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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES

COMMON ASSESSMENT TASK

MARCH 2025

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TIME: 2 hours

MARKS: 100

This question paper consists of 12 pages, TWO data sheets and a special answer sheet for Question 3.

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INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK.**
2. This question paper consists of **EIGHT** 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 — 1.7) in the ANSWER BOOK, for example 1.8E

1.1 The statements below refer to vector and scalar quantities.

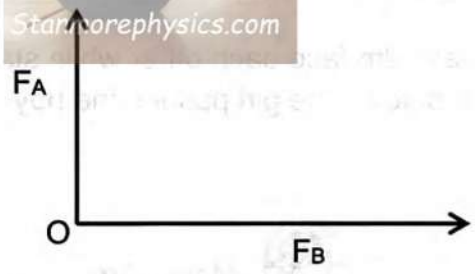
(i) A vector has magnitude and direction while a scalar has magnitude only.
(ii) A scalar quantity can always be added to a vector quantity.
(iii) Force is an example of a vector quantity, while the change in position is an example of a scalar quantity.

Which of the above statements is/are TRUE?

A (i) only
B (i) and (ii) only
C (i) and (iii) only
D (i), (ii) and (iii)

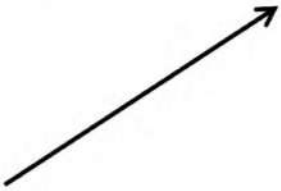
(2)

1.2 Two forces F_A and F_B act at a point O as shown.

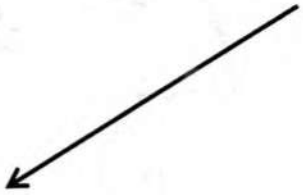


Which ONE of the following forces correctly represents the direction of the resultant of these two forces?

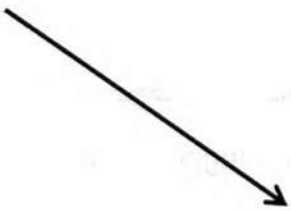
A



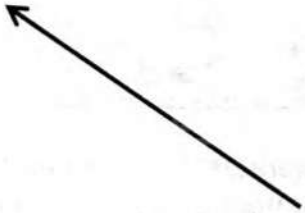
B



C



D



(2)

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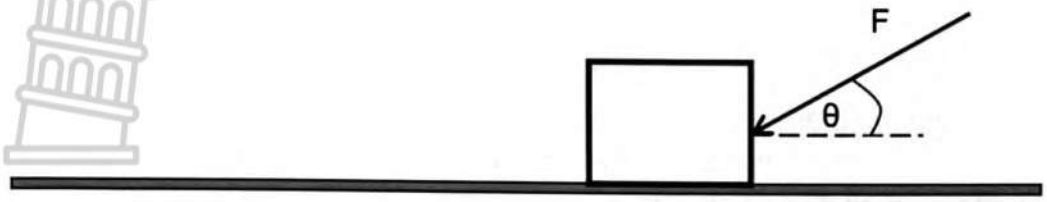
1.3 A force of magnitude F acts on a block at an angle θ to the horizontal, as shown in the diagram below. The block, initially at rest on a flat, frictionless surface, accelerates uniformly.



Angle θ is now halved. How will the NORMAL FORCE and the NET HORIZONTAL FORCE acting on the block change?

	NORMAL FORCE	NET HORIZONTAL FORCE
A	Increases	Increases
B	Decreases	Increases
C	Increases	Decreases
D	Decreases	Decreases

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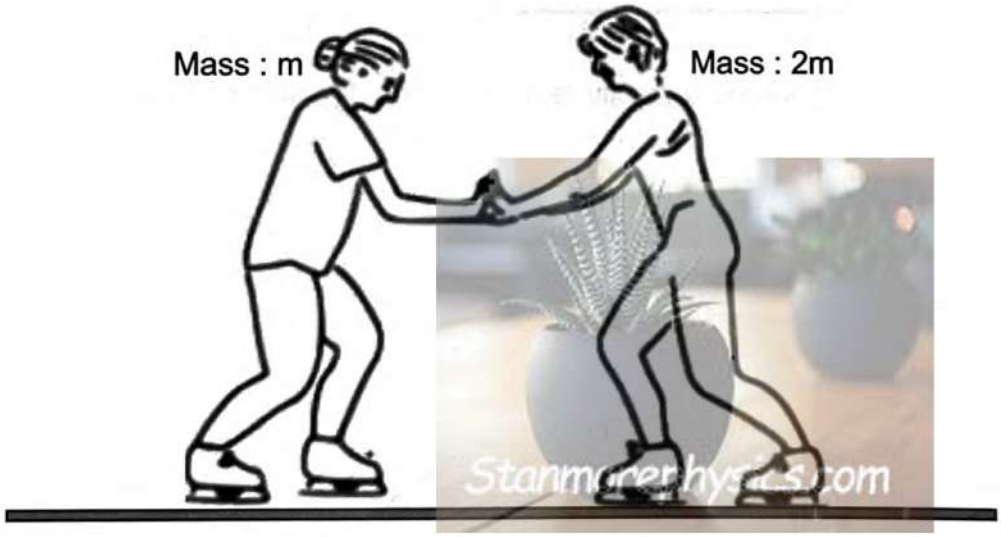
1.4 A girl of mass m and a boy of mass 2m face each other while standing at rest on roller-skates, as shown in the diagram below. The girl pushes the boy to the right with a force F. Ignore all frictional effects.



If the girl accelerates to the left at x $m \cdot s^{-2}$, what will be the magnitude of the acceleration of the boy immediately after they separate?

