAL:** 150

**DATA FOR PHYSICAL SCIENCES GRADE 11**  
**PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11**  
**VRAESTEL 1 (FISIKA)**

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

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Gravitational constant <i>Swaartekragkonstante</i>	G	6,67 × 10 <sup>-11</sup> N·m <sup>2</sup> ·kg <sup>-2</sup>
Radius of Earth <i>Radius van die Aarde</i>	R <sub>E</sub>	6,38 × 10 <sup>6</sup> m
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 × 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 × 10 <sup>8</sup> m·s <sup>-1</sup>
Charge on electron <i>Lading op elektron</i>	e	-1,6 × 10 <sup>-19</sup> C
Electron mass <i>Elektronmassa</i>	m <sub>e</sub>	9,11 × 10 <sup>-31</sup> kg
Mass of Earth <i>Massa van die Aarde</i>	M	5,98 × 10 <sup>24</sup> kg

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

**MOTION/BEWEGING**

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

**FORCE/KRAG**

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max/maks)}}{N}$
$\mu_k = \frac{f_k}{N}$	



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

$v = f \lambda$	$T = \frac{1}{f}$
$n_i \sin \theta_i = n_r \sin \theta_r$	$n = \frac{c}{v}$

**ELECTROSTATICS/ELEKTROSTATIKA**

$F = \frac{kQ_1 Q_2}{r^2} \quad (k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2} \quad (k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2})$	$n = \frac{Q}{e}$

**ELECTROMAGNETISM/ELEKTROMAGNETISME**

$\varepsilon = -N \frac{\Delta \Phi}{\Delta t}$	$\Phi = BA \cos \theta$
---	-------------------------

**ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE**

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \dots$	$R = r_1 + r_2 + r_3 + \dots$
$W = Vq$	$P = \frac{W}{\Delta t}$
$W = VI \Delta t$	$P = VI$
$W = I^2 R \Delta t$	$P = I^2 R$
$W = \frac{V^2 \Delta t}{R}$	$P = \frac{V^2}{R}$

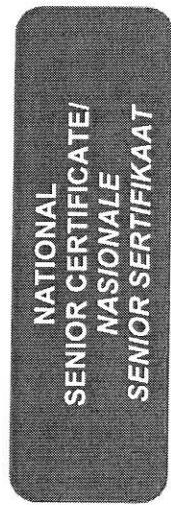






# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**



**GRADE/GRAAD 11**

**PHYSICAL SCIENCES: PHYSICS (P1)  
FISIESE WETENSKAPPE: FISIKA (V1)**

**NOVEMBER 2018**

**MARKING GUIDELINES/NASIERIGLYNE**

**MARKS/PUNTE: 150**

*These marking guidelines consist of 16 pages.  
Hierdie nasieriglyne bestaan uit 16 bladsye.*

*R. Ahmed  
Int. MSA  
2018-11-18*

**2018 -11- 12**  
**PROVED MARKING GUIDELINE**  
**PUBLIC EXAMINATION**

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**QUESTION 1/VRAAG 1**

- |      |      |     |
|------|------|-----|
| 1.1  | A ✓✓ | (2) |
| 1.2  | C ✓✓ | (2) |
| 1.3  | C ✓✓ | (2) |
| 1.4  | D ✓✓ | (2) |
| 1.5  | B ✓✓ | (2) |
| 1.6  | D ✓✓ | (2) |
| 1.7  | B ✓✓ | (2) |
| 1.8  | A ✓✓ | (2) |
| 1.9  | B ✓✓ | (2) |
| 1.10 | C ✓✓ | (2) |

[20]

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### QUESTION 2/VRAAG 2

Resultant (net) vector/Resultante (netto) vektor ✓

$$\begin{aligned} F_y &= F \sin \theta \\ &= 50 \sin 30^\circ \checkmark && \text{OR/OF } 50 \cos 60^\circ \\ &= 25 \text{ N } \checkmark \end{aligned} \quad (1)$$

