KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES

COMMON TEST

MARCH 2023

TIME: 2 hours

MARKS: 100

Stanmorephysics

This question paper consists of 13 pages, one data sheet and two answer sheets.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK.**
2. This question paper consists of **SIX** 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.

Copyright Reserved

QUESTION 1 : MULTIPLE CHOICE QUESTIONS

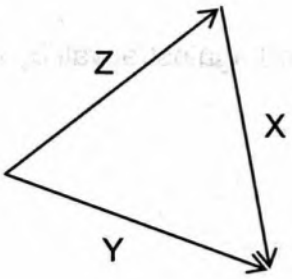
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 —1.7) in the ANSWER BOOK, for example 1.8 D.

1.1 Which ONE of the following pairs of physical quantities consists of a vector and a scalar?

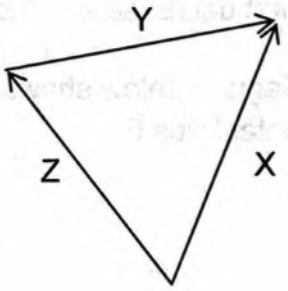
A Force and distance
B Force and acceleration
C Velocity and displacement
D Distance and speed (2)

1.2 Which ONE of the following diagrams is the best representation of the vector sum: X + Y= - Z?

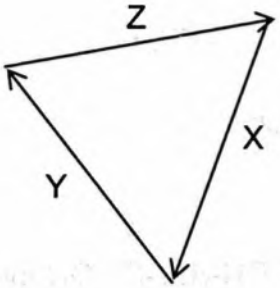
A



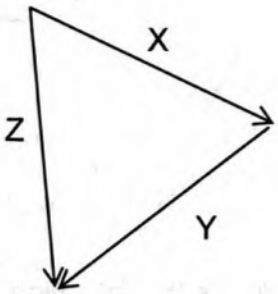
B



C

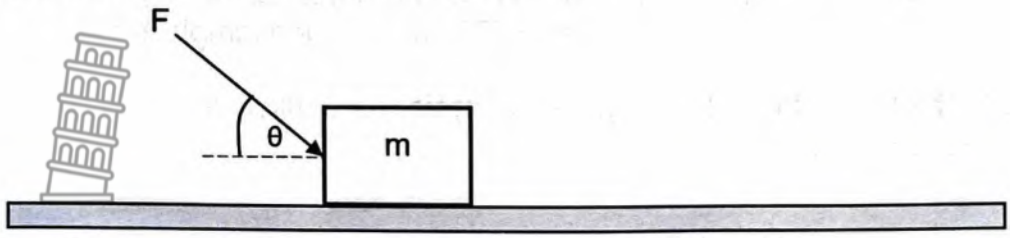


D



(2)

1.3 A crate of mass m is pushed across a horizontal surface by a force F acting at an angle θ to the horizontal as shown in the diagram below. The crate experiences a constant frictional force.

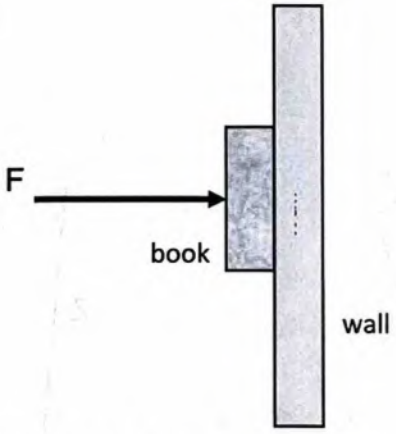


How will the magnitude of the frictional force be affected if the force F is INCREASED?

It will …

A decrease.
B increase.
C remain the same.
D first decrease and then increase. (2)

1.4 The diagram below shows a book which is pressed against a wall by a horizontal force F.



Which one of the following represents an ACTION-REACTION force pair according to Newton's third law?

