GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

2023

PHYSICAL SCIENCES

CONTROLLED TEST

QUESTION PARER

GRADE : 11

This QUESTION PAPER CONSISTS OF 14 PAGES INCLUDING DATA SHEET

TIME : 2 HOURS
MARKS : 100

1. **INSTRUCTIONS AND INFORMATION**
2.

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of ??? 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 sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. Write neatly and legibly.
7. You may use a non-programmable calculator.
8. You may use appropriate mathematical instruments.
9. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.
10. Show ALL formulae and substitutions in ALL calculations.
11. Round off your FINAL numerical answers to a minimum of TWO decimal places.
12. Give brief motivations, discussions, et cetera where required.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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, for example **1.3 A**.

1.1 Which of the following quantities is a vector quantity?

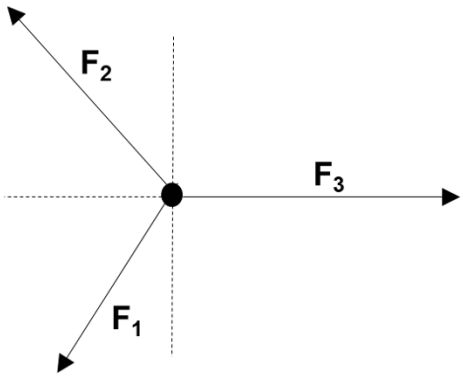
A Weight

B Speed

C Time

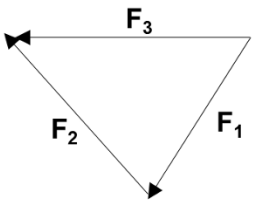
D Energy (2)

1.2. The following three forces are in equilibrium on a single point.

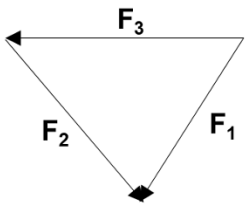


Which vector diagram correctly shows the relationship between the forces?

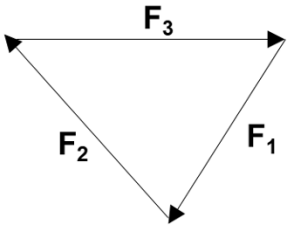
A.



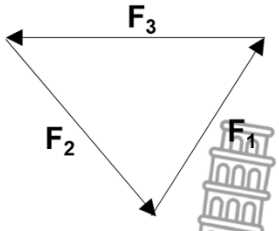
B.



C.



D.



(2)

1.3 A box of 1,5 kg is being pulled with a force of 20 N at an angle of 15° to the horizontal, as shown in the diagram.

The normal force is ....

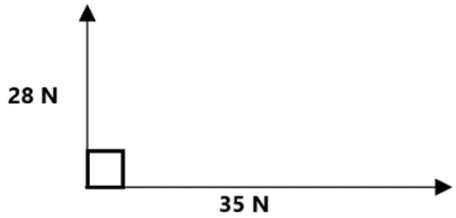
A 14,70 N

B 9,52 N

C 19,88 N

D 5,18 N (2)

1.4 Two forces act on an object as shown.



Calculate the magnitude of the resultant force

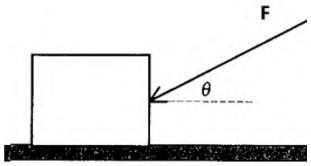
A 44,82 N

B 63 N

C 52,45N

D 7,94 N (2)

1.5 The diagram below shows a force with a magnitude F applied onto a block B resting on a flat surface, at an angle θ.



The angle is now decreased, the acceleration and the frictional force will now change as follows:

	ACCELERATION	FRICTIONAL FORCE
A	Increases	Increases
B	Decreases	Increases
C	Decreases	Decreases
D	Increases	Decreases

1.6 A 10 kg object is located at 1,9 x10^6 m from the centre of a larger object whose mass is 8,4 x 10^{24} kg.

What is the size of the force acting on the smaller object?

A 1552,02 N

B $29,48 \times 10^8$ N

C 1552,02 kg

D $29,48 \times 10^8$ kg

1.7 The potential difference over a specific resistor is changed, while the temperature of the resistor is kept constant. The reistance of the resistor will.....

