basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2016

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

MARKS: 150

TIME: 3 hours

This question paper consists of 17 pages, 2 data sheets and 1 answer sheet.

KWAZULU-NATAL

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 11A) in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK except QUESTION 10.2, which has to be answered on the attached ANSWER SHEET. The ANSWER SHEET has to be handed in together with 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, 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 substitutions 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 legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1   Four forces act on a point, as indicated in the diagram.
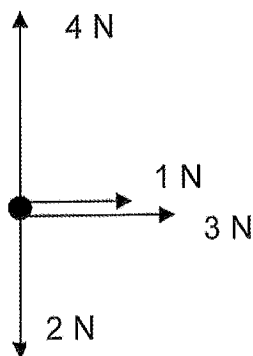
The magnitudes of the components of the resultant (net) force in the horizontal (F_X) and vertical (F_Y) directions are …

A $F_X = 3$ N and $F_Y = 6$ N.

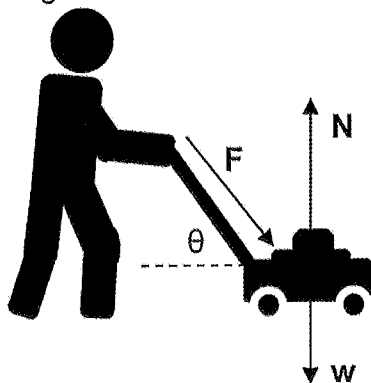B $F_X = 1$ N and $F_Y = 4$ N.

C $F_X = 2$ N and $F_Y = 2$ N.

D $F_X = 4$ N and $F_Y = 2$ N.   (2)

1.2   A lawnmower is pushed across the ground with a force of **F** at an angle of θ with the horizontal. The weight of the lawnmower is **w**.

The normal force, in **N**, on the lawnmower is …

A   w

B   w + F_Y
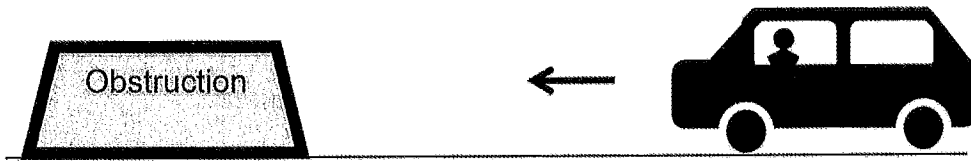
C   w - F_Y

D   w + F_X (2)

Please turn over

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1.3   A car is travelling along a road. The driver has his seat belt on. The driver sees an obstruction in the road ahead and suddenly applies the brakes.

An action-reaction pair is the force of the seat belt on the driver and the force of the ...

A   driver on the seat.

B   wheels on the road.

C   driver on the seat belt.

D   seat belt on the seat.   (2)

1.4   Planet X has a mass twice the mass of the Earth and a radius one and a half times that of the Earth. If the acceleration due to gravity on the Earth is **g**, then the gravitational acceleration on planet X will be ...

A $\dfrac{8}{9}g$

B $\dfrac{9}{8}g$

C $\dfrac{4}{3}g$

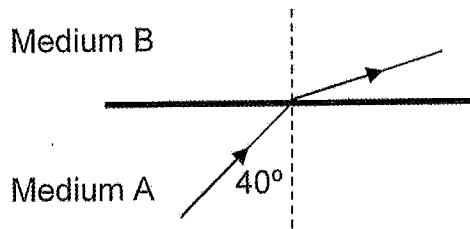D $\dfrac{3}{4}g$ (2)

Please turn over

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1.5   A light ray travels from medium A to medium B. Medium B has a lower refractive index than medium A.
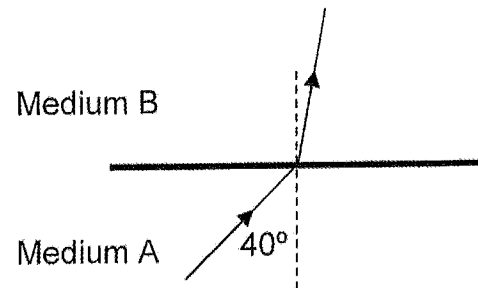
The critical angle for medium A in terms of medium B is 42°.

Which ONE of the sketches below represents the CORRECT path of the light ray?

A

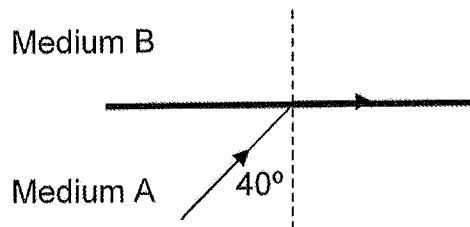Medium B

Medium A   40°

B

Medium B

Medium A   40°

C

Medium B

Medium A   40°

D

Medium B

Medium A   40°
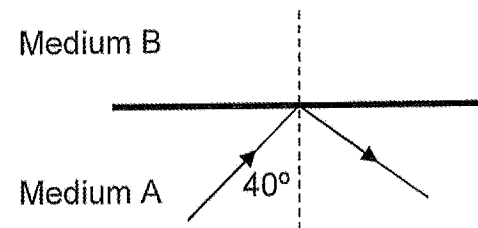
(2)

1.6   The ability of a wave to spread out in wave fronts as the wave passes around a sharp edge, is known as ...

A   Snell's law.

B   total internal reflection.

C   diffraction.

D   Huygens' principle.

(2)

1.7 Which ONE of the graphs below represents the correct relationship between force **F** on a charge and the electric field **E**?
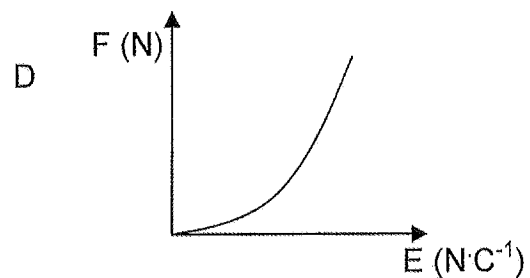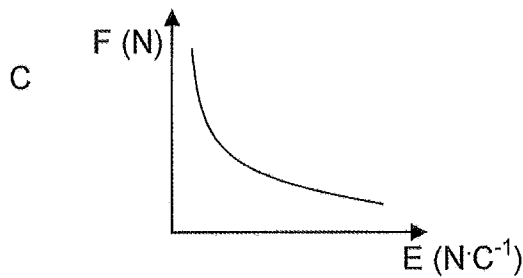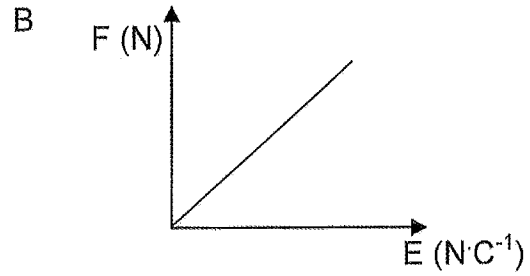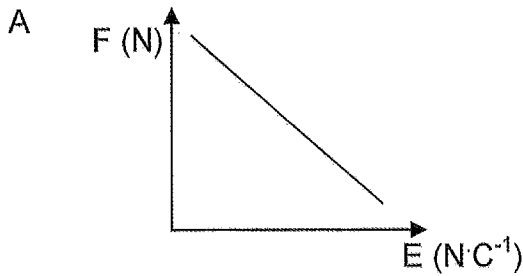
A

F (N)

E (N·C^{-1})

B

F (N)

E (N·C^{-1})

C

F (N)

E (N·C^{-1})

D

F (N)

E (N·C^{-1})   (2)

1.8 A negative charge Q is placed at a distance of **5d** from another charge R.

Q

P ⟵----- 2d -----⟶ R

⟵------------------------- 5d -------------------------⟶
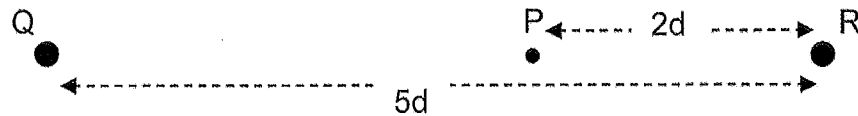
If the net electric field at point P, at a distance of **2d** from R, is ZERO, which ONE of the following combinations concerning the ratio of the charges Q and R and the charge on R, is CORRECT?