A The weight of the book and the force F on the book
B Force F on the book and the force of the book on the wall
C The weight of the book and the force that the book exerts on Earth
D The weight of the book and the friction between the book and the wall (2)

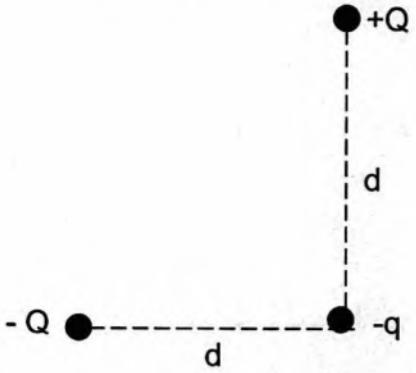
Copyright Reserved

1.5 A satellite experiences a gravitational force of magnitude F on the surface of Earth. The radius of Earth is R. The satellite now orbits Earth at an unknown height above the surface of Earth and experiences a gravitational force of magnitude $\frac{1}{16}$ F.
This unknown height above the surface of Earth is ....

A R
B 2 R
C 3 R
D 4 R

(2)

1.6 Two charges, + Q and – Q, are placed the same distance d from a negative charge – q. The charges, + Q and – Q, are located along lines that are perpendicular to each other as shown in the diagram below.



Which ONE of the following vectors shows the correct direction of the NET FORCE acting on charge – q due to charges + Q and – Q?

A


B


C


D


(2)

1.7 Which one of the statements below does NOT represent the properties of electric field lines? They ....

A are always at right angles to a surface.

B can never intersect or touch one another.

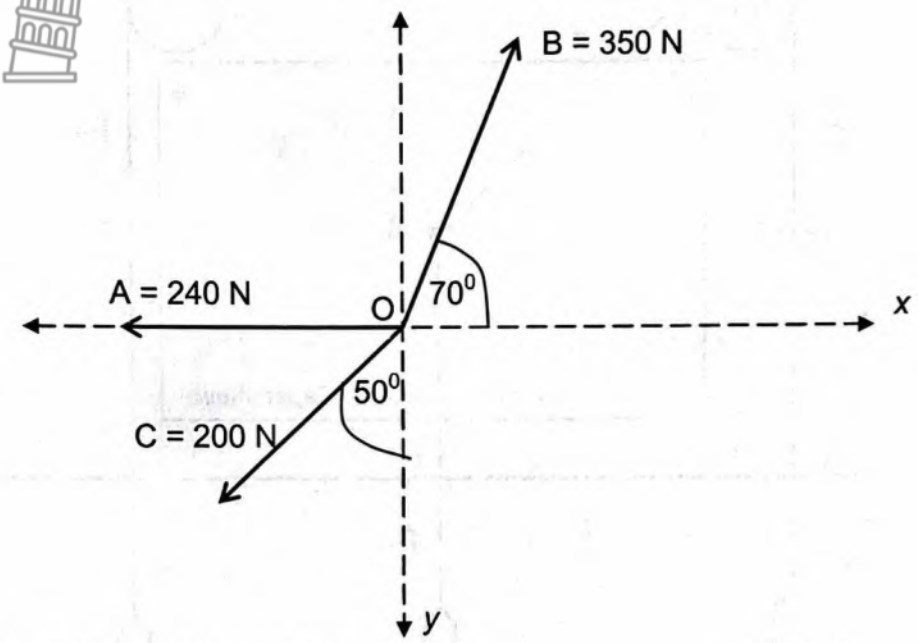
C are closest to one another where the electric field is the weakest.

D run parallel where the electric field is uniform. (2)

[14]

QUESTION 2 (Start on a new page)

2.1 Three forces A, B and C of magnitudes 240 N ,350 N and 200 N respectively act on a point O in the directions as shown below.
The forces are NOT drawn to scale.

