LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

MOGALAKWENA DISTRICT

PHYSICAL SCIENCES

NATIONAL SENIOR CERTIFICATE

TERM 1 PRE-CONTROL TEST
07 MARCH 2023
GRADE 11

MARKS : 100 **DURATION: 2 hours**

STARTING TIME: 08H00

This question paper consists of 13 pages including this one

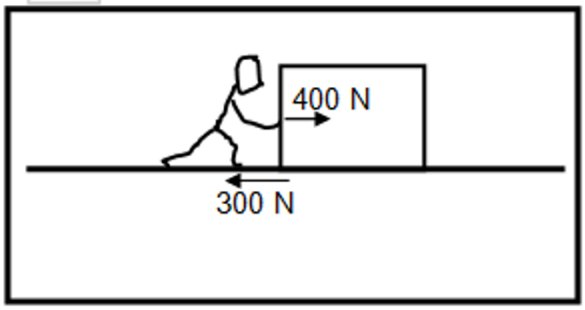
INSTRUCTIONS

1. This question paper consists of 13 pages including the cover page
2. Answer all the questions in the answer book
3. You are advised to use the attached DATA SHEETS.
4. Round off your final answer to a minimum of TWO decimal places
5. Show all your calculations including formulae where applicable.
6. Candidates may use non-programmable calculators.
7. Write neatly and legibly.

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

1.1 A boy applies a force of 400 N to push a crate as shown below. The frictional force acting on the crate is 300 N.



The magnitude of the force exerted by the crate on the boy is...

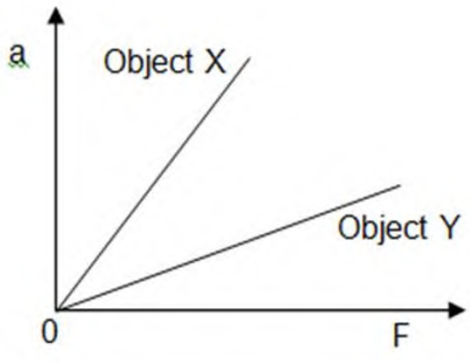
A 0 N

B 50 N

C 300 N

D 400 N (2)

1.2 The following graph represents the relationship between acceleration and net force F for two objects, X and Y, moving on the same frictionless surface.



Which one of the following statements is TRUE?

A **X** has a greater mass than **Y.**

B **X** has a smaller acceleration than **Y** for equal forces.

C **X** experiences a greater force than **Y** for equal accelerations.

D The gradient of graph **X** represents the inverse of the mass of **X**. (2)

1.3 Which ONE of the following physical quantities is a measure of the inertia of a body?

A Mass

B Energy

C Velocity

D Acceleration (2)

1.4 A car moving forward collides with a tree and comes to rest very quickly. The passenger who was not wearing a seat belt continued moving forward and collided with a car's windscreen. Which law explains this scenario?

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 on universal gravitation (2)

1.5 A laptop rests on a table. According to Newton's 3rd law, what is the reaction force to the weight of the laptop?

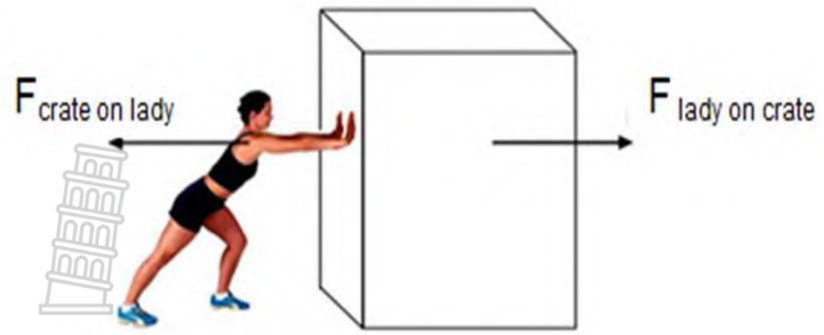
A The upward force of the table on the laptop.

B The upward force of the laptop on the earth.

C The downward force of the Earth on the laptop

D The normal force on the laptop. (2)

1.6 A lady pushes against a heavy crate on a horizontal surface. One action-reaction force pair applicable to this situation is indicated in the diagram below.



Which one of the following statements is correct for this situation?

A The crate accelerates because the magnitude of the force of the lady on the crate is greater than the magnitude of the force of the crate on the lady.

