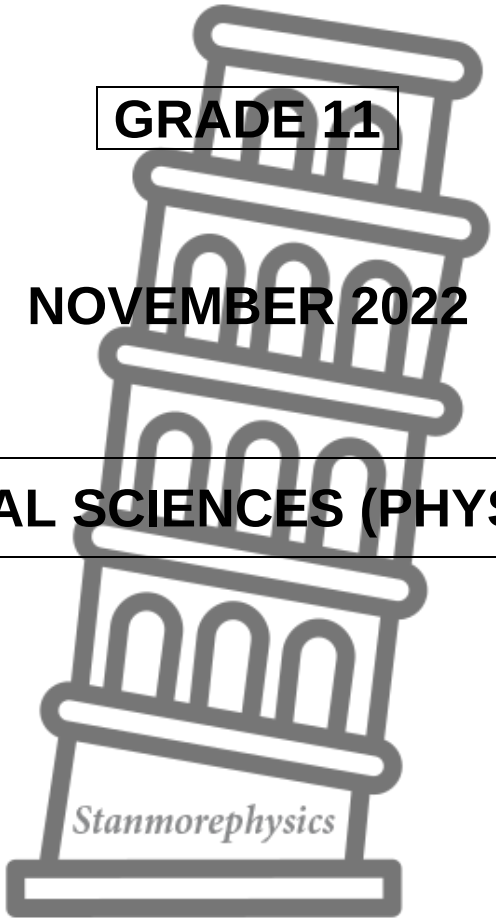
Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

PHYSICAL SCIENCES (PHYSICS) P1



MARKS: **100**

TIME: **2 hours**

This question paper consists of 15 pages, including 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. Answer ALL the questions.
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. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

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 1.7) in the ANSWER BOOK, for example 1.8 C

1.1 Two equal vectors **P** and **-P** act on a common point **O**. The angle between the two vectors is …

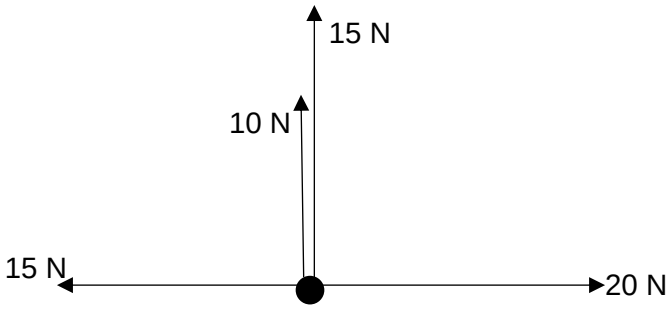
A 0°.

B 90°.

C 180°.

D 270°. (2)

1.2 Four vectors act on a point as indicated below.



The magnitudes of the resultant/net forces in the horizontal direction ($\mathbf{F_X}$) and in the vertical direction ($\mathbf{F_Y}$) are ...

	$\mathbf{F_X}$	$\mathbf{F_Y}$
A	35 N	25 N
B	5 N	25 N
C	35 N	5 N
D	5 N	5 N

(2)

1.3 The mass of a man on planet **R** is **m** kg. The acceleration due to gravity on planet **S** is twice the acceleration due to gravity on planet **R**. The mass of the same man on planet **S** will be ...

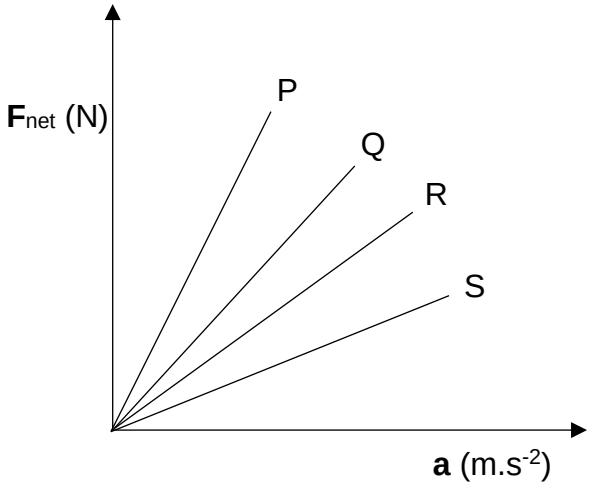
A **m** kg.