A x
B ½ x
C ¼ x
D 2 x

(2)

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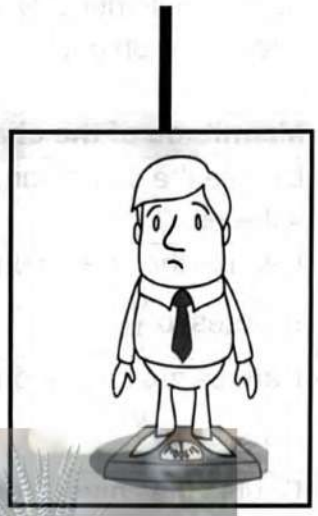
1.5 A man of mass 95 kg stands on a bathroom scale in a stationary lift. The scale registers a reading of 931 N.



Which ONE of the following readings on the scale is possible if the lift now moves upwards at constant acceleration?

A Less than 95 N.
B Less than 931N.
C Equal to 931 N.
D Greater than 931 N. (2)

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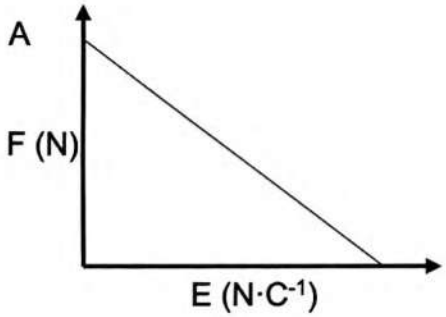
1.6 Two identical metallic spheres, each carrying a charge Q, are placed so that their centres are r metres apart.
Which ONE of the following changes, made simultaneously, will DOUBLE the electrostatic force that the charged spheres exert on each other?

	Distance between spheres	Magnitude of the charges
A	$\frac{r}{2}$	Double the charge on both spheres
B	$\frac{r}{2}$	Reduce the charge on one of the spheres to $\frac{Q}{2}$
C	$\frac{r}{\sqrt{2}}$	Reduce the charge on one of the spheres to $\frac{Q}{2}$
D	$\frac{r}{\sqrt{2}}$	Double the charges on both spheres

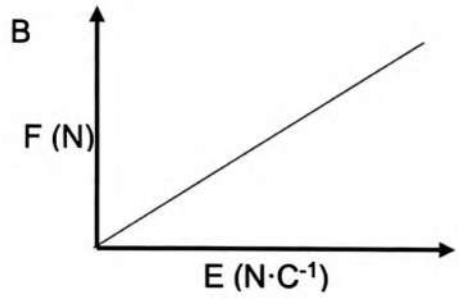
(2)

1.7 A small test charge **q** is placed **r** metres from a point charge, Q. Which ONE of the following graphs correctly shows the relationship between the electrostatic force, F, experienced by **q** and the electric field, E, generated by Q when r is constant?

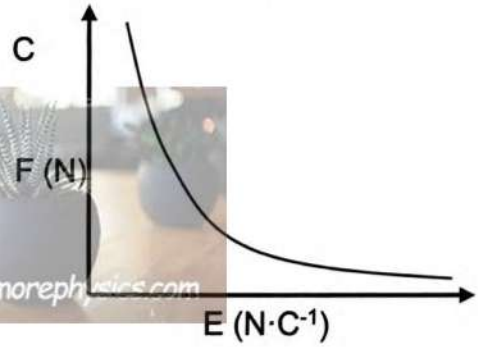
A



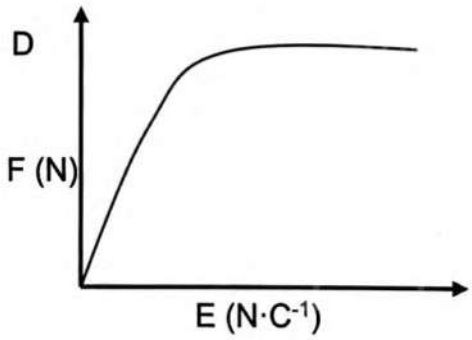
B



C



D



(2)
[14]

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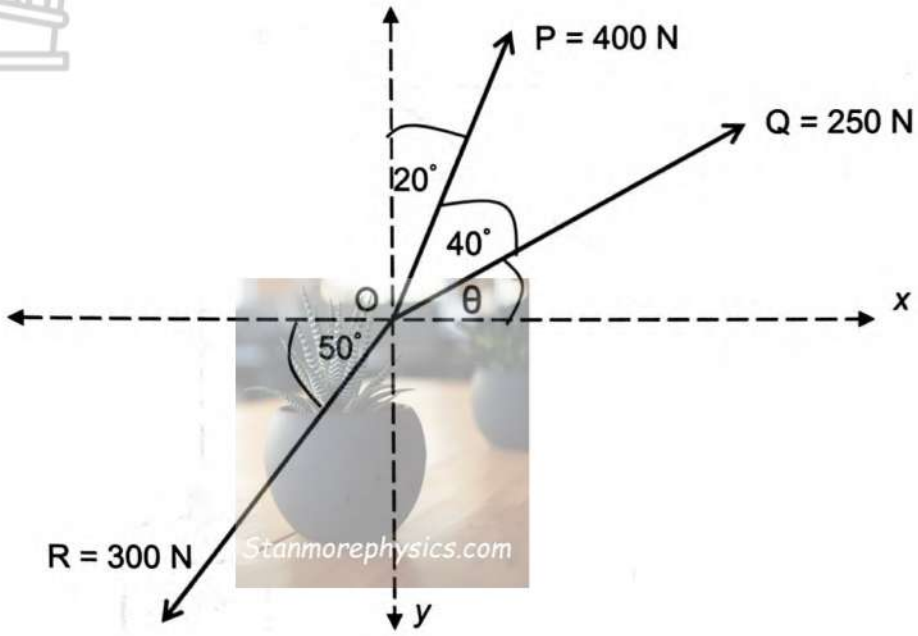
QUESTION 2

Three forces, **P**, **Q** and **R**, of magnitudes 400 N, 250 N and 300 N respectively, act at a point **O** in the directions shown in the diagram below.
The forces are NOT drawn to scale.