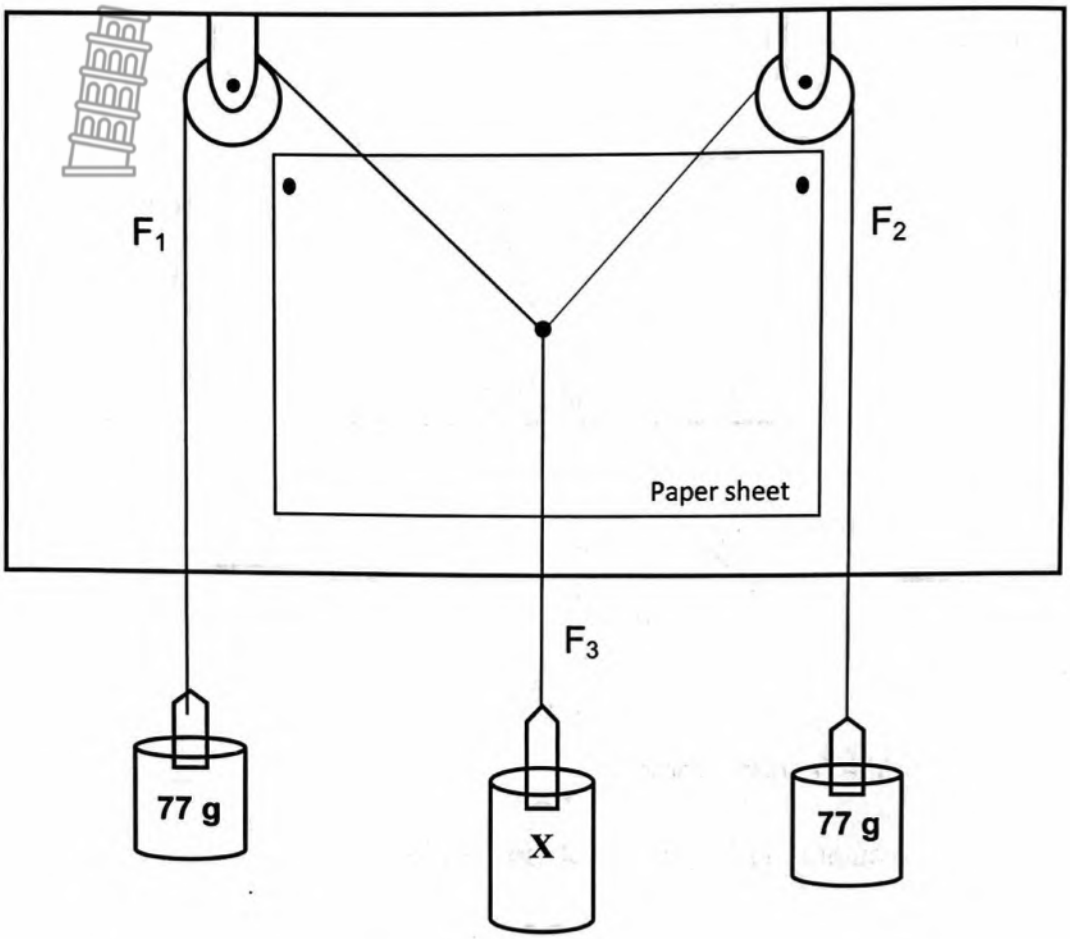


2.1.1 Define *resultant force* (2)

2.1.2 Calculate the magnitude of the resultant force (5)

Copyright Reserved

2.2 The apparatus shown below was used to determine the resultant of two co-planar forces, F_1 and F_2.



2.2.1 Calculate the magnitude of the force F_1 (2)

2.2.2 A mirror is used to plot the images of the forces acting in the string. Give a reason why the mirror is used (2)

2.2.3 An INCOMPLETE diagram for the results of this investigation is given ON PAGE 15 OF THIS QUESTION PAPER.
Complete the diagram using a scale of 10 mm = 0,1 N and determine the magnitude of the resultant force.
BE SURE TO SUBMIT THIS SHEET WITH YOUR ANSWER BOOK. (4)