	RATIO OF THE CHARGES Q : R	CHARGE ON R
A	4 : 9	Positive
B	3 : 2	Negative
C	5 : 2	Positive
D	9 : 4	Negative

(2)

1.9   In which ONE of the sketches below is the induced polarity of the coil
       CORRECTLY indicated?

A

Magnet is
pushed into
the coil

B

Magnet is
pushed into
the coil

C

Magnet is
pulled out of
the coil

D

Magnet is
pulled out of
the coil

(2)

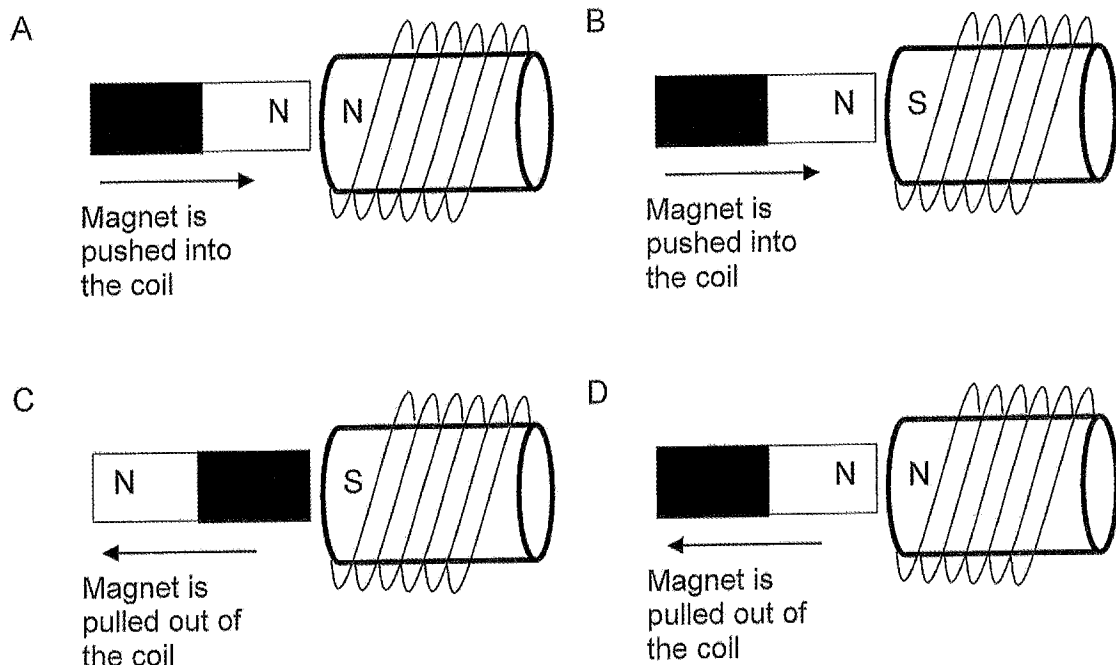1.10   The potential difference of the battery in the circuit below is 12 V. The internal
       resistance of the battery is negligible. Two voltmeters, V_1 and V_2, are
       connected to the circuit, as shown in the diagram.
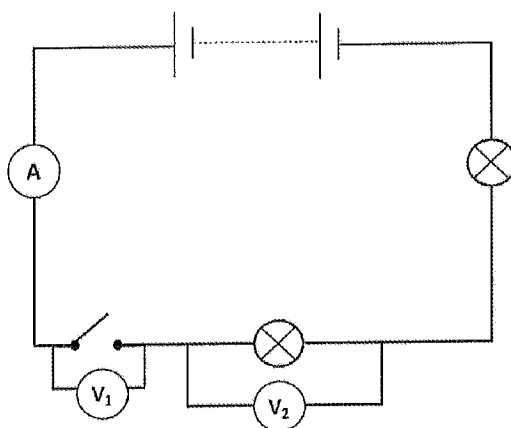
When the switch is open, the correct readings on V_1 and V_2 will be as follows:

	V_1	V_2
A	12 V	12 V
B	0 V	12 V
C	12 V	0 V
D	0 V	0 V

(2)

[20]

QUESTION 2   (Start on a new page.)

A heavy object is lifted using two ropes and two pulleys, as shown in the diagram below. The two pulleys are a distance **x** apart. The force F_A, in rope A, is 730 N and the force F_B, in rope B, is 1 440 N. Rope A makes an angle of 70° with the horizontal and rope B makes an angle of 10° with the vertical.

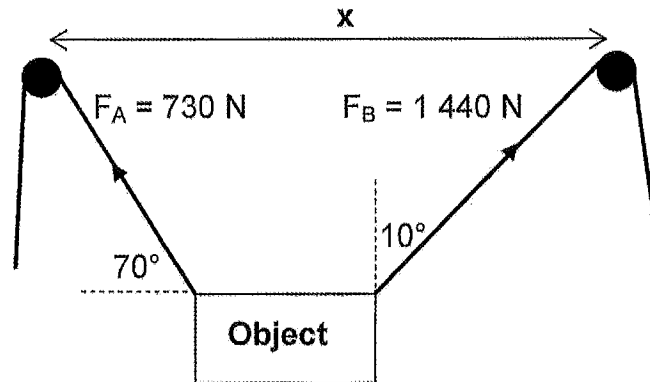2.1   Define the term *resultant vector.*   (2)

2.2   Explain why the vector diagram of force F_A, force F_B and the weight will NOT
        be a closed vector diagram.   (2)

2.3   Calculate the:

        2.3.1   Vertical component of F_A (2)

        2.3.2   Horizontal component of F_A (2)

2.4   Calculate the maximum weight that force F_A and force F_B will be able to lift
        from the ground. Show ALL calculations.   (4)

2.5   Explain why the rope and pulley system will be less effective if the distance **x**
        between the pulleys is increased.   (2)
                                                                                                        [14]

QUESTION 3   (Start on a new page.)

A hovering rescue helicopter has a container of supplies, with a weight of 1 960 N, hanging from a cable. The tension in the cable is 2 100 N.
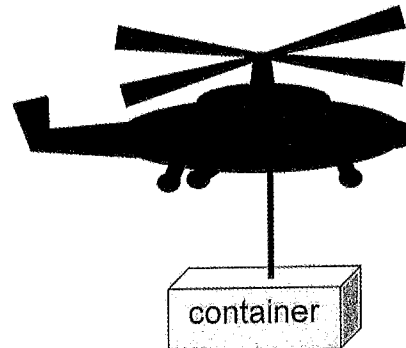
3.1   State *Newton's First Law of Motion* in words.   (2)

3.2   Draw a labelled force-diagram of ALL the forces acting on the container.   (3)

3.3   Why does the container remain stationary despite the tension being greater
than the weight?   (2)

Now the winch inside the helicopter starts to pull the container upwards with an acceleration of 0,13 m·s^{-2}, while the helicopter remains in its position.

3.4   Calculate the mass of the container.   (2)

3.5   Calculate the magnitude of the tension in the cable while the container is
being pulled upwards.   (4)

After an acceleration of a few metres the container is pulled up at a constant velocity of 0,8 m·s^{-1}.

3.6   What will be the magnitude of the tension in the cable while the container
moves upwards at a constant velocity?   (1)
                                                                                         [14]

QUESTION 4   (Start on a new page.)

Two blocks, of mass 8 kg and 4 kg respectively, are joined with an inelastic string of negligible mass. The string runs over a frictionless pulley. The 8 kg block is on a horizontal surface while the 4 kg block is on an inclined plane of 40° with the horizontal. The coefficient of kinetic friction for both blocks is 0,2. The 4 kg block accelerates down the slope.
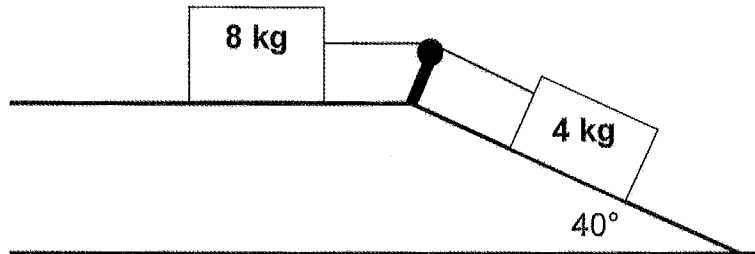

4.1	State *Newton's Second Law of Motion* in words.	(2)
4.2	Draw a labelled free-body diagram of ALL the forces acting on the 4 kg block.	(4)
4.3	Calculate the frictional force between the surface and the 4 kg block.	(4)
4.4	Calculate the magnitude of the acceleration of the system.	(6)
4.5	How will the acceleration compare if the positions of the 8 kg block and 4 kg block are switched? Choose from GREATER THAN, LESS THAN or THE SAME. Explain the answer.	(4)

[20]

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QUESTION 5   (Start on a new page.)

Two satellites orbiting the Earth are situated on opposite sides of the Earth. Satellite A has a mass of 3 800 kg and Satellite B has a mass of 4 500 kg. Satellite A is at a height of 25 000 km above the surface of the Earth.