B 2**m** kg.

C $\frac{1}{2}$**m** kg.

D 4**m** kg. (2)

1.4 The graphs below show the relationship between acceleration **a,** and net force $\mathbf{F_{net}}$ for four objects **P**, **Q**, **R** and **S**.



Which ONE of the objects has the greatest mass?

A **P**

B **Q**

C **R**

D **S** (2)

1.5 Two identical positively charged spheres, which are free to move, are placed near each other on a frictionless surface.

Which ONE of the following CORRECTLY describes the motion of the two spheres? They move away from each other with:

A Increasing acceleration

B Decreasing acceleration

C Constant acceleration

D Zero acceleration (2)

1.6 The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor.

This statement describes …

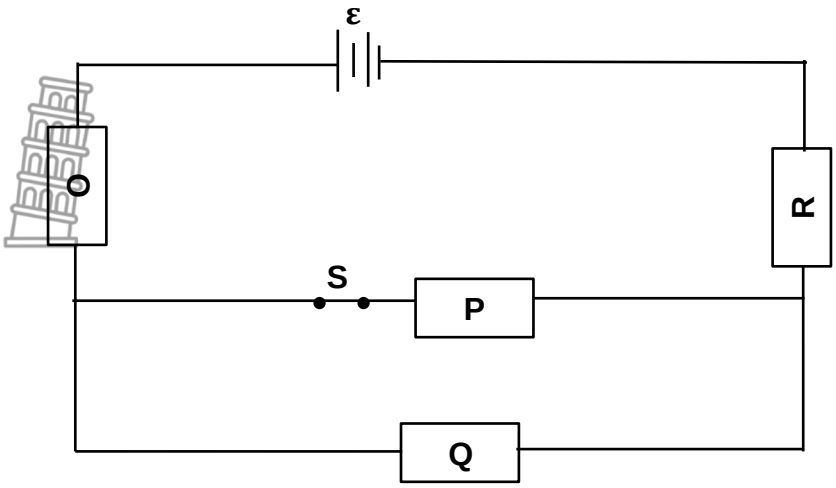
A Ohm's Law.

B Coulomb's Law.

C Faraday's Law.

D magnetic law. (2)

1.7 The four resistors **O**, **P**, **Q**, and **R** in the circuit below are identical. The battery has an emf ε and negligible internal resistance. The switch **S** is initially CLOSED.



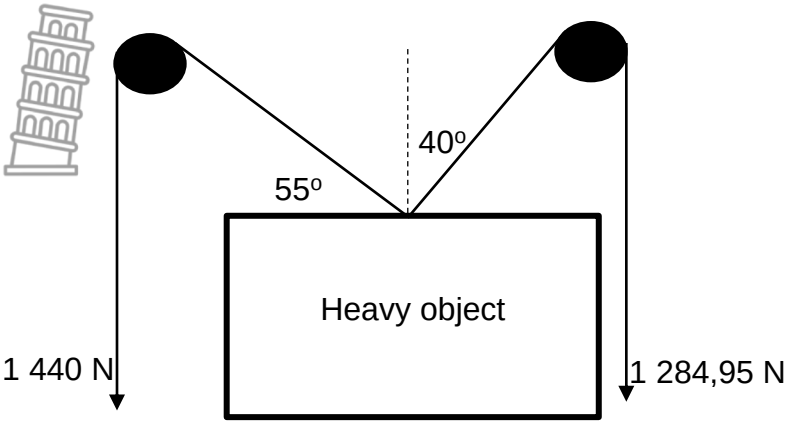
Switch **S** is now OPENED. Which ONE of the following combinations of changes will occur in **O**, **Q** and **R**?

	CURRENT IN O	CURRENT IN Q	CURRENT IN R
A	Decrease	Remains the same	Decrease
B	Increase	Remains the same	Increase
C	Increase	Increase	Increase
D	Decrease	Increase	Decrease

(2)
[14]

QUESTION 2 (Start on a new page.)

