Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

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PHYSICAL SCIENCES P1 (PHYSICS)

FINAL EXAMINATION

NOVEMBER 2025



GRADE 11

MARKS: 150

TIME: 3 hours

This question paper consists of 18 pages and THREE data sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

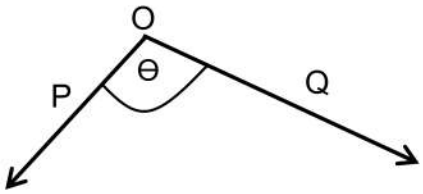
1. Write your name on the **ANSWER BOOK.**
2. This question paper consists of **TEN** questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subsections, 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 SHEET.
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.

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QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 — 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Two forces P and Q act at a point O.



As the angle Θ between P and Q varies, the MAXIMUM and MINIMUM resultant forces are 13 N and 3 N respectively. The magnitudes of the two forces are:

A 3 N and 10 N
B 16 N and 10 N
C 8 N and 5 N
D 10 N and 7 N (2)

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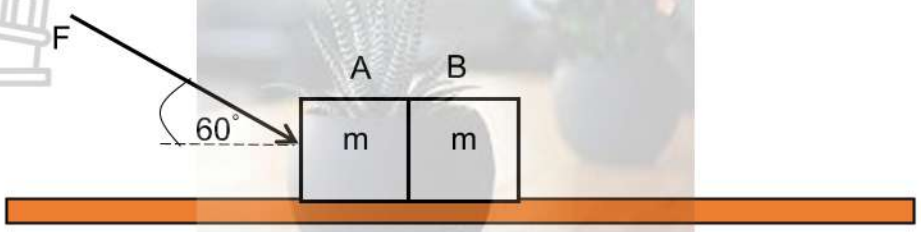
1.2 A passenger standing in a moving bus moves forward when the bus suddenly stops. This can best be explained by

A Newton's First law of motion
B Newton's Second law of motion
C Newton's Third law of motion
D Newton's law of Universal gravitation (2)

1.3 A learner sits on a chair. What is the reaction force to her sitting on the chair?

A Force that the learner exerts on the chair.
B Weight of the learner.
C Force that the chair exerts on the learner.
D Force that the learner exerts on Earth. (2)

1.4 Force F, acting at an angle of 60° to the horizontal, is applied to two identical blocks, A and B lying on a smooth horizontal surface. The blocks, each having mass m, are in contact with each other.

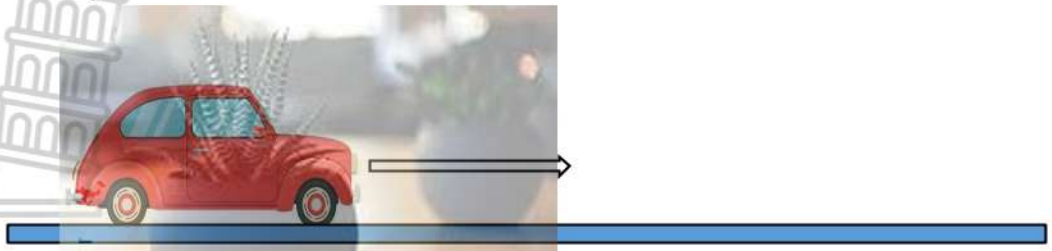


What is the magnitude of the force that block A exerts on block B in terms of F?

A ½ F
B ¼ F
C ¾ F
D F

(2)

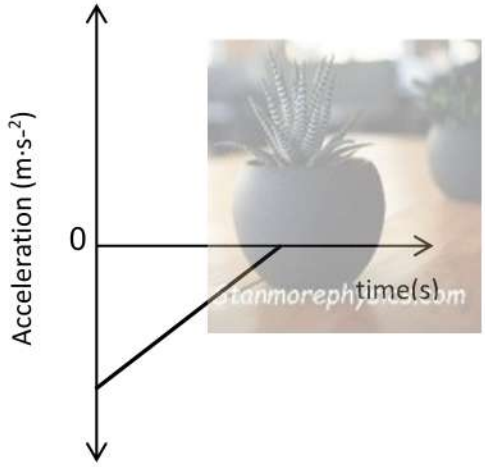
1.5 A car, moving to the right along a rough horizontal surface, is brought to rest by a constant net force.