A increase as the potential difference increases

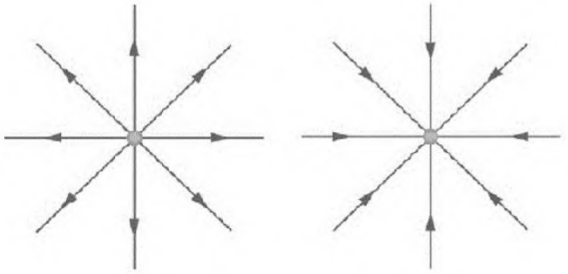
B decrease as the potential difference decreases

C increase as the potential difference decreases

D remain constant. (2)

1.8 The following diagrams represent charges:

A B



Which one of the following answers is correct?

	Charge A	Charge B
A	- q	- q
B	+ q	- q
C	- q	+ q
D	+ q	+ q

(2)

1.9 In an electric circuit the potential difference is doubled across a particular resistor. If the resistance does not change, the power in the resistor will change from P to …

A ½ P

B ¼ P

C 2P

D 4P (2)

1.10 Two identical points charges A and B having charges of –3pC and +9pC

respectively, are allowed to touch and then moved apart. What is the charge in pC on each sphere now?

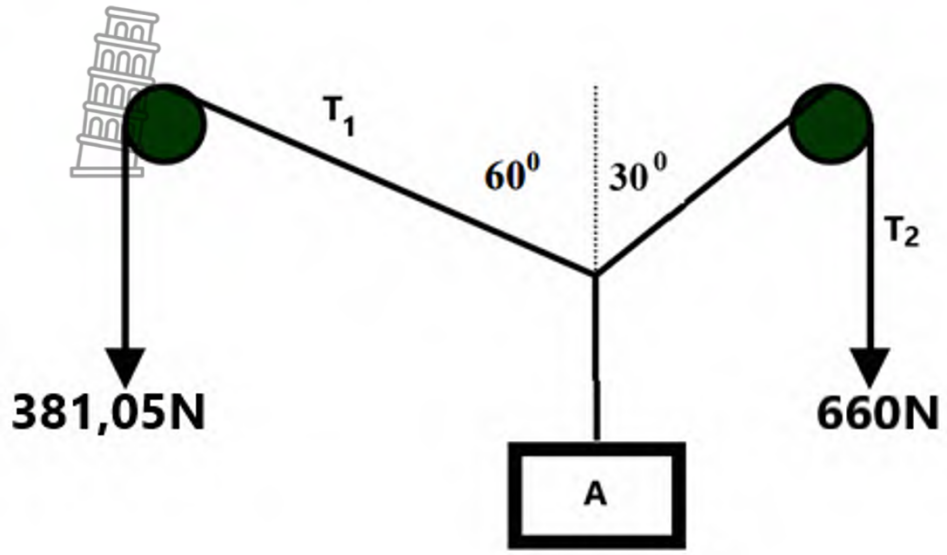
	A	B
A	+3	–9
B	+3	+3
C	–3	–3
D	0	0

(2)

10 x 2 = **[20]**

QUESTION 2: (START ON A NEW PAGE.)

Learners doing a Force board practical, finds that the following forces could balance object A.



2.1 What is the magnitude of the resultant force of the system? (1)

2.2 State Newton's first Law in words. (2)

2.3 Calculate:

2.3.1 the components of the force in string T_1. (3)

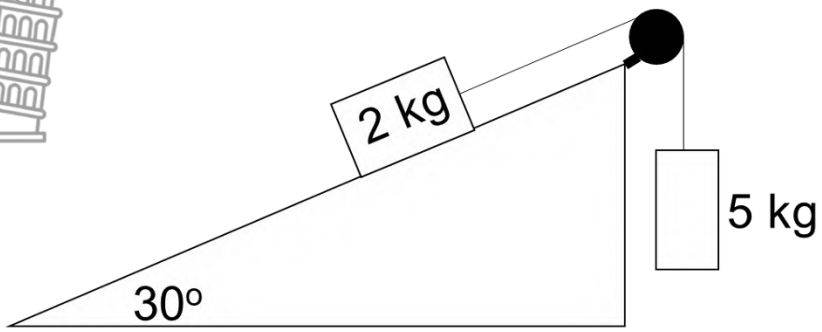
2.3.2 the components of the force in string T_2. (2)

2.3.3 the mass of object A (3)

[11]

QUESTION 3: (START ON A NEW PAGE.)

A 2 kg wooden block is on a metal surface that is at 30° to the horizontal. The wooden block is connected by a frictionless pulley to a 5kg mass piece which is hanging vertically. The system is free to move.



