



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.

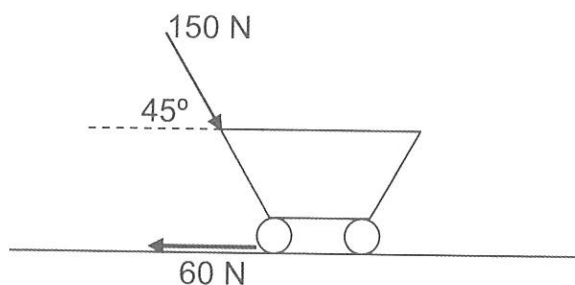
(2)

- 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° to the horizontal. The trolley experiences a constant frictional force of 60 N.



The NET FORCE acting on the trolley:

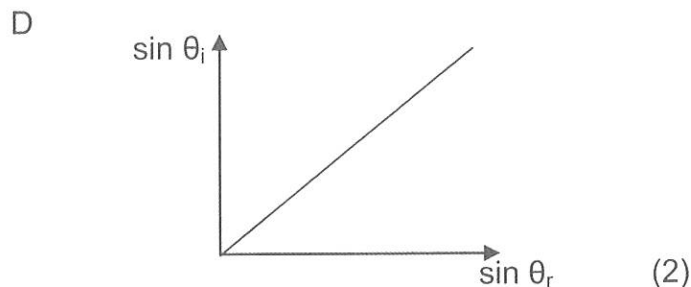
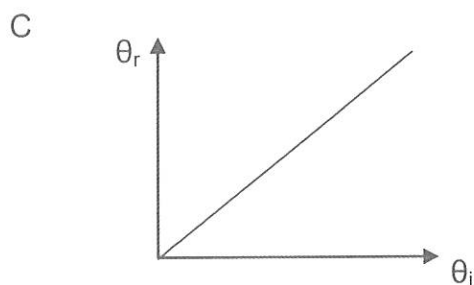
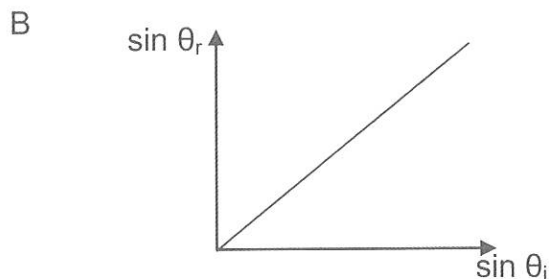
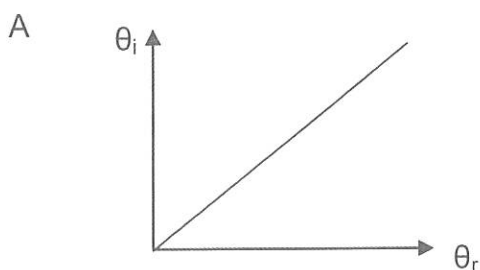
- (i) Causes the trolley to accelerate horizontally
(ii) Is equal to the applied force
(iii) Is horizontally forward

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?

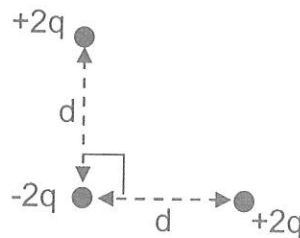


1.7 Every point on a wave front acts as a point source of spherical, secondary waves that move forward at the same speed as the wave. This statement represents ...

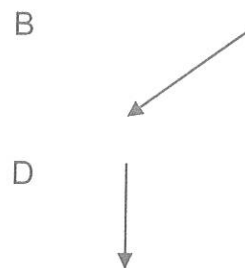
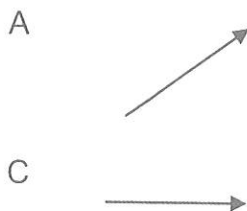
- A Snell's law.
- B Huygens' principle.
- C refraction.
- D the law of reflection.

(2)

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

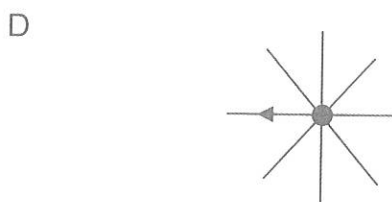
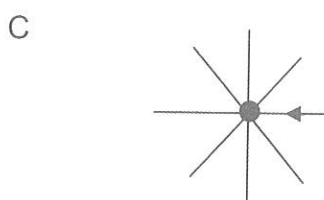
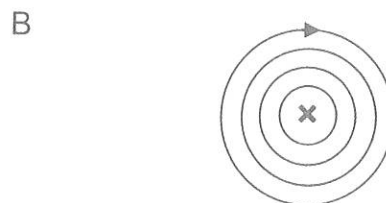
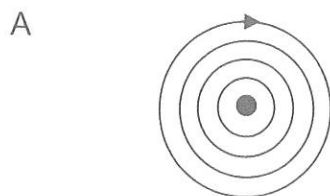


Which arrow CORRECTLY indicates the direction of the NET FORCE acting on the $-2q$ charge?



(2)

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

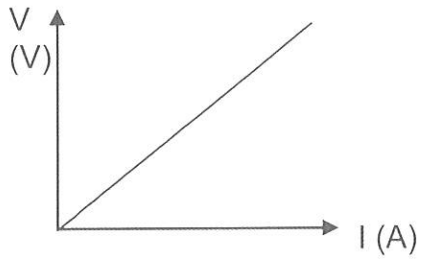


(2)

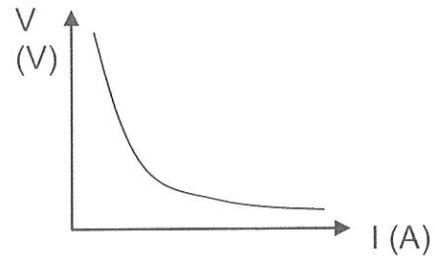


1.10 Which ONE of the graphs below CORRECTLY represents the relationship between potential difference and current in a non-ohmic resistor?

