LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES

CONTROL TEST

13 MARCH 2024

MARKS: 100

TIME: 2 HOURS

THIS QUESTION PAPER CONSISTS OF 11 PAGES AND 1 DATA SHEET

INSTRUCTIONS AND INFORMATION

1. Write your name and surname in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of SIX questions.
3. Answer ALL the questions in the ANSWER BOOK.
4. Start EACH question on a NEW page in the ANSWER BOOK.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two sub-questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
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, etc. where required.
13. Write neatly and legibly.

SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 The force exerted by a surface on an object which is in contact with it and acts perpendicular to the surface is called:

A Gravitational force.

B Frictional force.

C Applied force.

D Normal force. (2)

1.2 The gravitational acceleration on the surface of a planet of radius ***R*** is ***g***.

The gravitational acceleration at a height of ***3R*** above the surface of the same planet is:

A $\frac{g}{16}$

B $\frac{g}{9}$

C 16 g

D 9 g (2)

1.3 The mass of a man on Earth is 85 kg. What will the mass of the same man be on the surface of a planet which has the same mass as Earth but half the radius of the Earth?

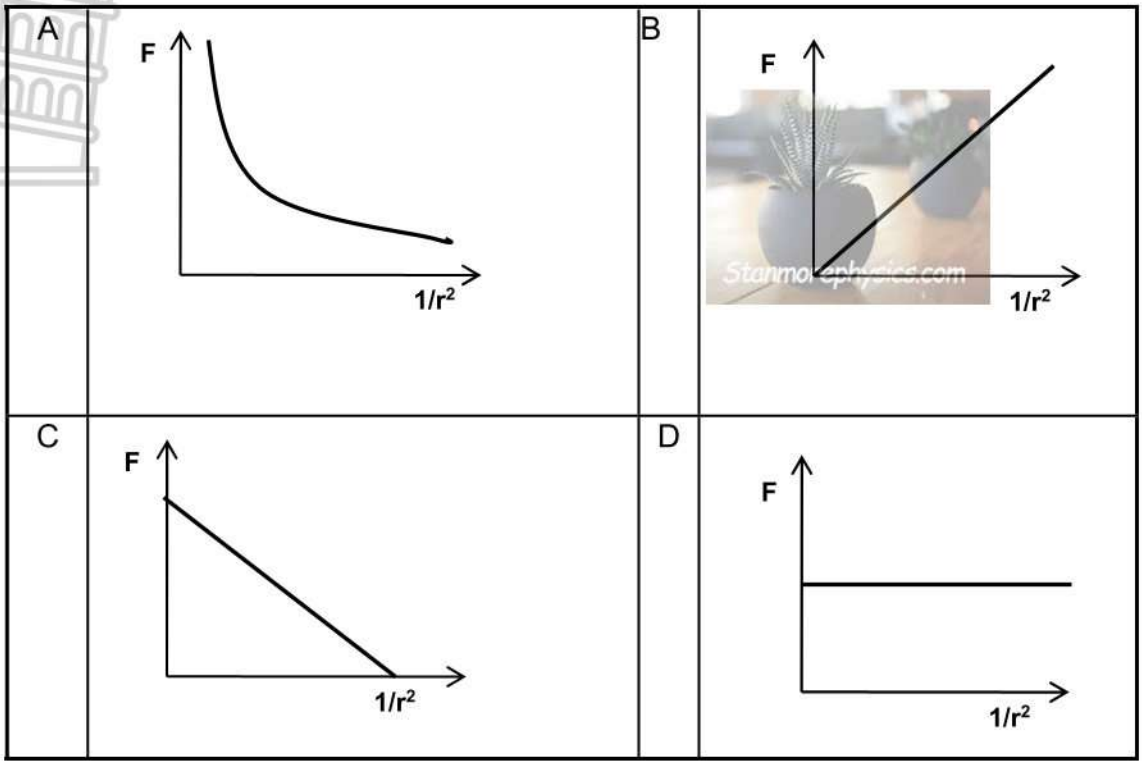
A 42,5 kg

B 21,25 kg