Earth

Satellite A
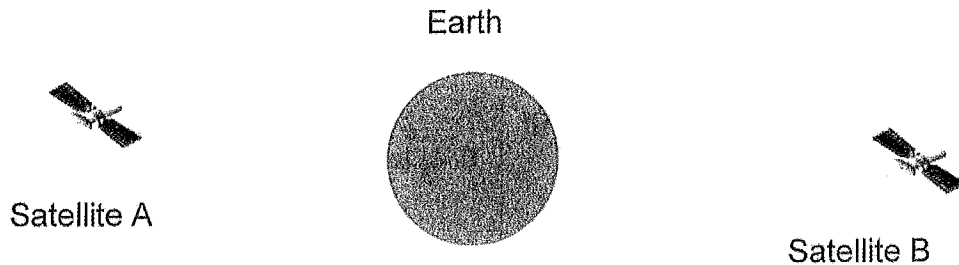
Satellite B

5.1   State *Newton's Universal Gravitational Law* in words.   (2)

5.2   Explain the term *weightlessness*.   (2)

5.3   Calculate the force between the Earth and Satellite A.   (4)

5.4   What distance above the surface of the Earth should Satellite B be to experience the *same* force towards the Earth as Satellite A?

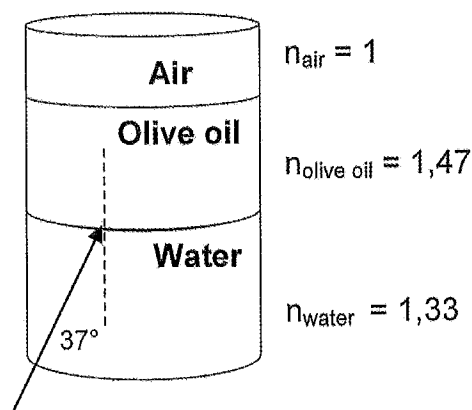   Choose from: GREATER THAN, LESS THAN or EQUAL TO the distance above the Earth. Explain how you arrived at the answer.   (4)
                                                                                          [12]

QUESTION 6   (Start on a new page.)

Olive oil floats on water because its density is less than the density of water. However, the refractive index of olive oil is 1,47 while the refractive index of water is 1,33.


6.1   Define the term *refractive index*.   (2)

6.2   Calculate the speed of light through olive oil.   (3)

6.3   If light travels through water and hits the water-olive oil boundary at an angle of 37°, calculate the angle of refraction of the light in olive oil.   (4)

6.4   What does the refractive index of oil tell us about the *optical density of olive oil* compared to the *optical density of water*?   (2)

6.5   6.5.1   If the light ray exits the oil into the air, will it refract TOWARDS or AWAY from the normal?   (1)

        6.5.2   Give a reason for the answer to QUESTION 6.5.1.   (2)

6.6   6.6.1   At which surface is total internal reflection most likely to occur? Choose from *oil and air* or *water and oil*.   (1)

        6.6.2   Give a reason for the answer to QUESTION 6.6.1.   (2)

6.7   Which other wave characteristic, WAVELENGTH or FREQUENCY, will change together with the speed, when a wave moves from one medium to another?   (1)

                                                                                       [18]

QUESTION 7   (Start on a new page.)

Two learners investigate the effect of the slit width on the degree of diffraction. They use a green light with a wavelength 520 nm. They set up an experiment, as shown below, and measure the position of the first dark line from the centre of the bright, central band when changing the slit width.
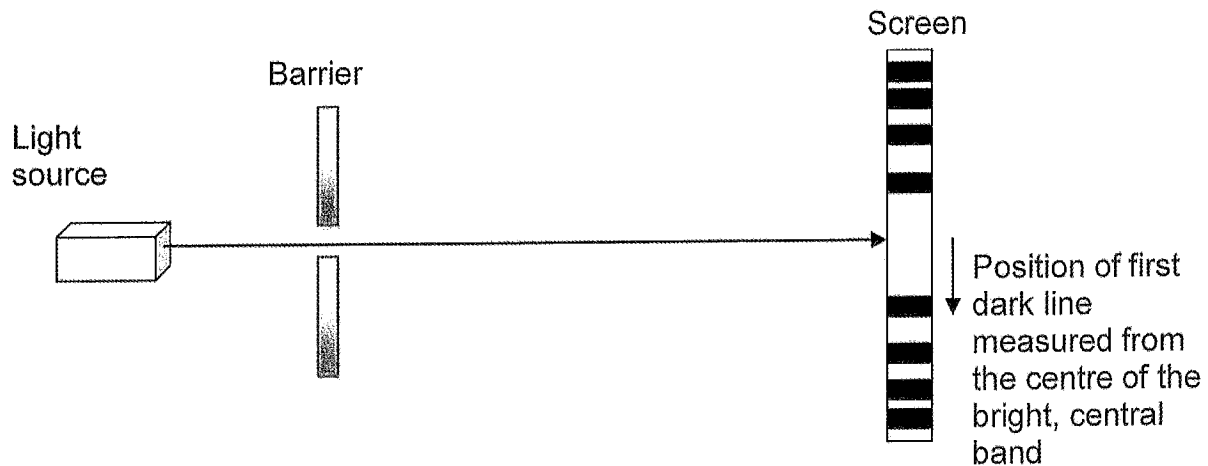

The following results are obtained:

SLIT WIDTH (mm)	POSITION OF FIRST DARK LINE FROM THE CENTRE (mm)
$5,3 \times 10^{-5}$	19,6
$4,9 \times 10^{-5}$	21,2
$4,2 \times 10^{-5}$	24,8

7.1   State *Huygens' principle* in words.   (2)

7.2   For this experiment, write down:

    7.2.1   The independent variable   (1)

    7.2.2   The dependant variable   (1)

    7.2.3   ONE controlled variable   (1)

7.3   Give a conclusion for the results obtained in this experiment.   (2)

7.4   7.4.1   How will the pattern on the screen change if red light, with a wavelength of 660 nm, is used instead of green light?   (2)

    7.4.2   Explain the answer to QUESTION 7.4.1.   (1)
[10]

QUESTION 8   (Start on a new page.)

Two charged spheres, **X** and **Y**, are placed in a vacuum at a distance of 0,04 m apart.

X +5 μC		**Y** -5 μC

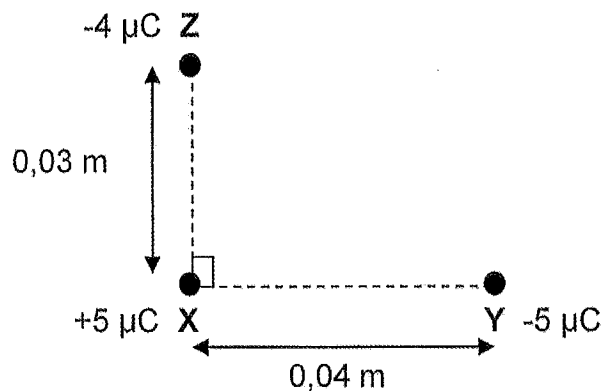0,04 m
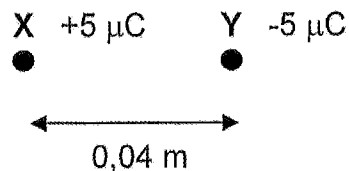
8.1   Draw the resulting electric field pattern between the two charges.   (3)

8.2   Calculate the electrostatic force sphere **X** experiences due to the charge
       on sphere **Y**.   (4)

8.3   8.3.1   If sphere **Y** is at a fixed position and sphere **X** is free to move, will
                the acceleration experienced by sphere **X** towards sphere **Y** be
                constant? Write down YES or NO.   (1)

       8.3.2   Explain the answer to QUESTION 8.3.1 by referring to the electric
                field and the force.   (2)

A third sphere, **Z**, with a charge of -4 μC, is placed at right angles to sphere **X** and at
a distance of 0,03 m from sphere **X**.

-4 μC **Z**

0,03 m

+5 μC **X**   **Y** -5 μC

0,04 m

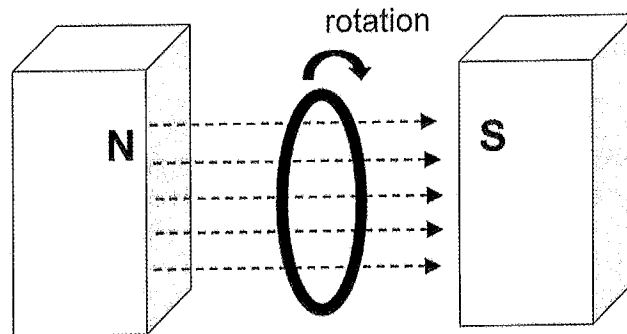8.4   Calculate the magnitude of the net force on sphere **X** due to sphere **Y** and
       sphere **Z**.   (4)

                                                                                            [14]

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QUESTION 9   (Start on a new page.)