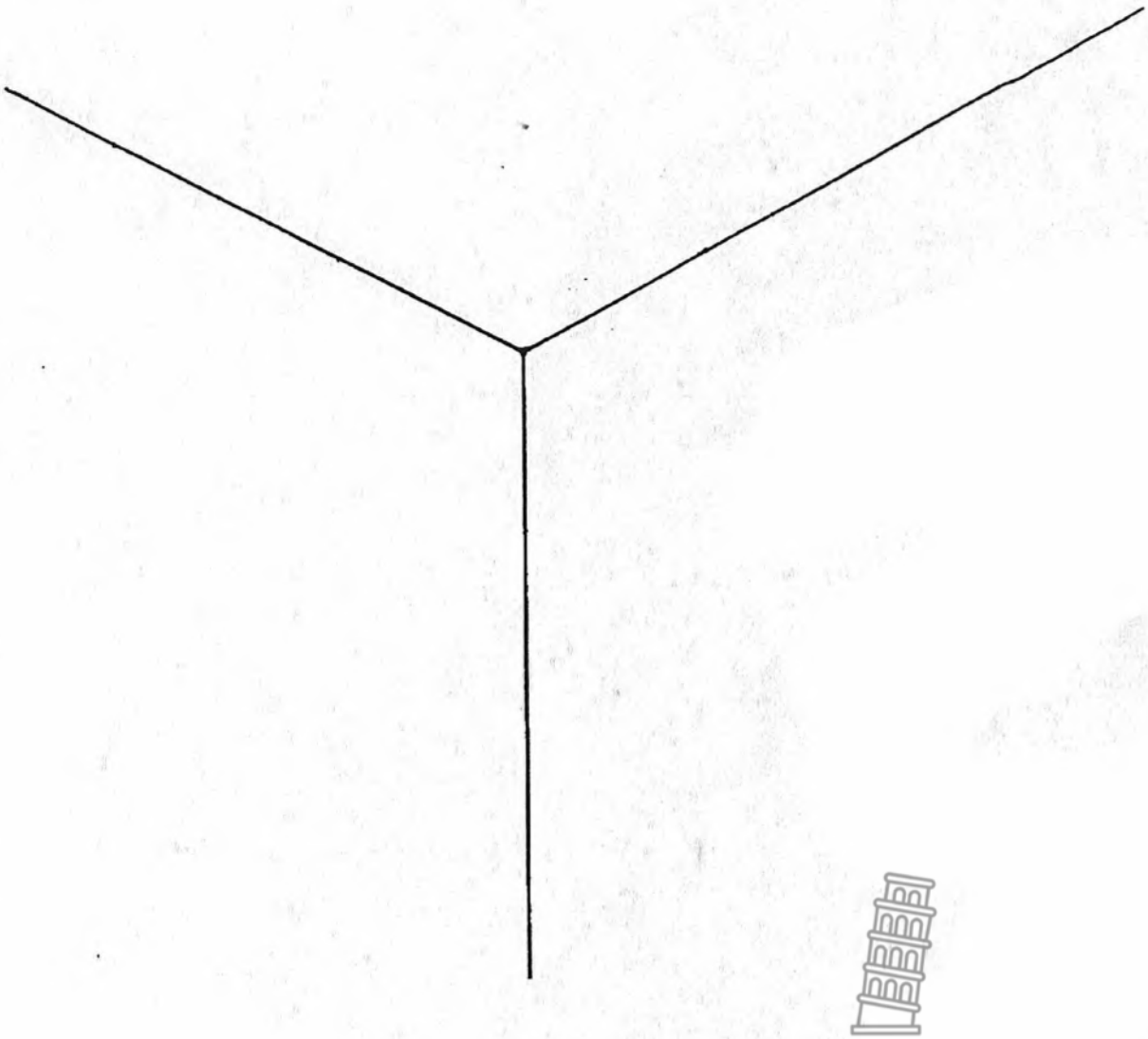
2.2.4 Hence calculate the mass of X (2)
[17]

