Hillcrest High School

PHYSICAL SCIENCE P1

Nov 2024

Grade 11

MARKS: 125
TIME: 2,5 Hours

EXAMINER: Ms N. Badenhorst
MODERATOR: Mrs J. Knox-Whitehead

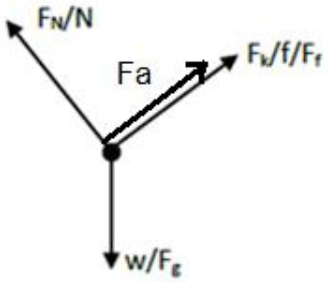
Question 1

1.1 C
1.2 A
1.3 B
1.4 B
1.5 C
1.6 B
1.7 D
1.8 C

QUESTION 2

2.1.1 The force that <u>opposes the motion of an object</u>✓ and which <u>acts parallel to the surface.</u> ✓ (2)

2.1.2



	Accepted symbols
F_N✓	N /Normal force/ *N/normaalkrag*
f✓	F_f /f_k /frictional force/kinetic frictional force *F_f /f_k /wrywingskrag/kinetiese wrywingskrag*
w✓	F_g /mg/ weight /Gravitational force/ $F_{Earth\ on\ box}$ *F_g /mg/gewig/gravitasie krag/$F_{aarde\ op\ blok}$*

2.1.3

OPTION 1:/*OPSIE 1*	**OPTION 2:/ *OPSIE 2***	**Marking Criteria:/ *nasien riglyne***
a = gradient $= \frac{\Delta v}{\Delta t}$ $= \frac{6-2,5}{2,0-0}$ ✓ = 1,75 m·s^{-2} ✓ Any one / Enige een	$v_f = v_i + a\Delta t$ ✓ 6 = 2,5 ✓+ a(2) ✓ a = 1,75 m·s^{-2}	Gradient / $\frac{\Delta v}{\Delta t}$ ✓ Numerator as shown ✓ Denominator as shown ✓ (3) *Teller✓ en noemer✓getoon*

2.1.4 When a (non – zero) resultant/net force acts on an object, the object accelerates in the direction of the (net) force at an <u>acceleration</u> which is <u>directly proportional to the (net) force</u> ✓ and <u>inversely proportional to the mass of the object.</u> ✓

2.1.5.1 Fnet ✓

Fgll – a = m.a

m.g.sin Θ – μk.N - Fa = m.a

65(9,8)sin 20 - μk.m.g.cos Θ- Fa = m.a

65(9,8)sin 20 - μk.(65)(9,8).cos 20- 10 = 65 (1,75)

μk = 0,16 ✓ (6)

2.2

$F = \frac{Gm_1m_2}{r^2}$ or $F = \frac{Gm_1m_2}{d^2}$ ✓

$F_{(\text{inner walls})} = \frac{Gm_1m_2}{(r)^2}$ ✓

$F_{(\text{outer walls})} = \frac{Gm_1m_2}{(35)^2}$ ✓

$\therefore \frac{F_{(\text{inner walls})}}{F_{(\text{outer walls})}} = \frac{Gm_1m_2}{49} \div \frac{Gm_1m_2}{1225}$ ✓

$= \frac{1225}{49}$

$= 25$

$\therefore F_{(\text{inner walls})} = 25 \times F_{(\text{outer walls})}$

(4)

Question 3

3.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres.✓ (2)

3.2

$$F_G = \frac{Gm_1m_2}{d^2} \quad \checkmark$$

$$5{,}71\times10^{15} = \frac{(6{,}67\times10^{-11})(6{,}39\times10^{23})(1{,}08\times10^{16})}{d^2}$$