A pulley system is used to keep a heavy object at rest as shown on the diagram below.



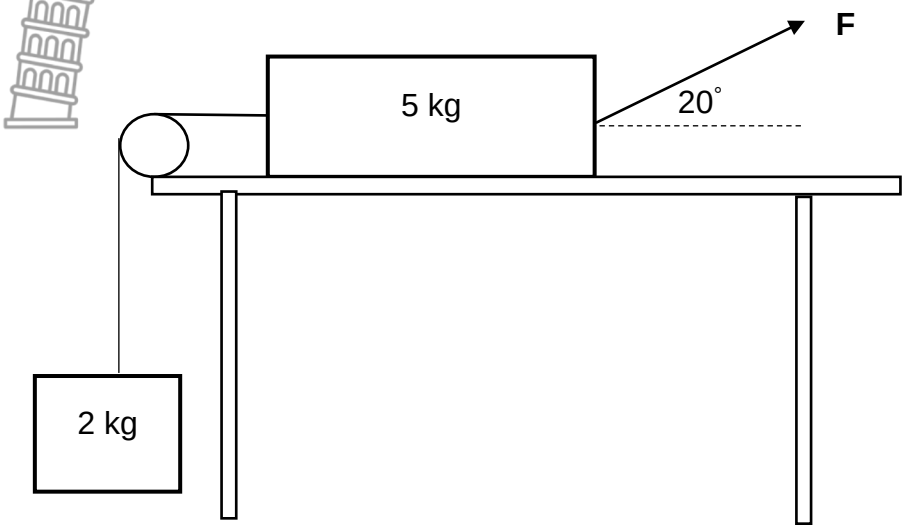
2.1 Define the term *resultant vector*. (2)

2.2 Draw a vector diagram showing the forces acting on the object. Label the forces and indicate the angles on your diagram. (4)

2..3 Calculate the weight of the object. (3)
[9]

QUESTION 3 (Start on a new page.)

Two blocks of masses 5 kg and 2 kg are connected by a light inextensible string. A force **F** is applied on 5 kg at an angle of 20° to the horizontal and the system of blocks accelerates to the right at 2 $m.s^{-2}$ as shown on the diagram below. The kinetic frictional force on the 5 kg block is 10 N.



3.1 Define the term *normal force*. (2)

3.2 Draw a free-body diagram of ALL forces acting on the 5 kg block. (5)

3.3 Calculate the:

3.3.1 Tension in the string (3)

3.3.2 Force **F** as shown on the diagram (4)

3.3.3 Coefficient of kinetic frictional force on the 5 kg block (4)

[18]

QUESTION 4 (Start on a new page.)

A rescue helicopter is lifting two people upwards as shown in the diagram below. The tension in the cable is 1 205,4 N while the helicopter ascends at a CONSTANT SPEED. Ignore air resistance.

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

4.2 Calculate the combined mass of the two people. (4)

4.3 The helicopter now starts to accelerate upwards at 2,25 $m.s^{-2}$. Calculate the tension in the cable. (4)

[10]

QUESTION 5 (Start on a new page.)

The moon is the earth's nearest neighbour. The distance between the centres of the earth and the moon is $3,84 \times 10^8$ m. The mass of the moon is $7,5 \times 10^{22}$ kg.