Copyright Reserved

DETACH THIS PAGE

NAME OF LEARNER : _____

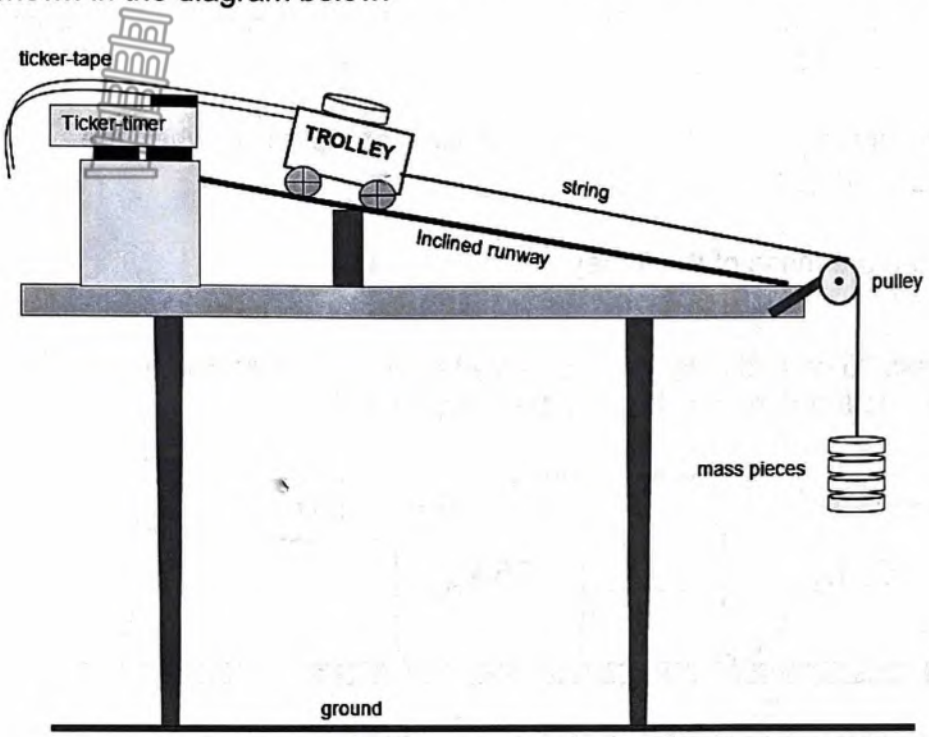
Question 2.2.3



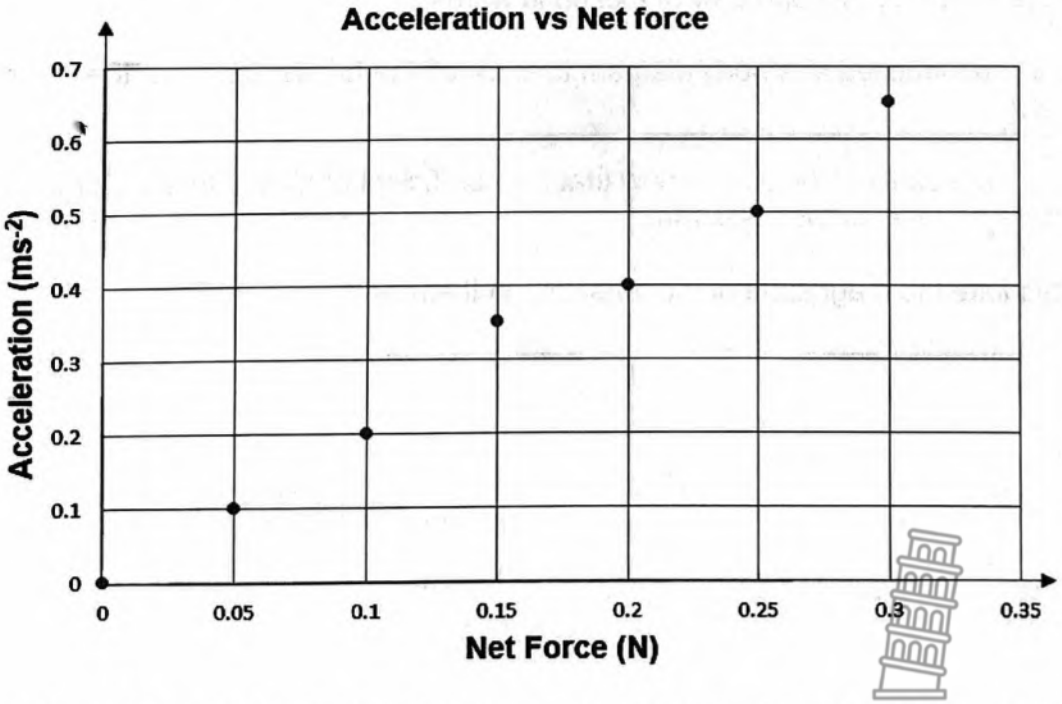
Copyright Reserved

QUESTION 3 (Start on a new page)

3.1 The experiment below was used to verify a relationship between the acceleration produced and the net force acting on an object. Learners set up the apparatus as shown in the diagram below.



The results obtained are used to plot the INCOMPLETE graph shown.