A circular coil with 250 windings (turns) and a radius of 0,04 m, is rotated clockwise inside a magnetic field with a field strength of 3,2 T.

9.1   Calculate the magnetic flux through the coil at the position indicated on the diagram, where the coil is perpendicular to the field.   (3)

9.2   If the coil rotates clockwise through 25°, and the potential difference induced is 2,8 V, calculate the time in which this rotation took place.   (4)

9.3   Which law can be used to explain the phenomenon described in QUESTION 9.2?

      Name and state the law.   (2)

9.4   9.4.1   If the circular coil is replaced with a square coil with a side length of 0,04 m, and the same movement is made in the same amount of time, will the induced emf be the same as, larger than or smaller than the circular coil?

              Write down only THE SAME AS, LARGER THAN or SMALLER THAN.   (1)

      9.4.2   Explain the answer to QUESTION 9.4.1.   (2)
   **[12]**

QUESTION 10   (Start on a new page.)

An experiment is done to verify that <u>the potential difference across a conductor is directly proportional to the current in the conductor if the temperature stays constant</u>.

Four cells, each with an emf of 1,5 V, are connected in series with an ammeter, switch S and a combination of a resistor R and resistors of 4 Ω and 6 Ω, as shown in the diagram.

Voltmeters V_1 and V_2 are connected across the battery and the parallel resistors respectively. The internal resistance of the battery and wires are negligible.
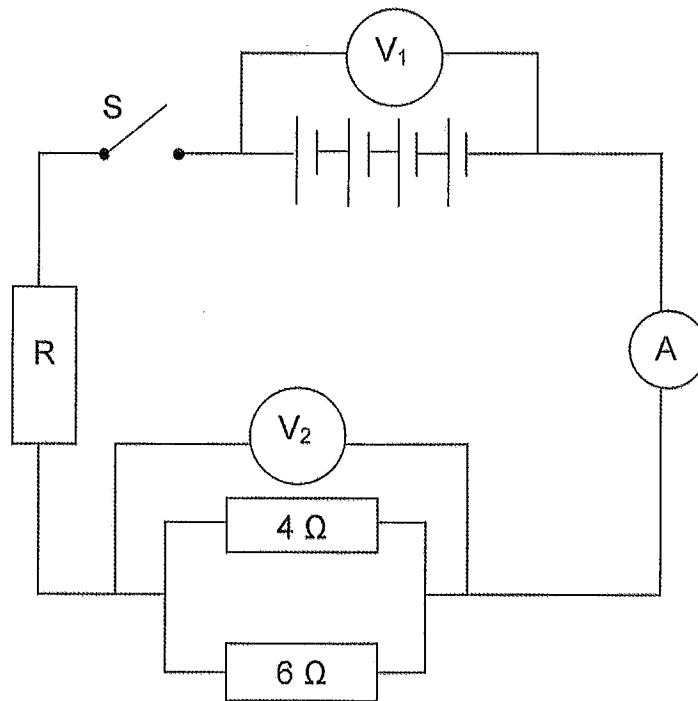
10.1   Which law is represented by the underlined phrase above?   (1)

The switch is now closed and six resistors (R_1–R_6), each with a different resistance, are placed in the place of R, one at a time. The voltmeter and ammeter readings are recorded. The results are as follows:

RESISTORS AT R	READING ON VOLTMETER V_2 (V)	READING ON AMMETER (A)
R_1	1,2	0,5
R_2	1,4	0,6
R_3	1,9	0,8
R_4	2,4	1
R_5	2,9	1,2
R_6	3,6	1,5

10.2 Use the attached graph paper and draw a graph of potential difference versus current using the data in the table. (4)

10.3 What does the gradient of the graph represent? (1)

10.4 If voltmeter V_2 is only connected across the 4 Ω resistor, how will the gradient of the graph change? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)

10.5 If the 4 Ω resistor is removed, how will the gradient of the graph change? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)

10.6 Calculate the resistance of resistor R_3 using the values in the table. (5)

10.7 Calculate the energy dissipated in resistor R_4 in 10 seconds. (3)

[16]

TOTAL: **150**

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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 *Swaartekragversnelling*	g	$9,8 \ m \cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6,67 \times 10^{-11} \ N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6,38 \times 10^6 \ m$
Coulomb's constant *Coulomb se konstante*	K	$9,0 \times 10^9 \ N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8 \ m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19} \ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31} \ kg$
Mass of the earth *Massa van die Aarde*	M	$5,98 \times 10^{24} \ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

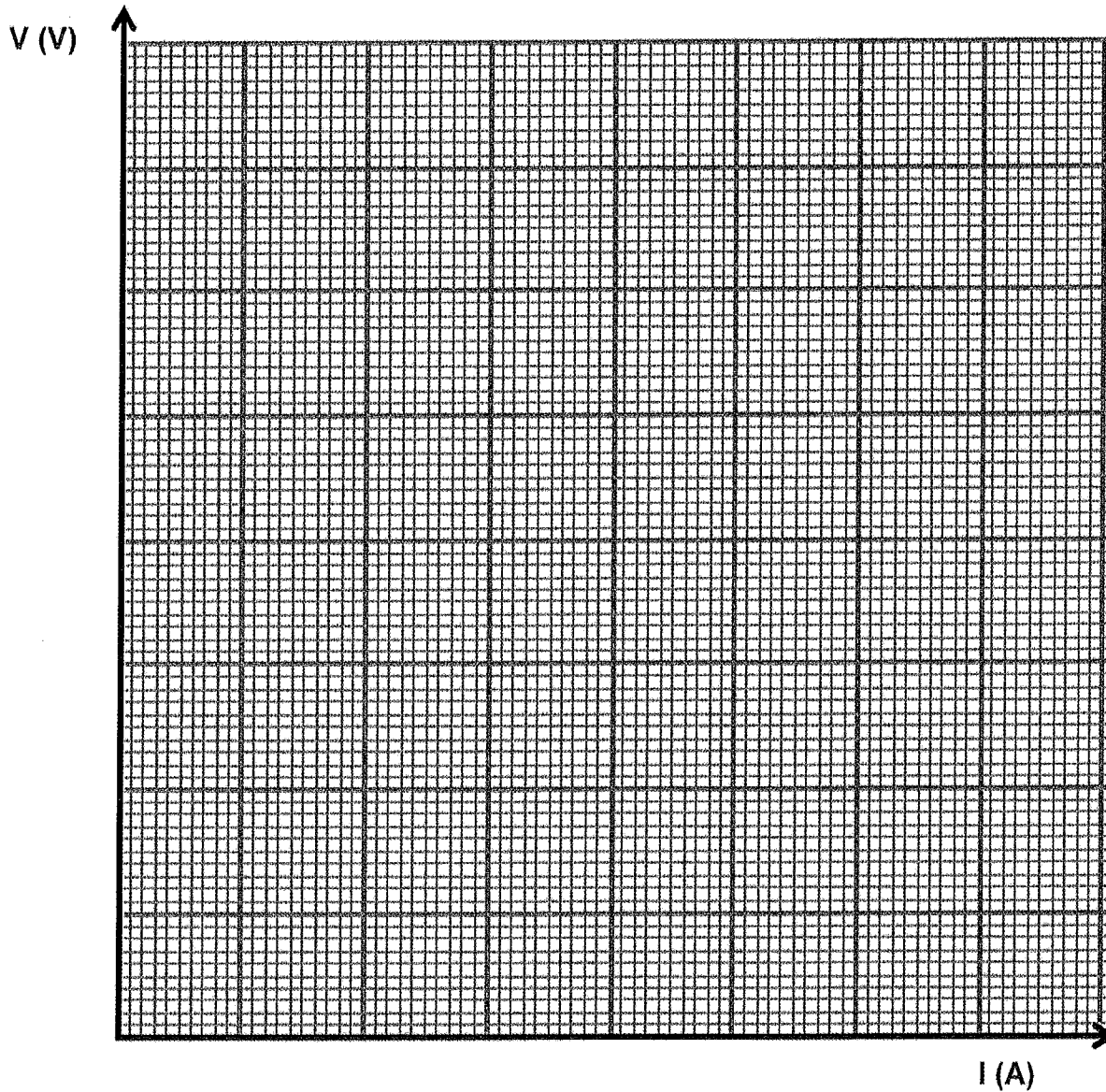|	
$F_{net} = ma$	$w = mg$
$F = \dfrac{Gm_1m_2}{r^2}$	$\mu_s = \dfrac{f_{s(max)}}{N}$
$\mu_k = \dfrac{f_k}{N}$	

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NAME _____ CLASS _____

ANSWER SHEET FOR QUESTION 10.2

HAND IN THIS ANSWER SHEET TOGETHER WITH THE ANSWER BOOK.