2.2.2

### POSITIEWE NASIEN VANAF VRAAG 2.2.1

POSITIEWE NASIEN VANAF VRAAG 2.2.1

$$\begin{aligned} F_x &= 50 \cos 30^\circ \checkmark \\ &= 43,3 \text{ N } \checkmark \end{aligned}$$

$$\begin{aligned} R_x &= 80 \checkmark - 43,3 \checkmark \\ &= 36,7 \text{ N } \checkmark \end{aligned}$$

$$\begin{aligned} F_{\text{net}}^2 &= R_x^2 + F_y^2 \\ &= 36,7^2 + 25^2 \checkmark \\ &= 44,41 \text{ N } \checkmark \end{aligned}$$

2.2.3

### POSITIVE MARKING FROM QUESTION 2.2.1 AND 2.2.2

#### OPTION 1/OPSIE 1

$$\begin{aligned} \tan \theta &= \frac{36,7}{25} \checkmark \\ \theta &= 55,74^\circ \checkmark \end{aligned}$$

$$\begin{array}{c} R_y = 25 \text{ N} \\ \theta \\ \phi \\ F_{\text{net}} = 44,41 \text{ N} \end{array}$$

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$$\begin{aligned} \sin \theta &= \frac{36,7}{44,41} \checkmark \\ \theta &= 55,74^\circ \checkmark \end{aligned}$$

#### OPTION 3/OPSIE 3

$$\begin{aligned} \sin \theta &= \frac{36,7}{44,41} \checkmark \\ \theta &= 55,74^\circ \checkmark \end{aligned}$$

#### OPTION 4/OPSIE 4

$$\begin{aligned} \cos \theta &= \frac{25}{44,41} \checkmark \\ \theta &= 55,74^\circ \checkmark \end{aligned}$$

Accept direction as /Aanvaar rigting as  
 $\phi = 90^\circ - \theta$   
 $= 34,26^\circ \checkmark \checkmark$

### QUESTION 3/VRAAG 3

The force that opposes the motion of a moving object relative to a surface. ✓✓  
Die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenwerk.

[2 of 0]

3.1 A body will remain in its state of rest or motion at constant velocity ✓ unless a non-zero resultant/net force acts on it. ✓  
In Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly/voldraai tenzij 'n meetbaar resultante/netto krag daarop inwerk.

[2 of 0]

3.2 Penalise -1 if key words/phrase is omitted/  
Penaliseer -1 indien sleutelwoorde/frase is uitgelaat

3.3  $F_x = 90 \cos 50^\circ \checkmark$  OR/OF  $90 \sin 40^\circ \checkmark$   
 $R_x = 57,85 \text{ N } \checkmark$  (2)

3.4  $N = F_g - F_y \checkmark$   
 $N = 45(9,8) \checkmark - 90 \sin 50^\circ \checkmark$   
 $N = 372,06 \text{ N } \checkmark$  (4)

3.5  $f_k = \mu_k N \checkmark$   
 $57,85 \checkmark = \mu_k(372,06) \checkmark$   
 $\mu_k = 0,16 \checkmark$  (4)

3.6 No ✓ The coefficient is dependent on the (nature of) the surfaces / type of material in contact. ✓  
Nee. Die koëffisiënt is afhanglik van die (type) oppervlakte / soort materiaal/in kontak.

(2)

[16]

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#### QUESTION 4/VRAAG 4

- 4.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the net force and inversely proportional to the mass of the object. ✓  
Wanneer 'n resultanteerde/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versneling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.  
[Penalise -1 if key words/phrase is omitted/  
Penaliseer -1 indien sleutelwoorde/phrase is uitgelaat]

- 4.2 Accept any set of coordinates from the graph, e.g.:  
Aanvaar enige kombinasie van koördinate vanaf die grafiek, bv.:

$$\text{Gradient/Helling} = \frac{2.5 - 0}{1.25 - 0} \checkmark = 2 \checkmark$$

OR/OF

$$\text{Gradient/Helling} = \frac{2.1 - 1.7}{1.05 - 0.85} \checkmark = 2 \checkmark$$