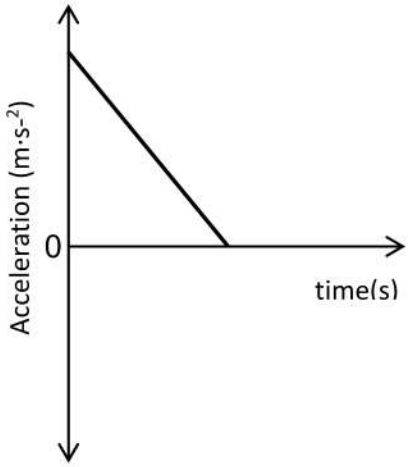
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If the motion of the car to the right is taken as positive, which ONE of the following acceleration versus time graphs is correct for the motion of the car?

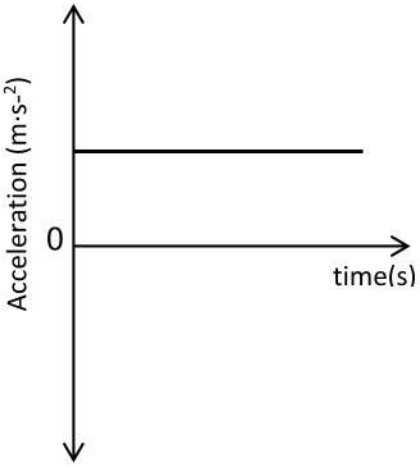
A



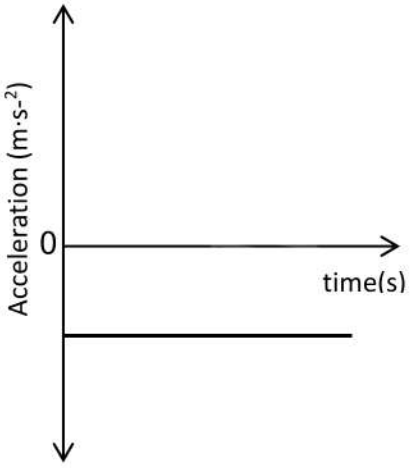
B



C

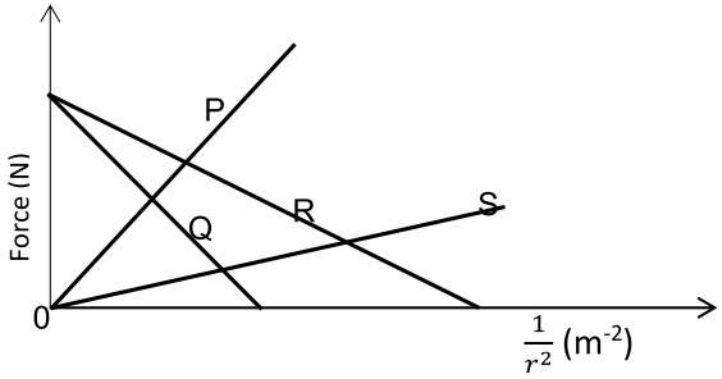


D



(2)

1.6 The graphs P, Q, R and S drawn below show a relationship between the force of attraction that two masses exert on each other and the inverse of the square of the distance between their centres.



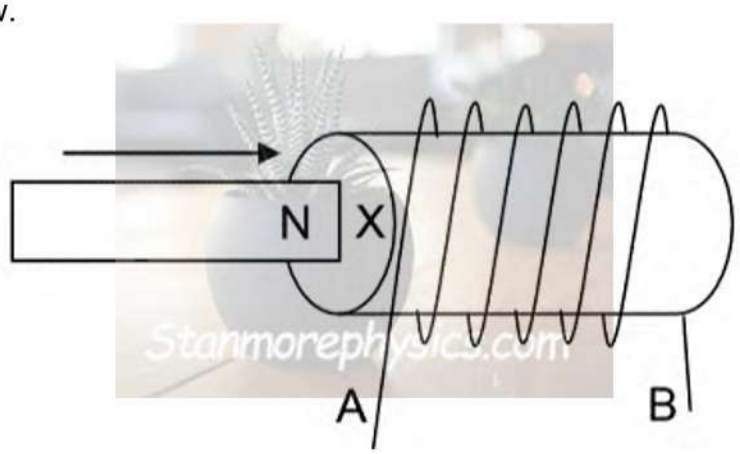
In which graph will the product of their masses be the largest?

A P
B Q
C R
D S (2)

1.7 The force of attraction between two charges q_1 and q_2 is F.
If the distance between the charges is made four times smaller, then the new force of attraction will be ...