B The crate remains stationary because the force of the lady on the crate is equal in magnitude to the force of the crate on the lady.

C The crate remains stationary because the force of the lady on the crate is equal in magnitude to the force of friction on the crate.

D The crate moves at constant velocity because the force of the lady on the crate is equal in magnitude to the force of the crate on the lady. (2)

1.7 The gravitational force between two uniform spheres will change to one half of the original force if the …

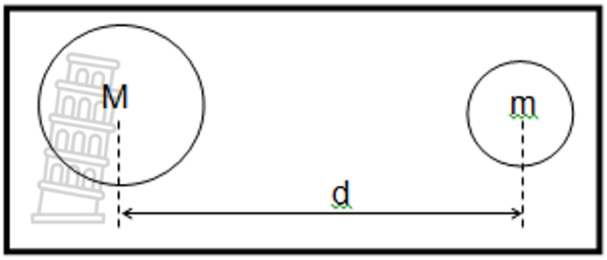
A Mass of each sphere is halved.

B Distance between them is halved.

C Distance between them is doubled.

D Mass of one of the spheres is halved. (2)

1.8 Two small objects with masses **M** and **m** exert a gravitational force of **F** on each other when separated by a distance **d.**



What gravitational force would be exerted by the objects with masses **3M** and **2m** at a separation distance of **6d**?

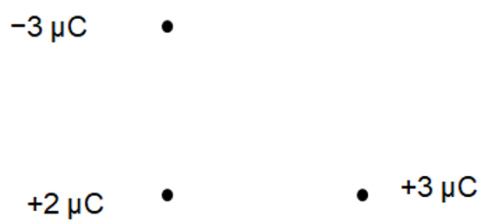
A 36F

B 6F

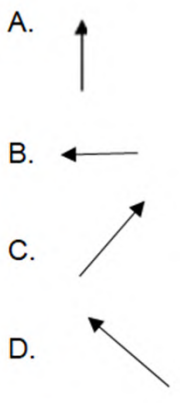
C F

D $\frac{F}{6}$ (2)

1.9 Three point charges of magnitudes −3 μC, +3 μC and +2 μC are placed at the three corners of a right angled triangle as indicated in the diagram.

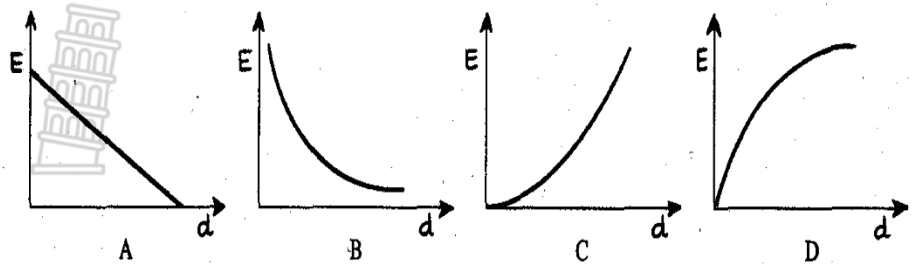


Which one of the following best represents the direction of the resultant force exerted on the +2 μC charge by the other two charges?



(2)

1.10 Which one of the following sketch graphs best represents the relationship between the electric field strength E and the distance d from a given charge Q?

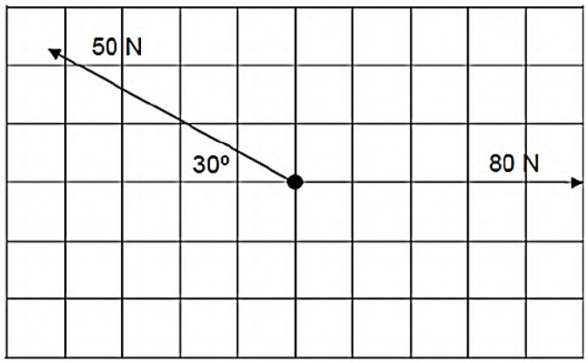


(2)

[20]

QUESTION 2

Two forces, of magnitude 50 N and 80 N, act at a point on a Cartesian plane in the directions shown in the sketch below.