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

2.2 Calculate the vector sum of the:

2.2.1 HORIZONTAL components of the forces acting at O (2)

2.2.2 VERTICAL components of the forces acting at O (2)

2.3 Using the answers to QUESTIONS 2.2.1 and 2.2.2, draw a labelled vector diagram. Show the resultant force on this diagram.
Your diagram need NOT be drawn to scale. (3)

2.4 Hence, calculate the magnitude and direction of the resultant force acting at point O. (5)
[14]

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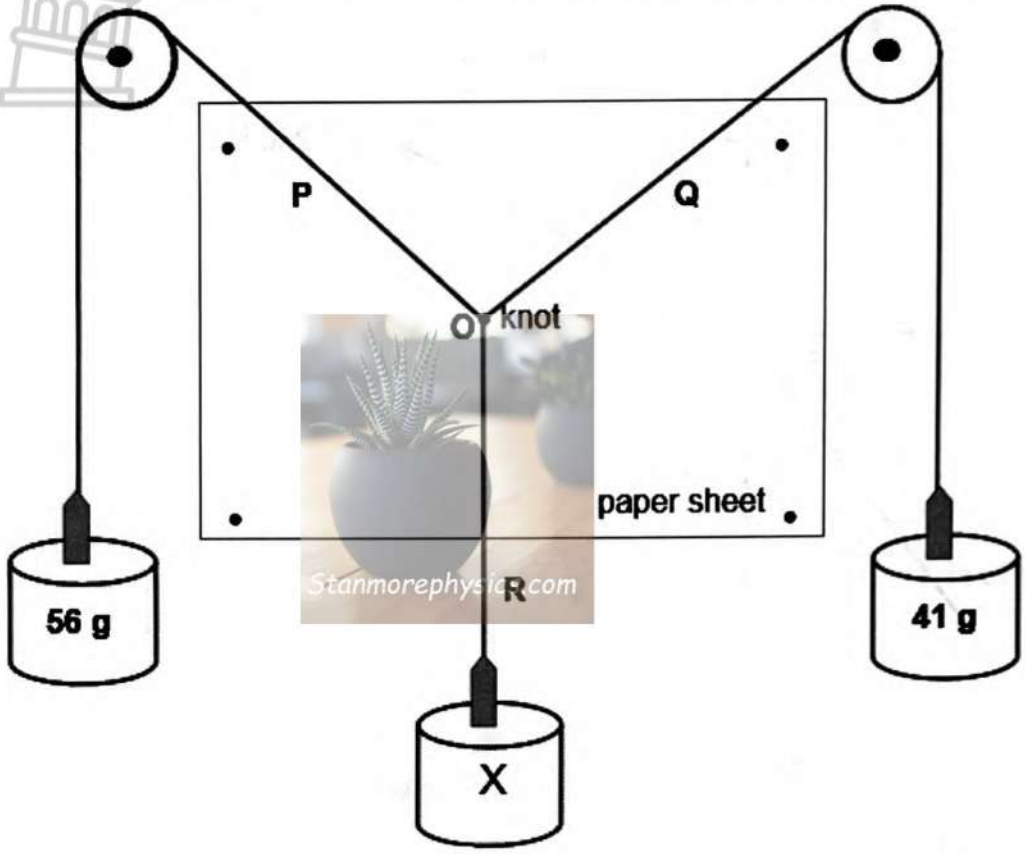
QUESTION 3

Grade 11 learners conduct an experiment to investigate three co-planar forces at equilibrium, acting at a point. Strings P, Q and R are joined by means of a knot at point O, and masses are attached at the end of each string, as shown in the diagram below.



3.1 What is the magnitude of the net force acting on the knot (point O)? (1)

3.2 Calculate the magnitude of the force in string P. (2)

3.3 The data obtained from their experiment was plotted on the attached graph sheet.

3.3.1 **You must answer this question using the special answer sheet at the end of this question paper.**
Determine graphically, using the parallelogram law, the magnitude of the resultant of the forces acting in strings P and Q. (5)
Use the scale: 10 mm represents 0,1 N.

3.3.2 What is the magnitude of X? (3)

[11]

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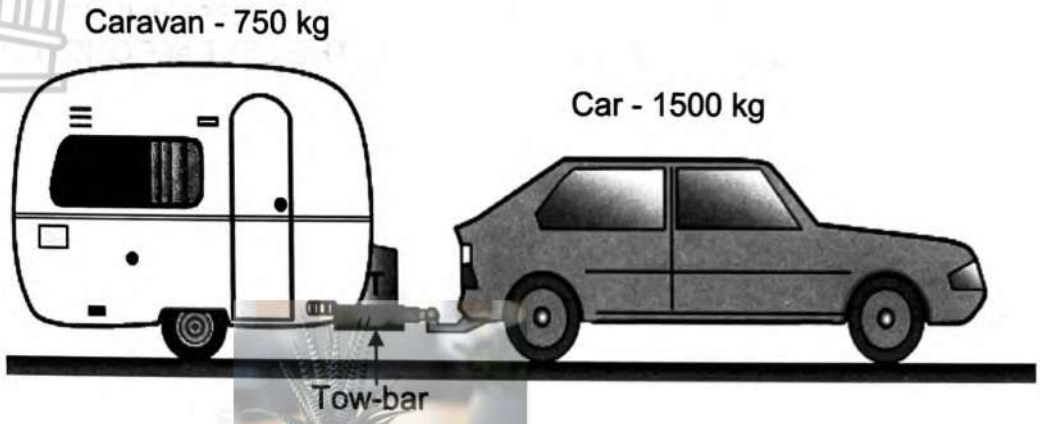
QUESTION 4

A small caravan of mass 750 kg is being towed by a car of mass 1500 kg by means of a tow-bar, as shown in the diagram below.