A 0,5 F
B 1,78 F
C 2,5 F
D 16 F (2)

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



The polarity of X on the solenoid and the direction of flow of the induced current through the solenoid will be …

	Polarity of X	Direction of current flow
A	North	B to A
B	South	A to B
C	North	A to B
D	South	B to A

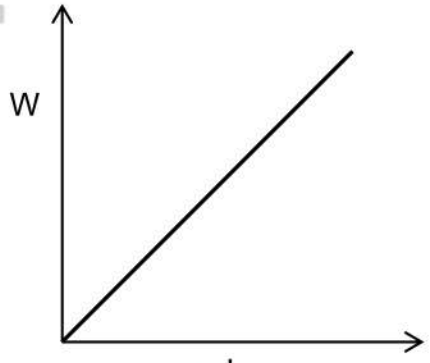
(2)

1.9 The ampere second (A·s) is the unit for

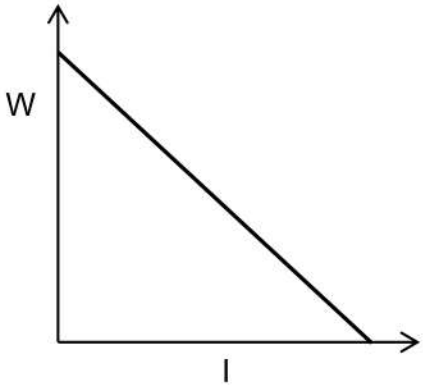
A Current strength
B Quantity of Charge
C Resistance
D Potential difference (2)

1.10 Which ONE of the following graphs represents the relationship between the total electrical energy transferred (W) and the electric current (I) in the element of a kettle? The resistance of the element and the time for which the current flows are constant.

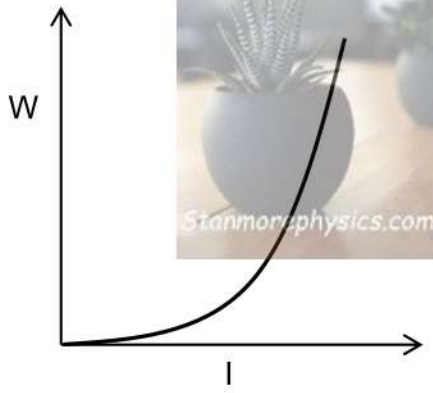
A



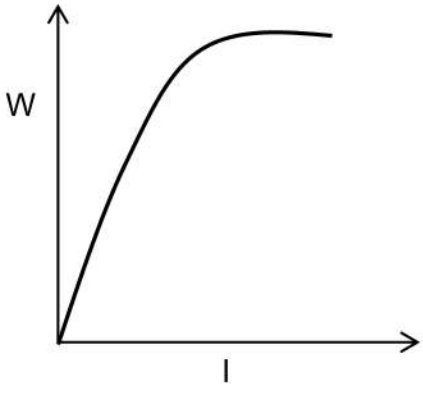
B



C



D

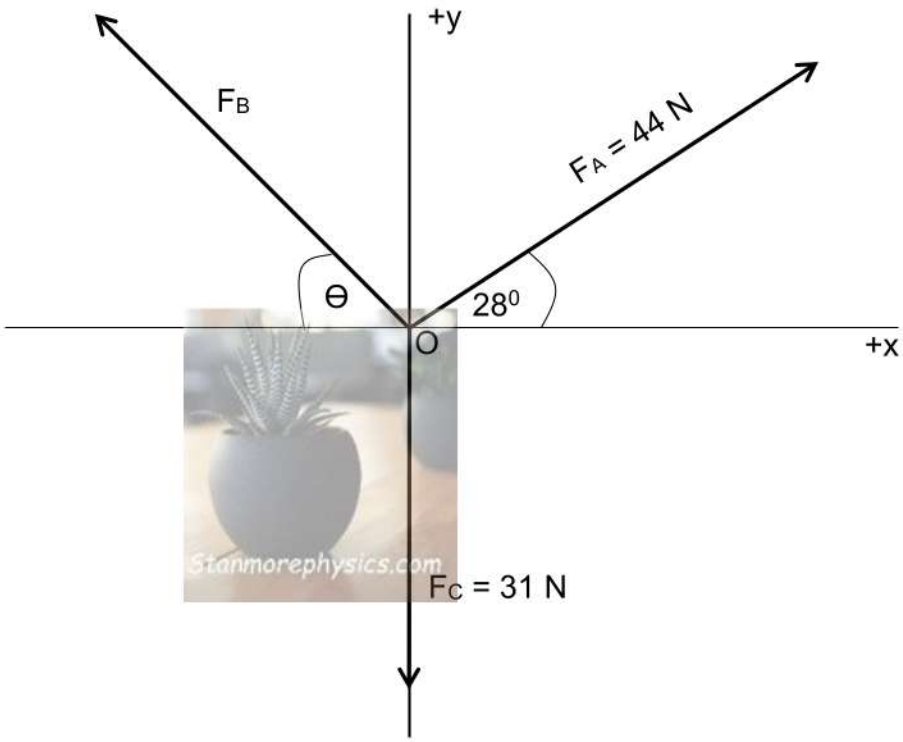


(2)

[20]

QUESTION 2

Three forces F_A, F_B and F_C act on a point O in the directions shown in the diagram below. The magnitudes of F_A and F_C are 44 N and 31 N respectively. The magnitude of F_B is unknown. The forces are NOT drawn to scale.



