basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2019

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 2 data sheets.

IPHSCE1

EASTERN CAPE

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 TEN 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.

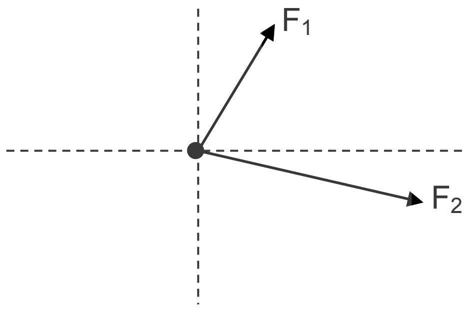
11. Give brief motivations, discussions, etc. where required.

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

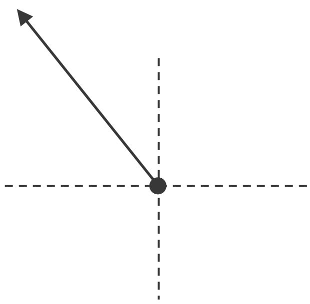
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Two forces, F_1 and F_2, act simultaneously at a point in the directions as shown in the sketch below.

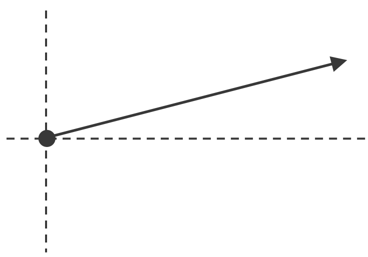


Which ONE of the following represents the resultant of the two forces?

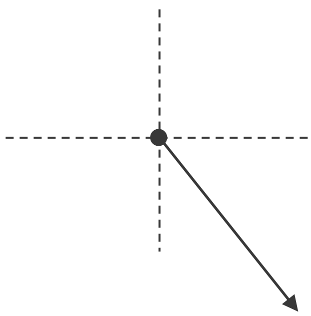
A



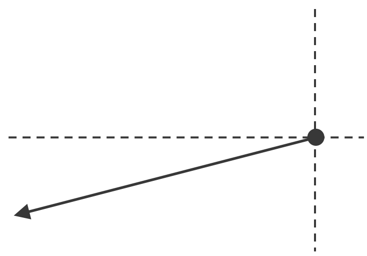
B



C



D



(2)

1.2 Which ONE of the following statements regarding inertia of an object is CORRECT?

The inertia of an object …

A is greater if its mass is smaller.

B increases as the applied force on the object increases.

C is the resistance to any change in its state of motion.

D increases as the frictional force on the object increases.

1.3 Which ONE of the following statements regarding the frictional force acting on an object is CORRECT?

The frictional force is …

A directly proportional to the normal force.

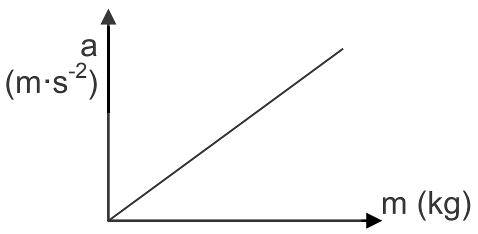
B dependent on the velocity of the motion.

C independent of the type of surface.

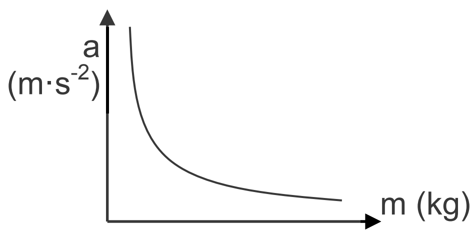
D equal to the weight of the object. (2)

1.4 Which ONE of the following graphs represents the relationship between acceleration and mass of an object if a constant net force acts on it?