C 85 kg

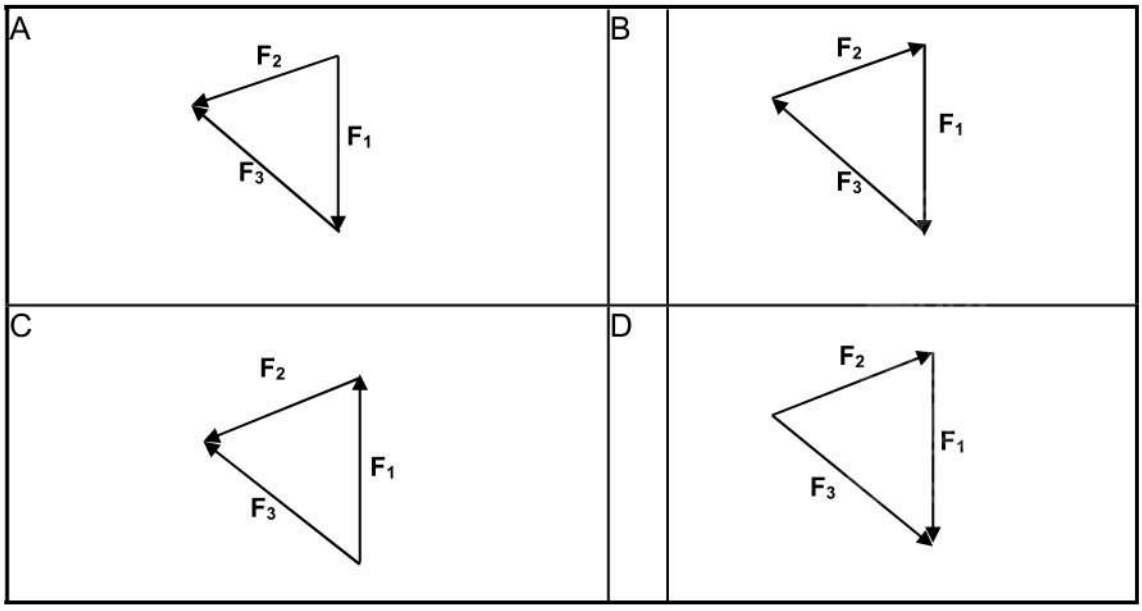
D 340 kg (2)

1.4 An object placed a distance **r** from the centre of a planet experiences an attractive force **F**. Which ONE of the graphs below represents the relationship between the force **F** and the distance **r** from the centre of the planet?



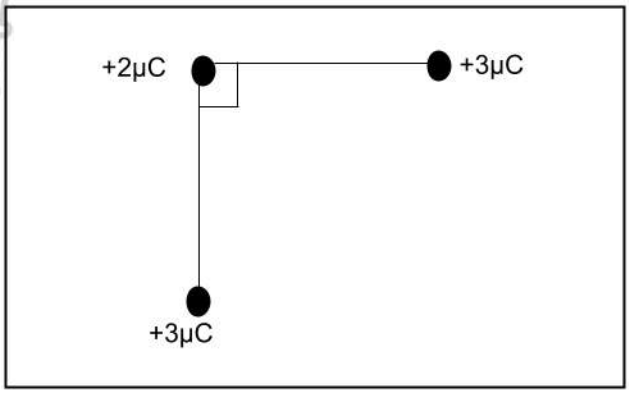
(2)

1.5 Three forces acting on an object are in equilibrium. Which ONE of the vector diagrams below indicates the forces in equilibrium?



(2)

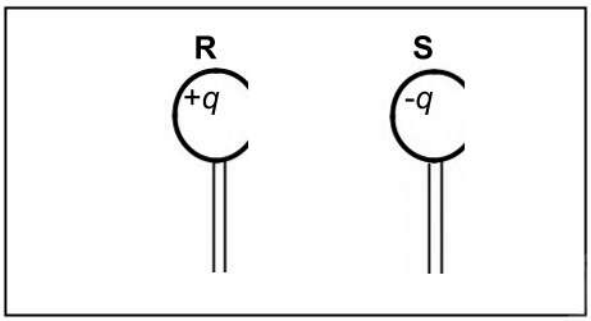
1.6 Three point-charges of magnitude +2 μC, +3 μC and +3 μC are placed in a vacuum to form a right-angle as shown in the diagram below.



The net force acting on the + 2 μC can by represented by …

(2)

1.7 Two identical spheres, **R** and **S**, on insulated stands, carrying charges of $+q$ and $-q$ respectively, are placed a distance ***r*** apart. Sphere **R** exerts an electrostatic force of magnitude ***F*** on sphere **S**.



The two spheres are now brought into contact and are then returned to their original positions.

The magnitude of the electrostatic force that sphere **R** exerts on sphere **S** is now:

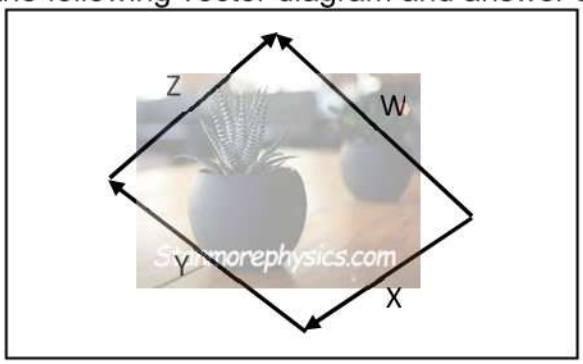
A F

B $\frac{F}{2}$

C zero

D 2F (2)

1.8 Consider the following vector diagram and answer the question.



Which ONE of the vectors is the resultant of the other three vectors?