The coefficient of kinetic friction between the wooden block and the metal plane is 0,3.

3.1. Define the term *kinetic friction.* (2)

3.2. Draw a labelled free-body diagram showing ALL the forces acting on the 2 kg wooden block. (4)

3.3. Calculate the kinetic friction experienced by the 2 kg block. (3)

3.4. State Newton's Second Law in words. (2)

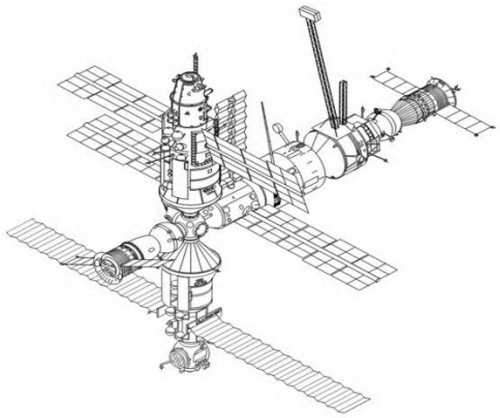
3.5. Calculate the acceleration of the system. (5)

3.6. Calculate the tension is the string between the two blocks. (2)

[18]

QUESTION 4: (START ON A NEW PAGE.)

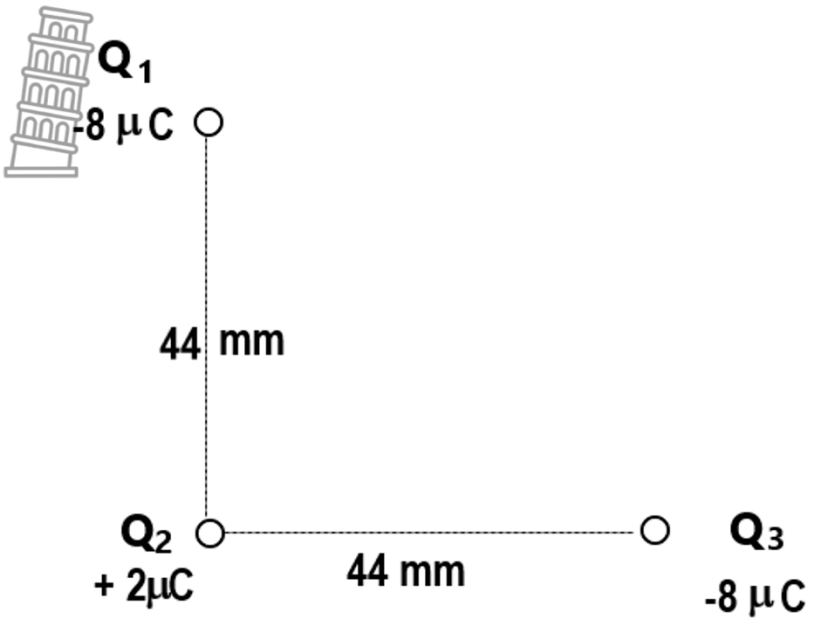
The international Space station was launched on 20 November 1998. It has a mass of 4 197 250 kg. Astronaughts and food are taken to the International Space station with the Soyuz capsule which launches on top of a Soyuz **rocket**. After the launch, the capsule and the rocket separate. The rocket part of the Soyuz returns to Earth. The Soyuz capsule keeps going to dock onto the Space station. The mass of the Soyus capsule is 2900 kg.



4.1	Define Newton's Universal Law of Gravity.	(2)
4.2	Calculate how many kilometers above the earth's surface the International Space station is if it experiences a net force of 36,99 N to keep it in orbit. (HINT: do not use scientific notation for **this** question.)	(5)
4.3	The Soyus capsule is now approaching the space station. Calculate the force between the Space station and the capsule if it is 200 m apart.	(3)
4.4	How does the acceleration of the satellite change? Only answer INCREASE, DECREASE, REMAIN THE SAME	(1)
4.5	Explain your answer in 4.4	(2)
		[13]

QUESTION 5: (START ON A NEW PAGE.)

Three charges Q_1, Q_2 and Q_3 are placed at right angles to each other as indicated in the diagram below.