2.1 Give the correct term for the following description: A single vector having the same effect as two or more vectors together (1)

2.2 Calculate the:

2.2.1 Magnitude of the vertical component of the 50 N force (2)

2.2.2 Magnitude of the horizontal resultant (net) force (3)

2.2.3 Magnitude of the resultant (net) force (2)

2.2.4 Direction of the resultant (net) force (2)

2.3 An athlete at point A runs 100 m north, then 70 m east, then 100 m south and then 70 m south.

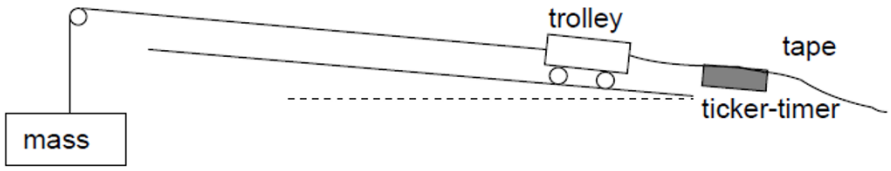
2.3.1 Draw a neat labelled vector diagram in the Cartesian place acting from the origin using the tail-to-head method (2)

2.3.2 Explain why the vector diagram from Question 2.3.1 is referred to as a closed vector diagram (1)

[13]

QUESTION 3

Grade 11 learners investigate the relationship between the net force and acceleration by pulling a trolley across a surface which is slightly inclined to compensate for friction. The trolley is connected to different masses by a string of negligible mass. The string passes over a frictionless pulley. Refer to the diagram below.



Ticker-tape attached to the trolley passes through the ticker-timer. The acceleration of the trolley is determined by analysing the ticker-tape. The results of the net force produced by the different masses and the acceleration of the trolley were recorded in the table below.

Net Force (N)	Acceleration ($m.s^{-2}$)
0,3	0,41
0,6	0,81
0,9	1,22
1,2	1,63

3.1 Write down a hypothesis for this experiment (2)

3.2 Identify the:

3.2.1 Independent variable (1)

3.2.2 Dependent variable (1)

3.2.3 Law being investigated (1)

3.3 Use the graph paper on the ANSWER SHEET and draw a graph of the acceleration versus net force. (4)

3.4 Calculate the gradient of the graph (3)

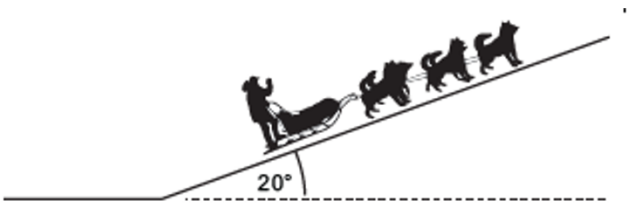
3.5 Use the gradient of the graph calculated in Question 3.4 to determine the mass of the trolley. (2)

3.6 Use the information gained from your calculation and investigation to explain why overloading the car is dangerous. (2)

[16]

QUESTION 4

A moving sled pulled by dogs begins to climb a slope which is inclined at 20° to the horizontal. The total mass of the sled and the two passengers is 150 kg. The coefficient of kinetic friction for the sled is 0,145. The dogs exert a combined force of 600 N on the sled.



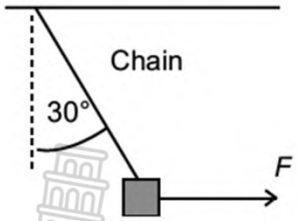
4.1 Draw a labelled free-body diagram (4)

4.2 Calculate the kinetic frictional force acting on the sled (3)

4.3 Calculate the acceleration of the sled. (6)

4.4 If the direction of the acceleration is down the slope, what can you say about the motion of the sled? (1)

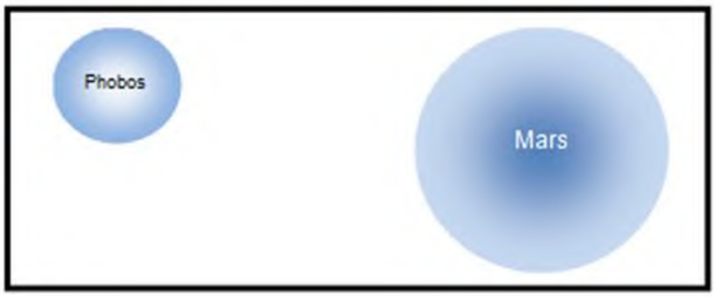
4.5 Consider a car engine which hangs from a chain. A mechanic pulls the engine sideways by applying a force of 100 N to the right. The engine is held in such a position that the chain makes an angle of 30° to the vertical



Calculate the tension T in the chain. (3)

[17]