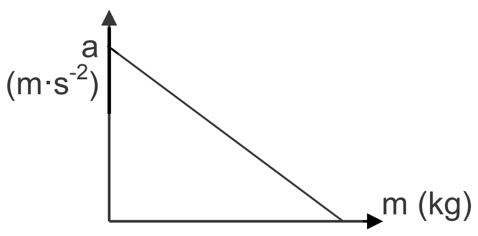
A



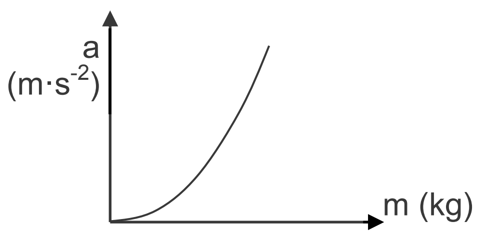
B



C



D



(2)

1.5 According to Newton's Third Law of Motion, the reaction force to the weight of a book lying on a table is the …

A normal force.

B force of the book on Earth.

C force of Earth on the book.

D force of the book on the table. (2)

1.6 The measure of the refractive power of a medium is called the …

A refractive index.

B optical density.

C refraction.

D speed of light in the medium.

1.7 A central bright band is observed when light of wavelength **λ** travels through a slit of width **w**.

Light of wavelength **2λ** is now used. A central bright band of the SAME broadness will be produced if the slit width used is …

A w

B ½w

C ¼w

D 2w (2)

1.8 The electric field at a point is defined as …

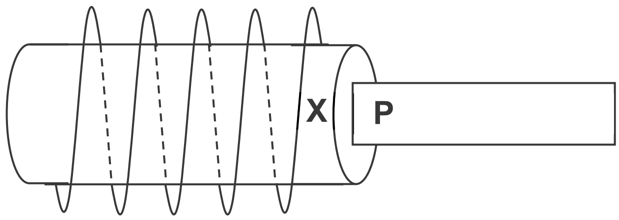
A the region in space where an electric charge experiences an electrostatic force.

B the electrostatic force per unit positive charge.

C directly proportional to the product of the charges.

D the direction that a negative test charge would move. (2)

1.9 The diagram below shows a coil and a magnet with a pole, **P**. A magnetic field is induced in the coil due to the motion of the magnet.

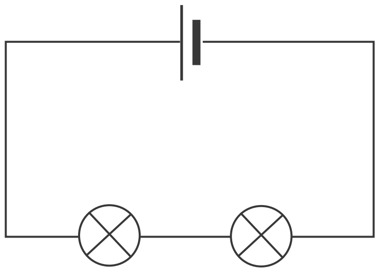


Which ONE of the following combinations will result in an induced magnetic field with a NORTH POLE at point **X**?

	DIRECTION OF MOTION OF MAGNET	POLARITY OF P
A	Into the coil	North
B	Up and down inside the coil	North
C	Into the coil	South
D	Up and down inside the coil	South

(2)

1.10 The cell in the circuit below delivers a potential difference of 1,5 V. The bulbs are identical and the current in the circuit is 0,2 A.



The energy, in joule, transferred by ONE of the bulbs in one minute is …

A $1,5 \times 0,2 \times 1$

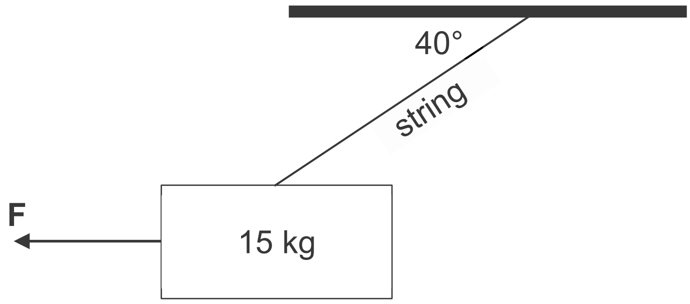
B $1,5 \times 0,2 \times 60$

C $0,75 \times 0,2 \times 1$

D $0,75 \times 0,2 \times 60$ (2)
[20]

QUESTION 2 (Start on a new page.)

A billboard, mass 15 kg, is suspended from a roof by means of a light inextensible string. Force **F** pulls the billboard sideways, as shown in the diagram below.



When the angle between the roof and the string is 40°, a closed vector diagram is obtained for all the forces acting on the billboard.