5.1 Define Coulomb's Law in words. (2)

5.2 Calculate:

5.2.1 The magnitude and direction of the force of Q_1 on Q_2 (3)

5.2.2 The magnitude of the resultant Force of Q_1 and Q_3 on Q_2. (3)

5.2.3 The direction of the resultant Force of Q_1 and Q_3 on Q_2. (1)

5.3 Q_2 is now replaced with a charge of -2 nC. **Explain** how this change will influence…

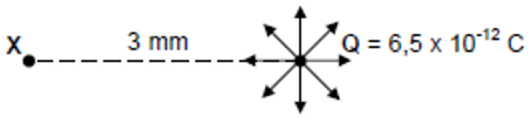
5.3.1 the magnitude of the net Force on it. Only use INCREASE, DECREASE or REMAIN THE SAME. (1)

5.3.2 the direction of the net Force on it. (2)

[12]

QUESTION 6 : (START ON A NEW PAGE.)

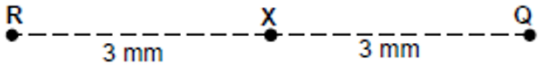
An isolated point charge **Q** is located in space as shown in the diagram below. Point charge **Q** contributes to an electric field as shown. Point **X** is located 3 mm away from point charge **Q**.

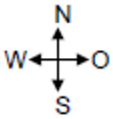


6.1 Define the term *electric field* at a point. (2)

6.2 Calculate the magnitude of the electric field at point X. (3)

6.3 Point charge R carrying a charge of + 6,5 x 10^{-12} C is placed 3 mm away from point **X** as shown in the diagram below.



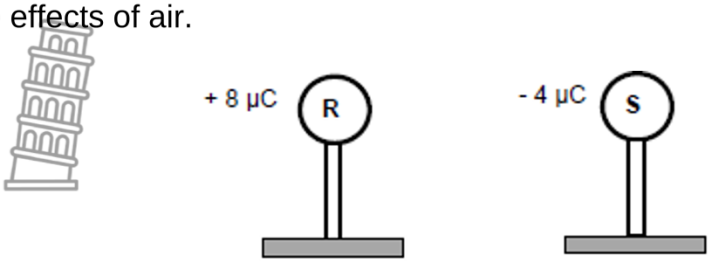


Calculate the net electric field at point X. (4)

[9]

QUESTION 7: (START ON A NEW PAGE.)

The diagram below shows two small identical metal spheres, **R** and **S**, each placed on a wooden stand. Spheres **R** and **S** carry charges of + 8 µC and - 4 µC respectively. Ignore the effects of air.



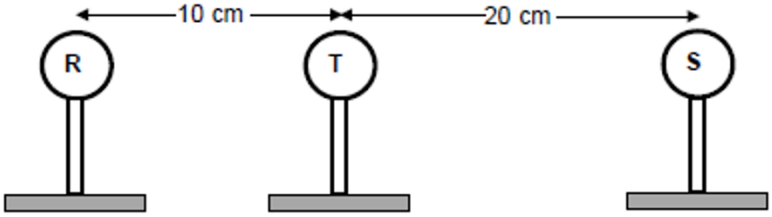
7.1 Explain why the spheres were placed on wooden stands. (1)

Spheres **R** and **S** are brought into contact for a while and then separated by a small distance.

7.2 Calculate the net charge on each of the spheres. (2)

7.3 Draw the electric field pattern due to the two spheres **R** and **S**. (3)

After **R** and **S** have been in contact and separated, a third sphere, **T**, of charge + 1 µC is now placed between them as shown in the diagram below.



7.3.1 Draw a free-body diagram showing the electrostatic forces experienced by sphere **T** due to spheres **R** and **S**. (2)

7.3.2 Calculate the net electrostatic force experienced by **T** due to **R** and **S**. (6)

7.3.3 Calculate the magnitude of the net electric field at the location of **T**

due to **R** and **S**. (Treat the spheres as if they were point charges. (3)

[17]

TOTAL 100

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

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

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*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

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

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PROVINCIAL CONTROLLED TEST

MARCH 2023
GRADE 11 MARKING GUIDELINES

PHYSICAL SCIENCES
GRADE11

MARKS: 100

This Marking Guideline consists of 7 pages. Including analysis grid

QUESTION 1 / *VRAAG 1:*

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

QUESTION 2:

2.1 0 N ✓ (1)

2.2 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓ (2)

2.3.1 $T_{x1} = T_1 \times \cos 30^\circ$ ✓

$= 381{,}05 \times \cos 30^\circ$

$= 330$ N West/ left ✓

$T_{y1} = T_1 \times \sin 30^\circ$ (3)