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

The resultant of the three forces is 26,69 N at an angle of 25,82° to the horizontal, and lies in the first quadrant.

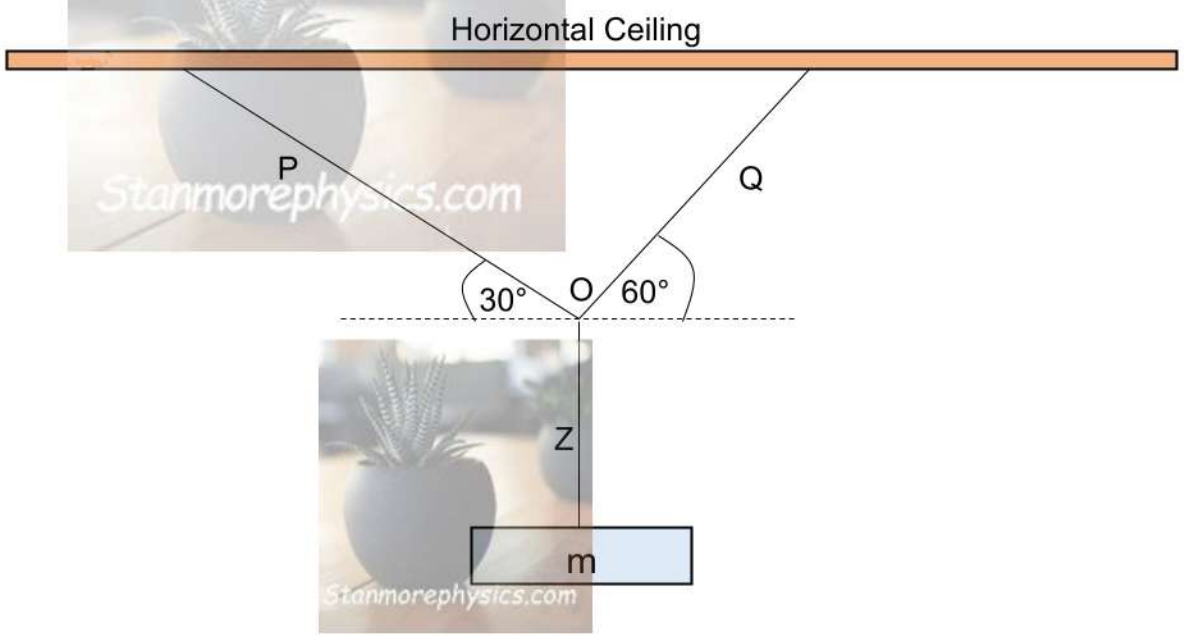
2.2 Calculate the magnitude of F_B. (7)

2.3 Determine Θ (2)

[11]

QUESTION 3

An object of mass m is attached to string Z and hangs vertically downwards at point O. Strings P and Q connect point O to a horizontal ceiling, making angles of 30° and 60° with the horizontal respectively at point O, as shown in the diagram below. All the strings are light and inextensible.



3.1 State what is meant by *forces in equilibrium*. (2)

3.2 Draw a labelled closed vector diagram of forces, showing ALL the forces acting on point O. Indicate TWO angles in the diagram. (3)

3.3 The tension in string P is 50 N.
Calculate:

3.3.1 The tension in the string Q (3)

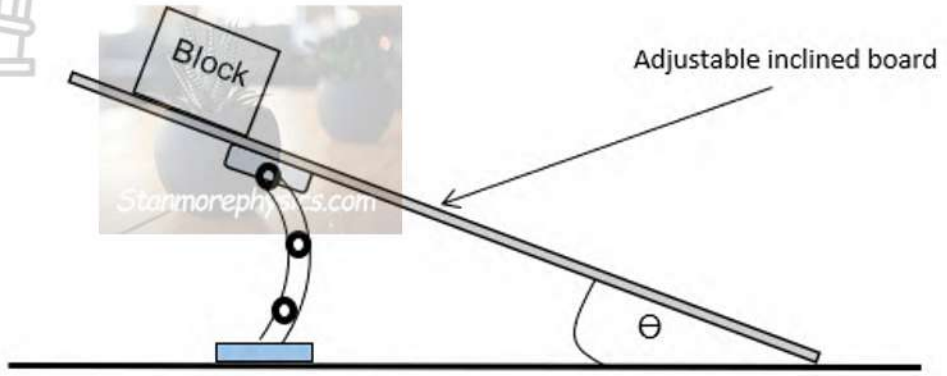
3.3.2 The mass of the object (4)

3.4 In which of the strings P, Q or Z will the tension be the greatest? Give a reason for the answer. (2)

[14]

QUESTION 4

Learners set up an experiment to determine the coefficient of static (μ_s) for a block placed on an inclined plane. They set up the experiment as shown below.