5.1 State Newton's Law of universal gravitation in words. (2)

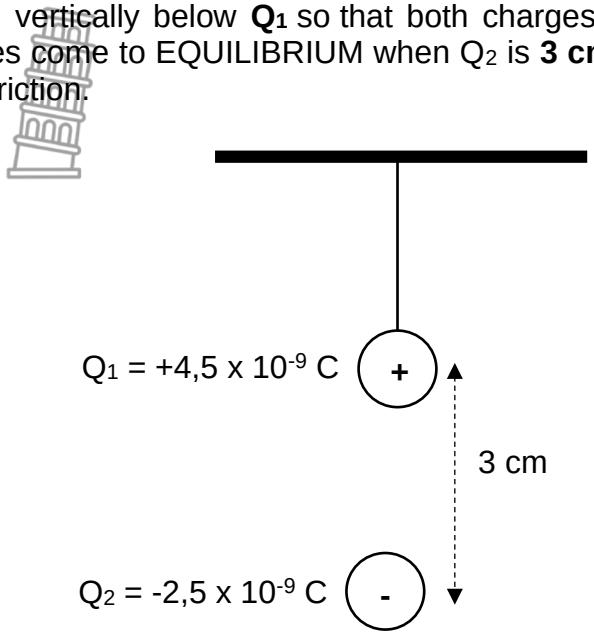
5.2 Calculate the force exerted by the earth on the moon. (4)

5.3 What is the magnitude of the force exerted by the moon on the earth? Explain your answer. (2)

[8]

QUESTION 6 (Start on a new page.)

6.1 Two small spheres, each of mass **5 g**, are arranged as shown on the diagram below. **Q_1**, with a charge of +4,5 x 10^{-9} C, is suspended from a light inextensible string secured to a support. **Q_2**, with a charge of -2,5 x 10^{-9} C, is placed vertically below **Q_1** so that both charges are in a straight line. Both spheres come to EQUILIBRIUM when Q_2 is **3 cm** from Q_1. Ignore the effects of air friction.



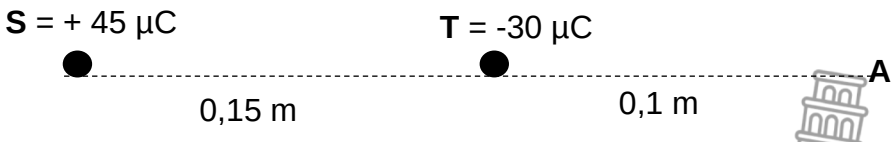
6.1.1 Calculate the number of electrons that were removed from **Q_1** to give it a charge of +4,5 x 10^{-9} C. Assume that the sphere was neutral before being charged. (3)

6.1.2 Draw a labelled free-body diagram showing all the forces acting on sphere **Q_1**. (3)

6.1.3 State Coulomb's Law in words. (2)

6.1.4 Calculate the magnitude of the tension in the string. (5)

6.2 Two-point charges **S** and **T** are placed at 0,15 m apart, as shown in the diagram below. **S** carries a charge of +45 µC and **T** a charge of -30 µC. Point **A** is 0,1 m to the right of point charge **T** on the same line as the two-point charges.



6.2.1 Define *electric field at a point* in words. (2)

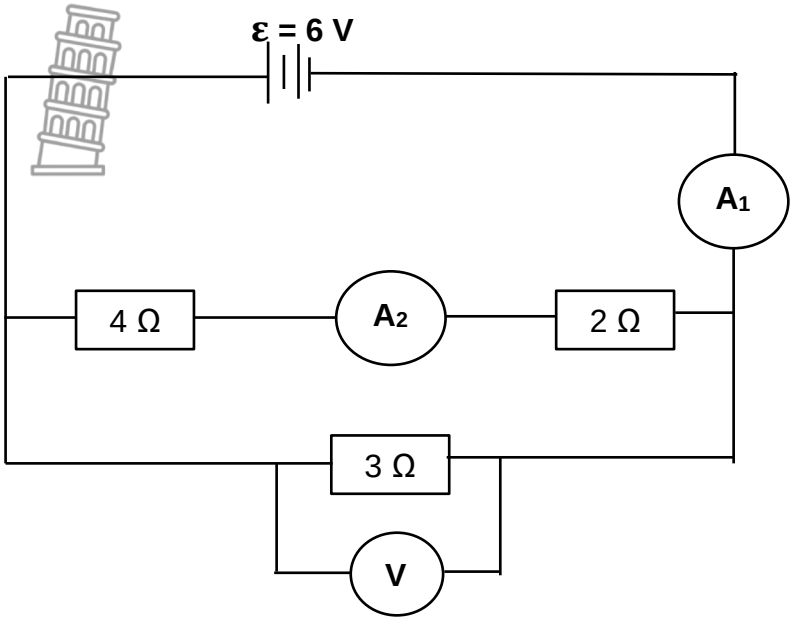
6.2.2 Draw the electric field pattern between the two-point charges. (3)

6.2.3 Calculate the net electric field at point **A** due to the two-point charges. (6)

[24]

QUESTION 7 (Start on a new page.)