$= 381{,}05 \times \sin 30^\circ$

$= 190{,}53$ N North/ up ✓

2.3.2 $T_{x2} = T_2 \times \cos 60^\circ$

$= 660 \times \cos 60^\circ$

$= 330$ N East/ right ✓

$T_{y2} = T_2 \times \sin 60^\circ$

$= 660 \times \sin 60^\circ$ (2)

$= 571{,}58$ N North/ up ✓

2.3.3 $T_{xnet} = 0$ N and $T_{ynet} = 0$ N Equilibruim ✓

$\therefore \quad T_{y2} + T_{y1} = F_g = m \times g$

$571{,}58 + 190{,}53 = m \times 9{,}8$ ✓

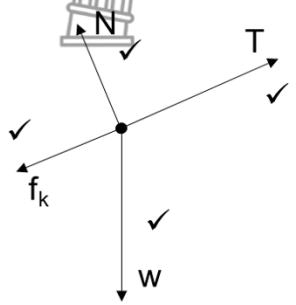
m = 77,77 kg ✓ (3)

[11]

QUESTION 3:

3.1. The force that opposes the motion of a moving object relative to a surface. (2)

3.2.



N = normal force

T = tension force

w = weight

f_k = friction / kinetic friction

(4)

3.3. $f_k = \mu_k N$ ✓

$= \mu_k F_g \cos\theta$

$=(0,3)[(2)(9,8)\cos 30^o]$ ✓

= 5,09 N ✓ (3)

3.4. When resultant force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force and inversely proportional to the mass of the object. ✓✓ (2)

3.5.

2kg	5 kg
$F_{net} = ma$ ✓	$F_{net} = ma$
$T - F_{g\parallel} - f_k = ma$	$F_g - T = ma$
$T - F_g\sin\theta - f_k = ma$	$(5)(9,8) - T = 5a$
$T - (2)(9,8)\sin 30^o - 5,09 = 2a$	$49 - T = 5a$ ✓.....(2)
$T - 14,89 = 2a$ ✓.....(1)	

Add 1 and 2: $T - 14,89 = 2a$ ✓

$\underline{49 - T = 5a}$

$34,11 = 7a$

$a = 4,87\ m.s^{-2}$ ✓ (5)

3.6. $T - 14,89 = 2a$ ✓ (into 1 or 2)

$T - 14,89 = 2(4,87)$

$T = 34,37$ N ✓ (2)

[18]

QUESTION 4:

4.1 Every particle in the universe exerts a force of gravitational attraction on every other particle. The force between the two particles is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between **their centres**. ✓ (2)

4.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

$36,99$ ✓ $= \frac{6 \times 10^{-11} \times 5,98 \times 10^{24} \times 4197250}{(r)^2}$ ✓ (5)

$= 6380672738 \text{ m} \div 1000$

$= 6380672,74 \text{ km}$

Height above surface of earth = $6388449307 - 6,38 \times 10^6$ ✓

$= 672,74 \text{ km}$ ✓

4.3 $F = \frac{Gm_1m_2}{r^2}$

$F = \frac{6 \times 10^{-11} \times 4197250 \times 2900}{(200)^2}$ ✓ (3)

$= 1,83 \times 10^{-5}$ N attraction ✓

4.4 REMAIN THE SAME (1)

4.5 The force of attraction between the Soyus capsule and the Space station is so small that it will no affect the acceleration. ✓✓ (2)

[13]

QUESTION 5:

5.1 The magnitude of the electrostatic force exerted by two-point charges (Q_1 and Q_2) on each other is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓ (2)

5.2.1 $\mathbf{F = \frac{kQ_1Q_2}{r^2}}$ ✓

$= \frac{(9 \times 10^9)(8 \times 10^{-8})(2 \times 10^{-8})}{(44 \div 1000)^2}$ ✓

= 74,38 N upwards/ North. ✓ (3)

5.2.2 $F_{net}^2 = F_{Q1}^2 + F_{Q2}^2$ ✓

$= \sqrt{74{,}38^2 + 74{,}38^2}$ ✓

$= 105{,}19$ N✓ (3)

5.2.3 45 ° ✓ (1)

5.3.1 REMAIN THE SAME ✓ (1)

5.3.2 Opposite to initial direction/ 225° ✓ Repulsion✓ (2)

[12]

[9]

Question 6

6.1The force ✓per unit charge ✓ at that point. (2)