When towing the caravan on a straight horizontal road, the car accelerates uniformly from rest, reaching a speed of 30 $m \cdot s^{-1}$ in 25 s. A constant frictional force of 200 N acts on the caravan, while the tension in the towbar is **T**. Ignore the mass of the tow-bar and the rotational effects of the wheels.

4.1 Define the term *kinetic frictional force*. (2)

4.2 Draw a labelled free body diagram showing all the forces acting on the caravan. (4)

4.3 Calculate the magnitude of **T**, the tension in the tow-bar immediately after the car starts moving from rest. (5)

4.4 After 25 s, the car travels at a CONSTANT VELOCITY. Write down the magnitude of each of the following while the car travels at constant velocity:

4.4.1 The net force acting on the caravan (1)

4.4.2 The frictional force acting on the caravan (1)

4.4.3 The tension in the tow-bar (1)

[14]

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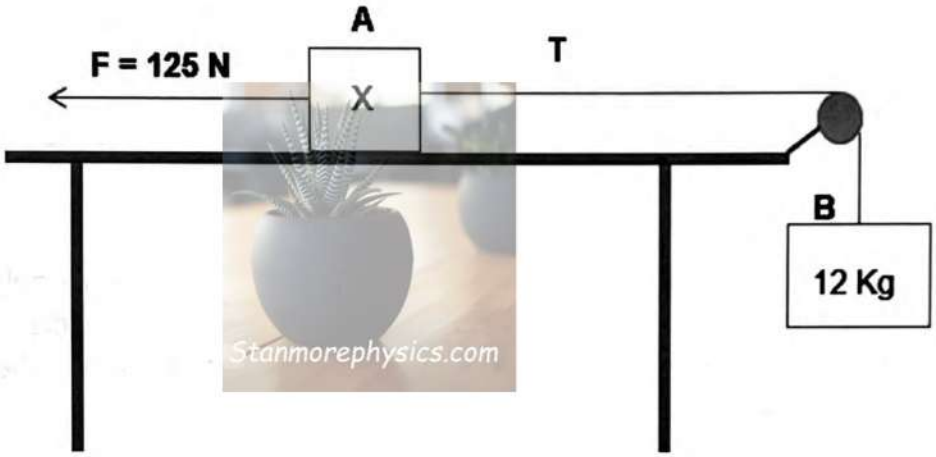
QUESTION 5

Block A, initially at rest on a rough horizontal surface, is connected to block B by a light inextensible string that passes over a frictionless pulley. The mass of block A is **X** kg, while that of block B is 12 kg. When a force F of magnitude 125 N, acting parallel to the surface, is applied as shown in the diagram below, block A moves to THE LEFT at CONSTANT VELOCITY.



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5.1 State Newtons Second law of motion in words. (2)

5.2 If the coefficient of kinetic friction (μ_k) between block A and the surface is 0,25, calculate:

5.2.1 The tension, T, in the string (3)

5.2.2 The magnitude of the kinetic frictional force acting on block A (3)

5.2.3 **X**, the mass of block A (3)

5.3 The magnitude of force F is now doubled. How will the acceleration of the blocks change? Choose from INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)

[13]

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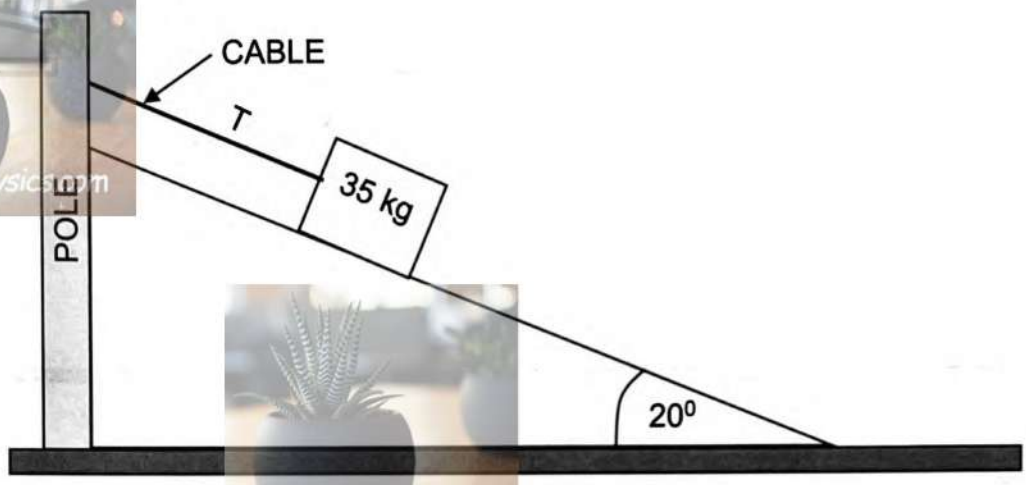
QUESTION 6

A block of mass 35 kg is prevented from sliding down a rough inclined plane by means of a light, inextensible cable that is parallel to the incline and attached to a vertical pole, as shown in the diagram below.



The incline makes an angle of 20° with the horizontal.