A Y
B X
C W
D Z (2)

1.9 A girl which has a weight of 600 N is standing on a bathroom scale in a lift that is moving and she noticed that the scale reads 660 N. Which ONE of the following is theCORRECT conclusion about the motion of the lift? The lift is:

A Moving downwards at constant velocity.
B Accelerating downwards.
C Moving upwards at constant velocity.
D Accelerating upwards. (2)

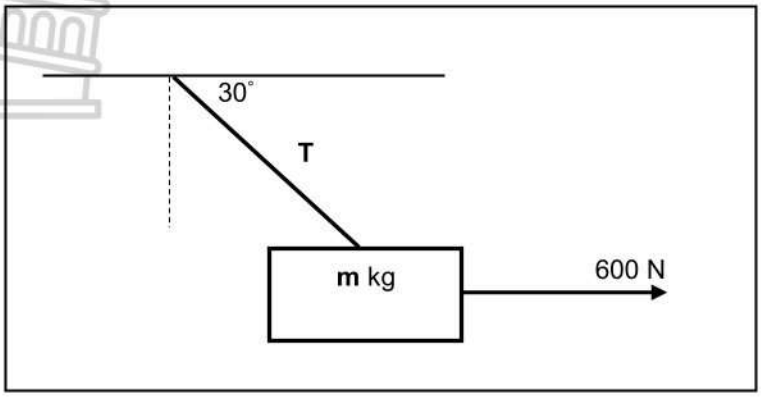
1.10 Passengers in a moving car are advised to wear safety belts. This will reducetheir chances of getting injured in the event of an accident. This precaution is an application of which ONE of the following Physics laws?

A Newton's first law
B Newton's second law
C Newton's third law
D Newton's law of universal gravitation (2)

[20]

QUESTION 2

A 600 N force is applied horizontally on a block of mass **m** kg by means of a massless inextensible rope. The block remains stationary when the angle that the rope makes with the horizontal is 30°.



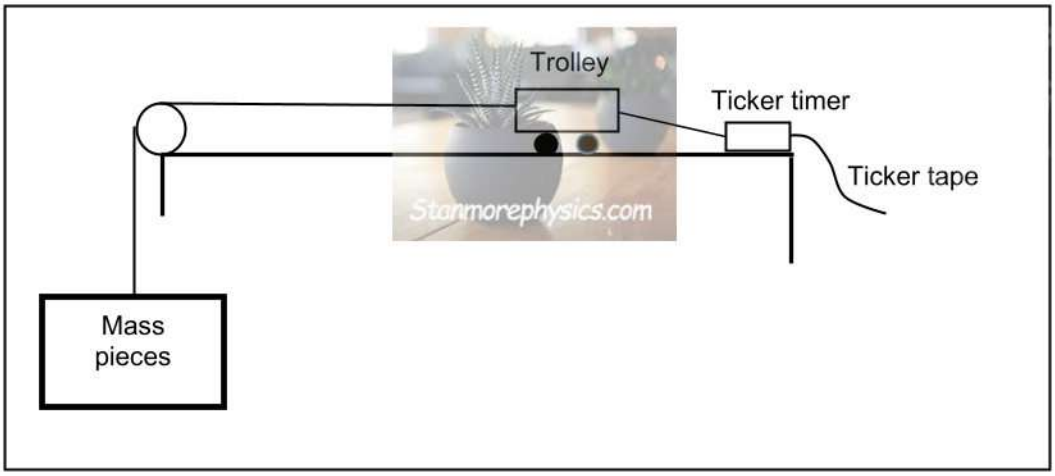
2.1 Explain why the block is stationary. (2)

2.2 Use either calculation or construction to determine the tension, **T**, in the rope. Use a scale of 1 cm : 100 N. (4)

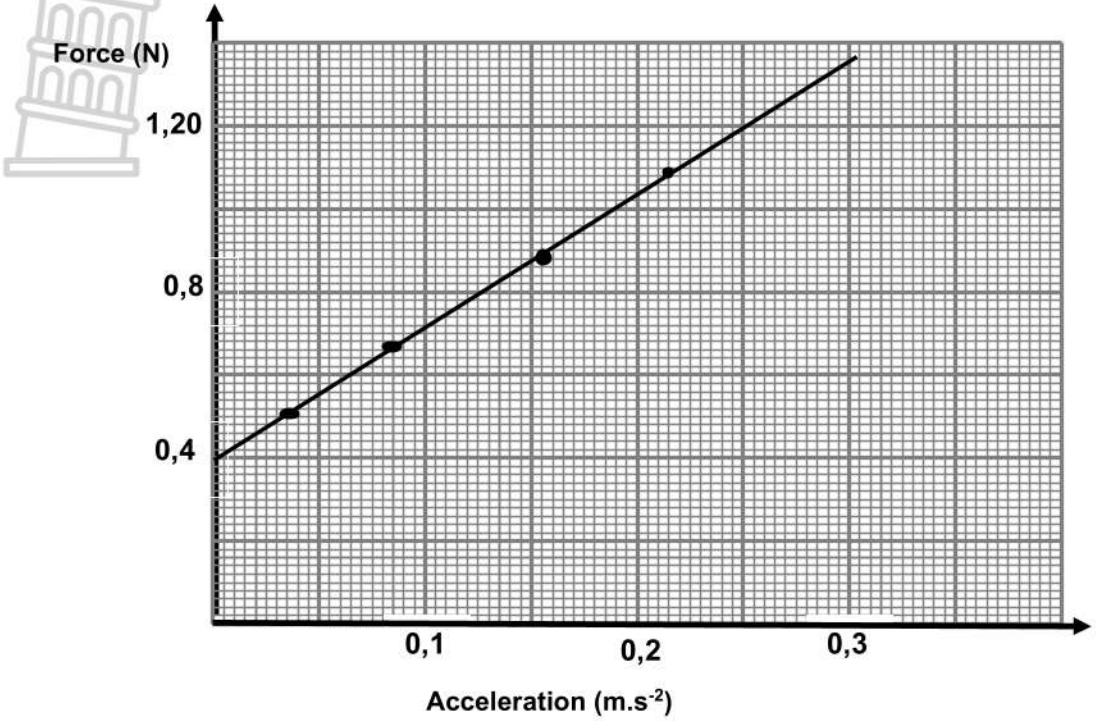
2.3 Calculate the mass (**m**) of the block. (6)
[12]