(3)  
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- 4.3 OPTION 1/OPSIE 1  
 $\text{Gradient/Helling} = \frac{1}{\text{ma}} = \frac{1}{F_{\text{net}}} = 2 \checkmark$

$$F_{\text{net}} = \frac{1}{2} = 0.5 \text{ N} \checkmark \quad \text{Accept/Aanvaar } F_{\text{net}} = 0.5 \text{ N} \checkmark$$

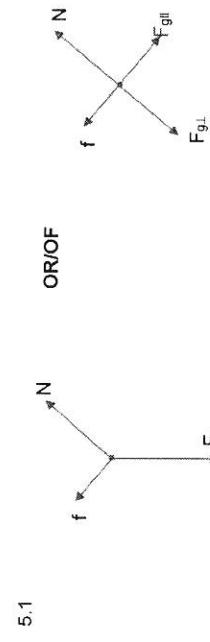
OPTION 2/OPSIE 2

$$F_{\text{net}} = \text{ma} \\ = (1)(1/2) \checkmark \\ = 0.5 \text{ N} \checkmark$$

Accept any coordinates from graph  
Aanvaar enige koördinate vanaf grafiek

- 4.4 Acceleration is inversely proportional to the mass of an object (if the net force is kept constant) ✓  
Accept: The inverse of acceleration is directly proportional to the mass of the object (if the net force is kept constant)  
OR  $\frac{1}{a} \propto m$   
Versneling is omgekeerd eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)  
Aanvaar: Die omgekeerde van die versneling is direk eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)  
OR  $\frac{1}{a} \propto m$

#### QUESTION 5/VRAAG 5



#### Accepted Labels/Aanvaarbare Byskrifte (3)

	Accepted Labels/Aanvaarbare Byskrifte	Mark/Punt
w	Weight/F <sub>g</sub> /F <sub>9</sub>	OR Both components for one mark
N	Normal force/F <sub>N</sub>	Gewig/gravitasiekrag/swaartekrag OF Beide komponente vir een punt
f	Friction/F <sub>f</sub>	Normal force/krag/F <sub>N</sub>
F <sub>g</sub>	Vrywingskrag/F <sub>f</sub>	Any additional force; deduct 1 mark (maximum 2/3) Enige addisionele krag; trek 1 punt af (maksimum 2/3)
		Omission of arrow heads; deduct 1 mark (maximum 2/3) Pylpunte uitgelaat; trek 1 punt af (maksimum 2/3)
		Lines must touch object otherwise (maximum 2/3) Lyne moet voorwerp raak anders (maksimum 2/3)
		Do not penalise if vectors are not to scale Moenie penalisear indien vektore nie op skaal is nie

	Accepted Labels/Aanvaarbare Byskrifte	Mark/Punt
w	Weight/F <sub>g</sub> /F <sub>9</sub>	OR Both components for one mark
N	Normal force/F <sub>N</sub>	Gewig/gravitasiekrag/swaartekrag OF Beide komponente vir een punt
f	Friction/F <sub>f</sub>	Normal force/krag/F <sub>N</sub>
F <sub>g</sub>	Vrywingskrag/F <sub>f</sub>	Any additional force; deduct 1 mark (maximum 2/3) Enige addisionele krag; trek 1 punt af (maksimum 2/3)
		Omission of arrow heads; deduct 1 mark (maximum 2/3) Pylpunte uitgelaat; trek 1 punt af (maksimum 2/3)
		Lines must touch object otherwise (maximum 2/3) Lyne moet voorwerp raak anders (maksimum 2/3)
		Do not penalise if vectors are not to scale Moenie penalisear indien vektore nie op skaal is nie

	Accepted Labels/Aanvaarbare Byskrifte	Mark/Punt
w	Weight/F <sub>g</sub> /F <sub>9</sub>	OR Both components for one mark
N	Normal force/F <sub>N</sub>	Gewig/gravitasiekrag/swaartekrag OF Beide komponente vir een punt
f	Friction/F <sub>f</sub>	Normal force/krag/F <sub>N</sub>
F <sub>g</sub>	Vrywingskrag/F <sub>f</sub>	Any additional force; deduct 1 mark (maximum 2/3) Enige addisionele krag; trek 1 punt af (maksimum 2/3)
		Omission of arrow heads; deduct 1 mark (maximum 2/3) Pylpunte uitgelaat; trek 1 punt af (maksimum 2/3)
		Lines must touch object otherwise (maximum 2/3) Lyne moet voorwerp raak anders (maksimum 2/3)
		Do not penalise if vectors are not to scale Moenie penalisear indien vektore nie op skaal is nie