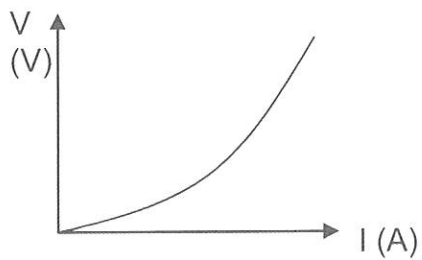
A



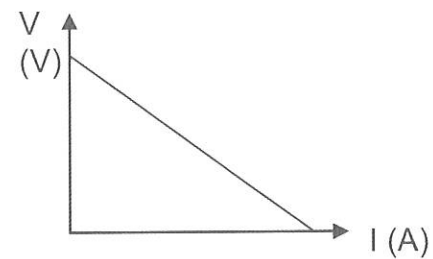
B



C



D

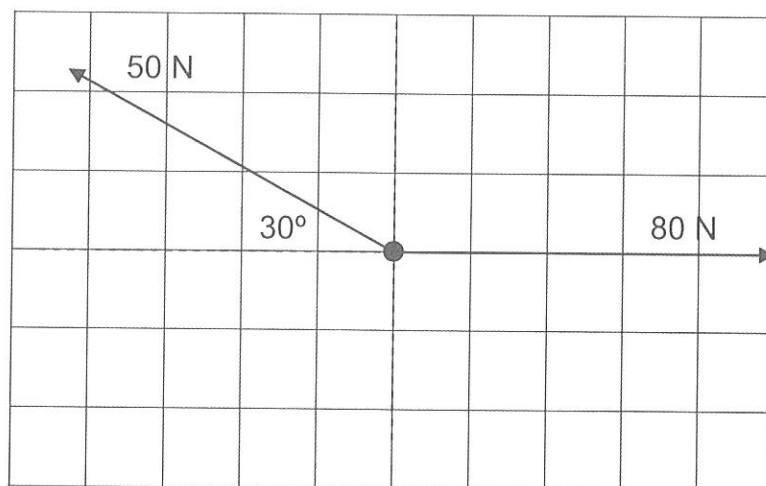


(2)
[20]



QUESTION 2 (Start on a new page.)

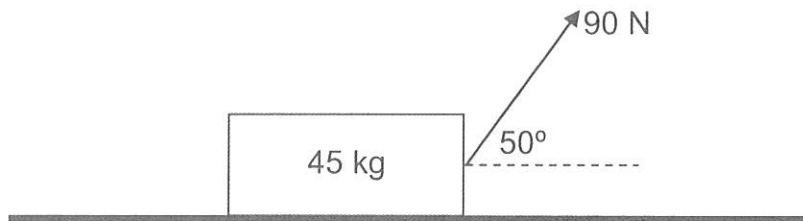
Two forces, of magnitudes 50 N and 80 N, act at a point on a Cartesian plane in the directions shown in the sketch below.



- 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° to the horizontal. The box moves at a **CONSTANT VELOCITY**.