3.1.1 Write down the name of the quantity that must be kept constant in this experiment (1)

Copyright Reserved

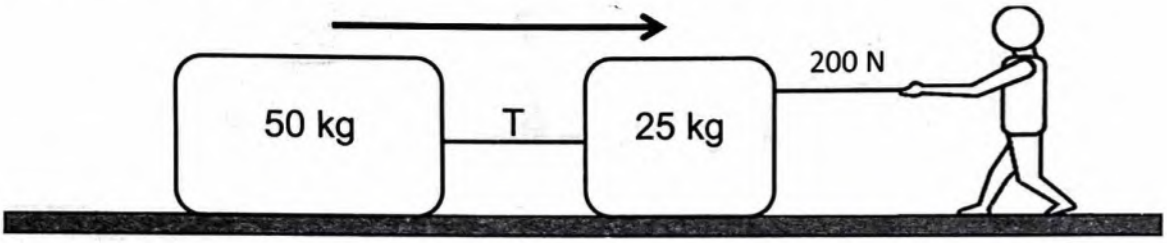
3.1.2 ON THE DIAGRAM SHEET provided on PAGE 16, draw the graph that can be expected.
BE SURE TO SUBMIT THIS SHEET WITH YOUR ANSWER BOOK. (1)

3.1.3 State in words the mathematical relationship between acceleration produced and the net force acting on an object. (1)

3.1.4 Use the graph to determine the acceleration of the trolley when the net force is 0,25 N. (2)

3.1.5 Calculate the mass of the trolley. (3)

3.2 Two crates of mass 25 kg and 50kg are connected by a light inextensible rope. A force of 200 N is applied to the right, as shown in the diagram below.



The crates move with an acceleration of 1,25 $m \cdot s^{-2}$ to the right across a rough horizontal surface. The coefficient of kinetic friction is the same for both crates.

3.2.1 State *Newton's Second Law of motion* in words. (2)

3.2.2 Draw the labelled free body diagram to show all the forces acting on the 25 kg crate. (5)

3.2.3 Using relevant calculations, show that the coefficient of kinetic friction for the crates and the surface is 0,144. (6)

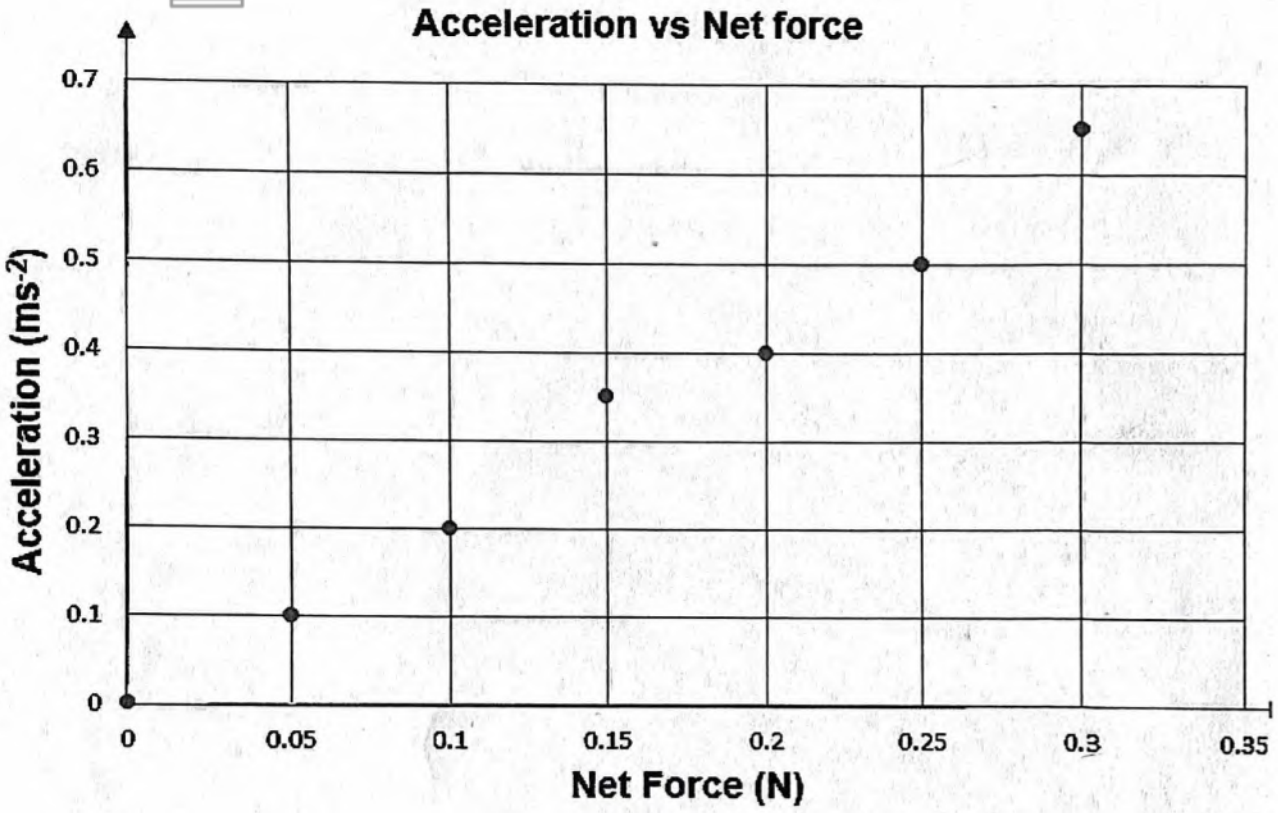
3.2.4 Calculate the magnitude of the tension T in the rope. (2)