## QUESTION 6/VRAAG 6

6.1

Each particle in the universe attracts every other particle with a gravitational force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. ✓

*Elike deeltjie in die heelal trek elke ander deeltjie aan met 'n krag wat direk eweredig is aan die produk van hulle massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle middelpunte.*

[Penalise -1 if key words/phrase is omitted/  
Penalise -1 indien sleutelwoorde/phrase is uitgeslaaf]

6.2

$$F = \frac{Gm_1 m_2}{r^2} \quad \checkmark$$

$$3.338 \checkmark = \frac{(6.67 \times 10^{-11})(6.39 \times 10^{23})}{(3.390 \times 10^3)^2} (m) \quad \checkmark$$

OR/OF

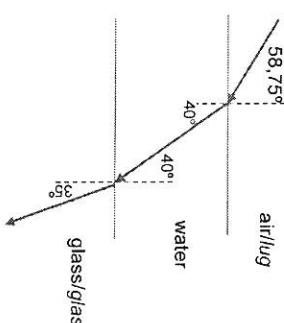
$$m = 900 \text{ kg} \quad \checkmark$$

7.3

$$\begin{aligned} n_i \sin \theta_i &= n_r \sin \theta_r \\ 1.33 \sin 40^\circ &\checkmark = n_r \sin 35^\circ \quad \checkmark \\ n_r &= 1.49 \quad \checkmark \end{aligned}$$

(3)

7.4



(4)

Allocation of marks/Toekennings van punte:

(5)

$$w = mg$$

$$= 900(9.8) \checkmark$$

$$= 8820 \text{ N} \checkmark$$

## POSITIVE MARKING FROM QUESTION 6.2 POSITIEWE NASIEN VANAF VRAAG 6.2

6.3

$$\begin{aligned} F_g &= mg \\ 3.338 &= m(3.71) \quad \checkmark \\ m &= 900 \text{ kg} \quad \checkmark \quad (899.73 \text{ kg}) \end{aligned}$$

(4)

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Allocation of marks/Toekennings van punte:	
Light ray bends towards normal in water	✓
Ligstraal/breek na die normaal in water	✓
Light ray bends further towards normal in glass	✓
Ligstraal/breek nog meer na die normaal in glas	✓
Angle of incidence 58.75° shown (OR 31.25°)	✓
Invalshoek 58.75° aangedui (OF 31.25°)	✓
Angles in water (40°)	✓
Hoeke in water (40°)	✓
Angle in glass (35°)	✓
Hoeke in glas (35°)	✓
If normal lines are not indicated, penalise with one mark	
Indien normaal lyne nie aangedui is nie, penaliseer met een punt	
If arrows are omitted, penalise -1 (maximum 4/5)	
Indien pypunte weggeblaat word, penaliseer -1 (maxima 4/5)	

## QUESTION 7/VRAAG 7

7.1 Refraction/Refraksie ✓

7.2

### OPTION 1/OPTIE 1

### OPTION 2/OPTIE 2

### OPTION 3/OPTIE 3

$n_i \sin \theta_i = n_r \sin \theta_r \quad \checkmark$	$n = \frac{\sin \theta_i}{\sin \theta_r} \quad \checkmark$
$1 \sin 40^\circ = 1.33 \sin 30^\circ \quad \checkmark$	$1.33 = \frac{\sin 40^\circ}{\sin 30^\circ} \quad \checkmark$
$\theta_i = 58.75^\circ$	$\sin \theta_i = 1.33 \sin 40^\circ$
	$\theta_i = 58.75^\circ$
	$\theta_r = 31.25^\circ$