2.1 What deduction can be made when the forces acting on an object forms a closed vector diagram? (2)

2.2 Calculate the weight of the billboard. (2)

2.3 Draw a labelled closed vector diagram of ALL the forces acting on the billboard. Indicate the value of ONE of the angles. (4)

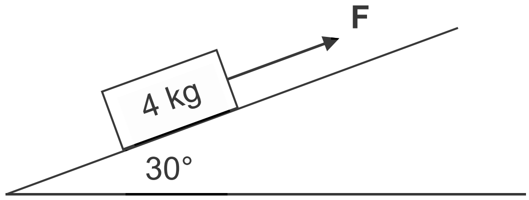
2.4 Calculate the tension in the string. (2)

2.5 The magnitude of force **F** is equal to the magnitude of the horizontal component of the tension in the string.

Give a reason why these two forces are NOT considered to be an action-reaction pair according to Newton's Third Law. (1)
[11]

QUESTION 3 (Start on a new page.)

A 4 kg block is pulled up along a frictionless incline by a constant force **F** acting parallel to the incline, as shown below. The incline makes an angle of 30° with the horizontal. The block moves at CONSTANT VELOCITY.



3.1 State *Newton's First Law of Motion* in words. (2)

3.2 Draw a labelled free-body diagram showing all the forces acting on the block. (3)

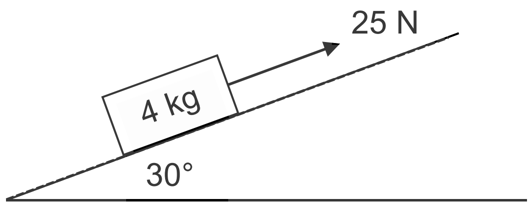
3.3 Calculate the magnitude of:

3.3.1 The perpendicular component of the weight of the block (3)

3.3.2 Force **F** (3)

The same block is now pulled up along a rough incline by a constant force of 25 N acting parallel to the incline, as shown below. The incline makes an angle of 30° with the horizontal.

The acceleration of the block is now 0,2 $m \cdot s^{-2}$ upwards along the incline.

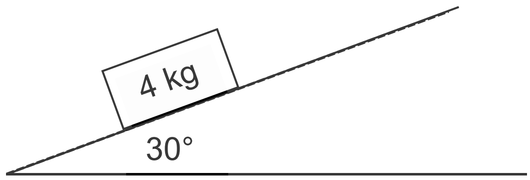


3.4 Calculate the:

3.4.1 Magnitude of the kinetic frictional force acting on the block (4)

3.4.2 Coefficient of kinetic friction between the block and the surface of the incline (3)

The force of 25 N acting on the block on the rough incline is now removed, as shown below.



3.5 How will EACH of the following quantities change in MAGNITUDE and DIRECTION?

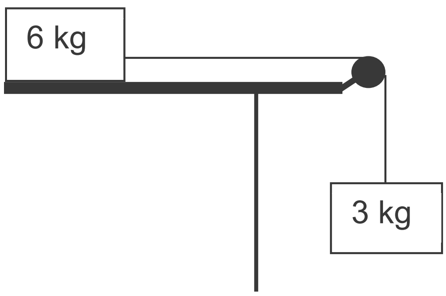
3.5.1 Weight of the block (2)

3.5.2 Acceleration of the block (2)

3.5.3 Kinetic frictional force acting on the block (2)
[24]

QUESTION 4 (Start on a new page.)

A 6 kg block, held at rest on a rough horizontal table, is connected to another block of mass 3 kg by a light inextensible string passing over a frictionless pulley. The 3 kg block hangs vertically, as shown in the diagram below.



When the 6 kg block is released, it accelerates to the right and experiences a kinetic frictional force of 24 N. Ignore the effects of air friction.