Graph of potential difference versus current

V (V)

I (A)

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ NASIONALE SENIOR SERTIFIKAAT

GRADE/GRAAD 11

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

NOVEMBER 2016

MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 18 pages.
Hierdie memorandum bestaan uit 18 bladsye.
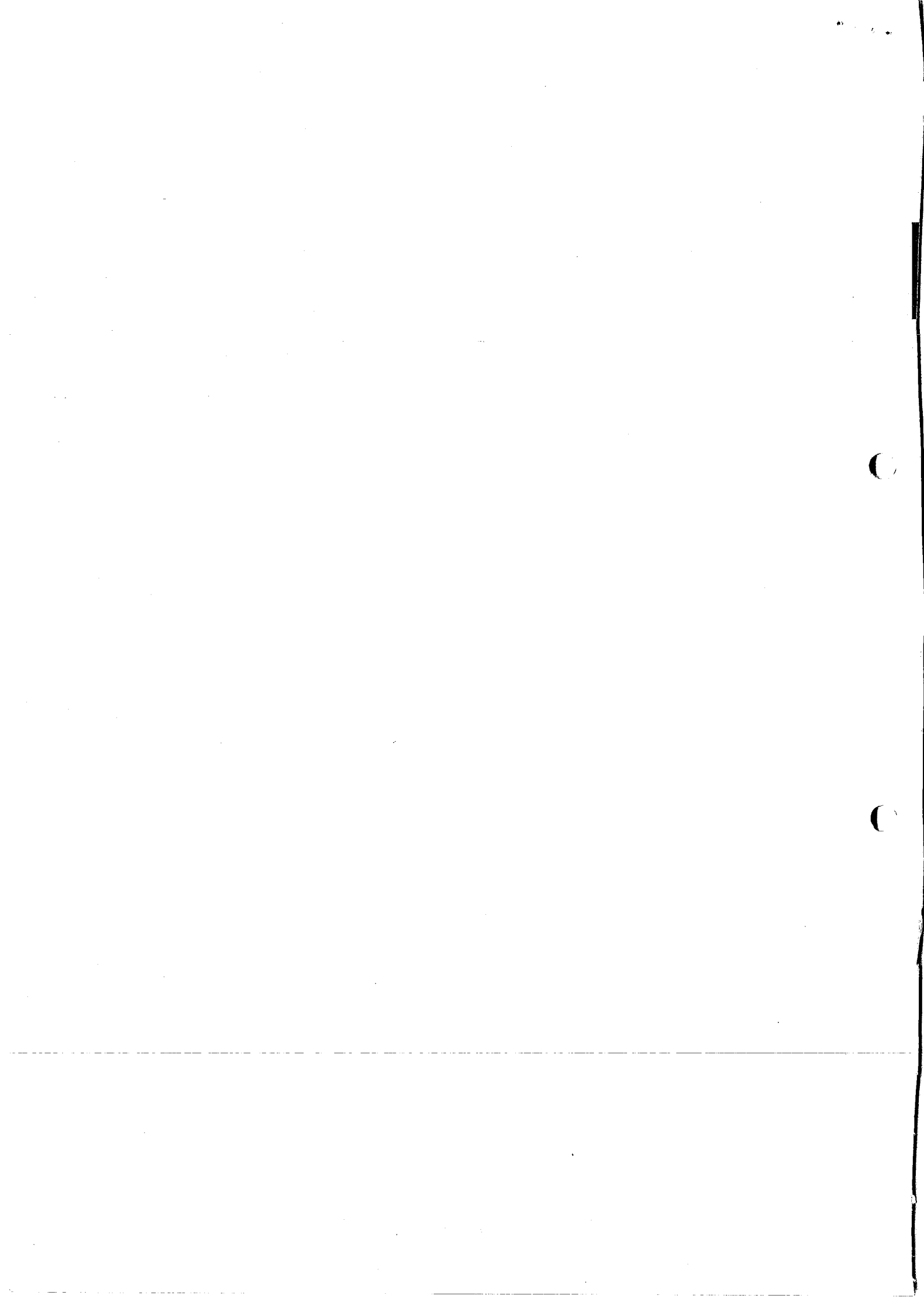
QUESTION 1/VRAAG 1

1.1	D ✓✓	(2)
1.2	B ✓✓	(2)
1.3	C ✓✓	(2)
1.4	A ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	A ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1 The sum of two or more vectors ✓✓   (2 or nothing / 2 of niks)
Die som van twee of meer vektore
OR/OF
The single vector having the same effect as two or more (all) vectors together.
Die enkele vektor wat dieselfde effek as twee of meer (al die) vektore saam het. (2)

2.2 There will be a resultant/net force not equal to zero. ✓✓ 2 or nothing/2 of niks)
Dit sal 'n resultante/netto krag wees wat nie nul is nie.
OR/OF
The (system) is not in equilibrium.
Die (sisteem) is nie in ewewig nie.
OR/OF
The forces are unbalanced.
Die kragte is ongebalanseerd.
NOTE IF : The object is lifted upwards – no marks
NOTA INDIEN : Die voorwerp word opgelig – geen punte (2)

2.3.1 OPTION 1
$F_{Ay} = F_A \sin 70°$
$= 730 \sin 70°$ ✓
$= 685,98$ N ✓

OPTION 2
$F_{Ay} = F_A \cos 20°$
$= 730 \cos 20°$ ✓
$= 685,98$ N ✓ (2)

2.3.2 OPTION 1
$F_{Ax} = F_A \cos70°$
$= (730)\cos70°$ ✓
$= 249,67$ N ✓

OPTION 2
$F_{Ax} = F_A \sin 20°$
$= (730)\sin 20°$ ✓
$= 249,67$ N ✓ (2)

2.4 OPTION 1
$F_{By} = F_B \cos10°$
$= (1\ 440)\cos10°$ ✓
$= 1418,12$ N ✓

OPTION 2
$F_{By} = F_B \sin 80°$
$= (1\ 440)\sin80°$ ✓
$= 1418,12$ N

POSITIVE MARKING FROM 2.3.1
POSITIEWE NASIEN VANAF 2.3.1
Maximum/*Maksimum* $w = F_{YA} + F_{YB}$
$= 685,98 + 1418,12$ ✓
$= 2\ 104,1$ N ✓ (4)

2.5 If the distance x increases, the vertical components of the applied forces will decrease ✓ and then the system will (possibly) not be able to pick up the weight. ✓
Indien die afstand x vergroot, sal die vertikale komponente van die toegepaste krag verklein en dan sal die stelsel (moontlik) nie die gewig kan optel nie.
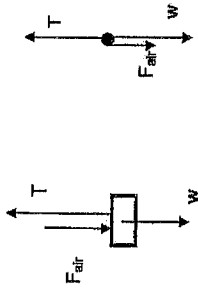(2)
[14]

QUESTION 3/VRAAG 3

3.1 A body will remain in its state of rest or motion/moving at constant/uniform velocity ✓ unless a non-zero resultant/net force/unbalanced force acts on it ✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante/uniforme snelheid bly tensy 'n nie-nul resulterende/netto kragongebalanseerde krag daarop inwerk. (2)
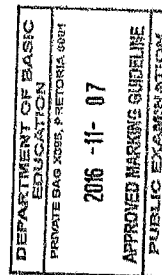
3.2

Notes: Accepted Labels/Aanvaarbare Byskrifte	Mark/Punt
w	weight/gravitational force/F$_G$/F$_g$ *gewig/gravitasiekrag/swaartekrag*	✓
T	Tension/F$_T$/F$_{applied}$/F$_A$ *Spanning/F$_{toegepas}$*	✓
F$_{air}$	F of the blades/f/Air friction/Downward force of the blades/F$_{air on container}$ *F van die lemme/f/Lugweerstand/Afwaartse krag van lemme/ F$_{lug op houer}$*	✓
Any non-applicable force(s): deduct 1 mark (maximum ⅔) *Enige nie-toepaslike krag(te): trek 1 punt af (maksimum ⅔)*	
Lines must touch object otherwise (maximum ⅔) *Lyne moet voorwerp raak anders (maksimum ⅔)*	
Accept a free-body diagram *Aanvaar 'n vrye kragtediagram*	

(3)

3.3 There is an extra downward force ✓✓(on the container created by the air / blades of the helicopter)
Daar is 'n ekstra afwaartse krag (op die houer as gevolg van die lug / lemme van die helikopter) (2)

3.4 w = mg
1 960 = m(9,8) ✓
m = 200 kg ✓ (2)