Therefore the angle between ray and surface/Daaron is die hoek tussen invalende straal en oppervlak  
 $\theta = 90^\circ - 58.75^\circ \quad \checkmark$   
 $= 31.25^\circ \quad \checkmark$

(4)

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7.5  $n = \frac{c}{v}$  ✓  
 $15 = \frac{3 \times 10^8}{v}$  ✓  
 $v = 2 \times 10^8 \text{ m} \cdot \text{s}^{-1}$  ✓  
 7.6 Nei/nee ✓

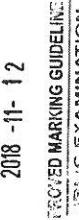
#### QUESTION 8/VRAAG 8

8.1 Diffraction is the ability of a wave to spread out in wave fronts ✓ as the wave passes through a small aperture or around a sharp edge. ✓  
 Diffraksié is die vermoe van 'n golf om uit te staan in golffronte soos wat die golf deur 'n klein opening of om 'n sterp rand/kant beweeg. (2)

8.2 Criteria for investigative question/Riglyne vir ondersoekende vraag ✓  
 The dependent and independent variables are stated correctly. ✓  
 Die afhanglike en onafhanglike veranderlikes korrek genoem. ✓  
 Ask the relationship between the dependent and independent variables in a question, not as a statement. The question may not be written in a way that the answer is yes or no.  
 Vra die verband tussen die afhanglike en onafhanglike veranderlike as 'n vraag, nie 'n stelling nie. Die vraag mag nie op so 'n manier gevormuleer word dat die antwoord ja of nee is nie.  
 Dependent variable/Afhanglike veranderlike: degree of diffraction/mate van diffraksié  
 Independent variable/Onafhanglike veranderlike: wavelength/golfslengte  
 Examples/Voorbeide:  
 What is the relationship between the wavelength of a light ray and the degree of diffraction?  
 Wat is die verband tussen die golflengte van 'n ligstraal en die mate van diffraksié?

OR/OF  
 How does a change in wavelength affect the degree of diffraction?  
 Hoe beïnvloed 'n verandering in golflengte die mate van diffraksié?  
 OR/OF  
 Degree of diffraction is directly proportional to the wavelength. ✓✓  
 Mate van diffraksié is direk eweredig aan die golflengte.

8.3 Degree of diffraction is directly proportional to the wavelength. ✓✓  
 Mate van diffraksié is direk eweredig aan die golflengte.  
 OR/OF  
 Degree of diffraction  $\propto \lambda$ . ✓✓  
 Mate van diffraksié  $\propto \lambda$ .  
 8.4 Red/Rooi ✓

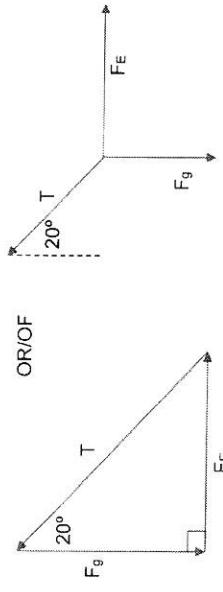


8.5	Line should indicate inverse proportionality ✓✓ <i>Lyn moet omgekeerde eweredigheid aandui</i>	[9]
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#### QUESTION 9/VRAAG 9

9.1 The magnitude of the electrostatic force exerted by two point charges on each other is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the distance between them. ✓  
 Die grootte van die elektrostatisiese krag wat deur twee puntholdings op mekaar uitgeoefen word, is direk eweredig aan die produkt van die (groottes van die) ladingas en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓  
 Penaliseer -1 indien sleutelwoorde/frase is uitgelaat!  
 NOTE: If learners refers to masses, no marks awarded!  
 NOTA: Indien feerdeer na massa verwys, geen punte (2)



9.2

Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
w	weight/ $F_g$ / $F_g$	✓
T	weight/gravitasiekrag/swaartekrag	✓
$F_E$	Tension/ $F_T$	✓
OR/OF	Electrostatic force	✓
	Elektrostatisiese krag	✓
	One angle indicated	✓
	Een hoek aangedui	✓

(4)