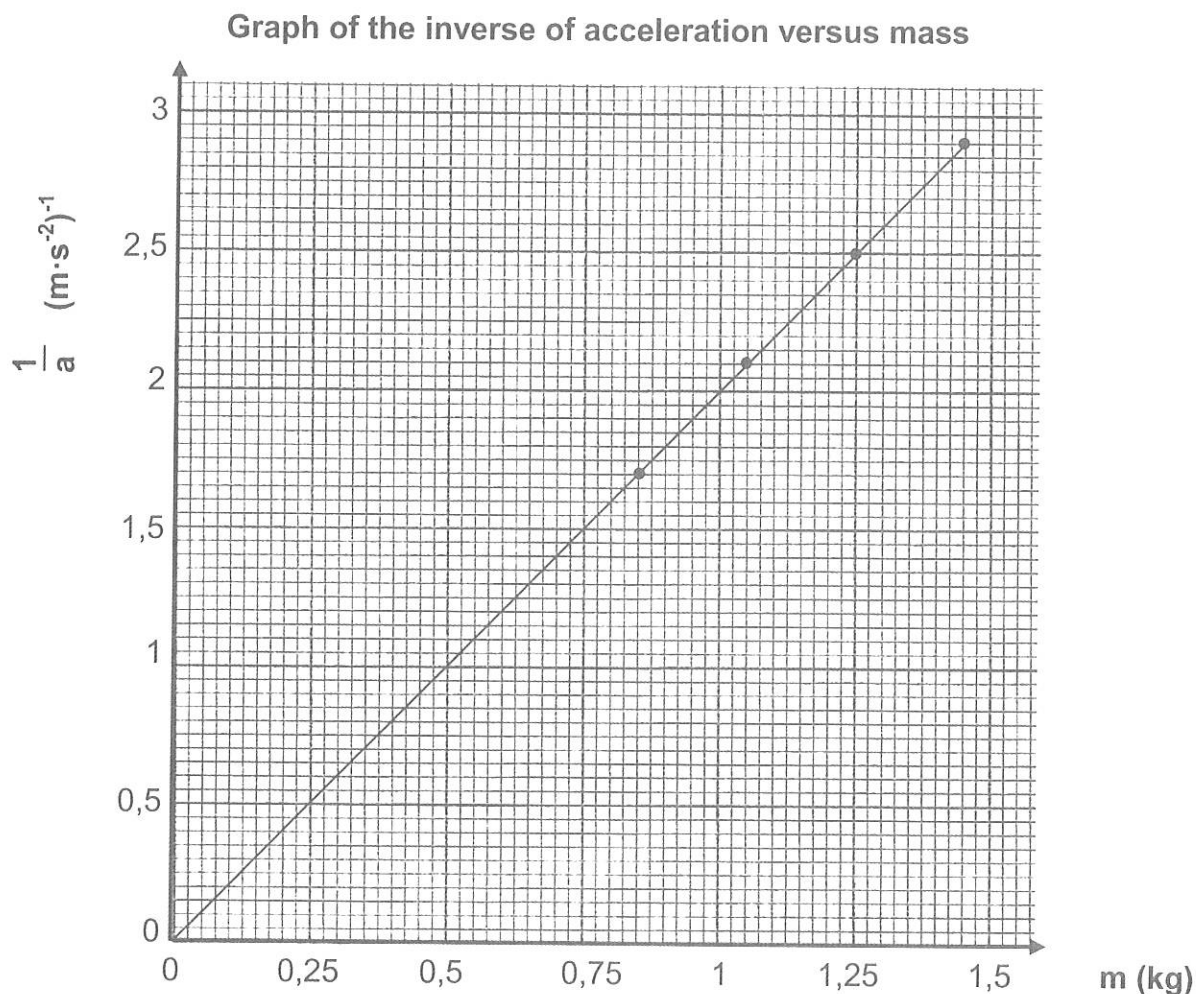


- 3.1 Define the term *kinetic frictional force*. (2)
- 3.2 State *Newton's First Law of Motion* in words. (2)
- 3.3 Calculate the magnitude of the horizontal component of the applied force. (2)
- 3.4 Calculate the magnitude of the normal force. (4)
- 3.5 Calculate the coefficient of kinetic friction. (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.

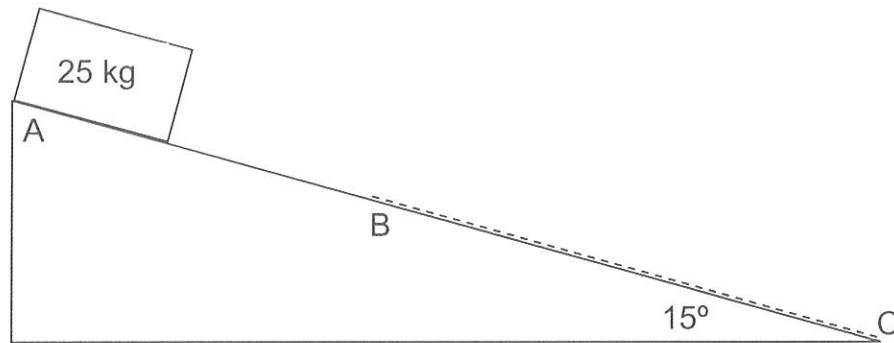


- 4.1 State *Newton's Second Law of Motion* in words. (2)
- 4.2 Calculate the gradient of the graph. (3)
- 4.3 Hence, determine the net force applied on the object during the experiment. (2)
- 4.4 Write down a conclusion for this experiment. (2)

[9]

QUESTION 5 (Start on a new page.)

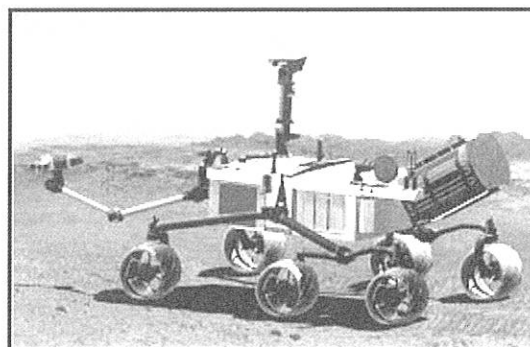
A crate, with a mass of 25 kg, slides down a plane which is inclined at 15° to the horizontal. During the first part of the motion, from A to B, there is no friction between the crate and the plane, but part BC has a rough surface.



- 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 $6,39 \times 10^{23} \text{ kg}$.

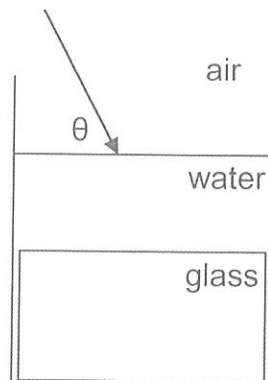


- 6.1 State *Newton's Law of Universal Gravitation* in words. (2)
- 6.2 Calculate the mass of the probe. (4)
- 6.3 Calculate the weight of the probe on Earth. (2)
- [8]**

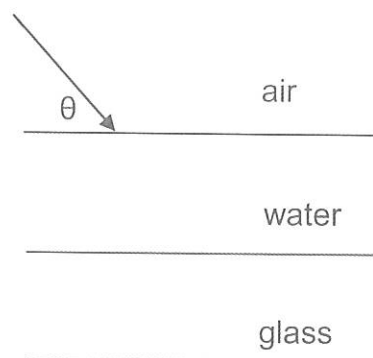


QUESTION 7 (Start on a new page.)

