Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2019

PHYSICAL SCIENCES P1 (EXEMPLAR)

MARKS: **150**

TIME: **3 hours**

This question paper consists of 16 pages, including 2 datasheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions in the ANSWER BOOK.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. The formulae and substitutions must be shown in ALL calculations.
8. Give brief motivations, discussions, et cetera where required.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Start EACH question on a NEW page.
11. All diagrams are not necessarily drawn according to scale.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 The force exerted by a surface on an object which is in contact with it and acts perpendicular to the surface is called …

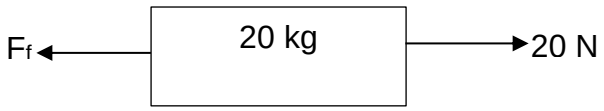
A gravitational force.

B frictional force.

C normal force.

D applied force. (2)

1.2



In the diagram above, a 20 N force is applied on a box of mass 20 kg. The box did not move. What is the magnitude of the static frictional force acting on the box?

A 20 N

B 198 N

C 0 N

D 178 N (2)

1.3 The mass of a man on earth is 85 kg. What will be the mass of the same man on the surface of a planet which has the same mass as earth but half the radius of earth?

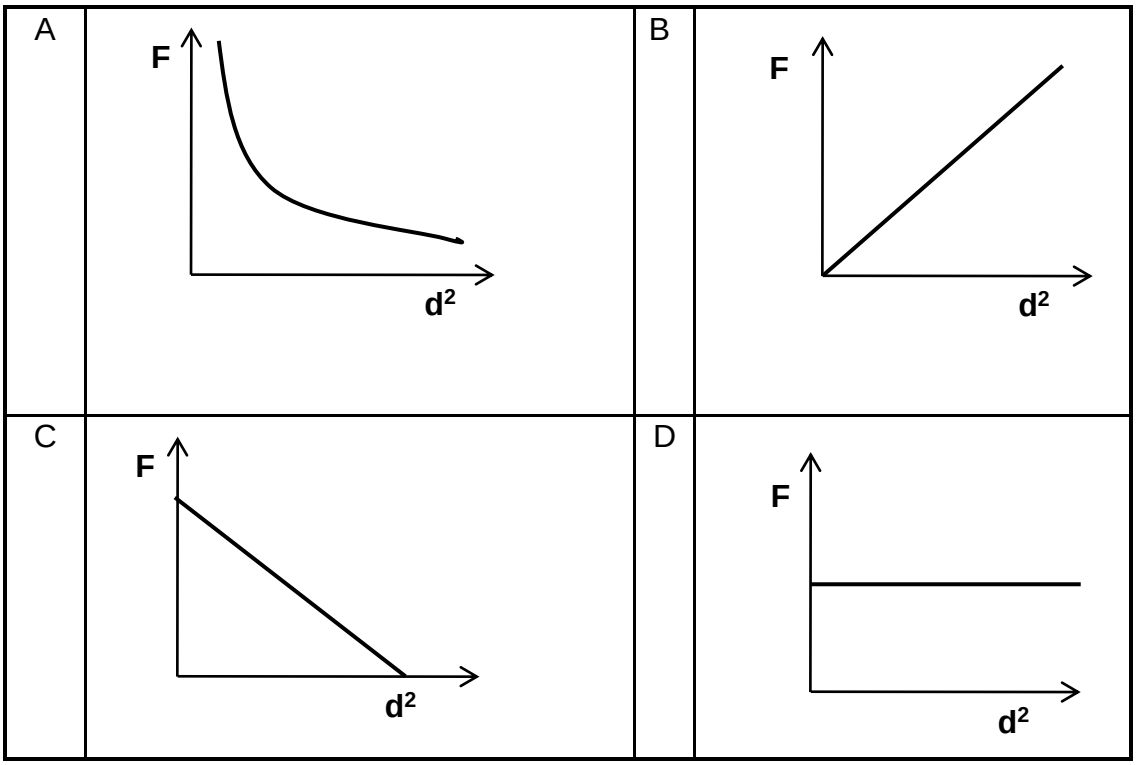
A 42,5 kg

B 21,25 kg

C 340 kg

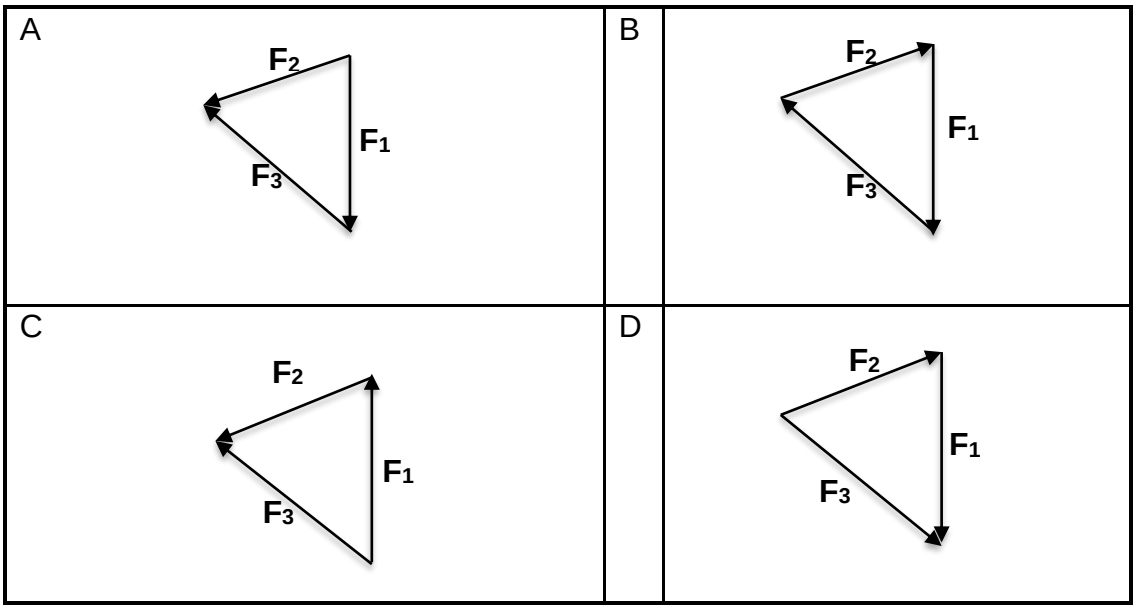
D 85 kg (2)

1.4 An object placed a distance **d** from the centre of a planet experiences an attractive force **F**. Which ONE of the graphs below represents the relationship between force **F** and the distance **d** from the centre of the planet?



(2)

1.5 Three forces acting on an object are in equilibrium. Which ONE of the vector diagrams below indicates the forces in equilibrium?



(2)

1.6 A light ray passes from glass into air. How will the wavelength and frequency of the refracted ray change?

	Wavelength	Frequency of light
A	Increases	Remains the same
B	Increases	Decreases
C	Decreases	Remains the same
D	Decreases	Decreases

(2)

1.7 Which ONE of the phenomena given below explains the wave nature of light?

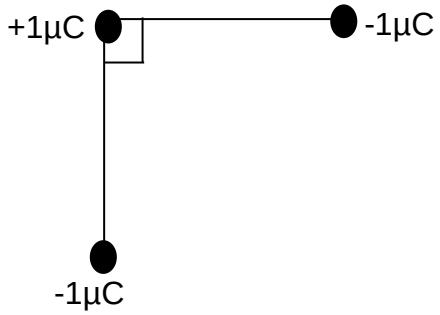
A Refraction

B Diffraction

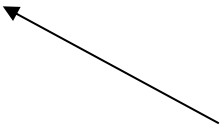
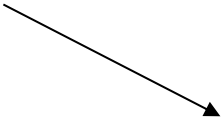
C Reflection

D Superposition (2)

1.8 Three point-charges of magnitude +1 µC, -1 µC and -1 µC are placed in a vacuum to form a right-angle as shown in the diagram below.