6.1 Define the term *static friction* in words. (2)

6.2 Calculate the magnitude of the component of the weight of the block that acts parallel to the incline. (2)

The cable breaks, and the block begins to slide down the incline.

6.3 If the coefficient of static friction is 0,3, show that the magnitude of the acceleration of the block CANNOT be less than 0,589 $m \cdot s^{-2}$. (5)
[9]

QUESTION 7

The mass of the sun is 1.99×10^{30} kilograms and its distance from the centre of Earth is 150 million kilometers.

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

7.2 Calculate the gravitational force that the Sun exerts on Earth. (5)
[7]

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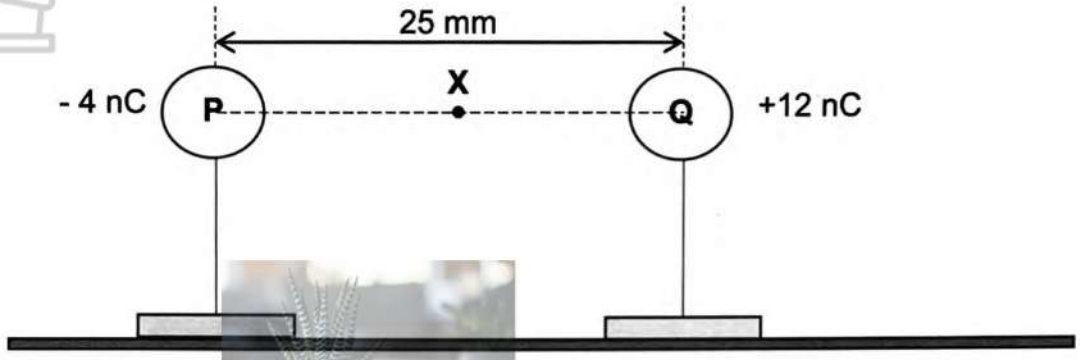
QUESTION 8

Two small charged conducting spheres, P and Q, on insulated stands, carry charges of - 4 nC and +12 nC respectively. The centres of the spheres are 25 mm apart, as indicated in the diagram below. **X** is the midpoint of the line joining the centres of the spheres.



8.1 Define *electric field at a point*. (2)

8.2 Calculate the magnitude of the:

8.2.1 Resultant electric field at point **X** (5)

8.2.2 Force that an electron will experience at point **X** (3)

The two spheres are brought into contact with each other, and then separated and moved back to their original positions.

8.3 Determine the new charge on each sphere. (2)

8.4 Calculate the amount of charge transferred upon contact. (2)

8.5 Calculate the electrostatic force that the two spheres exert on each other after they made contact with each other and were separated. (4)

[18]

TOTAL MARKS: [100]

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DATA SHEET

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	$6,4 \times 10^{6}\ m$
Mass of the Earth	M_E	$5,98 \times 10^{24}\ kg$
Charge on an electron	q_e	$-1,6 \times 10^{-19}\ C$

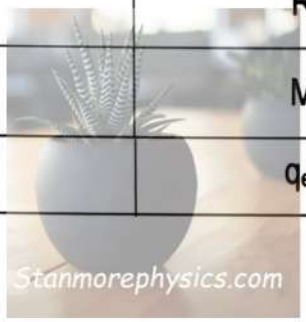

TABLE 2: FORMULAE

MOTION

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

FORCE

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

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ELECTROSTATICS

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

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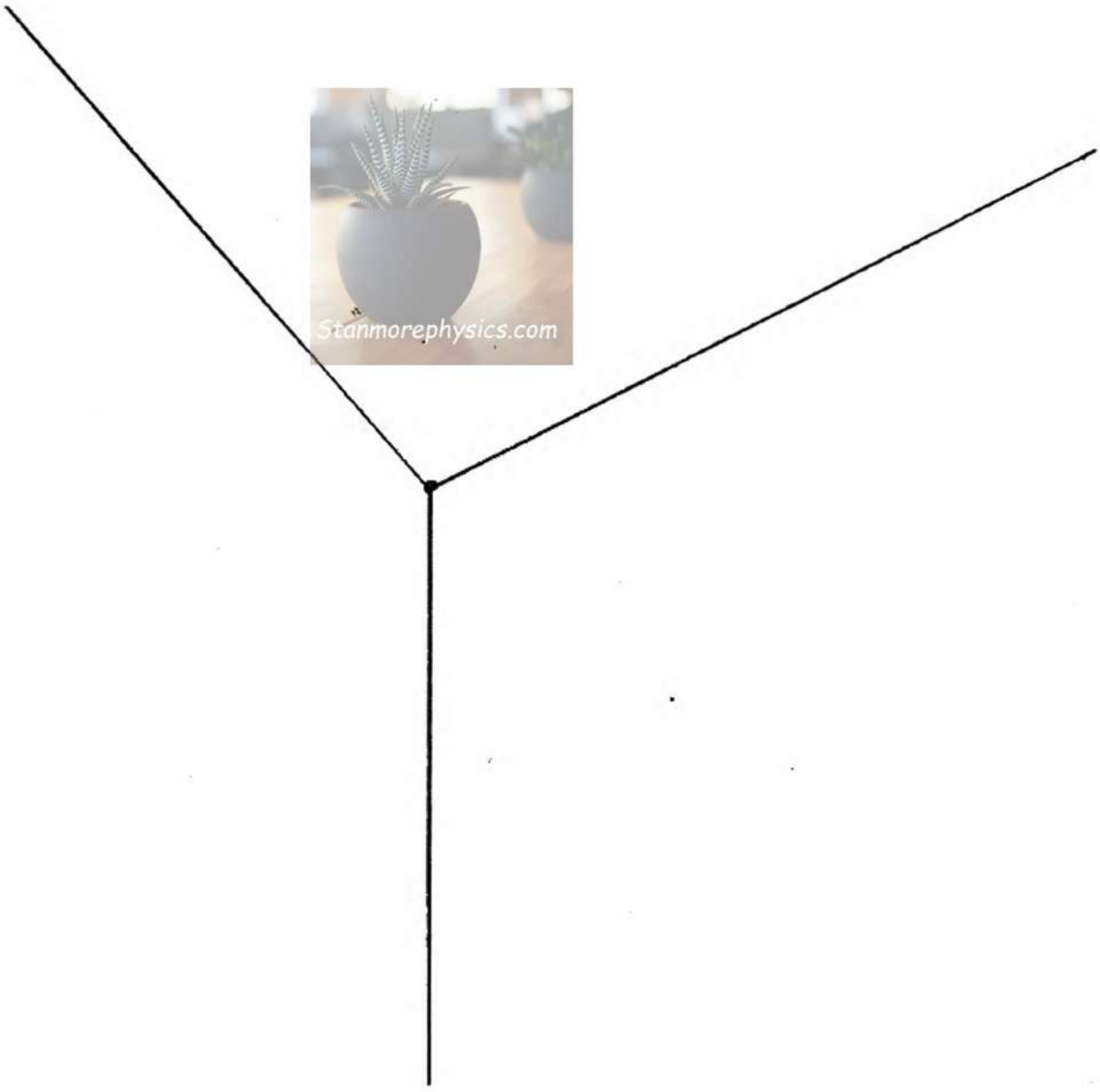
DETACH THIS PAGE AND HAND IN WITH YOUR ANSWER BOOKLET.