QUESTION 3

Learners conducted an investigation to determine the relationship between acceleration and applied force. During the investigation, a mass piece which hangs vertically by means of an inextensible string that passes over a frictionless pulley is used to accelerate a trolley across a horizontal surface as shown in the diagram below. Four different mass pieces were used to obtain four sets of readings.



A ticker timer and tape are attached to the trolley. As the trolley moves, the ticker timer makes dots on the tape. The tape is used to analyse the motion. The learners' results are plotted on a graph as shown below.



3.1 For this investigation write down:

3.1.1 The conclusion of the learners. (2)

3.1.2 An expression to calculate the net force acting on the trolley. (1)

3.2 Give a reason why the graph does not start from the origin (0;0). (2)

3.3 What physical quantity does the intercept on the vertical axis represent? (1)

3.4 What physical quantity does the gradient of the graph represent? (1)

3.5 Use the information from the graph to calculate the mass of the trolley. (4)

3.6 The learners conducted another investigation using a trolley of a larger mass than the trolley used in the first investigation but made of the same material. (3)

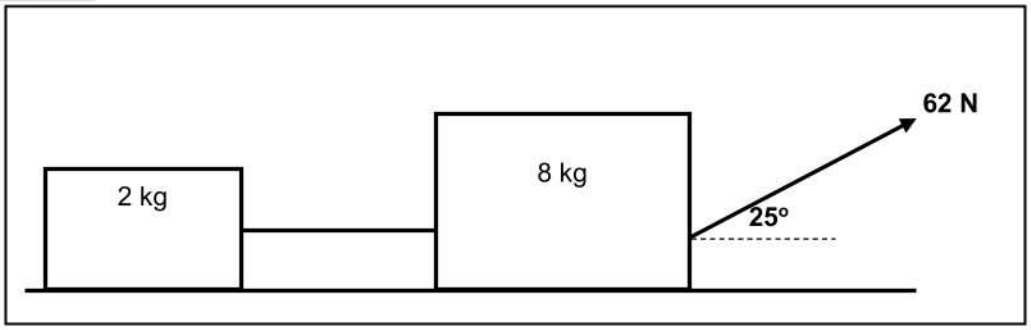
3.6.1 How does the vertical axis intercept of the graph of the second investigation compare with that of the first investigation? Answer LESS THAN, GREATER THAN or REMAINS THE SAME. (1)

3.6.2 Explain your answer to QUESTION 3.6.1. (2)

[14]

QUESTION 4

Two blocks of masses 8 kg and 2 kg are connected with a light inextensible string and placed on a ROUGH horizontal surface. When a force of 62 N is applied to the 10 kg block at an angle of 25° with the horizontal, the system accelerates at 3 $m.s^{-2}$ to the right as shown on the diagram below. The 2 kg block experiences a constant frictional force of 2,1 N.



4.1 State Newton's second law of motion in words. (2)

4.2 Draw a free body diagram of all forces acting on the 8 kg block. (5)

4.3 Calculate the:

4.3.1 Tension in the string connecting the two blocks. (4)

4.3.2 Coefficient of kinetic friction between the 8 kg block and the surface. (6)

4.4 The angle at which the force is applied is decreased to 10°.

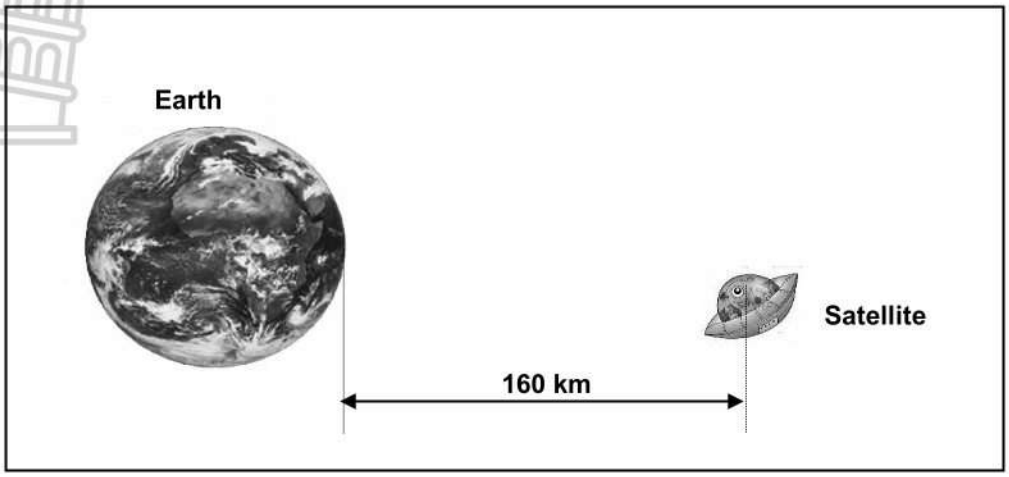
4.4.1 How will the answer in QUESTION 4.3.2 change? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

4.4.2 Explain your answer to QUESTION 4.4.1. (1)

[19]

QUESTION 5

A satellite of mass 980 kg is orbiting the Earth at a distance of 160 km from the surface of the Earth as shown on the diagram below.