They used the following apparatus:

- Wooden board (For adjustable inclined surface)
- Wooden block
- Protractor to measure the angle of inclination

The following procedure was followed:

A block was placed on the inclined surface and the incline was adjusted until the block just begins to move on its own (run 1). The angle at which the block starts to move (Θ_S) was recorded and the procedure was repeated for an additional 3 runs.

The data obtained from the above experiment is shown in the table below.

Run	Θ_S	Coefficient of static friction(μ_s)
1	31°	0,60
2	35°	0,70
3	34°	0,68
4	32°	**X**
Average coefficient of static friction (μ_s)	**Y**	

4.1 Define *static friction* in words. (2)

4.2 Using relevant formulae, show that $\mu_s = \tan \Theta$. (4)

4.3 Determine the values of **X** and **Y** in the table. (4)

4.4 Angle Θ is now set so that the block is allowed to slide down the inclined surface at constant velocity. How does the coefficient of kinetic friction compare to the coefficient of static friction? Choose from GREATER THAN, LESS THAN or EQUAL TO. (2)

[12]

QUESTION 5

5.1 A man of mass 80 kg stands on a scale placed on the floor of a stationary lift. The mass of the lift is 1500 kg.



When the lift accelerates upwards the tension in the cable, T, is 17 000 N.

5.1.1 State *Newton's Second law of motion* in words. (2)

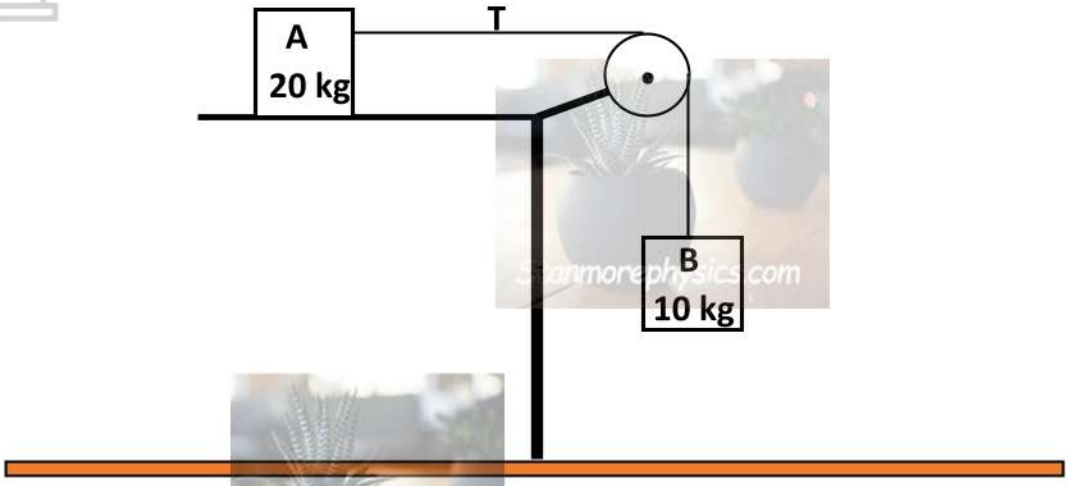
5.1.2 Calculate the magnitude of the acceleration of the lift as it moves upwards. (4)

5.1.3 Will the reading on the scale be GREATER THAN, LESS THAN or EQUAL TO the weight of the man? Briefly explain the answer by referring to the forces involved. (3)

The lift now accelerates downwards at 1 $m \cdot s^{-2}$.

5.1.4 Calculate the reading on the scale. (3)

5.2 The diagram below shows two blocks A and B of mass 20 kg and 10 kg respectively, connected by a light, inextensible string over a frictionless pulley. Block A is held at rest on a rough surface.



.5.2.1 Define the term *normal force*. (2)

When block A is released, it accelerates to the right. The tension in the string is T and the coefficient of kinetic friction (μ_k) between block A and the surface is 0,25.