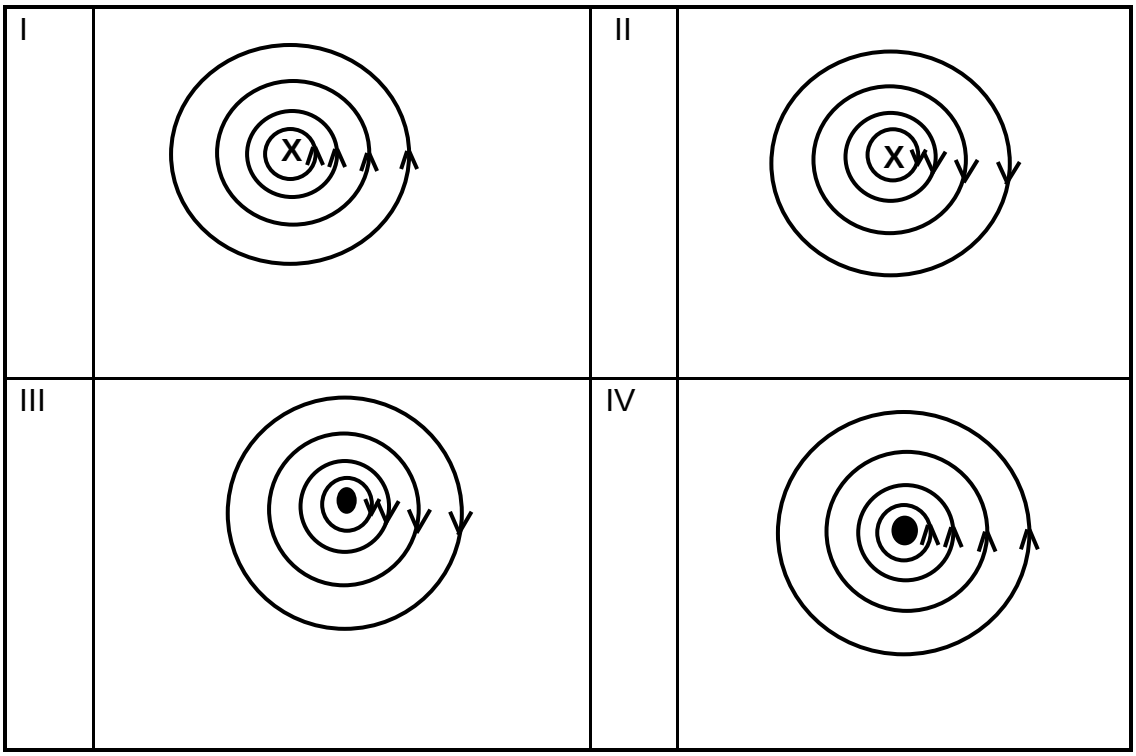


The net force acting on the + 1 µC can by represented by …

A		**B**	
C		**D**	

(2)

1.9 The diagrams below illustrate the shape and direction of the magnetic field around a straight conductor carrying current. Which diagram(s) given below represent(s) the CORRECT magnetic field around the conductor?



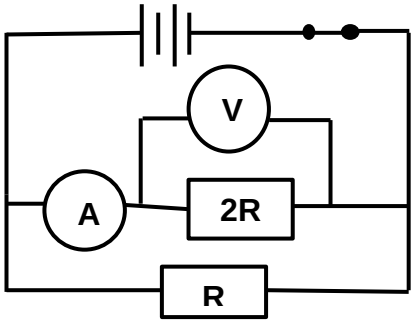
A I only

B I and III only

C IV only

D II and IV only (2)

1.10 In the circuit diagram below, a battery of emf, **ε,** and negligible internal resistance is connected to two resistors in parallel. The resistance of one resistor is double the resistance of the other.



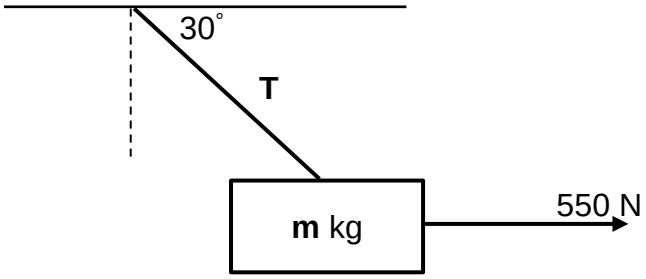
The current in the circuit is **I**. What are the readings on the ammeter and voltmeter?