6.2 $E = \frac{kQ}{r^2}$ ✔

$E = \frac{(9 \times 10^9)(6{,}5 \times 10^{-12})}{(0.003)^2}$ ✔

$E = 6{,}5 \times 10^3\ N \cdot C^{-1}$ ✔ (3)

6.3 **At point X**

$E_Q = 6{,}5 \times 10^3\ N \cdot C^{-1}\ West$ ✔

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

$E_R = \frac{(9 \times 10^9)(6{,}5 \times 10^{-12})}{(0.003)^2}$

$E_R = 6{,}5 \times 10^3\ N \cdot C^{-1}\ East$ ✔

$E_{net} = E_Q + E_R$ ✓

$E_{net} = 6{,}5 \times 10^3 + (-6{,}5 \times 10^3)$

$E_{net} = 0\ N \cdot C^{-1}$ ✔ (4)

[9]

Question 7

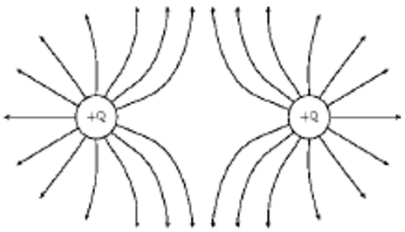
7.1To ensure that charge does not leak to the ground/insulated. ✓ (1)

7.2 Net charge $= \frac{Q_R + Q_S}{2}$

$Q_{net} = \frac{+8 + (-4)}{2}$ ✓

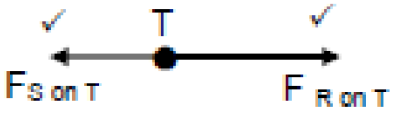
$Q_{net} = 2\mu C$ ✓ (2)

7.3.1



(3)

Criteria	Marks
Correct direction of field lines	✓
Shape of the electric field	✓
No field line crossing each other	✓



(2)

7.3.2 **OPTION 1**

$F = \frac{kQ_1Q_2}{r^2}$ ✓

$F_{ST} = \frac{(9\times10^9)(1\times10^{-6})(2\times10^{-6})}{(0,2)^2}$ ✓ ✓

$F_{ST} = 0,45\ N$ left

$F_{RT} = \frac{(9\times10^9)(2\times10^{-6})(1\times10^{-6})}{(0,1)^2}$ ✓

$F_{RT} = 1,8\ N$ right

$F_{net} = F_{ST} + F_{RT}$
$F_{net} = 1,8 + (-0,45)$ ✔
$F_{net} = 1,35\ N$ right or towards sphere S ✔ (6)

7.3.3 **OPTION 1**

$E = \frac{F}{q}$ ✔
$E = \frac{1,35}{1\times10^{-6}}$ ✔
$E = 1,35 \times 10^{6} N \cdot C^{-1}$ ✔

OPTION 2

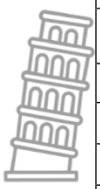
$E = \frac{F}{q}$ ✔
$E = \frac{1,8}{1\times10^{-6}}$ ✔
$E = 1,8 \times 10^{6} N \cdot C^{-1}$

$E = \frac{0,45}{1\times10^{-6}}$
$E = 4,5 \times 10^{5} N \cdot C^{-1}$

$E_{net} = 1,8 \times 10^{6} - 4,5 \times 10^{5}$
$E_{net} = 1,35 \times 10^{6} N \cdot C^{-1}$ ✔ (3)

[17]

Taxonomy Grid



	Recall		Comprehension		Analysis		Evaluation	
	Q no:	**Mark**	**Q no:**	**Mark**	**Q no:**	**Mark**	**Q no:**	**Mark**
	1.1	2	1.2	2	1.3	2	1.5	2
	1.7	2	1.4	2	1.6	2		
			1.8	2	1.9	2		
			1.10	2				
	2.1	2	2.2	3	2.4	5		
			2.3	2				
	3.1	2	3.2	4	3.3	3		
			3.4	2	3.5	6		
			3.6	2				
	4.1	2	4.3	3	4.2	4	4.4.1	1
							4.4.2	2
	5.5	2	5.1	2	5.2	3	5.4	2
			5.3	4				
	6.1	2	6.2	2	6.3	5		
	7.1	2	7.3	2	7.4	4	7.5	3
Total mark	**16%**	**16**	**34%**	**34**	**40%**	**40**	**10%**	**10**
Total %/**100%**	**P1&2: 15%**		**P1:35%/P2:40%**		**P1:40%/P2:35%**		**P1&2: 10%**