Copyright Reserved

DETACH THIS PAGE

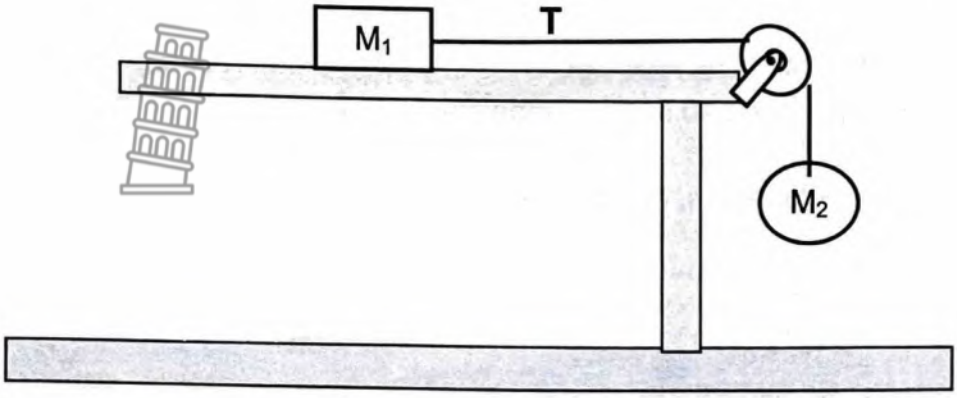
NAME OF LEARNER : _____

Question 3.1.2



Copyright Reserved

3.3 A block of mass M_1 and a ball of mass M_2 are connected by a light inextensible string that passes over a frictionless pulley as shown below. The block is placed on a ROUGH horizontal surface.

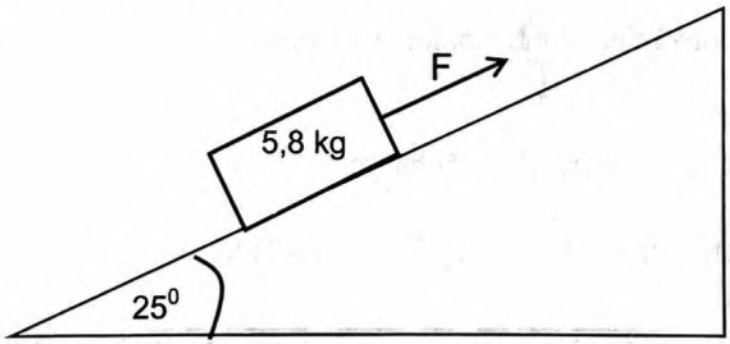


How will the acceleration of the blocks be affected when each of the following changes are made: (Choose from INCREASES, DECREASES, or REMAINS THE SAME)

3.3.1 The mass of the ball, M_2, is doubled? (1)

3.3.2 The mass of the block, M_1, is doubled? Fully explain the answer. (4)

3.4 A block of mass 5,8 kg is pulled up an incline at CONSTANT VELOCITY by a force F that makes an angle of 25^0 with the horizontal.
The kinetic frictional force between the block and the surface is 51,51 N.