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 θ between the light ray and the SURFACE OF THE WATER if the angle of refraction in the water is 40° . (4)
- 7.3 The angle of refraction in the glass is 35° . 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. (5)

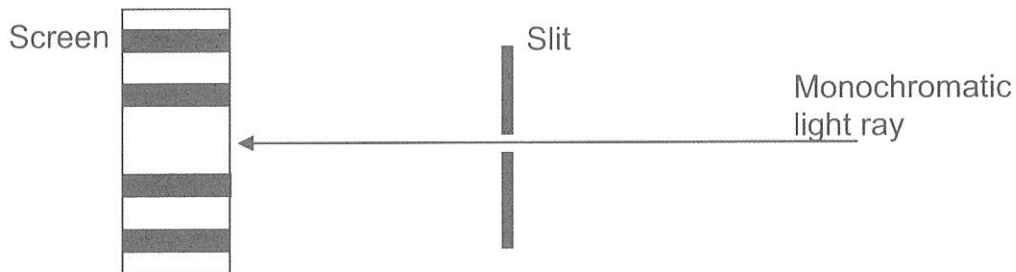


- 7.5 Calculate the speed of light through the glass prism if the refractive index of glass is 1,5. (3)
- 7.6 Is it possible that total internal reflection of the light ray can occur in the above situation? Write only YES or NO. (1)

[17]

QUESTION 8 (Start on a new page.)

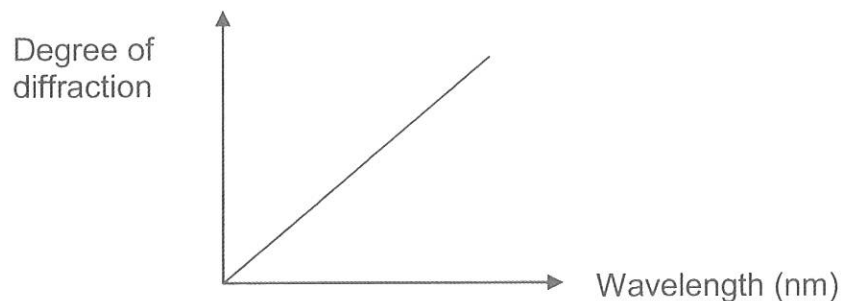
An experiment is performed to investigate the effect of wavelength on the degree of diffraction. Monochromatic light shines through a slit with a width of 0,002 mm and the pattern produced is shown on a screen.



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.

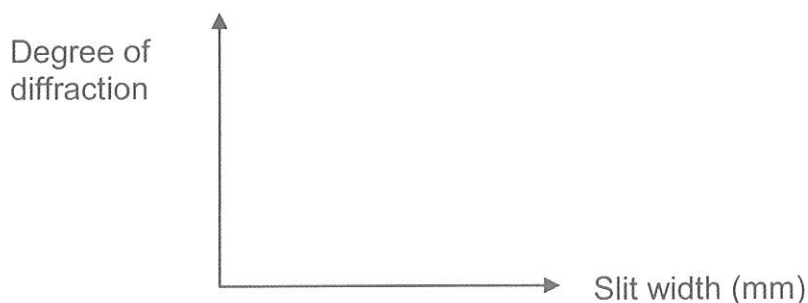


8.3 Write the mathematical relationship between wavelength and the degree of diffraction. (2)

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.

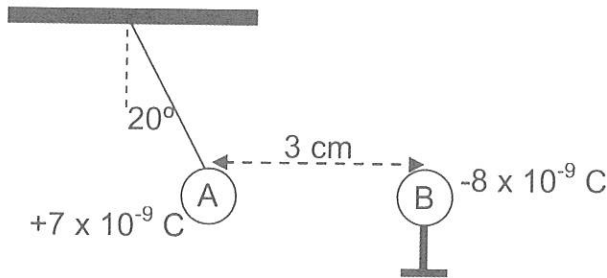


(2)
[9]



QUESTION 9 (Start on a new page.)

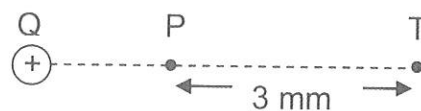
A small isolated sphere A, with a mass of 0,2 g, carrying a charge of $+7 \times 10^{-9} \text{ C}$, is suspended from a horizontal surface by a string of negligible mass. A second sphere B, carrying a charge of $-8 \times 10^{-9} \text{ C}$, on an isolated stand, attracts sphere A so that the string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



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

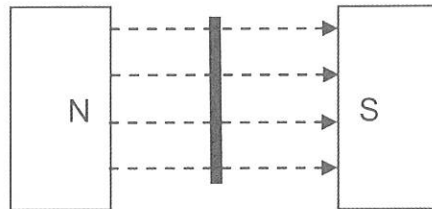
The magnitude of the electric field at point P is $4 \times 10^6 \text{ N}\cdot\text{C}^{-1}$ and at point T the magnitude is $2,5 \times 10^5 \text{ N}\cdot\text{C}^{-1}$.

- 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° in 0,08 s.



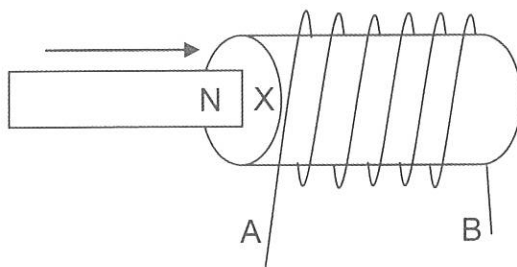
An emf of 7 V is induced in the coil.

- 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° 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.