NAME OF LEARNER : _____ GRADE: 11 ____

Question **3.3.1**



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GRADE 11

PHYSICAL SCIENCES

COMMON TEST

MARCH 2025

MEMORANDUM

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QUESTION ONE

1.1 A ✓✓
1.2 A ✓✓
1.3 B ✓✓
1.4 B ✓✓
1.5 D ✓✓
1.6 B ✓✓
1.7 B ✓✓

7 x 2 = [14]

QUESTION TWO

2.1 It is a single vector / force that can represent a number of vectors/ forces acting on an object in both magnitude and direction. ✓✓ (2 or 0) (2)

2.2.1 **OPTION 1**: $\Sigma Rx = (250\cos30^0) + (400\cos70^0) + (-300\cos50^0)$✓ = +160,48N✓

OPTION 2 : $\Sigma Rx = (250\sin60^0) + (400\sin20^0) + (-300\sin40^0)$ ✓= 160 ,48 N✓ (2)

2.2.2 **OPTION 1** : $\Sigma Ry = 400\sin70^0 + 250\sin30^0 + (-300\sin50^0)$✓= +271,06 N ✓

OPTION 2 ; $\Sigma Ry = 400\cos20^0 + 250\cos60^0 + (-300\cos40^0)$✓=271,06 N✓ (2)

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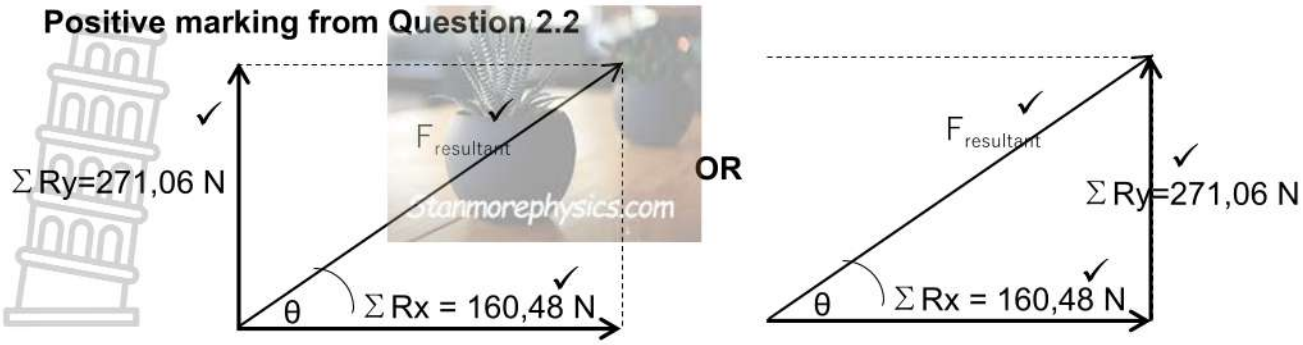
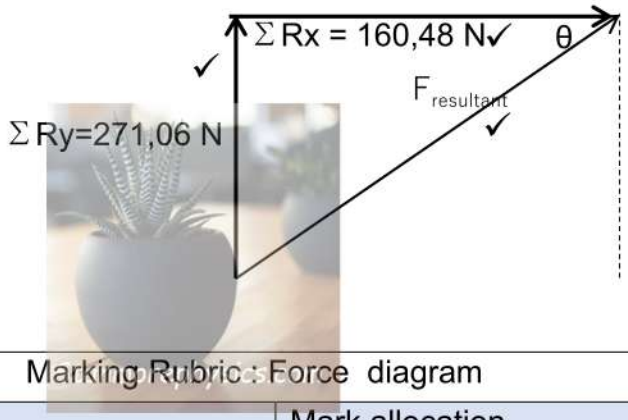
2.3 **Positive marking from Question 2.2**



OR



Marking Rubric : Force diagram	
Criteria	**Mark allocation**
Σ Rx drawn correctly	1 mark
Σ Ry drawn correctly	1 mark
Resultant force drawn correctly	1 mark

(3)