3.4.1 Calculate the magnitude of force F (4)

3.4.2 The applied force F is now removed. Briefly describe the motion of the block immediately after F is removed (3)
[35]

Copyright Reserved

QUESTION 4 (Start on a new page)

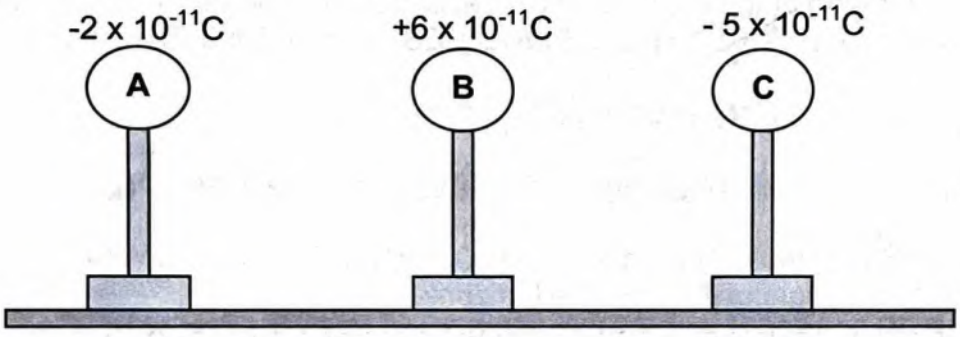
4.1 State *Newton's Law of Universal Gravitation* in words. (2)

4.2 A communications satellite of mass 1500 kg moves in a fixed orbit around Earth. Earth exerts a force of magnitude 10 500 N on the satellite in order to keep it in the specified orbit.
Calculate the distance, in kilometers, of the satellite above the surface of Earth. (5)

[7]

QUESTION 5 (Start on a new page)

5.1 Three identical metal spheres A, B and C carry charges of -2×10^{-11} C, $+6 \times 10^{-11}$ C and -5×10^{-11} C respectively.



All three spheres are brought into contact with each other and then separated AT THE SAME TIME.

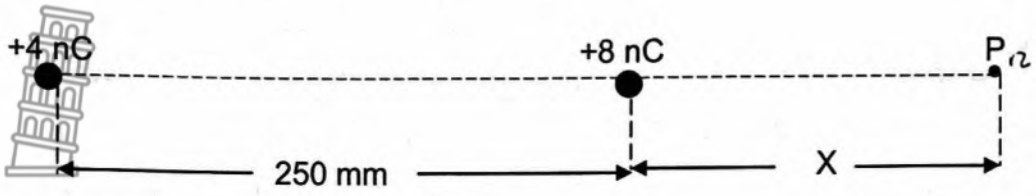
5.1.1 State the *Principle of conservation of charge*. (2)

5.1.2 Calculate the charge on each sphere after separation. (3)

5.1.3 By calculating the change in charge of sphere B, explain why sphere B becomes negatively charged after contact. (3)

Copyright Reserved

5.2 Two point charges of magnitudes +4 nC and +8 nC are placed at a distance of 250 mm apart. P is a point on the line joining the two charges, a distance X mm from the +8 nC charge, as shown in the diagram below.



5.2.1 State *Coulomb's Law* in words. (2)

5.2.2 Calculate the magnitude of the force that the +4 nC charge exerts on the +8 nC charge. (4)

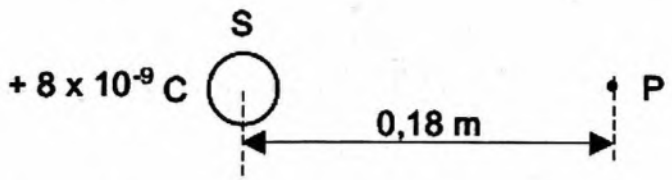
5.2.3 A third point charge of magnitude +12 nC is now placed at point P so that the resultant electrostatic force acting on the +8 nC charge is **zero**.
Calculate the distance X. (5)

[19]

QUESTION 6 (Start on a new page)

6.1 Define *electric field,* in words. (2)

6.2 S is a small, positively charged sphere carrying a charge of + 8 x 10^{-9} C.
P is a point 0,18 m from the centre of S.



6.2.1 Draw the electric field pattern for S. (2)

6.2.2 Calculate the electric field at P. (4)

[8]

TOTAL : 100

Copyright Reserved

DATA SHEET:

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	$5{,}98 \times 10^{24}\ kg$
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	$9{,}11 \times 10^{-31}\ kg$

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 $g = G\frac{M}{r^2}$

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 $n = \frac{Q}{q_e}$	

Copyright Reserved