	AMMETER READING	VOLTMETER READING
A	$\frac{2}{3}$ **I**	2 **ε**
B	$\frac{1}{3}$ **I**	**ε**
C	$\frac{1}{3}$ **I**	2 **ε**
D	$\frac{2}{3}$ **I**	**ε**

(2)
[20]

QUESTION 2

A 550 N force is applied horizontally on a block of mass **m** kg by means of a massless inextensible rope. The block remains stationary when the angle that the rope makes with the horizontal is 30°.



2.1 Explain why the block is stationary. (2)

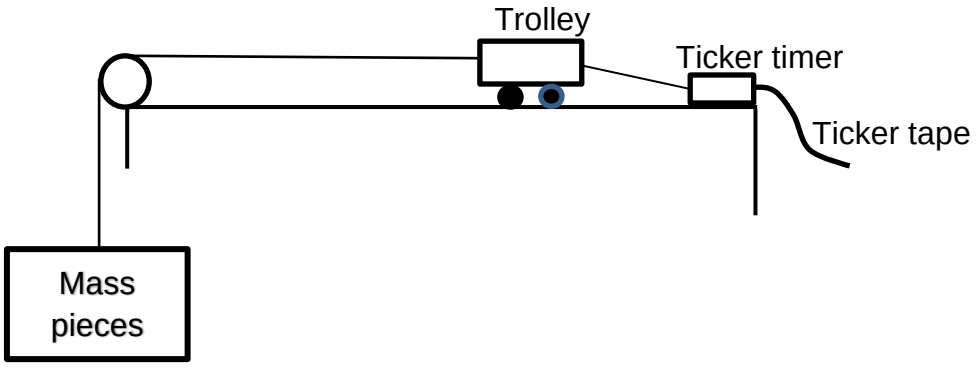
2.2 Use either calculation or construction to determine the tension, **T**, in the rope. Use a scale of 1 cm : 100 N. (4)

2.3 Calculate the mass of the block. (6)

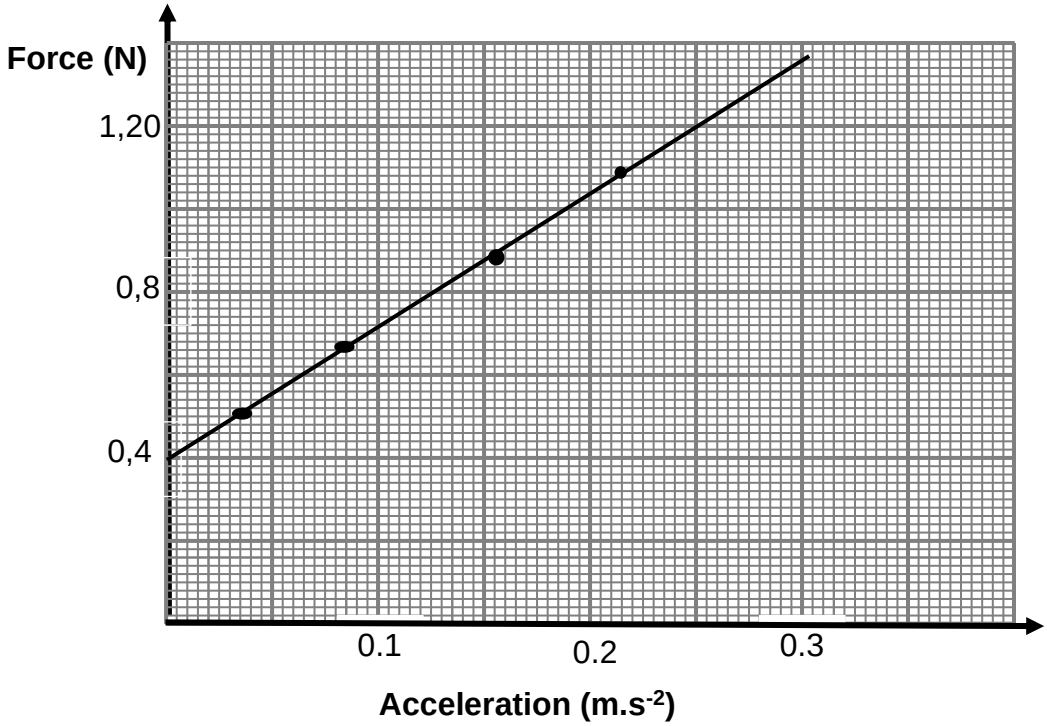
[12]