2.4 **POSITIVE MARKING FROM Q2.2**

$R_{NET}^2 = R_X^2 + R_Y^2$

$= (160,48)^2$ ✓ $+ (271,06)^2$ ✓

$R_{NET} = 315,00$ N ✓

$\tan \theta = \frac{271,06}{160,48}$ ✓

θ = 59,37^0 North of East ✓ **OR** at a bearing of 30,63°

OR 30,63° East of North

(5)

[14]

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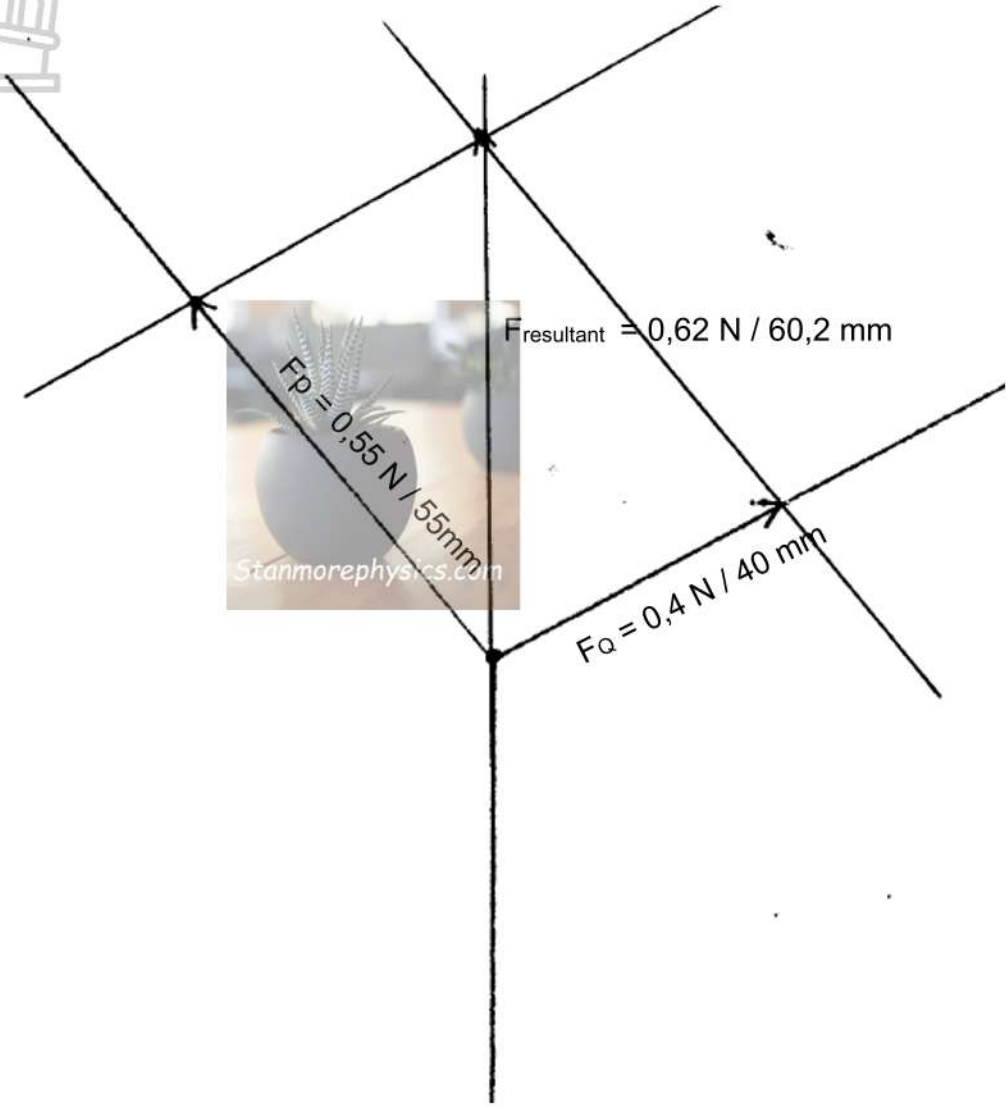
QUESTION 3

3.1 0 N / zero ✓ (1)

3.2 $F_P = mg$
$= (0,056 \times 9,8)$ ✓
$= 0,55$ N✓ (2)

3. 3.1



MARKING RUBRIC : FORCE DIAGRAM	
Criteria	Mark allocation
F_P and F_Q drawn correctly .	2 x 1 = 2 marks
Parallelogram completed correctly	1 mark
Resultant force drawn correctly	1 mark
Final answer: Resultant force (correct conversion using scale) Accept (0,58N – 0,64 N)	1 mark

(5)

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POSITIVE MARKING FROM QUESTION 3.3.1

3.3.2 $W_X = mg$
$0,62$✓ $= X \times 9.8$✓
$X = 0,063$ kg or 63g✓ (3)

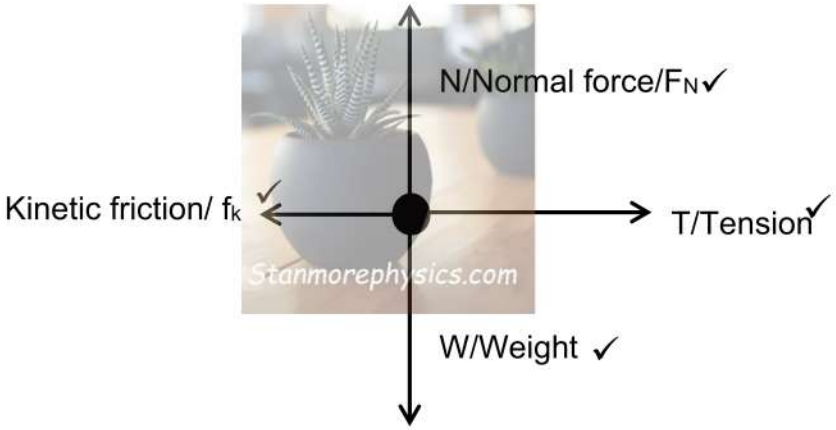
[11]

QUESTION 4

4.1 It is the force that opposes the motion of a moving object ✓relative to a surface. ✓ (2)

NOTE: Only award the second mark if the context is correct.