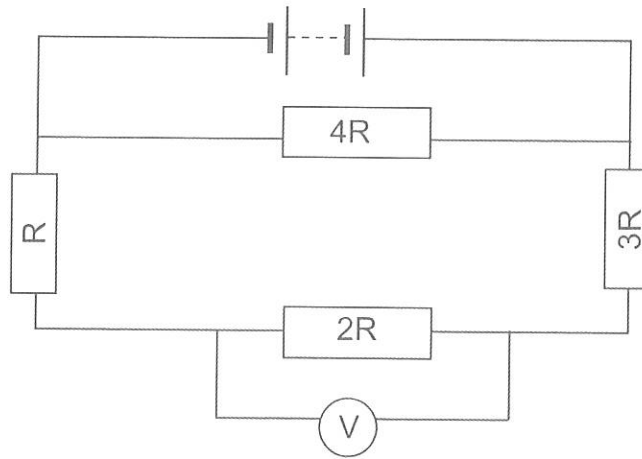
- 11.6 Which pole will be induced at point X? Write only NORTH or SOUTH. (1)
- 11.7 In which direction will the induced current flow? Write only FROM A TO B or FROM B TO A. (1)

[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 ⁻²
Gravitational constant <i>Swaartekragkonstante</i>	G	6,67 x 10 ⁻¹¹ N·m ² ·kg ⁻²
Radius of Earth <i>Radius van die Aarde</i>	R _E	6,38 x 10 ⁶ m
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 x 10 ⁹ N·m ² ·C ⁻²
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 x 10 ⁸ m·s ⁻¹
Charge on electron <i>Lading op elektron</i>	e	-1,6 x 10 ⁻¹⁹ C
Electron mass <i>Elektronmassa</i>	m _e	9,11 x 10 ⁻³¹ kg
Mass of Earth <i>Massa van die Aarde</i>	M	5,98 x 10 ²⁴ 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

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



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

$F = \frac{kQ_1Q_2}{r^2}$ ($k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$)	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ ($k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$)	$n = \frac{Q}{e}$

ELECTROMAGNETISM/ELEKTROMAGNETISME

$\varepsilon = -N \frac{\Delta\Phi}{\Delta t}$	$\Phi = BA \cos \theta$
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ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

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



QUESTION 2/VRAAG 2

- 2.1 Resultant (net) vector/Resultante (netto) vektor ✓ (1)
- 2.2.1 $F_y = F \sin \theta$
 $= 50 \sin 30^\circ$ ✓ $\text{OR/OF } 50 \cos 60^\circ$ (2)

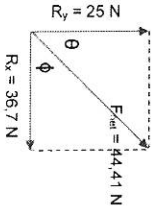
2.2.2 **POSITIVE MARKING FROM QUESTION 2.2.1**
POSITIEWE NASIEN VANAF VRAAG 2.2.1

- $F_x = 50 \cos 30^\circ$ ✓
 $= 43,3 \text{ N}$ ✓
 $R_x = 80 - 43,3$ ✓
 $= 36,7 \text{ N}$ ✓
 $F_{\text{net}}^2 = R_x^2 + F_y^2$
 $= 36,7^2 + 25^2$ ✓
 $= 44,41 \text{ N}$ ✓ (5)

Substitution marks awarded within the question even if calculations for F_x and R_x are wrong. Substitusiepunte toegeken in die vraag selfs indien berekeninge vir F_x en R_x verkeerd bereken word.

2.2.3 **POSITIVE MARKING FROM QUESTION 2.2.1 AND 2.2.2**
POSITIEWE NASIEN VANAF VRAAG 2.2.1 EN 2.2.2

- OPTION 1/OPSIE 1**
 $\tan \theta = \frac{36,7}{25}$ ✓
 $\theta = 55,74^\circ$ ✓
- OPTION 2/OPSIE 2**
 $\cos \theta = \frac{44,41}{25}$ ✓
 $\theta = 55,74^\circ$ ✓
- OPTION 3/OPSIE 3**
 $\sin \theta = \frac{36,7}{44,41}$ ✓
 $\theta = 55,74^\circ$ ✓
- OPTION 4/OPSIE 4**
 $\cos \theta = \frac{25}{44,41}$ ✓
 $\theta = 55,74^\circ$ ✓



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



(2)
 [10]



QUESTION 3/VRAAG 3

- 3.1 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 or/of 0] (2)

- 3.2 A body will remain in its state of rest or motion at constant velocity ✓ unless a non-zero resultant/net force acts on it. ✓
 'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly/volhard tensy 'n nie-nul resultierende/netto krag daarop inwerk. [Penalise -1 if key words/phrase is omitted/ Penaliseer -1 indien sleutelwoord/frase is uitgehaal] (2)

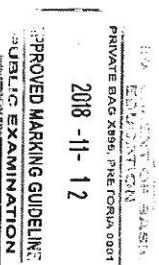
- 3.3 $F_x = 90 \cos 50^\circ$ ✓ **OR/OF** $90 \sin 40^\circ$
 $= 57,85 \text{ N}$ ✓ (2)

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

NOTENOTA:
 Weight and the vertical component can be calculated separately, award one mark each even if the formula for N is incorrect.
 Gewig en vertikale komponent kan apart bereken word, een punt elk selfs indien die formule vir N verkeerd is.

3.5 **POSITIVE MARKING FROM QUESTION 3.3 and 3.4**
POSITIEWE NASIEN VANAF VRAAG 3.3 en 3.4

- $f_k = \mu_k N$ ✓
 $57,85 \times \mu_k = \mu_k(372,06)$ ✓
 $\mu_k = 0,16$ ✓ (4)
- 3.6 No ✓ The coefficient is dependent on the (nature of) the surfaces / type of material in contact. ✓
 Nee. Die koëffisiënt is afhanklik van die (type) oppervlakte / soort materiaal in kontak. (2)



(2)
 [16]



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 resultierende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.
[Penalise -1 if key words/phrases is omitted/
Penaliseer -1 indien sleutelwoorde/frase is uitgelaat] (2)
- 4.2 Accept any set of coordinates from the graph, e.g.:
Aanvaar enige kombinasie van koördinate vanaf die grafiek, bv.:

Gradient/Helling = $\frac{2,5 - 0}{1,25 - 0} \checkmark = 2 \checkmark$

OR/OF

Gradient/Helling = $\frac{2,1 - 1,7}{1,05 - 0,85} \checkmark = 2 \checkmark$

4.3 OPTION 1/OPSIE 1

Gradient/Helling = $\frac{1}{ma} = \frac{1}{F_{net}} = 2 \checkmark$

$F_{net} = \frac{1}{2} = 0,5 \text{ N} \checkmark$ Accept/Aanvaar $F_{net} = 0,5 \text{ N} \checkmark$

OPTION 2/OPSIE 2

$F_{net} = ma$
= $(1)(\frac{1}{2}) \checkmark$
= $0,5 \text{ N} \checkmark$
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 $\frac{1}{a} \propto m$
Versnelling is omgekeerd eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)
Aanvaar: Die omgekeerde van die versnelling is direk eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)

OF $\frac{1}{a} \propto m$

(2) [9]

QUESTION 5/VRAAG 5

5.1



w	Accepted Labels/Aanvaarbare Byskrifte	Mark/Punt
	weight/ F_g OR Both components for one mark gewig/grawitasiekrag/swaartekrag OF Beide komponente vir een punt	✓
N	Normal force/ F_N Normaalkrag/ F_N	✓
f	Friction/ F_f Wrywingskrag/ F_f	✓
	Any additional force: deduct 1 mark (maximum $\frac{3}{4}$) Enige addisionele krag: trek 1 punt af (maksimum $\frac{3}{4}$)	
	Omission of arrow heads: deduct 1 mark (maximum $\frac{3}{4}$) Pylpunte uitgelaat: trek 1 punt af (maksimum $\frac{3}{4}$)	
	Lines must touch object otherwise (maximum $\frac{3}{4}$) Lyns moet voorwerp raak anders (maksimum $\frac{3}{4}$)	
	Do not penalise if vectors are not to scale Moenie penaliseer indien vektore nie op skaal is nie	

5.2

$F_{net} = ma$ } ✓ Any one/Enige een
 $mgsin \theta = ma$
 $25(9,8)sin 15^\circ \checkmark = 25a \checkmark$
 $a = 2,54 \text{ m}\cdot\text{s}^{-2} \checkmark$
 OR/OF
 $25(9,8)cos 75^\circ \checkmark = 25a \checkmark$
 $a = 2,54 \text{ m}\cdot\text{s}^{-2} \checkmark$

NOTE/NOTA:
Award one mark for the parallel component if calculated separately
Ken een punt toe indien die parallel komponent apart bereken is

5.3 Up the slope/Teen die helling op ✓ (1)

5.4 $F_{net} = ma$ } ✓ Any one/Enige een

$F_{gill} + (-f) = ma$
 $25(9,8)sin 15^\circ - f \checkmark = 25(-1,2) \checkmark$
 $f = 93,41 \text{ N} \checkmark$

OR/OF
 $25(9,8)cos 75^\circ - f \checkmark = 25(-1,2) \checkmark$
 $f = 93,41 \text{ N} \checkmark$

Note/Lef wel:

Accept if calculation is done with direction up the slope as positive
Aanvaar indien berekening gedoen is met rigting teen die helling op as positief

(4) [12]

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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. ✓
Eke 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
 Penaliseer -1 if key words/phrases is omitted/
 Penaliseer -1 indien sleutelwoorde/frase is uitgelaat!

(2)

6.2

$$F = \frac{Gm_1m_2}{r^2} \quad \checkmark$$

$$3\,338 \checkmark = \frac{(6,67 \times 10^{-11})(6,39 \times 10^{23})(m)}{(3\,380 \times 10^3)^2} \quad \checkmark$$

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

OR/OF

$$g = \frac{Gm}{r^2} \quad \checkmark$$

$$g = \frac{(6,67 \times 10^{-11})(6,39 \times 10^{23})}{(3\,380 \times 10^3)^2} \quad \checkmark$$

$$g = 3,71 \text{ m}\cdot\text{s}^{-2}$$

$$F_g = mg$$

$$3\,338 = m(3,71) \quad \checkmark$$

$$m = 900 \text{ kg} \quad \checkmark (899,73 \text{ kg})$$

(4)

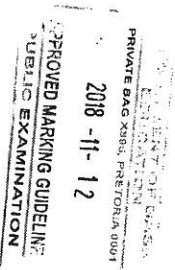
**6.3 POSITIVE MARKING FROM QUESTION 6.2
 POSITIEWE NASIEN VANAF VRAAG 6.2**

$$w = mg$$

$$= 900(9,8) \quad \checkmark$$

$$= 8\,820 \text{ N} \quad \checkmark$$

(2)
 [8]



QUESTION 7/VRAAG 7

7.1

Refraction/Refraksie ✓

(1)

7.2

<p>OPTION 1/OPSIE 1</p> <p>$n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad \checkmark$ $1 \sin \theta = 1,33 \sin 40^\circ \quad \checkmark$ $\theta = 58,75^\circ$</p>	<p>OPTION 2/OPSIE 2</p> <p>$n = \frac{\sin \theta_1}{\sin \theta_2} \quad \checkmark$ $1,33 = \frac{\sin 40^\circ}{\sin \theta} \quad \checkmark$ $\sin \theta = 1,33 \sin 40^\circ$ $\theta = 58,75^\circ$</p>
--	---

Therefore the angle between ray and surface/Daaron is die hoek tussen invallende straal en oppervlak
 $\theta = 90^\circ - 58,75^\circ$
 $= 31,25^\circ \quad \checkmark$

(4)