5.2.2 Draw a labelled free body diagram showing all the forces acting on block A while it accelerates. (4)

5.2.3 Calculate the magnitude of the acceleration of the blocks, by applying Newton's second law separately to each block. (6)

A 4 kg block is now placed on top of block A while it is accelerating to the right. The 4 kg block does not slide on block A.

5.2.4 How will the tension in the string, T be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME.
Explain the answer. (3)
[27]

QUESTION 6

The mass of planet Jupiter is 300 times the mass of Earth and its radius is 11 times larger than that of Earth. An astronaut has a mass of 120 kg.

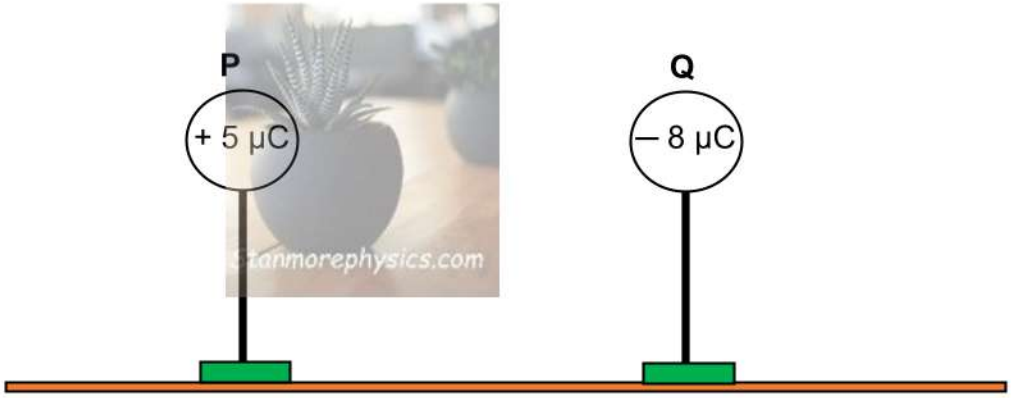
6.1 State *Newton's law of universal gravitation* in words. (2)

6.2 What will the weight of the astronaut be on the surface of Jupiter? (4)

[6]

QUESTION 7

7.1 Two spheres P and Q, placed on insulated stands, carry charges of +5 μC and −8 μC respectively.



7.1.1 Explain why the charges are placed on insulated stands. (1)

The charges are brought into contact and are then separated.

7.1.2 Are electrons transferred from **P** to **Q** or from **Q** to **P** during contact? Give a reason for the answer. (2)

7.1.3 Calculate the number of electrons transferred. (5)

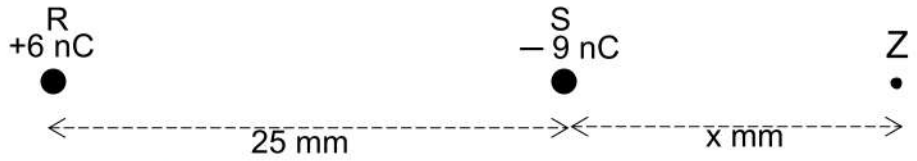
7.1.4 Name and state the law used in the calculation in QUESTION 7.1.3. (3)

7.2 R is a point charge of magnitude +6nC

R ●

7.2.1 Draw the electric field pattern for charge R. (2)

S is a point charge of magnitude –9 nC placed 25 mm to the right of R. Z is a point x mm east of point charge S. Point charges R and S, and point Z lie on the same line.



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

7.2.3 Calculate the magnitude of the electrostatic force that charge R exerts on charge S. (4)

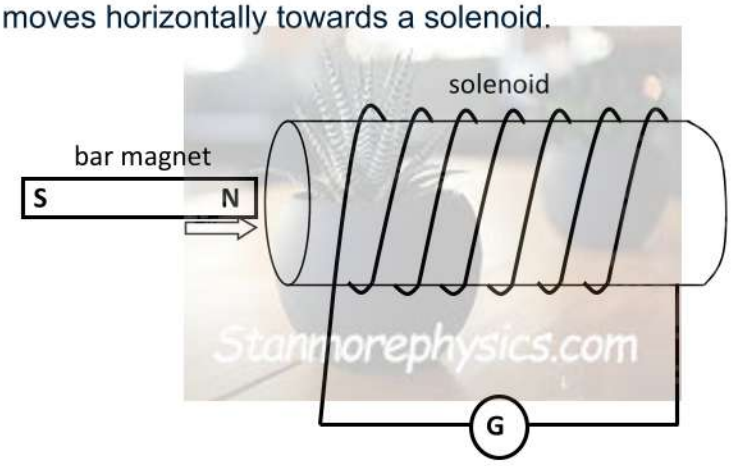
The net electric field at point Z is $7{,}66 \times 10^5$ N·C^{-1} west.