4.1 State *Newton's Second Law of Motion* in words. (2)

4.2 Draw a labelled free-body diagram showing ALL the forces acting on the 6 kg block. (4)

4.3 Calculate the magnitude of the acceleration of the 3 kg block. (6)

4.4 Explain the following statement:

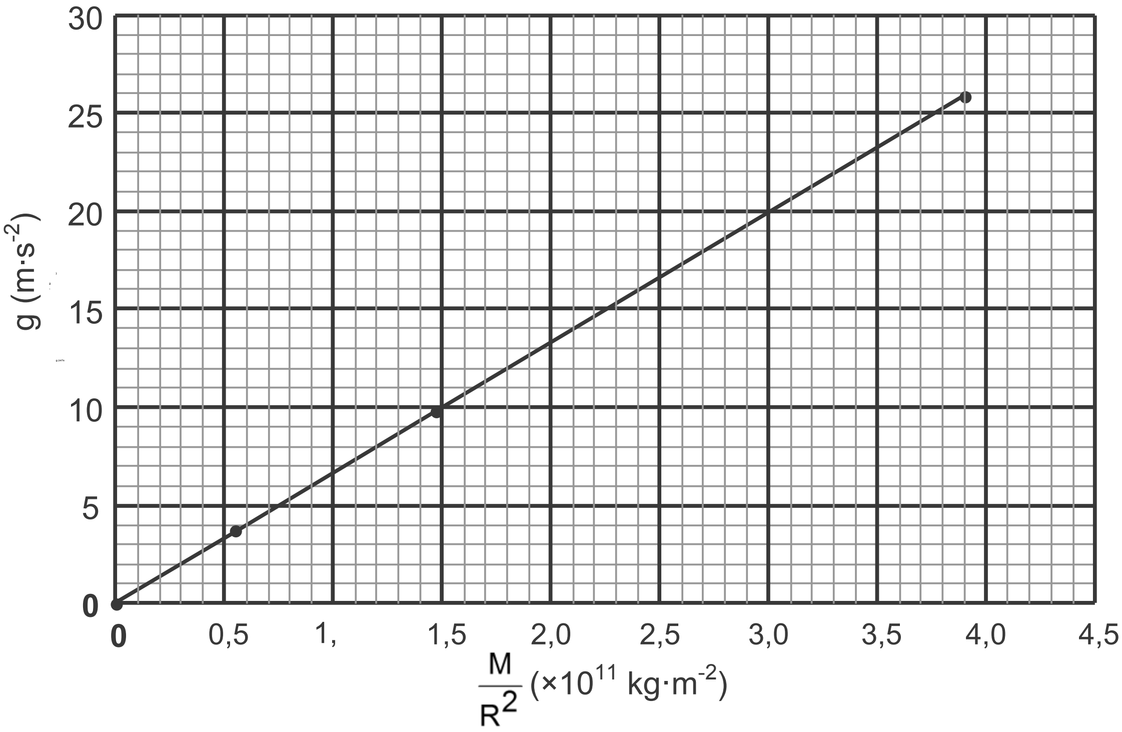
The acceleration of an object is 0,6 $m\cdot s^{-2}$. (2)
[14]

QUESTION 5 (Start on a new page.)

The relationship between gravitational acceleration and the ratio of the mass to the square of the radius ($\frac{M}{R^2}$) of different planets are investigated.

The graph below is obtained from the data collected.

Graph of g versus $\frac{M}{R^2}$



5.1 What relationship between g and $\frac{M}{R^2}$ can be deduced from the graph? (1)

5.2 Calculate the gradient of the graph. (3)

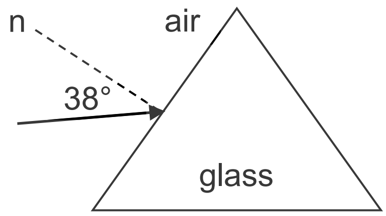
5.3 Which physical constant is represented by the gradient of the graph? (1)

5.4 The gravitational acceleration on Uranus is 9 m·s^{-2}. Use the graph to determine the $\frac{M}{R^2}$ value for Uranus. (2)

5.5 Calculate the mass of Uranus if the radius is 2,54 × 10^{7} m. (2)
[9]

QUESTION 6 (Start on a new page.)

A light ray is incident on a glass prism. The angle of incidence is 38°, as shown below. The refractive index of glass is 1,5 and that of air is 1.