QUESTION 3

Learners conducted an investigation to determine the relationship between acceleration and applied force. During the investigation, a mass piece which hangs vertically by means of an inextensible string that passes over a frictionless pulley is used to accelerate a trolley across a horizontal surface as shown in the diagram below. Four different mass pieces were used to obtain four sets of readings.



A ticker timer and tape are attached to the trolley. As the trolley moves, the ticker timer makes dots on the tape. The tape is used to analyse the motion. The learners' results are plotted on a graph as shown below.



3.1 For this investigation write down:

3.1.1 The conclusion of the learners (2)

3.1.2 An expression to calculate the net force acting on the trolley (1)

3.2 Give a reason why the graph does not start from the origin (0;0). (2)

3.3 What physical quantity does the intercept on the vertical axis represent? (1)

3.4 What physical quantity does the gradient of the graph represent? (1)

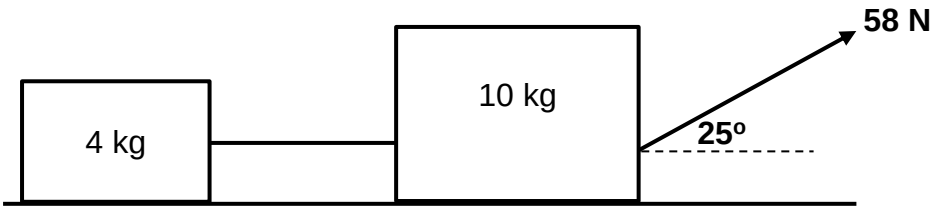
3.5 Use the information from the graph to calculate the mass of the trolley. (4)

3.6 The learners conducted another investigation using a trolley of a bigger mass than the trolley used in the first investigation but made of the same material. How does the vertical axis intercept of the graph of the second investigation compare with that of the first investigation? Answer LESS THAN, GREATER THAN or REMAINS THE SAME. Explain your answer. (3)

[14]

QUESTION 4

Two blocks of masses 10 kg and 4 kg are connected with a light inextensible string and placed on a horizontal surface. When a force of 58 N is applied to the 10 kg block at an angle of 25° with the horizontal, the system accelerates at 2,72 $m.s^{-2}$ to the right as shown on the diagram below. The 4 kg block experiences a constant frictional force of 2,5 N.



4.1 State Newton's second law of motion in words. (2)

4.2 Draw a free body diagram of all forces acting on the 10 kg block. (5)

4.3 Calculate the: …

4.3.1 Tension in the string connecting the two blocks (4)

4.3.2 Coefficient of kinetic friction between the 10 kg block and the surface (6)

4.4 The angle at which the force is applied is decreased to 15°. How will the answer in QUESTION 4.3.2 change? Write down only INCREASES, DECREASES or REMAINS THE SAME. Explain your answer. (2)

[19]

QUESTION 5

An object of mass 200 kg is orbiting the earth at a distance **d** from the earth's surface. The weight of the object at that position is 10% less than its weight on the earth's surface.

5.1 State Newton's law of universal gravitation in words. (2)

5.2 Calculate the distance **d** from the earth's surface at which the satellite is orbiting. (7)

5.3 The object is moved to a new position where the distance from the centre of the earth is twice the radius of the earth.