7.2.4 Calculate the value of x in metres. (5)

[24]

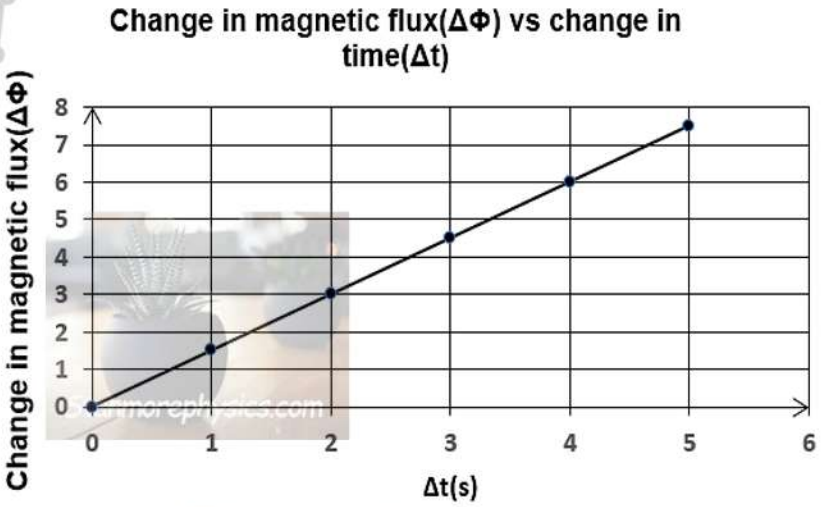
QUESTION 8

8. A bar magnet moves horizontally towards a solenoid.



8.1 State Faraday's Law of *electromagnetic induction* in words (2)

The graph below shows the change in magnetic flux (ΔΦ) versus the change in time (Δt) as the bar magnet moves through the solenoid.



8.2 Use the graph to calculate the rate of change of magnetic flux linked to the coil. (3)

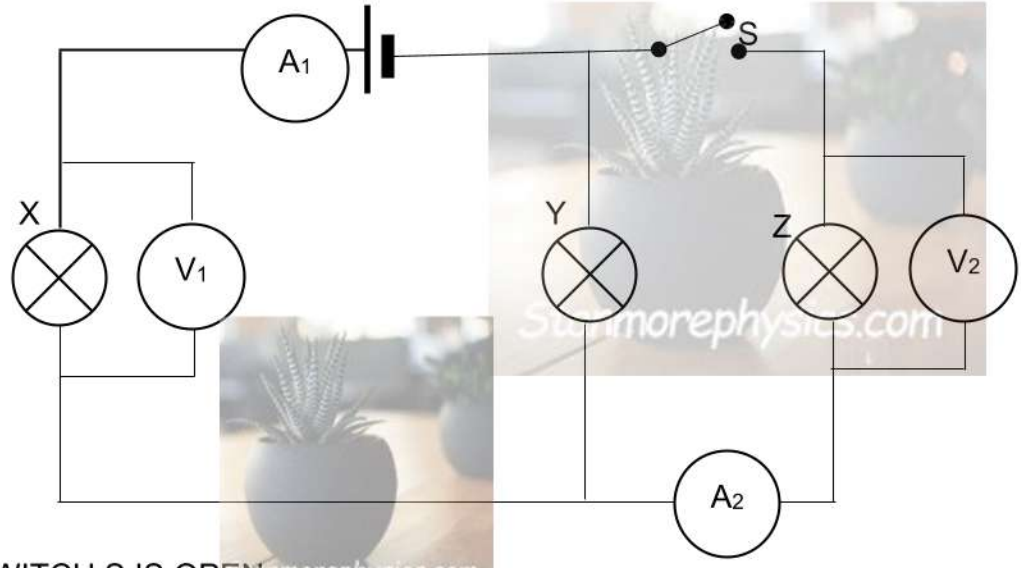
8.3 Calculate the magnitude of the EMF induced across the coil if the coil has 120 turns. (4)

8.4 State TWO ways by which the induced EMF in the coil can be increased. (2)

[11]

QUESTION 9

9.1 The circuit diagram below shows three identical light bulbs X, Y and Z connected to a battery of negligible internal resistance. Two voltmeters, a switch S and two ammeters are also connected in the circuit as shown.



SWITCH S IS OPEN

9.1.1 How does the brightness of bulb X compare to that of bulb Y? Choose from X IS BRIGHTER, X IS DIMMER or X AND Y ARE EQUALLY BRIGHT. Give a reason for the answer. (2)

SWITCH S IS NOW CLOSED.