In the circuit diagram below the battery has emf of 6 V and negligible internal resistance.



7.1 Calculate the:

7.1.1 Effective resistance in the circuit (3)

7.1.2 Reading on ammeter **A_1** (3)

7.1.3 Reading on ammeter **A_2** (3)

7.1.4 Power dissipated by the 4 Ω resistor (3)

7.2 What is the reading on voltmeter **V**? No calculation is required. (1)

7.3 A kettle is rated 1 500 W. Calculate how much a learner will pay for electricity for using the kettle for 4 hours. Eskom charges 1 kWh electricity at R2,05. (4)

[17]

TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 12

PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12

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 / *Universele gravitasiekonstante*	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*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$\mu_s = \frac{f_s^{max}}{N}$
$\mu_k = \frac{f_k}{N}$	

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*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N.m^2.C^{-1})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N.m^2.C^{-1})$	$n = \frac{Q}{q_e}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$R_s = R_1 + R_2 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

Province of the
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NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

NOVEMBER 2022

PHYSICAL SCIENCES P1/ *FISIESE WETENSKAPPE V1* MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: **100**

This marking guideline consists of 10 pages./
Hierdie nasienriglyn bestaan uit 10 bladsye.

QUESTION/*VRAAG* 1: MULTIPLE-CHOICE QUESTIONS/
MEERVOUDIGEKEUSE-VRAE

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 A ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (2)

1.7 D ✓✓ (2)

[14]

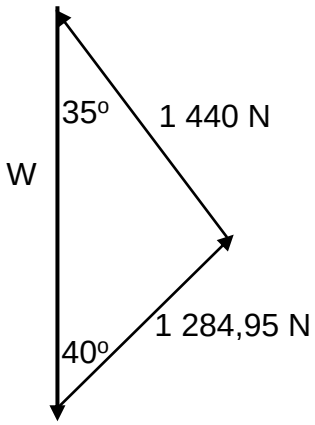
QUESTION/*VRAAG* 2

2.1 The vector sum of two or more vectors. ✓✓
Die vektor som van twee of meer vektore.

OR/*OF*

A single vector having the same effect as two or more vectors acting together.//
Is 'n enkele vektor wat dieselfde effek het as twee of meer vektore wat saam werk. (2)

2.2



Marking criteria/*Nasienkriteria*	
W vector drawn and labelled. *W vektor getrek en byskrif*	✓
1 440 N vector drawn and labelled *1 440 N vektor getrek en byskrif*	✓
1 284,95 N vector drawn and labelled *1 284,95 N vektor getrek en byskrif*	✓
Both angles labelled *Beide hoeke benoem*	✓

(4)

2.3 **OPTION 1/*OPSIE 1***

$\frac{W}{\sin 105^\circ}$ ✓ = $\frac{1\,440}{\sin 40^\circ}$ ✓
W = 2 163,91 N ✓

OPTION 2/*OPSIE 2*

$\frac{W}{\sin 105^\circ}$ ✓ = $\frac{1\,284,95}{\sin 35^\circ}$ ✓
W = 2 163,91 N ✓