3.5 **POSITIVE MARKING FROM 3.4**
POSITIEWE NASIEN VAN 3.4

F$_{net}$ = ma   ✓

T + F$_g$ + F$_{air}$ = ma   [Any one/*Enige*]

T – F$_g$ – F$_{air}$ = ma

T – 1 960 – 140 ✓ = (200)(0,13) ✓   **OR/OF**   T – 2 100 = ma
T = 2 126 N ✓   T – 2 100 = (200)(0,13)
                             T = 2 126 N

(4)

3.6 2 100 N ✓ (1)
[14]

QUESTION 4/VRAAG 4

4.1 When a <u>net force</u> acts on an object, it will accelerate in the direction of the (net) force. ✓ The acceleration is directly proportional to the mass of the (net) force and inversely proportional to the mass of the object. ✓
Wanneer 'n netto krag op 'n voorwerp inwerk, sal dit in die rigting van die (netto) krag versnel. Die versnelling is direk eweredig aan die (netto) krag en omgekeerd eweredig aan die massa van die voorwerp. ✓

Accept Newton's Second Law in terms of momentum: The net force on an object is equal to the rate of change in momentum. ✓✓
Aanvaar Newton se tweede wet in terme van momentum: Die netto krag is gelyk aan die tempo van verandering in momentum.
(2)

4.2

Notes:	Accepted Labels/Aanvaarbare byskrifte	MARK/PUNT
N	Normal force/ F_N / Normaalkrag	✓
w	Weight/F_g/F_g /Gewig/Gravitasiekrag/Swaartekrag	✓
T	Tension/F_T /Spanning	✓
f	Friction/F_f /Wrywingskrag	✓

Any non-applicable force(s): deduct 1 mark maximum (maximum ¾)
Enige nie-toepaslike krag(te): trek 1 punt af (maksimum ¾)
Is both weight and its components are shown, penalise 1 mark
Indien beide gewig en die komponente van gewig getoon, penaliseer 1 punt
Lines must touch dot otherwise (maximum ¾)
Lyne moet kolletjie raak anders (maksimum ¾)
Do not penalise if angle is shown/not shown
Moenie penaliseer as hoek getoon/nie getoon is nie.
Ignore the comparitive lengths of the arrows
Ignoreer die vergelykende lengtes van pyle
(4)

4.3 $f_k = \mu_k N$ ✓
$f_k = 0{,}2(4)(9{,}8)\cos 40°$ ✓   OR/OF $0{,}2(4)(9{,}8)\sin 50°$
$f_k = 6{,}01$ N ✓ up the slope/teen die helling op ✓
(4)

4.4 POSITIVE MARKING FROM 4.3
POSITIEWE NASIEN VAN 4.3

$F_{net} = ma$ ✓

For the 4 kg box:
Vir die 4 kg-blok:
$F_{g||} - T - f = ma$
$4(9{,}8)\sin 40° - T - 6{,}01$ ✓ $= 4a$ ✓
$25{,}2 - 6{,}01 - T = 4a$
$19{,}19 - 4a = T$ ....(2)

For the 8 kg box:
Vir die 8 kg-blok:
$T - f = ma$
$T - 0{,}2(8)(9{,}8)$ ✓ $= 8a$
$T = 8a + 15{,}68$ ....(1)

Mark allocation / Puntetoekenning:
Formula/Formule ✓
Left side sub for 8 kg/Links sub vir 8kg ✓
Left side sub for 4 kg/Links sub vir 4kg ✓
Sub of both 8a and 4a/ Sub vir beide 8a and 4a ✓
Combining of eq/ Kombineer vergelykings ✓
Answer/Antwoord ✓

Combining equations (1) and (2):
Kombineer vergelykings (1) en (2)
$4(9{,}8)\sin 40° - 6{,}01 - 4a = 0{,}2(8)(9{,}8) + 8a$ ✓
$a = 0{,}29$ m·s⁻²

OR/OF
$8a + 15{,}68 = 19{,}19 - 4a$ ✓✓
$a = 0{,}29$ ms⁻²

System approach: one mark for formula and one mark for answer, max ²/₆
Sisteembenadering: een punt vir formule en een punt vir antwoord, maks ²/₆
(6)

4.5 Greater than ✓
Groter as

Explanation:/Verduideliking:
The total mass remains the same ✓
Component of weight parallel to the slope increases ✓
The force of friction increases ✓

Die totale massa bly dieselfde
Komponent van gewig parallel aan die helling vermeerder
Die wrywingskrag vergroot
OR/OF
The total mass remains the same ✓
The net force increases ✓
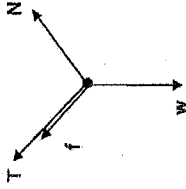
Die totale massa bly dieselfde
Die netto krag vergroot

OR/OF
For the 8 kg box:
Vir die 8 kg-blok:
$8(9{,}8)\sin 40° - (0{,}2)(8)(9{,}8)\cos 40° - T = 8a$ ✓
$50{,}39 - 12{,}01 - T = 8a$ ...(1)
$50{,}39 - 12{,}01 - 8a = 4a + 7{,}84$
$a = 2{,}545$ ms⁻² ✓

For the 4 kg box:
Vir die 4 kg-blok:
$T - 0{,}2(4)(9{,}8) = 4a$ ✓
$T - 7{,}84 = 4a$ ...(2)

(4)
[20]

QUESTION 5/VRAAG 5

5.1 Every body in the universe attracts every other body with a force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte.
NOTE: if charges are mentioned, no marks
NOTA: indien ladings genoem word, geen punte
(2)

5.2 Weightlessness is the sensation experienced when all contact forces are removed. ✓✓
Gewigloosheid is die sensasie wat ervaar word wanneer alle kontakkragte verwyder word.
(2)

5.3 $F = G \dfrac{m_1 m_2}{r^2}$ OR/OF $= G \dfrac{M_E m}{R_E^2}$ ✓

$= \dfrac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(3800)}{[6,38 \times 10^6 + 25 \times 10^6]^2}$ ✓ $= 1\ 539,23\ N$✓ ✓
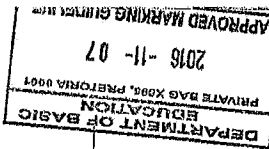(4)

5.4 **OPTION 1/OPSIE 1**
Greater than ✓✓
the mass is greater ✓
and for the same force ✓ the distance must also be greater (because the product of the masses is directly proportional to the square of the distance between the centres.)
Groter as
Die massa is groter
en vir dieselfde krag moet die afstand ook groter wees
(omdat die produk van die massas direk eweredig is aan die kwadraat van die afstand tussen die middelpunte)

OPTION 2/OPSIE 2
POSITIVE MARKING FROM 5.3
POSITIEWE NASIEN VAN 5.3
Greater than ✓✓
Groter as
$F = G \dfrac{m_1 m_2}{R^2}$

$\sqrt{} \; 1539,23 = 6,67\ 10^{-11} \times \dfrac{(5,98 \times 10^{24})(4500)}{R^2}$ ✓

$R = 3,41 \times 10^7$ m

Distance above the surface of the Earth
Afstand bo oppervlak van Aarde
$D = 3,41 \times 10^7 - 6,38 \times 10^6$
$D = 2,78 \times 10^7$ m

OPTION 3/OPSIE 3
Greater than ✓✓
Groter as
$G \dfrac{m_1 m_2}{R_1^2} = G \dfrac{m_1 m_2}{R_2^2}$

$\dfrac{3800}{R_1^2} = \dfrac{4500}{R_2^2}$ ✓

$R_2^2 = \dfrac{4500}{3800} R_1^2$
$R_2^2 = 1,0882...(25 \times 10^8 + 6,38 \times 10^6)$
$R_2 = 3,41 \times 10^7$
$D = 3,41 \times 10^7 - 6,38 \times 10^7$ m
$D = 2,78 \times 10^7$ m
OR/OF
$D = 1,0882...(25 \times 10^6)$
$D = 2,78 \times 10^7$ m
(4)
[12]

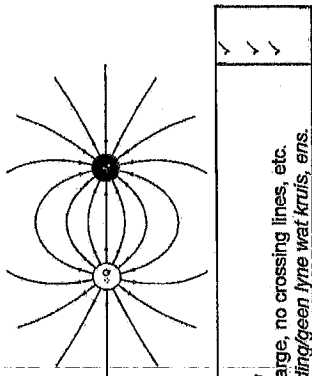## QUESTION 6/VRAAG 6

6.1 The refractive index is the ratio between the speed of light in a vacuum ✓ and the speed of light in a medium. ✓
Die brekingsindeks is die verhouding tussen die spoed van lig in 'n vakuum en die spoed van lig in 'n materiaal/medium.
(2)