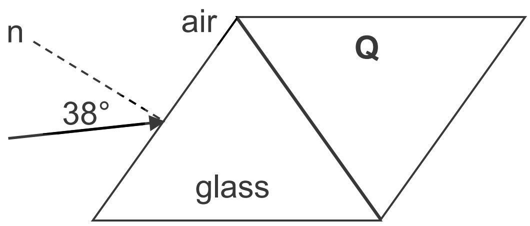


6.1 Define the term *angle of refraction*. (2)

6.2 Calculate the angle of refraction inside the glass prism. (3)

6.3 Redraw the glass prism in the ANSWER BOOK. Complete the path of the light ray inside the prism and label the angle of refraction. (2)

A second prism, **Q**, of unknown material, is now placed next to the glass prism, as shown in the diagram below.



The light ray travels from the glass prism and enters prism **Q** at an angle of incidence of 36°. The angle of refraction inside prism **Q** is 41°.

6.4 Calculate the refractive index of prism **Q**. (2)

6.5 How does the speed of light in the glass prism compare to the speed of light in prism **Q**? Write only GREATER THAN, SMALLER THAN or REMAINS THE SAME. (1)

6.6 Explain the answer to QUESTION 6.5 by referring to the refractive indices of the materials. (2)

The critical angle for the glass prism **Q** boundary is 63,3°. The angle of incidence when the light ray travels from the glass prism to prism **Q** is increased to 65°.

6.7 Define the term *critical angle*. (2)

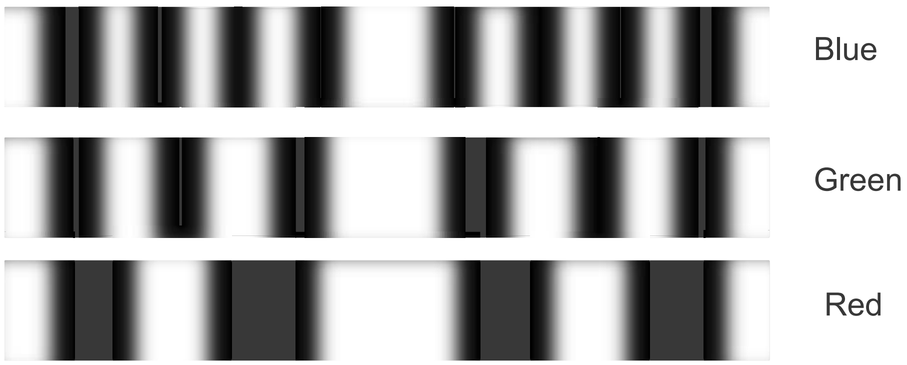
6.8 What observation will be made? Briefly explain the answer. (3)
[17]

QUESTION 7 (Start on a new page.)

An experiment is set up to determine the relationship between the DEGREE OF DIFFRACTION and WAVELENGTH of light. Blue light is passed through a single slit and the pattern formed is observed.

The experiment is now repeated with green light and then with red light. The distance between the light source and the slit remains constant during the investigation.

The patterns obtained are shown in the diagram below.



7.1 Define the term *wave front.* (2)

7.2 What nature of light is demonstrated by diffraction? (1)

7.3 For this experiment, write down:

7.3.1 ONE controlled variable (1)

7.3.2 The independent variable (1)

7.4 Fully explain the difference in the patterns observed. (4)

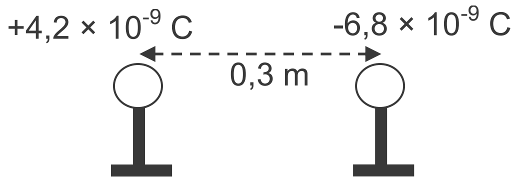
7.5 The experiment with red light is now repeated using a NARROWER slit.

How will the broadness of the central band be affected? Write only INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)

[11]

QUESTION 8 (Start on a new page.)

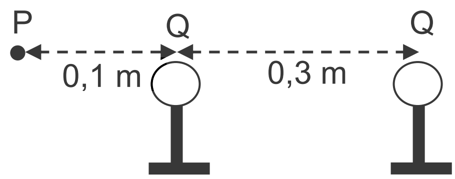
Two small identical metal spheres on insulated stands carry charges of $+4,2 \times 10^{-9}$ C and $-6,8 \times 10^{-9}$ C respectively. They are placed at a distance of 0,3 m apart.