### 9.3

#### OPTION 1/OPSIE 1 If $F_A$ and $F_B$ were used/Indien $F_A$ en $F_B$ gebruik word

$$F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(8 \times 10^{-9})(7 \times 10^{-9})}{0,03^2} \checkmark$$

$$= 5,60 \times 10^{-4} N \checkmark$$

#### OPTION 2/OPSIE 2

If  $F_g$  and  $F_E$  were used/Indien  $F_g$  en  $F_E$  gebruik word

$$F_g = mg$$

$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} N \checkmark$$

$$F_E = (1,96 \times 10^{-3})\tan 70^\circ \checkmark$$

$$= 7,13 \times 10^{-4} N \checkmark$$

#### OPTION 3/OPSIE 3

If  $F_g$  and  $F_E$  were used/Indien  $F_g$  en  $F_E$  gebruik word

$$F_g = mg$$

$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} N \checkmark$$

$$\frac{F_E}{\sin 20^\circ} = \frac{F_g}{\sin 70^\circ} \checkmark$$

$$\frac{F_E}{\sin 20^\circ} = \frac{(1,96 \times 10^{-3})}{\sin 70^\circ} \checkmark$$

$$F_E = 7,13 \times 10^{-4} N \checkmark$$

### 9.4

#### POSITIVE MARKING FROM QUESTION 9.3

##### OPTION 1/OPSIE 1 POSITIEWE NASIEN VANAF VRAAG 9.3

Using  $F_g$  and  $F_E$ /Gebruik  $F_g$  en  $F_E$   
 $F_g = mg$

$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} N$$

$$T^2 = (1,96 \times 10^{-3})^2 + (5,6 \times 10^{-4})^2 \checkmark$$

$$T = 2,04 \times 10^{-3} N \checkmark$$

$$T^2 = (1,96 \times 10^{-3})^2 + (5,6 \times 10^{-4})^2 \checkmark$$

$$T = 2,09 \times 10^{-3} N \checkmark$$

##### OPTION 2/OPSIE 2

Using  $F_g$  and angle/Gebruik  $F_g$  en hoek  
 $F_g = mg$

$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

$$= 1,96 \times 10^{-3} N$$

$$T = \frac{1,96 \times 10^{-3}}{\sin 70^\circ} \checkmark$$

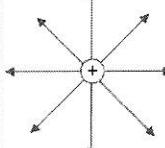
$$T = 2,09 \times 10^{-3} N \checkmark$$

##### NOTE/NOTA:

As gevolg van die inligting in die vraag gegee, aanvaar alle moontlike opsies

### 10.1

#### QUESTION 10/VRAAG 10



Criteria for marking/Nasienkriteria	✓
Shape of the field (minimum of 4 field lines)	✓
Vorm van veld (minimum van 4 veldlyn)	✓
Direction of the field	
Rigting van veld	
Lines don't touch charge/lynnes cross etc. (maximum ½)	
Lyne raak nie laeding/lynne kruis ens. (maksimum ½)	

- (2) 10.2.1 16 : 1 ✓  
(1) (4)

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OPTION 1/OPSIE 1		OPTION 2/OPSIE 2
$E_p : E_T$	16 : 1 ✓	$E_p = \frac{kQ}{r^2} \quad \checkmark$
Because/Omdat		$4 \times 10^{-6} = \frac{9 \times 10^9 Q}{r^2} \quad \checkmark$
$E \propto \frac{1}{r^2}$	✓	$9 \times 10^9 Q = (4 \times 10^6)r^2 \dots (1)$
$r_p : r_T$	1 : 4 ✓	$E_T = \frac{kQ}{r^2}$
$r : r + 3 \text{ mm}$		$2.5 \times 10^{-5} = \frac{9 \times 10^9 Q}{(r+0.003)^2} \quad \checkmark$
$r = 1 \text{ mm} \quad (0.001 \text{ m})$		$9 \times 10^9 Q = (2.5 \times 10^5)(r + 0.003)^2 \dots (2)$
Equation/Vergelyking (1) = (2)		$(4 \times 10^6)r^2 = (2.5 \times 10^5)(r + 0.003)^2$
$16r^2 = r^2 + 0.006r + 9 \times 10^{-6}$		$r = 1 \text{ mm} \quad (0.001 \text{ m})$