4.2



(4)

4.3 $v_f = v_i + a\Delta t$ ✓
$30 = 0 + a(25)$✓
$a = 1,2\ m \cdot s^{-2}$
$F_{net} = ma$
$T + (-fk) = ma$ ✓ (any one)
$T - 200 = 750(1,2)$ ✓
$T = 1100$ N ✓ (5)

4.4.1 0 N /zero✓ (1)

4.4.2 200 N✓ (1)

4.4.3 200 N✓ (1)

[14]

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QUESTION 5

5.1 When a net/resultant force acts on an object, the object accelerates in the direction of the resultant force. This acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object.✓ (2)

5.2.1 $F_{net} = ma$
$T + (-W_B) = ma$
$T = W_B$ ✓ (any one)

$T - (12 \times 9,8) = 12(0)$ **OR** $T = 12 \times 9.8$✓

$T = 117,60$ N✓ (3)

5.2.2 **POSITIVE MARKING FROM QUESTION 5.2.1**

$F_{net} = ma$
$F + (-f_K) + (-T) = 0$
$F = f_K + T$ ✓ (any one)

$125 + (-f_K) + (-117,60)$ ✓ $= 0$ **OR** $125 = f_K + 117,60$

$f_K = 7,40$ N✓ (3)

5.2.3 **POSITIVE MARKING FROM QUESTION 5.2.2**

$f_k = \mu_k N$✓

$7,40 = (0,25)(9,8X)$ ✓

$X = 3,02$ kg✓ (3)

5.3 Increases✓, acceleration increases since the net/resultant force increases.
Accept: $a \propto F_{net}$✓ (2)

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QUESTION 6

6.1 It is the force that opposes the tendency of motion of a stationary object✓ relative to a surface. ✓

NOTE: Only award the second mark if the context is correct. (2)

6.2 $W_{//} = mg \sin\theta$

$= (35)(9,8)(\sin 20°)$ ✓

$= 117,31$ N✓ (2)

6.3 $f_s^{max} = \mu_s N$ ✓

$= 0,3 \times (35 \times 9,8 \times \cos 20°)$ ✓

$= 96,69$ N

$f_s^{max} \geq f_k$ ✓

$f_k = W_{//} - F_{net}$ ✓

$f_s^{max} \geq W_{//} - F_{net}$

$96,69 \geq 117,31 - 35a$ ✓

$\therefore a \geq 0,589\ m \cdot s^{-2}$ (5)

[9]

QUESTION 7

7.1 Every body in the universe attracts every other body with a gravitational force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓

NOTE: Marks must only be awarded if the definition is in context with the gravitational law) (2)

7.2 $F = \frac{Gm_1m_2}{r^2}$✓

$= \frac{(6,67 \times 10^{-11})(1,99 \times 10^{30})(5,98 \times 10^{24})}{(150 \times 10^{9}\checkmark)^2\checkmark}$ ✓

$= 3,53 \times 10^{22}$ N ✓

NOTE: If the conversion is incorrect, max $^3/_5$; Award a mark for squaring the incorrectly converted mark. (5)

[7]

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QUESTION 8

8.1 The force experienced by a unit positive charge placed at the point. ✓✓ (2)

8.2.1 $E_P = \frac{kQ}{r^2}$ ✓

$= \frac{9\times10^9\times 4\times10^{-9}}{(0{,}0125)^2}$ ✓

$= 230\ 400\ N\cdot C^{-1}$

$(2{,}30 \times 10^5\ N\cdot C^{-1})$

$E_Q = \frac{kQ}{r^2}$

$= \frac{9\times10^9\times12\times10^{-9}}{(0{,}0125)^2}$ ✓

$= 691\ 200\ N\cdot C^{-1}$

$(6{,}91 \times 10^5\ N\cdot C^{-1})$

$E_{NET} = 230\ 400 + 691\ 200$ ✓

$= 9{,}22 \times 10^5\ N\cdot C^{-1} / 921\ 600\ N\cdot C^{-1}$ ✓

NOTE: If an incorrect value is used for k, award the second and third marks if all other substitutions are correct, and for the final answer if it is computed correctly. This also applies for Question 8.5 (5)

8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1**

$F = Eq$ ✓

$= (9{,}22 \times 10^5)(1{,}6 \times 10^{-19})$ ✓

$= 1{,}47 \times 10^{-13}$ N ✓ (3)

8.3 $Q = \frac{Q_1 + Q_2}{2}$

$Q = \frac{-4 + 12}{2}$ ✓

$= 4$ nC ✓ (2)

8.4 $-4 - x = 4$ ✓ **OR** $12 + x = 4$

$x = -8$ nC ✓ $x = -8$ nC (2)

8.5 **POSITIVE MARKING FROM QUESTION 8.3**

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{9\times10^9 \times 4\times10^{-9}\ 4\times10^{-9}}{(0{,}025)^2}$ ✓ ✓

$= 2{,}30 \times 10^{-4}$ N away from each other ✓

ACCEPT: $2{,}30 \times 10^{-4}$ N repulsion (4)

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TOTAL MARKS: 100