6.2 $n = \dfrac{c}{v}$ ✓

$1,47 = \dfrac{3 \times 10^8}{v}$ ✓

$v = 2,04 \times 10^8\ m \cdot s^{-1}$ ✓
(3)

6.3 $n_i \sin \theta_i = n_r \sin \theta_r$ ✓
$1,33 \sin 37°$ ✓ $= 1,47 \sin \theta$ ✓
$\theta = 32,99°$
(4)

6.4 Olive oil has a higher optical density than water ✓✓
Olyfolie het 'n groter optiese digtheid as water
OR/OF
Water has a lower optical density than olive oil
Water het 'n laer optiese digtheid as olyfolie
(2)

6.5.1 Away from the normal ✓
Weg van die normale
(1)

6.5.2 The speed of light in air is faster than the speed of light in oil ✓ because the refractive index of oil is higher than of air. ✓ (When a light ray speeds up it refracts away from the normal.)
Die spoed van lig in lug is vinniger as die spoed van lig in olie omdat die brekingsindeks van olie groter is as van lug. (Wanneer die ligstraal vinniger beweeg breek dit weg van die normale.)
OR/OF
Light is moving from an optically more dense ✓ to less dense medium ✓
Lig beweeg vanaf 'n opties digter medium na 'n minder digte medium
(2)

6.6.1 Oil and air ✓
Olie en lug
(1)

6.6.2 (One of the conditions) for total internal reflection is that the light has to travel from a medium with high optical density ✓ to a medium of lower optical density. ✓
(Een van die voorwaardes) vir totale interne weerkaatsing is dat die lig van 'n medium met 'n hoë optiese digtheid na 'n medium met 'n laer optiese digtheid moet beweeg.
(2)

6.7 Wavelength ✓
Golflengte
(1)
[18]

QUESTION 7/VRAAG 7

7.1 Every point of a wave front serves as a point source of spherical, secondary waves. ✓✓ The positions of the new wave front will be that of the surface tangent to the secondary waves.
Elke punt van 'n golffront dien as 'n puntbron van sferiese, sekondêre golwe. Die posisies van die nuwe golffront sal dié van die oppervlakraaklyn tot die sekondêre golwe wees..   (2)

7.2.1 Slit width ✓
Spleetwydte   (1)

7.2.2 (Degree of) diffraction ✓
(Mate van) diffraksie   (1)

7.2.3 Wavelength/Frequency/Colour of light ✓
Golflengte/Frekwensie/Kleur van lig   (1)

7.3 The greater the width of the slit, the less the amount/degree of diffraction ✓✓
Hoe groter die wydte van die spleet, hoe kleiner die mate van diffraksie
OR/OF
The smaller the width of the slit, the greater the amount/degree of diffraction
Hoe kleiner die spleetwydte, hoe groter die mate van diffraksie
OR/OF
The amount of diffraction is inversely proportional to the slit width
Die mate van diffraksie is omgekeerd eweredig aan die spleetwydte
OR/OF
Diffraction $\alpha \frac{1}{width}$
Diffraksie $\alpha \frac{1}{wydte}$ (2)

7.4.1 The bright, central band will increase ✓
The coloured bands will be red instead of green ✓
Die helder, sentrale band sal vergroot/toeneem
Die gekleurde bande sal rooi in plaas van groen wees   (2)

7.4.2 If the wavelength increases, the (degree of) diffraction will increase. ✓
Indien die golflengte vergroot/toeneem, sal die (mate van) diffraksie vergroot/toeneem
OR/OF
Degree of diffraction is directly proportional to wavelength. ✓
Die mate van diffraksie is direk eweredig aan die golflengte   (1)
[10]

QUESTION 8/VRAAG 8

8.1

Shape/*Vorm*	✓
Direction/*Rigting*	✓✓
Touching the charge, no crossing lines, etc.	
Raak aan die lading/geen lyne wat kruis, ens.	

(3)

8.2

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

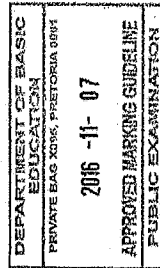$$F = \frac{9 \times 10^9 \,(5 \times 10^{-6})(5 \times 10^{-6})}{(0,04)^2} \,\checkmark\checkmark$$

$F_{Y\,on\,X} = 140,63 \text{ N} \checkmark$ (right/*regs*   accept attraction/*aanvaar aantrekkend*)   (4)

8.3.1 No ✓
Nee   (1)

8.3.2 The electric field is stronger closer to the charges / not a uniform field/not constant ✓ which means the force will not be constant/ increase ✓
Die elektriese veld is sterker nader aan die ladings/nie 'n uniforme veld nie/nie konstant nie wat beteken die krag sal ook nie konstant wees nie/toeneem   (2)

8.4

POSITIVE MARKING FROM 8.2
POSITIEWE NASIEN VAN 8.2

$F = \dfrac{kQ_1Q_2}{r^2}$

$F = \dfrac{9 \times 10^9 \ (4 \times 10^{-6})(5 \times 10^{-6})}{(0,03)^2}$ ✓ ✓

$F_{Z \text{ on } X} = 200$ N

$(F_{net})^2 = (F_{Y \text{ on } X})^2 + (F_{Z \text{ on } Y})^2$

$(F_{net})^2 = 140,63^2 + 200^2$ ✓

$F_{net} = \sqrt{140,63^2 + 200^2}$ ✓

$F_{net} = 244,49$ N ✓

(4)
[14]

QUESTION 9/VRAAG 9

9.1 $\Phi = BA\cos\theta$ ✓

$\Phi = (3,2)\pi(0,04)^2 \cos 0°$ ✓   accept/*aanvaar* $(3,2)\pi(0,04)^2$

$\Phi = 0,016$ Wb ✓   (or 0,02 Wb)

(3)

9.2   **POSITIVE MARKING FROM 9.1**
POSITIEWE NASIEN VAN 9.1

$\varepsilon = \dfrac{-N\Delta\Phi}{\Delta t}$ ✓

$28 = \dfrac{-250\big(0,016\cos 25° - 0,016\cos 0°\big)}{\Delta t}$ ✓

$\Delta t = 0,13$ s ✓   (0,17 s if 0,02 Wb was used/ *gebruik was*)

(4)

9.3   Faraday's law. ✓ 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. ✓
Faraday se wet. Die grootte van die geïnduseerde emk oor die ente van 'n geleier is direk eweredig aan die tempo van verandering in die magnetiese vloedkoppeling met die geleier.

(2)

NOTE: Since the panel found that not all controlled variables were given for QUESTION 9.4, this question could not be accurately answered. Hence do NOT mark this question. The total for the paper will be 147 marks.
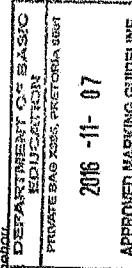
LET
WEL: *Aangesien die paneel ontdek het dat nie al die gekontroleerde veranderlikes vir VRAAG 9.4 gegee is nie, kon hierdie vraag nie akkuraat beantwoord word nie. Moet dus NIE hierdie vraag nasien NIE. Die totaal vir die vraestel sal 147 punte wees.*

9.4.1   Smaller ✓
        Kleiner as

(1)

9.4.2   The area of a square is smaller than the area of a circle ✓ (with the radius equal to the side length of the square), if the amount of turns are the same ✓
Die oppervlakte van 'n vierkant is kleiner as die oppervlakte van 'n sirkel met die radius gelyk aan die sylengte van die vierkant.
OR/OF
$0,04^2 < \pi \times 0,04^2$ area of square is smaller than area of circle.
$0,04^2 < \pi \times 0,04^2$ *oppervlakte van vierkant is kleiner as oppervlakte van sirkel.*
OR/OF
ε directly proportional to A
ε direk eweredig aan A

(2)
[9]

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2016 -11- 07
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

QUESTION 10/VRAAG 10

10.1 Ohm's law ✓
Ohm se wet   (1)

10.2 Graph/Grafiek

Graph of Potential difference versus Current
Grafiek van Potensiaalverskil teenoor Stroom

Marking criteria for graph *Naslenkriteria vir grafiek*	
Axes with correct/appropriate scale (It must be possible to plot ALL the coordinates on the graph and the divisions must be evenly spaced. If an inappropriate scale is used maximum $\frac{1}{4}$) *Asse met korrekte en toepaslike skaal* *(Dit moet moontlik wees om AL die koördinate op die grafiek te plot en die verdeling moet eweredig gespasieer wees. Indien nie-toespaslik skaal gebruik word, maksimum $\frac{1}{4}$)*	✓
5 or more of the 6 coordinates correctly plotted (3–4 one mark only) *5 of meer van die 6 koördinate korrek gestip* *(3–4 slegs een punt)*	✓✓
Drawing a line of best fit *Teken 'n lyn van beste passing*	✓