OPTION 3/*OPSIE 3*

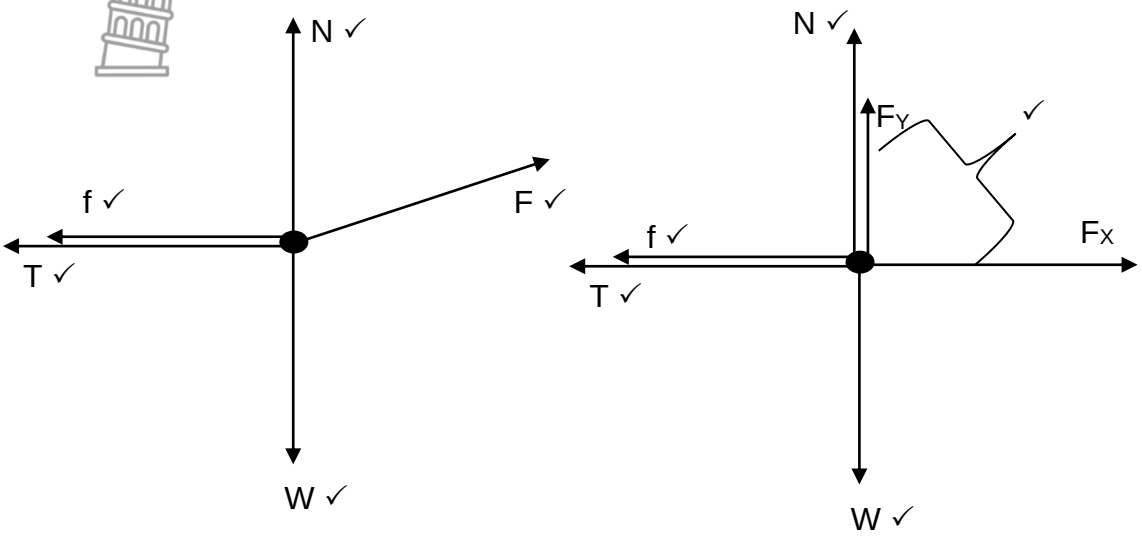
$1\,440 \sin 55^\circ$ ✓ + $1\,284,95 \sin 50^\circ$ ✓ – W = 0
W = 2 163,91 N ✓

(3)
[9]

QUESTION/*VRAAG 3*

3.1 The force or the component of a force which a surface exerts on an object in contact with it, and which is perpendicular to the surface. ✓✓
Die krag of komponent van 'n krag wat die oppervlakte uitoefen op 'n voorwerp waarin dit in kontak is en loodreg aan die oppervlakte is. (2)

3.2



Mark awarded for arrow and label. *Punt vir beide pyl en byskrif toegeken.*
Do not penalise for length of arrows since drawing is not drawn to scale./
Moenie vir die lengte van die pyltjie penaliseer nie aangesien die tekening nie volgens skaal geteken is nie.

Any other additional force(s) $\frac{4}{5}$

Enige addisionele kragte $\frac{4}{5}$

If force(s) do not make contact with body. Max. $\frac{4}{5}$

Indien krag(te) nie met die voorwerp kontak maak nie. Maks. $\frac{4}{5}$ (5)

3.3.1 $F_{net} = ma$
$T - W = ma$ } Any ONE/*Enige EEN* ✓
$T - 2 \times 9,8 = 2 \times 2$ ✓
$T = 23,6$ N ✓ (3)

3.3.2 $F_{net} = ma$
$F_X - T - f = ma$
$F\cos\theta - T - f = ma$ } Any ONE/*Enige EEN* ✓

$F\cos20^\circ$ ✓ $- 23,6 - 10 = 5 \times 2$ ✓
$F = 46,40$ N ✓ (4)

3.3.3 $N = W - F_Y$

$N = \underline{5 \times 9,8 - 46,40 \sin 20^o}$ ✓

$N = 33,13$ N

$f_k = \mu_k N$ ✓

$10 = \mu_k \times 33,13$ ✓

$\mu_k = 0,30$ ✓ (4)

[18]

QUESTION/*VRAAG 4*

4.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the resultant/net force with an accelereation that is directly proportional to the (resultant/net) force ✓ and inversely proportional to the mass ✓ of the object.
Wanneer 'n netto/resulterende krag op 'n voorwerp in werk sal die voorwerp versnel in die rigting van die netto/resulterende krag. Die versnelling is direk eweredig aan die netto/resulterende krag en omgekeerd eweredig aan die massa van die voorwerp. (2)