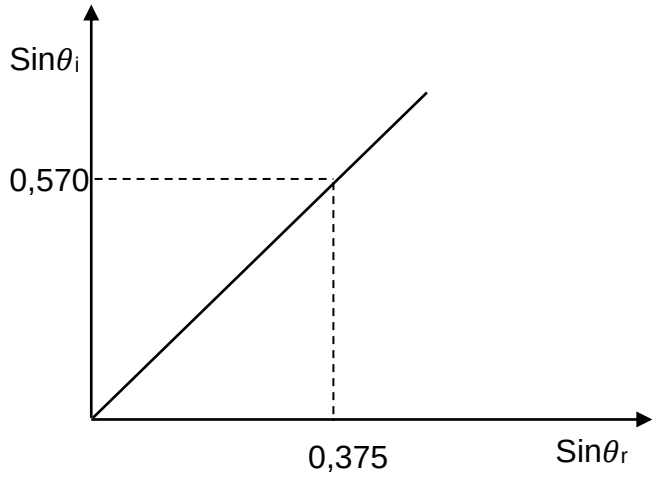
5.3.1 Write down the mathematical relationship between the weight of the object and the distance at which it is placed from the centre of the earth. (1)

5.3.2 Determine the weight of the object at the new position. (3)

[13]

QUESTION 6

Learners conducted an experiment to verify Snell's law. Using a ray box, light rays were incident at different angles on a glass prism and the corresponding angles of refraction measured and recorded. They plotted their results on the graph below. The refractive index of air is 1,00.



6.1 Calculate the:

6.1.1 Speed of light in a glass (4)

6.1.2 Critical angle for the glass (4)

6.1.3 Angle of incidence for which the angle of refraction is 25° (4)

6.2 In another experiment learners incident the light ray on a Perspex prism of refractive index at 1,42. Re-draw the graph on the question paper in your ANSWER BOOK. On the same set of axes draw a second graph for the experiment with Perspex prism. Label the graphs (Glass and Perspex). (2)

6.3 In which of the two graphs (Glass or Perspex), will light travel faster? Explain your answer. (2)

6.4 State TWO conditions necessary for total internal reflection to occur. (2)

[18]

QUESTION 7

When light passes through a narrow slit, a diffraction pattern can be observed on a screen.

7.1 State Huygen's Principle. (2)

7.2 Blue light is viewed through a narrow slit.

7.2.1 Draw the pattern that can be observed on a screen. (3)

7.2.2 Explain how this diffraction pattern is formed. (2)

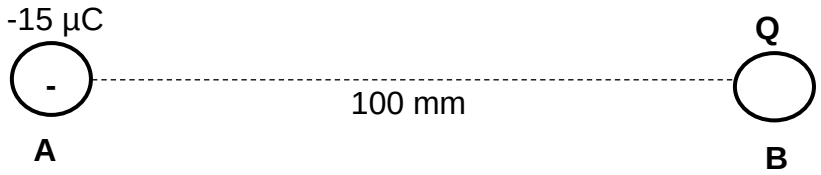
7.3 The slit width is now made smaller. How will the degree of diffraction for the second slit compare with that of the first slit? Write only GREATER THAN, LESS THAN or EQUAL TO. (1)

7.4 The blue light is replaced with red light. How will the pattern formed by the blue light compare with the pattern formed by the red light? (2)

[10]

QUESTION 8

A small sphere **A** carrying a charge of -15 µC is brought into contact with an identical neutral sphere **B**. After a while, sphere **B** gains a charge of **Q** and the spheres repel each other and are then separated to a distance 100 mm apart as shown on the diagram below.



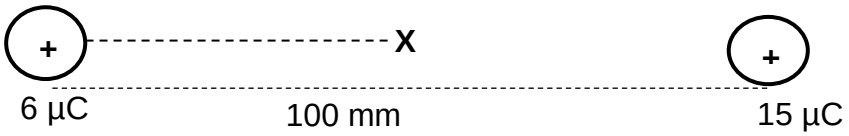
8.1 Calculate the number of electrons that will be transferred to the neutral sphere after they are separated. (3)

8.2 Draw the electric field pattern around the two charged spheres after they are separated. (3)

8.3 Calculate the electrostatic force between the two charged spheres. (4)

8.4 The charge on each sphere is now doubled, and the distance increased to 200 mm. How will the new electrostatic force between the charges compare to the answer calculated in QUESTION 8.3? Explain how you arrived at your answer. (2)