8.1 State *Coulomb's law* in words. (2)

8.2 Calculate the magnitude of the electrostatic force that the one charge exerts on the other. (3)

The two spheres are allowed to touch and are then returned to their original positions.



8.3 Calculate the new charge **Q** on EACH sphere. (3)

8.4 Draw the electric field pattern between the two charged spheres. (2)

8.5 Calculate the magnitude of the net electric field at point **P** situated at 0,1 m to the left of the spheres, as shown in the diagram above. (5)

[15]

QUESTION 9 (Start on a new page.)

A coil with 200 windings and a surface area of $2,8 \times 10^{-3}$ m is rotated at constant speed in a constant magnetic field of 2,5 T. An emf of 3,5 V is induced in the coil.

9.1 Consider the following statement: 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.

Name the law represented by the above statement. (1)

9.2 Calculate the:

9.2.1 Change in magnetic flux if the angle of the coil relative to the magnetic field changes from 0° to 90° (3)

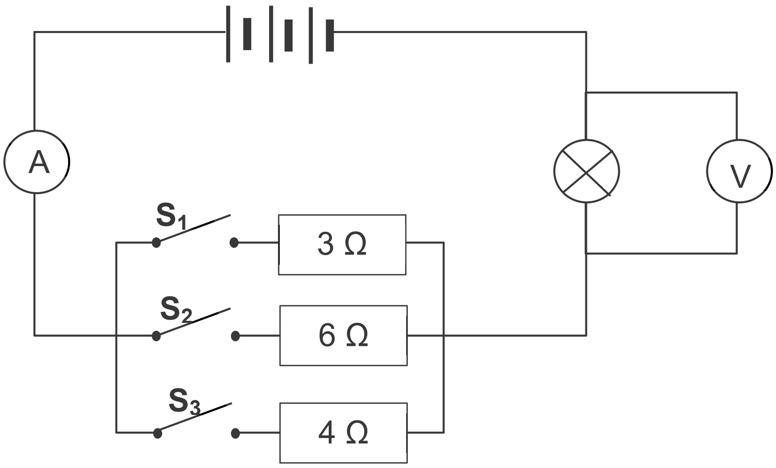
9.2.2 Time it takes the coil to rotate from 0° to 90° (3)

9.3 By what factor will the induced emf change if a coil with 100 windings is used under the same conditions? Give a reason for the answer. (2)

[9]

QUESTION 10 (Start on a new page.)

Three resistors, of resistances 3 Ω, 4 Ω and 6 Ω, and a bulb are connected in a circuit, as shown below. Initially all the switches, $\mathbf{S_1}$, $\mathbf{S_2}$ and $\mathbf{S_3}$, are open. The internal resistance of the battery and the resistance of the connecting wires may be ignored.



10.1 State *Ohm's law* in words. (2)

Switch $\mathbf{S_1}$ is now closed and the voltmeter and ammeter readings are recorded. The voltmeter and ammeter readings, when both switch $\mathbf{S_1}$ and switch $\mathbf{S_2}$ are closed, are then recorded, as well as the readings when all three switches, $\mathbf{S_1}$, $\mathbf{S_2}$ and $\mathbf{S_3}$, are closed.

The results obtained are shown in the table below.

SWITCHES CLOSED	VOLTMETER READING (V)	AMMETER READING (A)
$\mathbf{S_1}$	4,8	2,4
$\mathbf{S_1}$ and $\mathbf{S_2}$	6	3
$\mathbf{S_1}$, $\mathbf{S_2}$ and $\mathbf{S_3}$	7,2	3,6

10.2 Explain the increase in the ammeter reading as more switches are closed. (2)

10.3 Calculate the:

10.3.1 Resistance of the bulb (3)

10.3.2 Potential difference of the battery (4)

10.4 Define the term *power*. (2)

10.5 Calculate the power dissipated in the 6 Ω resistor when ONLY SWITCHES $\mathbf{S_1}$ and $\mathbf{S_2}$ are closed. (4)

10.6 How will the BRIGHTNESS of the bulb be affected as more switches in the circuit are closed? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

10.7 Explain the answer to QUESTION 10.6. (2)
[20]

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 *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 die 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 Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

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*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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