4.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$F_{net} = ma$ $T - W = ma$ $1\,205,4 - W = 0$ ✓ $W = 1\,205,4$ $W = mg$ $1\,205,4 = m \times 9,8$ ✓ $m = 123$ kg ✓ Any ONE/ *Enige EEN* ✓	$F_{net} = ma$ $T - W = ma$ $T - mg = ma$ Any ONE/ *Enige EEN* ✓ $1\,205,4 - m \times 9,8 = 0$ ✓ $1\,205,4 = m \times 9,8$ ✓ $m = 123$ kg ✓

(4)

4.3 **Positive marking from 4.2./*Positiewe nasien vanaf 4.2***

$F_{net} = ma$
$T - W = ma$
Any ONE/*Enige EEN* ✓

$T - 1\,205,4$ ✓ $= 123 \times 2,25$ ✓

$T = 1\,482,15$ N ✓ (4)

[10]

QUESTION/*VRAAG 5*

5.1 Each particle in the universe attracts every other particle 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 met 'n gravitasiekrag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig aan die vierkant van die afstand tussen hul middelpunte. (2)

5.2 $F = \frac{GM_1M_2}{d^2}$ ✓

$F = \frac{6,67 \times 10^{-11} \times 5,98 \times 10^{24} \times 7,5 \times 10^{22}}{(3,84 \times 10^{8})^2}$ ✓ ✓

$F = 2,03 \times 10^{20}$ N ✓ (4)

5.3 $2,03 \times 10^{20}$ N. ✓ **(Positive marking from 5.2 / *Positiewe nasien vanaf 5.2)***
According to Newton's Third Law, (When object A exerts a force on object B, object B simultaneously exerts a force of equal magnitude on object A in the opposite direction). The moon and the earth will exert equal force on each other but in opposite directions. ✓
Volgens Newton se Derde Wet (Wanneer voorwerp A 'n krag op voorwerp B uitoefen, oefen voorwerp B 'n gelyktydige krag op voorwerp A wat gelyk is aan grootte maar in die teenoorgestelde rigting). Die maan en aarde sal gelyke kragte op mekaar uitoefen maar in die teenoorgestelde rigting. (2)
[8]

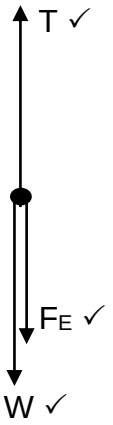
QUESTION/*VRAAG* 6

6.1.1 $n = \frac{Q}{q_e}$ ✓

$n = \frac{4,5 \times 10^{-9}}{1,6 \times 10^{-19}}$ ✓

$n = 2,81 \times 10^{10}$ (electrons/*elektrone*) ✓ (3)

6.1.2



(3)

Mark awarded for both arrow and label. / *Punt vir beide pyl en byskrif.*

Do not penalise for length of arrows since drawing is not drawn to scale.
Moenie vir die lengte van die pyltjie penaliseer nie aangesien die tekening nie volgens skaal geteken is nie.

Any other additional force(s) $\frac{2}{3}$

Enige addisionele kragte $\frac{2}{3}$

If force(s) do not make contact with body. Max. $\frac{2}{3}$

Indien krag(te) nie met die voorwerp kontak maak nie. Maks. $\frac{2}{3}$

6.1.3 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. ✓
Die grootte van die elektrostatiese krag tussen twee puntladings (Q_1 en Q_2) is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die vierkant van die afstand (r) tussen hul middelpunte. (2)