7.3

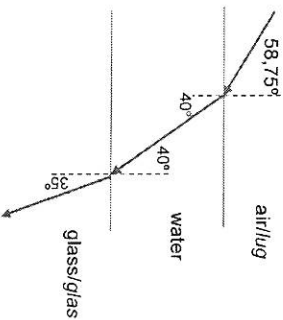
$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$1,33 \sin 40^\circ \checkmark = n \sin 35^\circ \quad \checkmark$$

$$n = 1,49 \quad \checkmark$$

(3)

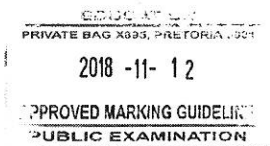
7.4



Allocation of marks/Toekenning 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°)	✓
Hoek in water (40°)	✓
Angle in glass (35°)	✓
Hoek 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 pylpunte weggelaat word, penaliseer -1 (maks 4/5)	

(5)



- 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 Noi/Nee ✓

(3)
(1)
[17]

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. ✓
 Diffraksie is die vermoë van 'n golf om uit te spreid in golffronte soos wat die golf deur 'n klein opening of om 'n skerp rand/kant beweeg.

8.2 Criteria for investigative question/Riglyne vir ondersoekende vraag ✓

The dependent and independent variables are stated correctly. ✓ Die afhanklike en onafhanklike 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 afhanklike en onafhanklike veranderlike as 'n vraag, nie 'n stelling nie. Die vraag mag nie op so 'n manier geformuleer word dat die antwoord ja of nee is nie.
Dependent variable/Afhanklike veranderlike: degree of diffraction/mate van diffraksie
Independent variable/Onafhanklike veranderlike: wavelength/golflengte

Examples/Voorbeelde:
 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 diffraksie?

(2)

- 8.3 Degree of diffraction is directly proportional to the wavelength. ✓ ✓
 Mate van diffraksie is direk eweredig aan die golflengte.

(2)
(1)

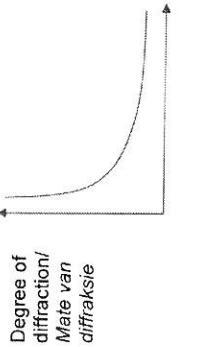
8.4 Red/Root ✓

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- 8.5 Line should indicate inverse proportionality ✓ ✓
 Lyn moet omgekeerde eweredigheid aandui



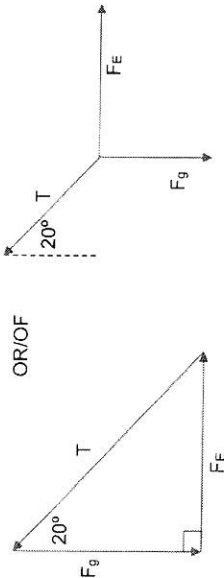
(2)

[9]

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 square of the distance between them. ✓
 Die grootte van die elektrostatiese krag wat deur twee puntladinge op mekaar uitgeoefen word, is direk eweredig aan die produk van die (groottes van die) ladinge en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.
 [Penaliseer -1 if key words/phrase is omitted/
 Penaliseer -1 indien sleutelwoorde/frase is uitgelaat]
 NOTE: if learners refers to masses, no marks awarded
 NOTA: Indien leerder na massa verwys, geen punte

9.2



Accepted Labels/Aanvaarbare Byskrifte	Mark/Punte
w weight/F of F _g gewig/grawitasiekrag/swaarkrag	✓
T Tension/F _T Spanning/F _T	✓
F _E Electrostatic force Elektrostatiese 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

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

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

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

NOTE/NOTA:
 Due to information given in the question, accept all possible options
 As gevolg van die inligting in die vraag gegee, aanvaar alle moontlike opsies

OPTION 2/OPSIE 2

If F_B and F_C were used/Indien F_B en F_C gebruik word

$$F_B = mg \checkmark$$

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

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

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

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

OPTION 3/OPSIE 3

If F_A and F_C were used/Indien F_A en F_C gebruik word

$$F_g = mg \checkmark$$

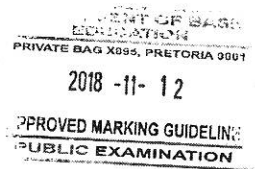
$$= (0,2 \times 10^{-3})(9,8) \checkmark$$

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

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

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

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



(4)

9.4

POSITIVE MARKING FROM QUESTION 9.3

OPTION 1/OPSIE 1

Using F_g and F_C /Gebruik F_g en F_C

$$F_g = mg \checkmark$$

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

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

OPTION 2/OPSIE 2

Using F_g and angle/Gebruik F_g en hoek

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

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

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

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

OPTION 3/OPSIE 3

Using F_C and angle/Gebruik F_C en hoek

$$T = \frac{F_C}{\cos 70^\circ} \checkmark$$

$$T = \frac{5,6 \times 10^{-4}}{\cos 70^\circ} \checkmark$$

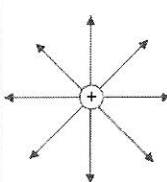
$$T = 1,64 \times 10^{-3} \text{ N} \checkmark$$

NOTE/NOTA:
 Due to information given in the question, accept all possible options
 As gevolg van die inligting in die vraag gegee, aanvaar alle moontlike opsies

(3) [13]

QUESTION 10/VRAAG 10

10.1



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

10.2.1 16 : 1 ✓

(1)