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

5.2 Calculate the magnitude of the force that the Earth exerts on the satellite to keep it in orbit. (5)

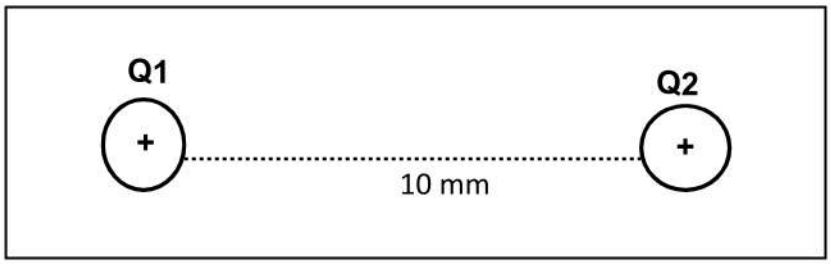
5.3 Calculate the weight of the satellite on the Earth surface. (3)

5.4 State THREE differences between mass and weight. (3)

[13]

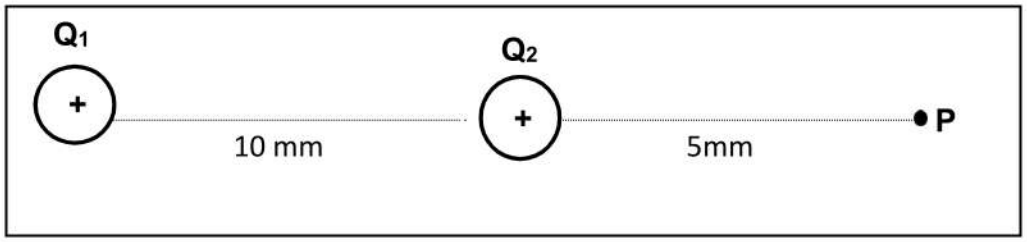
QUESTION 6

Two identical point charges are placed 10 mm apart in a vacuum as shown below.The electrostatic force that **Q1** exerts on **Q2** is 8 N.



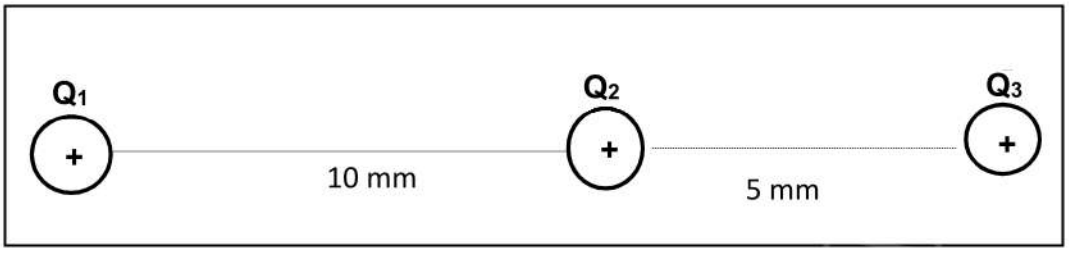
6.1 Draw the electric field pattern between the two charges. (3)
6.2 State *Coulomb's law* in words. (3)
6.3 Calculate the magnitude of each charge. (5)
6.4 Define electric field at a point. (2)

6.5 Calculate the net electric field at point **P**, as shown on the diagram below.



(6)

6.6 A third charge **Q3** of magnitude 5 µC is now placed at point **P** as shown in the diagram below.



Calculate the net electrostatic force experienced by point charge **Q3** due to point charge **Q1** and **Q2**. (3)

[22]

TOTAL: 100 MARKS

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•s^{-2}
Universal gravitational constant / *Universelegravitasiekonstant*	G	6,67 × 10^{-11} N•m^2•kg^{-2}
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	3,0 × 10^8 m•s^{-1}
Planck's constant / *Planck se konstante*	h	6,63 × 10^{-34} J•s
Coulomb's constant / *Coulomb se konstante*	k	9,0 × 10^9 N•m^2•C^{-2}
Charge on electron / *Lading op elektron*	e	-1,6 × 10^{-19} C
Electron mass / *Elektronmassa*	m_e	9,11 × 10^{-31} kg
Mass of earth / *Massa op aarde*	M	5,98 × 10^{24} kg
Radius of earth / *Radius van aarde*	R_E	6,38 × 10^3 km