QUESTION 5



5.1 State Newton's law of universal gravitation in words. (3)

5.2 Distinguish between the mass and the weight of an object (2)

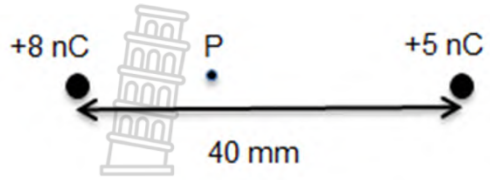
5.3 Mars has a mass of 6.4 x 1023 kg and its moon Phobos has a mass of 9,6 x 10^{15} kg. If the magnitude of the gravitational force between the two bodies is 4,6 x 10^{15} N, calculate how far apart Mars and Phobos are. (5)

5.4 Calculate the weight of an astronaut whose mass is 72kg on the Phobos if the radius of Phobos is 7,4 x 106 m. (3)

[13]

QUESTION 6

Two small conducting spheres which carry charges of +8 nC and +5 nC are placed a distance of 40 mm apart as shown in the diagram below.



6.1 State Coulomb's Law in words (2)

6.2 Calculate the magnitude of the electrostatic force that one charge exerts on the other. (4)

6.3 Define an electric field. (2)

6.4 Draw the electric field that would surround these two small conducting spheres. Show the conducting spheres as small circles. (2)

6.5 Along the line joining the two small spheres, there is a point P, which is 10 mm from the +8 nC charge. Show that the magnitude of the resultant or net electric field strength at P is $6,7 \times 10^5$ N.C^{-1}. (8)

6.6 An electron is placed at point P. Calculate the force experienced by the electron due to the electric field. (3)

[21]

GRAND TOTAL: 100 MARKS

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

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 die 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 vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of Earth *Massa van die Aarde*	M_E	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*