(4)

10.3 Resistance of the parallel connection ✓
Weerstand van die parallel kombinasie   (1)

10.4 Stay the same ✓
Bly dieselfde   (1)

10.5 Increase ✓
Toeneem   (1)

10.6

OPTION 1/OPSIE 1

Mark allocation/Puntetoekenning:
Formula/formule ✓
2 for substitution/2 vir invervanging ✓✓
Subtraction/Aftrek ✓
Answer/antwoord ✓

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \ \checkmark$$
$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6} \ \checkmark$$
$$R_p = 2{,}4 \ \Omega$$

$$R_{tot} = \frac{V}{I} \ \checkmark$$
$$R_{tot} = \frac{6}{0{,}8} \ \checkmark$$
$$R_{tot} = 7{,}5 \ \Omega$$

$$R = R_{tot} - R_{par}$$
$$= 7{,}5 - 2{,}4 \ \checkmark$$
$$= 5{,}1 \ \Omega \ \checkmark$$

(5)

OPTION 2/OPSIE 2

Mark allocation/Puntetoekenning:
Formula/formule ✓
2 for substitution/2 vir invervanging ✓✓
Subtraction/Aftrek ✓
Answer/antwoord ✓

$V_{tot} = 6$ V
$V_R = V_{tot} - V_2$
$= 6 - 1{,}9 \ \checkmark$
$= 4{,}1$ V

$$R = \frac{V}{I} \ \checkmark$$
$$R = \frac{4{,}1}{0{,}8} \ \checkmark\checkmark$$
$$R = 5{,}13 \ \Omega \ \checkmark$$

(5)

OPTION 3/OPSIE 3

Mark allocation/Puntetoekenning:
Formula/formule ✓
2 for substitution/2 vir invervanging ✓✓
Ratio/verhouding ✓
Answer/antwoord ✓

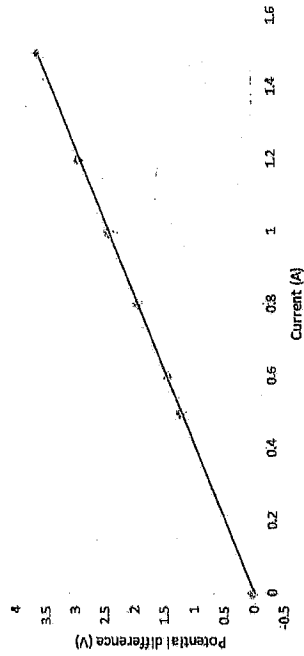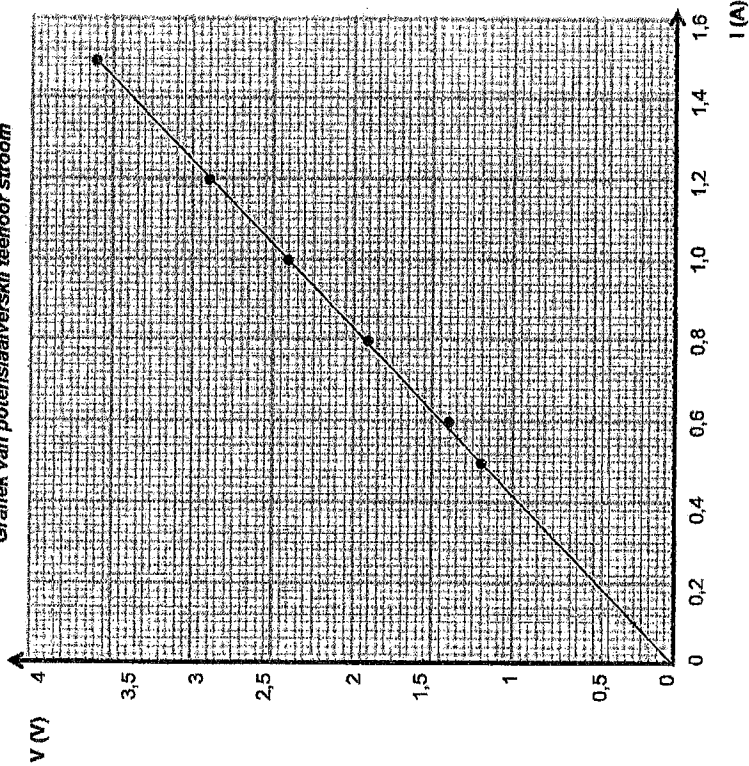$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \ \checkmark$$
$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6} \ \checkmark$$
$$R_p = 2{,}4 \ \Omega$$

$V_R : V_P = 4{,}1 : 1{,}9 \ \checkmark$
$R_R : R_P = 4{,}1 : 1{,}9$

$R_P : 2{,}4 = 4{,}1 : 1{,}9 \ \checkmark$
$R_P = 5{,}18 \ \Omega \ \checkmark$

10.7

OPTION 1/OPSIE 1
$V_R = 6 - 2,4 = 3,6$ V
$W = VI\Delta t$ ✓
$W = (3,6)(1)(10)$ ✓
$W = 36$ J ✓

OPTION 2/OPSIE 2
$V_R = 6 - 2,4 = 3,6$ V
$R = \dfrac{V}{I}$
$R = \dfrac{3,6}{1}$
$R = 3,6 \, \Omega$
(The above calculation need not be shown/Bogenoemde berekening hoef nie getoon te word nie)
$W = \dfrac{V^2 \, \Delta t}{R}$ ✓
$W = \dfrac{(3,6)^2(10)}{3,6}$ ✓
$W = 36$ J ✓

OPTION 3/OPSIE 3
$W = I^2R\Delta t$ ✓
$W = (1)^2(3,6)(10)$ ✓
$W = 36$ J ✓

(3)
[16]

Please turn over/Blaai om asseblief

ANSWER SHEET FOR QUESTION 10.2/ANTWOORDBLAD VIR VRAAG 10.2

HAND IN THIS ANSWER SHEET TOGETHER WITH THE ANSWER BOOK/
LEWER HIERDIE ANTWOORDBLAD SAAM MET DIE ANTWOORDEBOEK IN.

Graph of potential difference versus current
Grafiek van potensiaalverskil teenoor stroom

TOTAL/TOTAAL: 150

basic education

Department
Basic Education
REPUBLIC OF SOUTH AFRICA

TO: HEADS OF EXAMINATION SECTIONS
HEADS OF CURRICULUM SECTIONS

EXAMINATION INSTRUCTION NO. 31 OF 2016

AMENDMENTS TO THE MARKING GUIDELINE OF THE 2016 COMMON EXAMINATION FOR GRADE 11: PHYSICAL SCIENCES P1

Error on both English and Afrikaans versions: Applicable to Eastern Cape, Gauteng, KwaZulu-Natal, Mpumalanga, Northern Cape, and North West Provinces

1. An error was identified in sub question 9.4. All the necessary controlled variables were not given.

2. This sub question which carried 3 marks must not be marked, and, these 3 marks must be excluded.

3. Consequently the total marks for the question paper must be reduced to 147 marks, then scaled up to 150 marks.

4. Refer to **Annexure A** that provides the conversion table that must be used to calculate the learner's total marks.

5. For further information please contact the Director: Examinations and Assessment, Ms P Ogunbanjo at 012 357 3909 or email: Ogunbanjo.p@dbe.gov.za

DR RR POLIAH
CHIEF DIRECTOR: NATIONAL ASSESSMENT AND PUBLIC EXAMINATIOS
DATE: 7-11-16

Annexure A: English and Afrikaans versions. Marks converted from 147 to 150

Mark out of 147	Converted to 150
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
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18	18
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29	29
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31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44

Mark out of 147	Converted to 150
45	46
46	47
47	48
48	49
49	50
50	51
51	52
52	53
53	54
54	55
55	56
56	57
57	58
58	59
59	60
60	61
61	62
62	63
63	64
64	65
65	66
66	67
67	68
68	69
69	70
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74	76
75	77
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77	79
78	80
79	81
80	82
81	83
82	84
83	85
84	86
85	87
86	88
87	89
88	90

Mark out of 147	Converted to 150
89	91
90	92
91	93
92	94
93	95
94	96
95	97
96	98
97	99
98	100
99	101
100	102
101	103
102	104
103	105
104	106
105	107
106	108
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108	110
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110	112
111	113
112	114
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114	116
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116	118
117	119
118	120
119	121
120	122
121	123
122	124
123	126
124	127
125	128
126	129
127	130
128	131
129	132
130	133
131	134
132	135

Mark out of 147	Converted to 150
133	136
134	137
135	138
136	139
137	140
138	141
139	142
140	143
141	144
142	145
143	146
144	147
145	148
146	149
147	150