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

$F_{net} = ma$	$w = mg$
$\mu_k = \frac{f_k}{N}$	$\mu_s = \frac{f_s^{max}}{N}$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	p = mv
$F = \frac{Gm_1m_2}{d^2}$ or/of $F = \frac{Gm_1m_2}{r^2}$	$g = \frac{GM}{d^2}$ or/of $g = \frac{GM}{r^2}$

ELECTROSTATICS/*ELEKTROSTATIKA*

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

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GRADE/*GRAAD* 11

PHYSICAL SCIENCES/*FISIESE WETENSKAP*
CONTROL TEST MARKING GUIDELINES/*KONTROLE TOETS NASIENRIGLYNE*
13 MARCH/*MAART* 2024

MARKS/*PUNTE*: 100

THIS MARKING GUIDELINE CONSISTS OF 9 PAGES

HIERDIE NASIENRIGLYNE BESTAAN UIT 9 BLADSYE

QUESTION/*VRAAG* 1

1.1 D ✓✓ (2)

1.2 A ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

1.7 C ✓✓ (2)

1.8 C ✓✓ (2)

1.9 D ✓✓ (2)

1.10 A ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1 The resultant/net force of all forces acting on the block is equal to zero. ✓✓/ *Die resultante/netto krag van alle kragte wat op die blok inwerk is gelyk aan nul.*

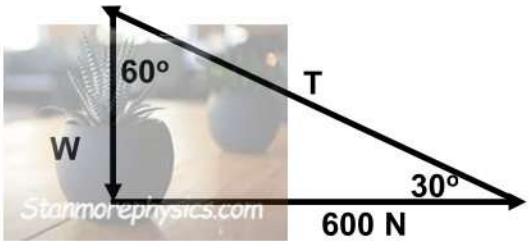
OR/*OF*

The forces acting on the block are balanced/in equilibrium/equal and opposite/ *Die kragte wat op die blok inwerk is gebalanseerd/in ewewig/gelyk en teenoorgesteld.*

OR/OF

There is no net/resultant force acting on the block/ *Daar is geen netto/resultante krag wat op die blok inwerk nie.* (2)

2.2

OPTION/*OPSIE* 1	OPTION/*OPSIE* 2
$T_x = 600$ ✓✓ or/*of* $T\cos30° = 600$ ✓ $T = 692,82$ N ✓	

Criteria for marking/*Nasien kriteria*

Criteria/*kriteria*	Mark/*punt*
600 N force accurately measured and drawn with arrow. (6 cm)/*600 N krag is akkuraat gemeet en geteken met 'n pyl (6cm)*	1
90° angle with the 600 N force measured and a vertical line representing the weight drawn with arrow/*90° hoek met die 600 N krag gemeet en vertikale lyn wat gewig verteenwoordig met 'n pyl geteken*	1
30° angle to the horizontal measured and T drawn with arrow/*30° hoek met die horisontaal gemeet en T met 'n pyl geteken*	1
Measure magnitude of the length of T (6.93 cm) T = (693 N)/*Meet die grootte of lengte van T (6.93 cm) T = (693 N)*	1

(4)

2.3 **POSITIVE MARKING FROM QUESTION 2.2/*POSITIEWE NASIEN VANAF VRAAG 2.2***

OPTION/*OPSIE* 1	OPTION/*OPSIE* 2
$w = T_y$ $w = T\sin30°$ } ✓ any one/*enige een* $w = 692,82 \sin 30°$ ✓ $w = 346,41$ N $w = mg$ ✓ $346.41 = m \times 9,8$ ✓ $m = 35,35$kg ✓	Vector representing weight accurately measured/*Vektor wat gewig verteenwoordig akkuraat gemeet* (~3,45 cm) ✓ Measured value converted to weight/*gemete waarde korrek omgeskakel na gewig as* (~ 345 N) ✓ $w = mg$ ✓ 345 ✓ $= m \times 9,8$ ✓ $m = 35,20$ kg ✓ (any approximate m/ *enige benaderde m*)

(6)
[12]

QUESTION/*VRAAG* 3

3.1.1 As the (magnitude) of the tension/applied force increases, the acceleration increases ✓✓/ *Soos die (grootte) van die spanning/toegepaste krag toeneem, sal die versnelling verhoog/toeneem*

or/*of*

There is a linear relationship between the force and acceleration./ *Daar is 'n lineêre verband tussen die krag en versnelling*

NB: Force is directly proportional to acceleration/ *Krag is direk eweredig aan versnelling* (0/2)

(2)

3.1.2 $F_{net} = F_{app} + f_k$
$F_{net} = F_{g(masspiece)} + f_k$ } Any one/*enige een* ✓ (1)

3.2 The applied force is not directly proportional to the acceration of the trolley✓✓/ *Die toegepaste krag is nie direk eweredig aan die versnelling van die trollie nie.*

OR/*OF*

There is frictional force acting on the trolley. ✓✓ / *Daar is wrywingskrag wat op die trollie inwerk.*

(2)

3.3 The frictional force ✓/*Die wrywingskrag* (1)

3.4 Mass of the trolley ✓/*Massa van die trollie*
(**NB**: From 3.1.2, $F_{net} = mg + f_k$ which is analogous to y = mx + c/*Vanaf 3.1.2 is* $F_{net} = mg + f_k$ *wat gelykstaande is aan* $y = mx + c$) (1)