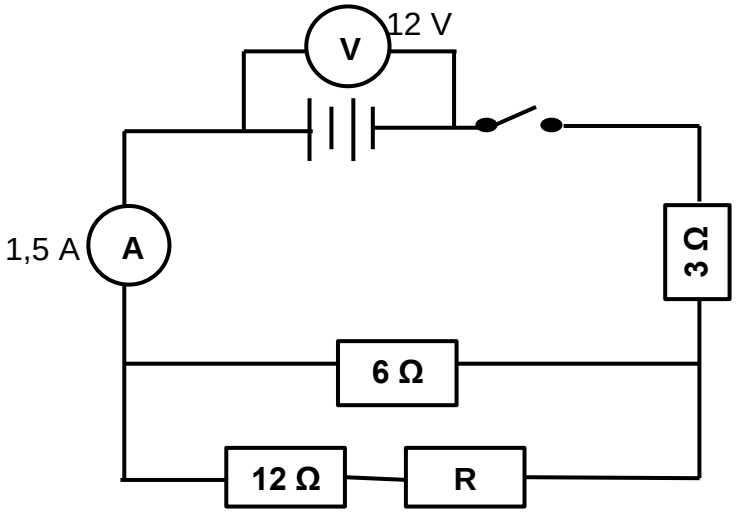
8.5 Two positive point charges of magnitude 6 µC and 15 µC are placed 100 mm apart in a vacuum as shown on the diagram below.



When an electron is placed at point **X**, a distance **r** to the right of the 6 µC, it experiences zero acceleration.
Calculate the distance **r** in metres. (5)
[17]

QUESTION 9

9.1 In the circuit diagram below, the battery has emf of 12 V and negligible internal resistance. The resistance of resistor **R** is unknown. When the switch is closed the ammeter, **A**, reads 1,5 A.



When the switch is closed calculate the:

9.1.1 Potential difference across the parallel resistors (4)

9.1.2 Resistance of the resistor R (5)

9.1.3 Power delivered by the 6 Ω resistor (3)

9.2 The 3 Ω resistor is now removed from the circuit and replaced with a conducting wire of negligible resistance, how will this change affect the ammeter reading? Write only INCREASE, DECREASE or REMAIN THE SAME. Explain your answer. (2)

9.3 The kettle is rated 2 000 W. Calculate how much it will cost to use the kettle for 5 hours. 1 unit of electricity (1 kWh of electricity) cost R1,02. (3)
[17]

QUESTION 10

An emf of 0,25 V is induced in a solenoid of 200 turns when it is pulled out of a magnetic field of 0,8 T at an angle θ in 0,01 second. The radius of the solenoid is 1 mm.

10.1 State Faraday's law in words. (2)

10.2 Calculate the …

10.2.1 change in magnetic flux linkage (Φ) with the solenoid. (3)

10.2.2 angle θ at which the solenoid is pulled out of the magnetic field. (4)

10.3 A second solenoid of a bigger cross section is now pulled out of the same magnetic field at the same angle. How will the emf induced in the second solenoid compare with that in the first solenoid? Write only INCREASE, DECREASE or REMAIN THE SAME. (1)

[10]

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•s^{-2}
Universal gravitational constant / *Universelegravitasiekonstant*	G	6,67 × 10^{-11} N•m^{2}•kg^{-2}
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	3,0 × 10^{8} m•s^{-1}
Planck's constant / *Planck se konstante*	h	6,63 × 10^{-34} J•s
Coulomb's constant / *Coulomb se konstante*	k	9,0 × 10^{9} N•m^{2}•C^{-2}
Charge on electron / *Lading op elektron*	e	-1,6 × 10^{-19} C
Electron mass / *Elektronmassa*	m_e	9,11 × 10^{-31} kg
Mass of earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 10^{3} km

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$\mu_s = \frac{f_s^{max}}{N}$
$\mu_k = \frac{f_k}{N}$	

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^{-1})	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ (k = 9,0 x 10^9 N.m^2.C^{-1})	$n = \frac{Q}{q_e}$

ELECTROMAGNETISM/ *ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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