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

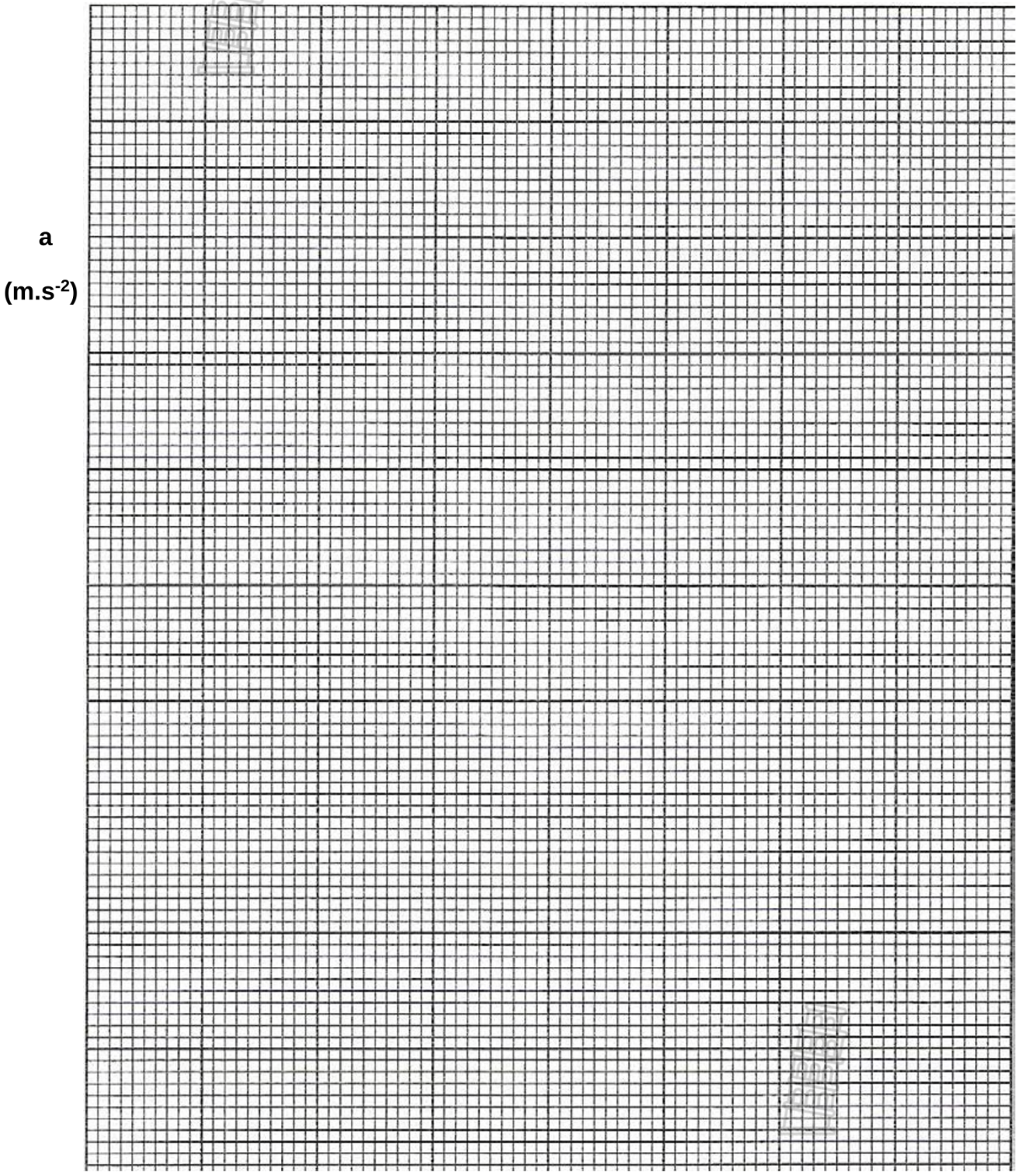
ELECTROSTATICS/*ELEKTROSTATIKA*

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

ANSWER SHEET
HAND IN THIS ANSWER SHEET TOGETHER WITH THE ANSWER BOOK.

NAME: _____ **CLASS:** _____

Question 3.3 **Graph of acceleration versus net**



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MEMORANDUM

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QUESTION 1

1.1 D✓✓
1.2 D✓✓
1.3 A✓✓
1.4 A✓✓
1.5 B✓✓
1.6 B✓✓
1.7 D✓✓
1.8 D✓✓
1.9 D✓✓
1.10 B✓✓

[20]

QUESTION 2

2.1 Resultant (net) vector ✓ (1)

2.2

2.2.1 $F_y = F\sin\theta$ (2)

$= 50\sin 30° \checkmark$ OR $50\cos 60°$

$= 25\ N \checkmark$

2.2.2 $F_x = F\cos\theta$ (3)

$= 50\cos 30°$ OR $50\sin 60°$

$= 43.30\ N$ to the left ✓

Substitution marks awarded within the question even if calculations for F_x and F_y are wrong

Horizontal resultant

$F_{Rx} = (-43.30) + (80)$ ✓

$= 36.70\ N$ to the right ✓

2.2.3 **Positive marking from Questions 2.2.1 and 2.2.2** (2)

Vertical resultant

F_{Ry}= 25 N upwards

Resultant Force

$F_R^2 = F_{Rx}^2 + F_{Ry}^2$

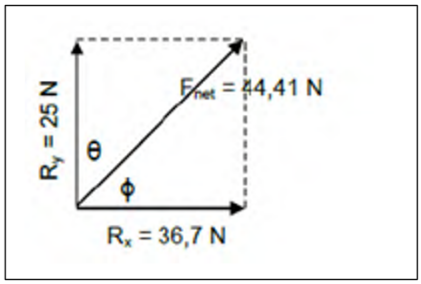
$F_R^2 = (36.70)^2 + (25)^2$ ✓

F_R=44.41 N ✓

2.2.4 **Positive marking from Question 2.2.1 and 2.2.2** (2)

$\tan\theta = \frac{36.7}{25}$ ✓

θ=55.74° ✓



OR

$\sin\theta = \frac{36.7}{44.41}$

θ=55.74°

OR

$\cos\theta = \frac{25}{44.41}$

θ=55.74°

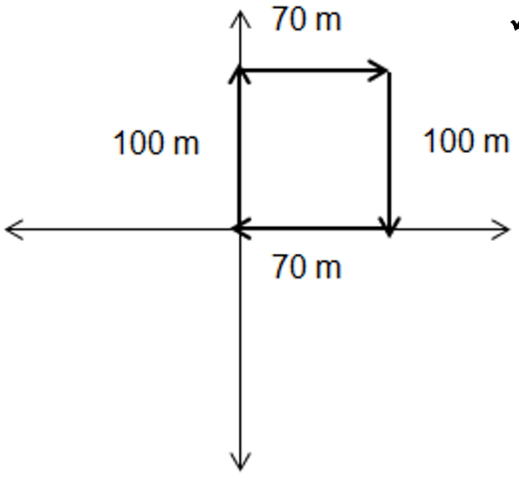
Also accept direction as:

$\emptyset = 90 - 55.74°$

$\emptyset = 34.26°$

2.3

2.3.1 (2)



✓✓Correct diagram

2.3.2 The first vector starts at the origin and the last vector ends at the origin. (The resultant would have a magnitude of zero since it is drawn from the tail of the first vector to the head of the final vector) ✓ (1)

[13]

QUESTION 3

3.1 (2)

Marking criteria
• The dependent and independent variables are stated correctly. • State the relationship between dependent and independent variable

The (net) force is directly proportional to acceleration if the mass of the trolley is kept constant ✓✓

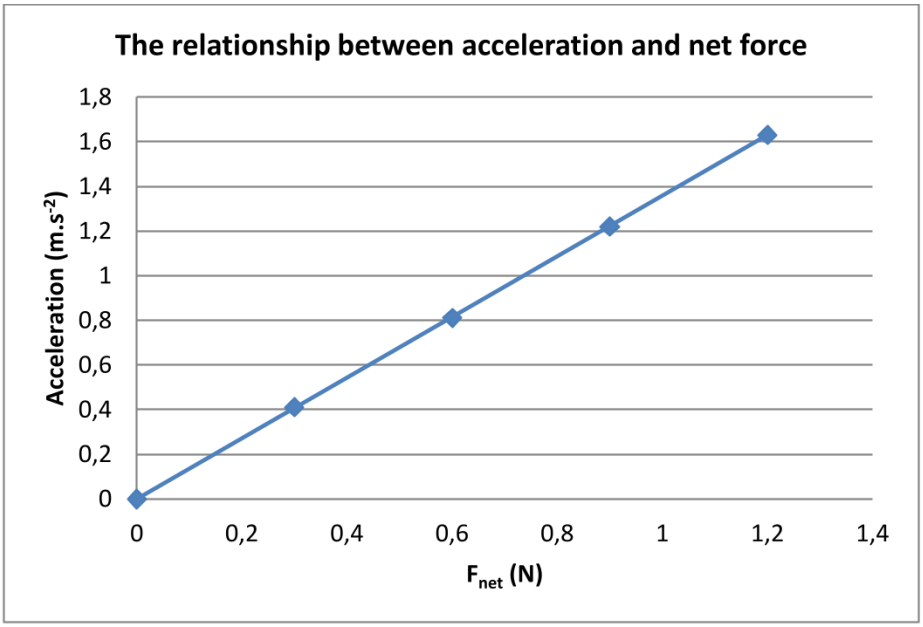
3.2

3.2.1 Net force ✓ (1)

3.2.2 Acceleration ✓ (1)

3.2.3 Newton's second law of motion ✓ (1)

3.3



Marking criteria for the graph	
Axes with correct/ appropriate scale	✓
3 or more coordinates correctly plotted	✓✓
Drawing a line of best fit	✓

(4)

3.4 $\text{Gradient} = \frac{1,63 - 0 \checkmark}{1,2 - 0 \checkmark} = 1,36 \checkmark$ (3)

OR

$$\text{Gradient} = \frac{1,63 - 1,22}{1,2 - 0.9} = 1,36$$

OR

$$\text{Gradient} = \frac{1,22 - 0,81}{0,9 - 0,6} = 1,36$$

3.5 **POSITIVE MARKING FROM QUESTION 3.4.** (2)

$$\text{Gradient} = \frac{a}{F_{Net}} = \frac{1}{m}$$

$$1,36 = \frac{1}{m} \checkmark$$

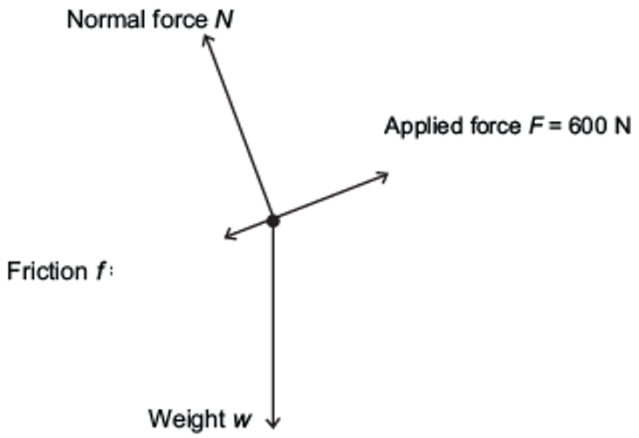
$m = 0.74$ kg ✓

3.6 For a constant applied force, an increase in mass decreases the negative acceleration. This cause the stopping time to increase and therefore the vehicle has a greater stopping distance. ✓✓ (2)