10.2.3 POSITIVE MARKING FROM QUESTION 10.2.2  
POSITIEWE NASIEN VANAF VRAAG 10.2.2

$$E_p = \frac{kQ}{r^2}$$

$$OR/OF \quad E_T = \frac{kQ}{r^2}$$

$$4 \times 10^{-6} = \frac{9 \times 10^9 Q}{(0.001)^2} \quad \checkmark$$

$$2.5 \times 10^{-5} = \frac{9 \times 10^9 Q}{(0.004)^2} \quad \checkmark$$

$$Q = 4.44 \times 10^{-10} \text{ C} \quad \checkmark$$

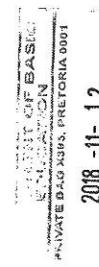
(2) [9]

11.6 North/Noord ✓

(1) (1) [13]

From A to B/Van A na B ✓

(1) (1) [13]



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### QUESTION 12/VRAAG 12

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓
$\frac{1}{4.8} = \frac{1}{4R} + \frac{1}{6R}$ ✓	$4.8 = \frac{4R \times 6R}{4R + 6R}$ ✓
$R = 2 \Omega$ ✓	$R = 2 \Omega$ ✓

(3)

### POSITIVE MARKING FROM QUESTION 12.1

#### OPTION 1/OPSIE 1

$$V_{4R} = (IR_{4R}) \\ = 1,8(4)(2) \checkmark \\ = 14,4V$$

#### OPTION 2/OPSIE 2

$$V_{4R} = |V_{4R}| \\ = 1,8(4)(2) \checkmark \\ = 14,4V$$

$$I_T = \frac{V}{R_T} \\ I_T = \frac{V}{14,4} \\ I_T = \frac{14,4}{12} \\ = 1,2A$$

$$V_{2R} = |IR| \\ = 1,2(4) \checkmark \\ = 4,8V \checkmark$$

$$I_{2R} = \frac{V}{R} \\ I_{2R} = \frac{V}{1,2A} \\ = 3A$$

$$I_{2R} = 3 - 1,8 \checkmark \\ = 1,2A$$

$$V_{2R} = IR \\ = 1,2(4) \checkmark \\ = 4,8V \checkmark$$

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#### OPTION 3/OPSIE 3

$$R_1 : R_2 \\ 4 : 6 \\ 1 : 2 \\ 6 : 4$$

#### OPTION 4/OPSIE 4

$$V_{4R} = |IR_{4R}| \\ = 1,8(4)(2) \checkmark \\ = 14,4V$$

$$\frac{6}{10} \times 1 = 18A \checkmark \\ I_R = 3A \\ I_{2R} = 3 - 1,8 \checkmark \\ = 1,2A \\ V_{2R} = |IR| \\ = 1,2(4) \checkmark \\ = 4,8V \checkmark$$

(5)

### QUESTION 12.1/VRAAG 12.1 EN 12.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2	OPTION 3/OPSIE 3
$W =  ^2R \Delta t$ ✓	$W =  V\Delta t$ ✓	$W = \frac{V^2 \Delta t}{R}$ ✓
$= 1,8^2(8)(120)$ ✓	$= (14,4)(1,8)(120)$ ✓	$= 3110,4J$ ✓
$= 1036,8J$ ✓		$W = \frac{(14,4)^2(120)}{8}$ ✓
		$W = 3110,4J$ ✓

(1)

### 12.4 Decrease/Neem af ✓

(-) The ammeter has such a low resistance ✓

OR

The ammeter short circuits the parallel part and all current flows through the ammeter. ✓

No current flows through resistor  $2R$  ✓

Die ammeter het so 'n lae weerstand

Die kortsluit die parallelgedeelte en al die stroom vloei deur die ammeter.

Die ammeter kortsluit die resistors

Daar vloei geen stroom deur resistor  $2R$  nie

(2)  
[14]

TOTAL/TOTAAL:

(2)  
[14]

TOTAL/TOTAAL:

(2)  
[14]

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