6.1.4 $F_{net} = ma$

$T - F_E - W = ma$

$T - (\frac{kQ_1Q_2}{r^2}) - W = ma$

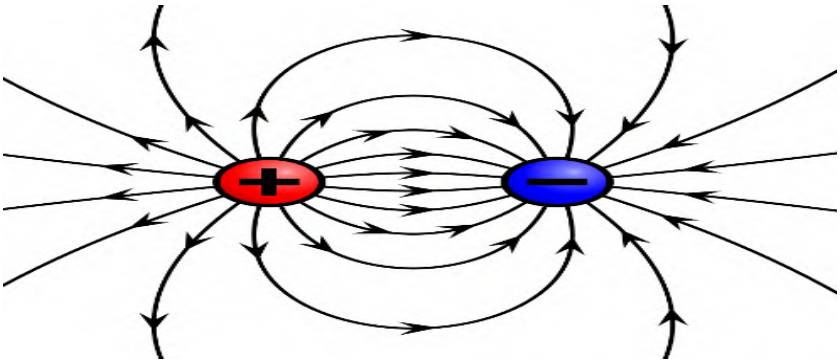
} Any one/*Enige EEN*

$T - (\frac{9 \times 10^{9} \times 4,5 \times 10^{-9} \times 2,5 \times 10^{-9}}{(3 \times 10^{-2})^2}$ ✓ $) - 5 \times 10^{-3} \times 9,8 = 0$ ✓

$T = 0,049$ N ✓ (5)

6.2.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓
Die elektriese veld by 'n punt is die elektrostatiese krag ervaar per eenheid positiewe lading by 'n punt. (2)

6.2.2



(3)

Marking criteria/*Nasienkriteria*	
Shape of the field/ *Vorm van die veld*	✓
Direction of field lines./ *Rigting van veldlyne*	✓
Lines not starting from the same point and not touching each other./ *Lyne begin nie by dieselfde punt en raak nie aan mekaar nie.*	✓

6.2.3 $E = \frac{kq}{r^2}$ ✓

$E_1 = \frac{9 \times 10^{9} \times 45 \times 10^{-6}}{0,25^2}$ ✓ = 6 840 000 N.C^{-1} right/*regs*

$E_2 = \frac{9 \times 10^{9} \times 30 \times 10^{-6}}{0,1^2}$ ✓ = 27 000 000 N.C^{-1} left/*links*

$E_{net} = E_1 + E_2$
$E_{net} = 6\,840\,000 - 27\,000\,000$ ✓
$E_{net} = -20\,160\,000$
$E_{net} = 20\,160\,000$ N.C^{-1} ✓ (2,016 x 10^7 N.C^{-1}) left/*links*. ✓ (6)

[24]

QUESTION/*VRAAG 7*

7.1 7.1.1

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}$ ✓ $\frac{1}{R_p}=\frac{1}{6}+\frac{1}{3}$ ✓ $R_p = 2\ \Omega$ ✓	$\frac{R_1R_2}{R_1+R_2}$ ✓ $\frac{6 \times 3}{6+3}$ ✓ $R_p = 2\ \Omega$ ✓

(3)

7.1.2

$R = \frac{V}{I}$ ✓

$2 = \frac{6}{I}$ ✓

$I = 3\ A$ ✓ (3)

7.1.3

OPTION 1/ *OPSIE 1*	OPTION 2/*OPSIE 2*	OPTION 3/*OPSIE 3*
$I_1 = \frac{1}{3}$ ✓ x 3 ✓ $I_1 = 1\ A$ ✓	$I_1 : I_2$ ✓ 1 : 2 ✓ $I_1 = 1\ A$ ✓	$R = \frac{V}{I}$ ✓ $6 = \frac{6}{I}$ ✓ $I = 1\ A$ ✓

(3)

7.1.4

OPTION 1/ *OPSIE 1*	OPTION 2/*OPSIE 2*	OPTION 3/*OPSIE 3*
$P = I^2R$ ✓ $P = 1^2 \times 4$ ✓ $P = 4\ W$ ✓	$V = IR$ $V = 1 \times 4 = 4\ V$ $P = VI$ ✓ $P = 4 \times 1$✓ $P = 4\ W$ ✓	$V = IR$ $V = 1 \times 4 = 4\ V$ $P = \frac{V^2}{R}$ ✓ $P = \frac{4^2}{4}$ ✓ $P = 4\ W$ ✓

(3)

7.2 6 V. ✓ (1)

7.3 $W = P\Delta t$ ✓
$W = 1,5 \times 4$ ✓
$W = 6\ kW.h$
$Cost = 6 \times 2,05$ ✓
$Cost = R\ 12,30$ ✓

(4)
[17]

TOTAL/*TOTAAL*: 100