9.1.2 Which of the ammeters, A_1 or A_2 will have a higher reading? (1)

9.1.3 Using relevant equations show that the reading on $V_1 = 2\ V_2$. (2)

BULB Y BURNS OUT WHILE SWITCH S IS CLOSED.

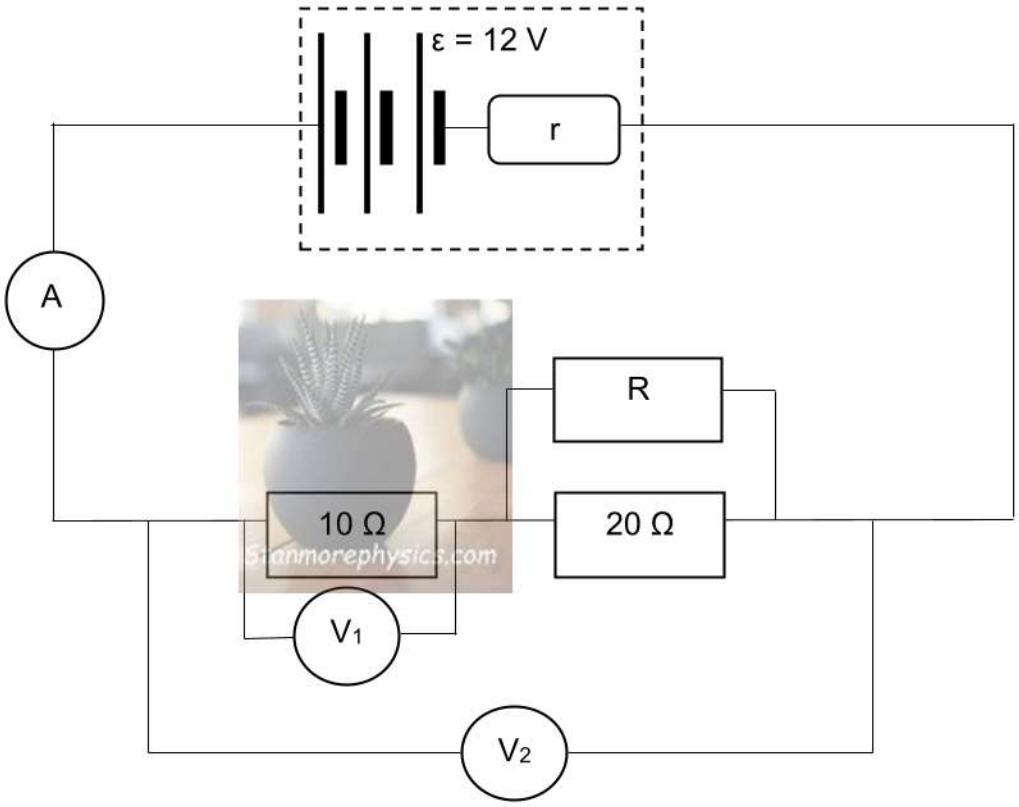
9.1.4 What effect will this have on the reading on voltmeter V_2? Choose from INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (4)

9.2 An electric iron has specifications " 220 V; 2000 W". Calculate the cost of using the iron for 15 minutes if the cost of electricity is R2,80 per kWh. (3)

[12]

QUESTION 10

Three resistors are connected in an electric circuit as shown in the diagram below. The ammeter and the connecting wires have negligible resistance. The voltmeters have very high resistance.
The battery has an emf (ε) of 12 V and significant internal resistance (r).



The voltmeters V_1 and V_2 read 8 V and 11,8 V respectively.

10.1 Calculate the reading on the ammeter. (3)

10.2 Calculate the resistance of resistor R. (5)

10.3 Calculate the internal resistance of the battery. (5)
[13]

TOTAL : 150

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DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m{\cdot}s^{-2}$
Universal gravitational constant	G	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Radius of the Earth	R_E	$6,38 \times 10^6\ m$
Mass of the Earth	M_E	$5,98 \times 10^{24}\ kg$
Speed of light in a vacuum	c	$3,0 \times 10^8\ m{\cdot}s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}\ J{\cdot}s$
Coulomb's constant	k	$9,0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2}$
Charge on electron	e	$-1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9,11 \times 10^{-31}\ kg$

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TABLE 2: FORMULAE

MOTION

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

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$	$g = G\frac{M}{d^2}$



ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$	

ELECTRIC CIRCUITS

$R = \frac{V}{I}$	emf (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

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ELECTROMAGNETISM

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