3.5

OPTION/OPSIE 1	**OPTION/OPSIE 2**
Gradient = $\frac{\Delta F}{\Delta a}$ ✓ Gradient = $\frac{1,20-0,4}{0,25-0}$ ✓✓ Gradient = mass/*massa* = 3,2 kg ✓	$F_{net} = F_{app} + f_k$ } Any one/*enige een* ✓ $ma = F_{app} + f_k$ m x 0,125 ✓ = 0,8 – 0,4 ✓✓ m = 3,2 kg ✓

(4)

3.6.1 Greater than. ✓/*Groter as* (1)

3.6.2 The intercept on the vertical axis represents the frictional force. Frictional force increases when mass increases. ✓✓($f_k = \mu_k N = \mu_k mg$) / *Die snypunt op die vertikale as verteenwoordig die wrywingskrag. Wrywingskrag neem toe wanneer massa toeneem.* ($f_k = \mu_k N = \mu_k mg$)

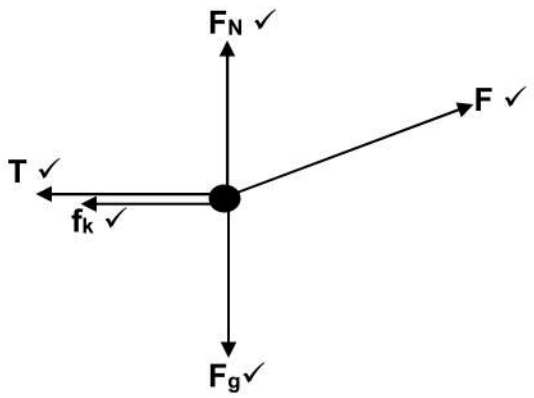
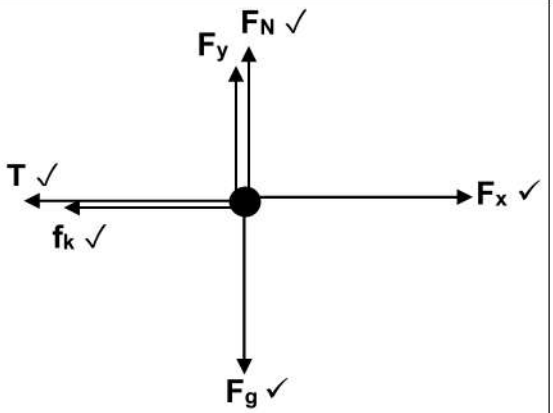
(2)
[14]

QUESTION/*VRAAG* 4

4.1 When a net (resultant) force acts on an object, the object will accelerate in the direction of the nett force. The acceleration is directly proportional to the net (resultant) force ✓ and inversely proportional to the mass ✓of the object./ *Wanneer 'n netto (resultante) krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig aan die netto (resultante) krag en omgekeerd eweredig aan die massa van die voorwerp*.

(2)

4.2

OPTION/*OPSIE* 1	**ACCEPT/*AANVAAR***
	

Mark awarded for arrow and label. /*punt toegeken vir pyl en byskrif*

Do not penalise for length of arrows since drawing is not drawn to scale/*moenie penaliseer vir lengte van pyle nie, diagram is nie volgens* skaal geteken nie.

Any other additional force(s)/*enige ander addisionele kragte* $\frac{4}{5}$

If force(s) do not make contact with body/*As die krag(te) nie met die liggaam kontak maak nie*. Max/*maks* $\frac{4}{5}$

(5)

4.3.1 **4 kg block/*blok***

$F_{net} = ma$
$T - f_k = ma$

Any one/*enige een* ✓

$T - 2.1$ ✓ $= 2 \times 3$ ✓
$T = 8,1$ N ✓

(4)

4.3.2 Positive marking from QUESTION 4.3.1/*positiewe nasien vanaf VRAAG 4.3.1*

10 kg block/*blok*

$F_{net} = ma$

$F_x - T - f_k = ma$

$\underline{62 \cos 25^o - 8,1}$✓ $- f_k = 8(3)$ ✓

$f_k = 24,09$ N

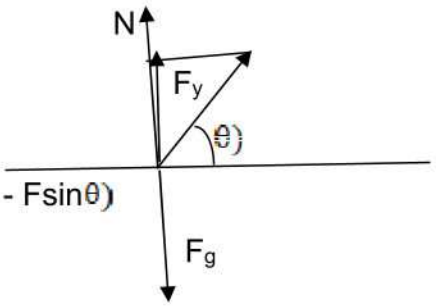
$f_k = \mu_k N$

$f_k = \mu (mg - F\sin\theta)$ $(N + F_y = F_g;\ N = F_g - F_y = mg - F\sin\theta)$

$24,09$ ✓$= \mu ((8)(9,80) - (62 \sin 25^\circ))$ ✓

$\mu = 0,46$ ✓

Any one ✓/*enige een*



(6)