[16]

QUESTION 4

4.1 (4)



	Accept the following symbols
N✓	F_N/ Normal force
Ff✓	Kinetic friction force/ f_K/ F_f/ F_r
Fg✓	W / mg
F✓	Fa/Force Applied/600N

NB: Do not penalise for the length of the arrows

4.2 $f_k = \mu N$ (3)

$= \mu mg\cos\theta$ ✓

$= 0{,}145\ (150)(9{,}8)\cos 20°$ ✓

$= 200{,}30$ N ✓

4.3 $W_{||} = mg\sin\theta$ (6)

$= (150)(9{,}8)\ \sin 20°$

$= 502{,}77$ N down the slope ✓

$F_{net} = ma$

$(F_{app}) + (-W_{||}) + (-f) = ma$ ✓

$(600) + (-502{,}77) + (-200{,}30)$ ✓ $= 150a$ ✓

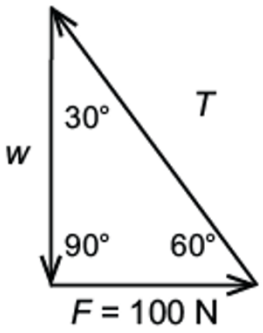
$-103.07 = 150a$

$a = -0{,}69\ m.s^{-2}$ ✓

$a = 0{,}69\ m.s^{-2}$ down the slope ✓

4.4 It means that the sled will slow down. ✓ (1)

4.5 (3)



$\sin 30° = \frac{100}{T}$ ✓

$T = \frac{100}{\sin 30°}$ ✓

T = 200 N ✓

[17]

QUESTION 5

5.1 Every object in the universe attracts every other object in the universe with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of distance✓ between their centres. ✓ (3)

5.2 The mass of an object is the amount of matter found in an object. ✓ (2)
The weight of an object is the force with which the centre of a planet attracts an object. ✓

5.3 $F= \frac{Gm_1m_2}{r^2}$ ✓ (5)

$4,6\times10^{15}$✓$= \frac{(6,67\times10^{-11})(6,4\times10^{23})(9,6\times10^{15})✓}{r^2}$

$r=9,44\times10^{6}$m ✓

5.4 $F= \frac{Gm_1m_2}{r^2}$ ✓ (3)

$= \frac{(6,67\times10^{-11})(9,6\times10^{15})(72)✓}{(7,4\times10^{6})^2}$

$=8,42\times10^{-7}$N ✓

[13]

QUESTION 6

6.1 The force between two charges is directly proportional to the product of the charges and inversely proportional to the distance between the charges squared✓✓ (2)

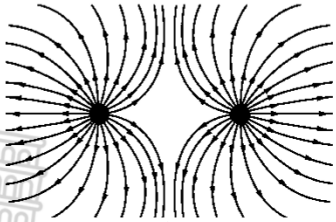
6.2 $F=k\frac{Q_1Q_2}{r^2}$ ✓ (4)

$=9\times10^{9}\frac{(8\times10^{-9})(5\times10^{-9})✓}{(40\times10^{-3})^2}$ ✓

$=2,25\times10^{-4}$N ✓

6.3 A region in space in which an electric charge ✓ will experience a force ✓ (2)

6.4 (2)



✓ direction ✓ shape

6.5 (8)

$E_{8nC} = k\frac{Q}{r^2}$ $E_{5nC} = k\frac{Q}{r^2}$

$= \frac{(9\times10^{9})(8\times10^{-9}\checkmark)}{(10\times10^{-3}\checkmark)^2}$ $= \frac{(9\times10^{9})(5\times10^{-9})\checkmark}{(30\times10^{-3})^2}\checkmark$

$= 720\ 000\ N.C^{-1}$ ✓ $= 50\ 000\ N.C^{-1}$ ✓

$E_{net} = 720\ 000 - 50\ 000$ ✓ (towards the right – positive direction)

$= 670\ 000\ NC^{-1}$ ✓

6.6 $F = qE$ $= (1,6\times10^{-19}) \times (670\ 000)$ ✓ (3)

$= 1,07 \times 10^{-13}$ N ✓ towards the +8nC charge ✓

[21]

GRAND TOTAL: 100 MARKS