10.2.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$E_p : E_t$ $16 : 1 \checkmark$ Because/Omdat $E \propto \frac{1}{r^2} \checkmark$ $r_p : r_t$ $1 : 4 \checkmark$ $r : r + 3 \text{ mm}$ $r = 1 \text{ mm} \checkmark (0,001 \text{ m})$	$E_p = \frac{kQ}{r^2} \checkmark$ $4 \times 10^5 = \frac{9 \times 10^9 Q}{r^2} \checkmark$ $9 \times 10^9 Q = (4 \times 10^6)^2 r^2 \dots (1)$ $E_t = \frac{kQ}{r^2}$ $2,5 \times 10^5 = \frac{9 \times 10^9 Q}{(r + 0,003)^2} \checkmark$ $9 \times 10^9 Q = (2,5 \times 10^5)(r + 0,003)^2 \dots (2)$ Equation/Vergelyking (1) = (2) $(4 \times 10^6)^2 = (2,5 \times 10^5)(r + 0,003)^2$ $16^2 = r^2 + 0,006r + 9 \times 10^{-6}$ $r = 1 \text{ mm} \checkmark (0,001 \text{ m})$

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 $E_t = \frac{kQ}{r^2}$
 $4 \times 10^5 = \frac{9 \times 10^9 Q}{(0,001)^2} \checkmark$ $2,5 \times 10^5 = \frac{9 \times 10^9 Q}{(0,004)^2} \checkmark$
 $Q = 4,44 \times 10^{-10} \text{ C} \checkmark$ $Q = 4,44 \times 10^{-10} \text{ C} \checkmark$

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QUESTION 11/VRAAG 11

- 11.1 The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor. $\checkmark \checkmark$
 Die grootte van die geïnduseerde emk oor die punte van 'n geleier is direk eweredig aan die tempo van verandering van die magnetiese vloedkoppeling met die geleier.
 [2 out/of 0] (2)
- 11.2 $\epsilon = \frac{-N \Delta\phi}{\Delta t} \checkmark$
 $7 = \frac{-400 \Delta\phi}{0,08} \checkmark$
 $\Delta\phi = -1,4 \times 10^{-3} \text{ Wb} \checkmark (-0,0014)$ (3)
- 11.3 POSITIVE MARKING FROM QUESTION 11.2
POSITIEWE NASIEN VANAF VRAAG 11.2
 $\Delta\phi = AB(\cos \theta_f - \cos \theta_i)$
 $-0,0014 \checkmark = (0,03)^2 B(\cos 45^\circ - \cos 0^\circ) \checkmark$
 $B = 5,31 \text{ T} \checkmark$ (4)
- 11.4 Increase/Toeneem \checkmark
- 11.5 $\epsilon \propto \frac{1}{\Delta t} \checkmark$
 OR/OF
 Emf is inversely proportional to time.
 Emk is omgekeerd eweredig aan tyd.
 If the time decreases, the emf will increase.
 Indien die tyd verminder, sal die emk toeneem. (1)
- 11.6 North/Noord \checkmark (1)
- 11.7 From A to B/Van A na B \checkmark (1)

[13]

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QUESTION 12/VRAAG 12

12.1	OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
	$R_p = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$ $= \frac{1}{\frac{1}{4,8} + \frac{1}{6R}}$ $R = 2 \Omega \checkmark$	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ $= \frac{4,8 \times 6R}{4,8 + 6R}$ $R = 2 \Omega \checkmark$

(3)

12.2 POSITIVE MARKING FROM QUESTION 12.1
 POSITIEWE NASIEN VANAF VRAAG 12.1

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$V_{AR} = IR_{4R}$ $= 1,8(4)(2) \checkmark$ $= 14,4 V \checkmark$	$V_{AR} = IR_{4R}$ $= 1,8(4)(2) \checkmark$ $= 14,4 V \checkmark$
$I_{BR} = \frac{V}{R_{BR}}$ $= \frac{14,4}{12} \checkmark$ $= 1,2 A \checkmark$	$I_T = \frac{V}{R_T}$ $= \frac{14,4}{4,8} \checkmark$ $= 3 A \checkmark$
$V_{ZR} = IR \checkmark$ $= 1,2(4) \checkmark$ $= 4,8 V \checkmark$	$I_{BR} = 3 - 1,8 \checkmark$ $= 1,2 A \checkmark$ $V_{ZR} = IR \checkmark$ $= 1,2(4) \checkmark$ $= 4,8 V \checkmark$
OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$R_1 : R_2$ $4 : 6$ $I_1 : I_2$ $6 : 4$ $\frac{6}{10} \times I = 18 A \checkmark$ $I_T = 3 A \checkmark$ $I_{BR} = 3 - 1,8 \checkmark$ $= 1,2 A \checkmark$ $V_{ZR} = IR \checkmark$ $= 1,2(4) \checkmark$ $= 4,8 V \checkmark$	$V_{AR} = IR_{4R}$ $= 1,8(4)(2) \checkmark$ $= 14,4 V \checkmark$ $R : 2R : 3R$ $1 : 2 : 3$ $V_R : V_{2R} : V_{3R}$ $1 : 2 : 3$ $V_{2R} = \frac{2}{6} \times 14,4 \checkmark$ $= 4,8 V \checkmark$

(5)

12.3 POSITIVE MARKING FROM QUESTION 12.1 AND 12.2
 POSITIEWE NASIEN VANAF VRAAG 12.1 EN 12.2

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

(3)

12.4 Decrease/Neem af \checkmark (1)

12.5 The ammeter has such a low resistance \checkmark
 It short circuits the parallel part and all current flows through the ammeter. \checkmark
 OR
 The ammeter short circuits the resistors \checkmark
 No current flows through resistor 2R \checkmark (2)

Die ammeter het so 'n lae weerstand
 Dit kortsluit die parallelgedeelte en al die stroom vloei deur die ammeter.
 OF
 Die ammeter kortsluit die resistors
 Daar vloei geen stroom deur resistor 2R nie (2)

TOTAL/TOTAAL: 150 [14]