4.4.1 Remain the same. ✓/*bly dieselfde* (1)

4.4.2 The coefficent of kinetic friction only depends on the type of surface. ✓/*Die koëffisiënt van kinetiese wrywing hang slegs af van die tipe oppervlakte* (1)

[19]

QUESTION/VRAAG 5

5.1 Every particle in the universe attracts every other particle in the universe 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. ✓✓/*Elke deeltjie in die heelal trek elke ander deeltjie in die heelal aan met 'n gravitasiekrag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte*

(2)

5.2 $F = \dfrac{Gm_1m_2}{r^2}$ ✓

$F = \dfrac{6,67 \times 10^{-11} \times 5,98 \times 10^{24} \times 980}{(6,38 \times 10^6 + 160 \times 10^3)^2}$ ✓✓

$F = 9\ 138,98$ N ✓ (5)

5.3

OPTION/*OPSIE* 1	**OPTION/*OPSIE* 2**
$w = mg$ ✓ $w = 980 \times 9,8$ ✓ $w = 9\ 604$ N ✓	$w = \dfrac{Gm_1m_2}{r^2}$ ✓ $w = \dfrac{6,67 \times 10^{-11} \times 980 \times 5,98 \times 10^{24}}{(6,38 \times 10^6)^2}$ ✓ $w = 9\ 603,11$ N ✓

5.4 **Any correctly stated and compared ✓✓✓ / *Enige korrek gestel en vergelyk***

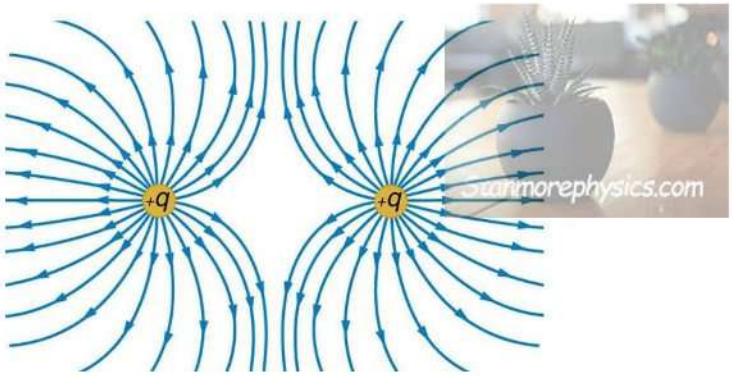
Mass/*massa*	**Weight/*gewig***
1. Scalar quantity/*skalaar hoeveelheid*	1. Vector quantity/*vektor hoeveelheid*
2. Measured in kg / *word in kg gemeet*	2 Measured in N /*word in N gemeet*
3. Measured using a chemical balance /*gemeet deur gebruik te maak van 'n chemiese balans*	3 Measured using a forcemeter / *gemeet deur 'n kragmeter te gebruik*
4. Does not change with position/*verander nie met posisie nie*	4. Changes with position./*verander met posisie*
5. Quantity of matter in an object/ *Hoeveelheid materie in 'n voorwerp*	4. Gravitational force exerted on an object by the Earth/ *Gravitasiekrag uitgeoefen op 'n voorwerp deur die Aarde*

(3)

[13]

QUESTION/*VRAAG* 6

6.1



CRITERIA FOR MARKING/*NASIENRIGLYNE*	
Correct shape/*korrekte vorm*	✓
Direction of field lines/*rigting van veldlyne*	✓
Field lines not crossing each other/*veldlyne kruis mekaar nie*	✓

(3)

6.2 The magnitude of the electrostatic force✓ exerted by one point charge Q_1 on point charge Q_2 is directly proportional the product of the magnitudes of the charges ✓ and inversely proportional to the square of the distance between them. ✓/

Die grootte van die elektrostatiese krag wat deur een puntlading Q1 op puntlading Q2 uitgeoefen word, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(3)

6.3 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$8 = \frac{9 \times 10^9 \times Q \times Q}{0,01^2}$ ✓✓

$Q^2 = 8,8889 \times 10^{-14}$

Q on each/*Q op elk* = $2,98 \times 10^{-7}$ C ✓✓

($Q = Q_1 = Q_2$) (5)

6.4 The electrostatic force per unit positive charge at that point. ✓✓ / *Die elektrostatiese krag per eenheid positiewe lading op daardie punt* (2)

6.5 $E = \frac{kQ}{r^2}$ ✓

$E_1 = \frac{9 \times 10^9 \times 2,98 \times 10^{-7}}{0,015^2}$ ✓

$= 11\ 920\ 000\ NC^{-1}$ right/*regs*

$E_2 = \frac{9 \times 10^9 \times 2.98 \times 10^{-7}}{0,\ 005^2}$ ✓

$= 107\ 280\ 000\ NC^{-1}$ right/*regs*

$E_{net} = E_1 + E_2$

$= 11\ 920\ 000 + 107\ 280\ 000$ ✓

$= 119\ 200\ 000\ NC^{-1}$✓ right/*regs* ✓ (6)

6.6 $E = F/q$ ✓

$119\ 200\ 000 = F/5 \times 10^{-6}$ ✓

$F = 596$ N✓ right/*regs*✓ (3)

[22]

TOTAL/TOTAAL: 100