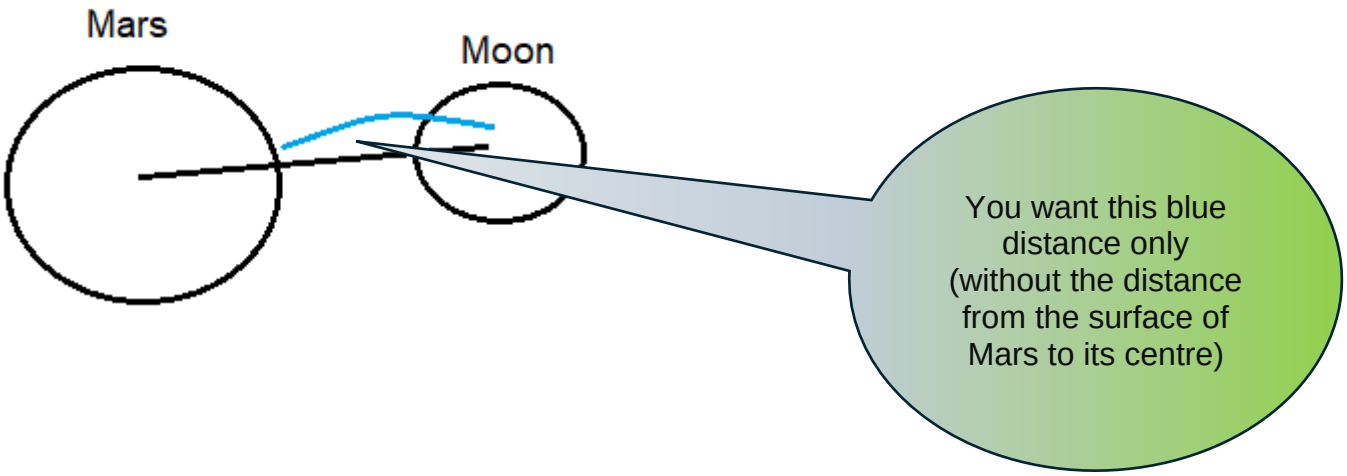
$$d^2 = 8{,}06\times10^{13}$$

$$d = 8{,}98\times10^{6}\ \text{m} \quad \checkmark$$

$$\therefore h = 8{,}98\times10^{6} - 3390\times10^{3}$$

$$h = 5{,}59\times10^{6}\ \text{m} \quad \checkmark$$

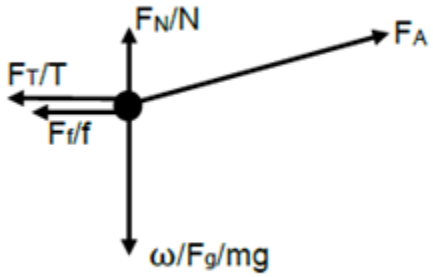
You need to **subtract the radius of the moon** and be careful – you need to convert the **distance to meters**



You want this blue distance only (without the distance from the surface of Mars to its centre)

Question 4

4.1



F_N: Normal force ✓

F_A: Applied force ✓

F_T: Tension ✓

F_f: Friction/Frictional force ✓

F_g: Gravitational force/ωeight/$F_{Earth\ on\ block}$ ✓

4.2

$F_{net} = ma$

$(F_{net})_x = m_1a_x$

$\therefore F_x + (-f_K) + (-T) = m_1a$

$\therefore F\cos30° - f_K - T = m_1a$ } Any one✓

$\therefore F\cos30° - \mu_K(m_1g - F\sin30°) - T = m_1a$

$\therefore 50\cos30° - (0,21)[(5)(9,8) - (50)(\sin30°)]$ ✓$-T = 5a$

$\therefore 50\cos30° - 5,04 - T = 5a$

$\therefore 38,26127 - T = 5a \ldots (1)$ ✓

$(F_{net})_y = m_2a_y$

$\therefore T + (w_2) = m_2a$

$\therefore T - m_2g = m_2a$

$\therefore T - (0,2)(9,8) = (0,2)a$✓

$\therefore T - (0,2)a + 1,96 \ldots (2)$

Subst… (2) into (1) :

$\therefore 38,26127 - [(0,2)a + 1,96] = 5a$

$\therefore 38,26127 - (0,2)a - 1,96 = 5a$

$\therefore 36,30127 = (5,2)a$

$\therefore a = 6,981\ m\cdot s^{-2}$

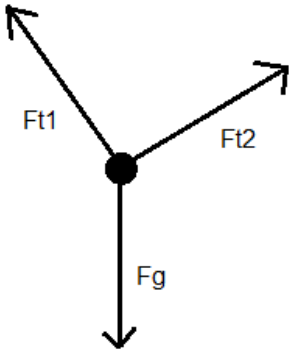
From (2): $T = (0,2)(6,981) + 1,96$

$\therefore T = 3,3562\ N$✓

(5)

Question 5

5.1



5.2 yes, block m is stationary thus all the Fnet acting on it is zero

.

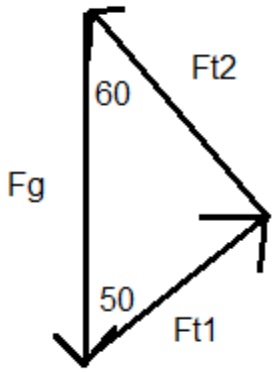
5.3 Learners must realise string Ft1 will break first, since it is the side opposite the largest angle.

$\frac{Ft1}{Sin\ 60} = \frac{Fg}{Sin\ 70}$

$\frac{8}{Sin\ 60}$ ✓$= \frac{Fg}{Sin\ 70}$✓

Fg = 8,6805 N

Fg = m.g
8,6805 = m (9,8) ✓
m = 0,88 kg ✓



Question 6 – circuits

6.1 24 Joules of work done per Coulomb/unit of charge.

When asked to define Emf in terms of a specific value, make sure to **include that value in your definition**

6.2.1

$r_i = \frac{\text{lost V}}{I}$ ✓

$I = \frac{24 - 22,3}{0,5}$ ✓

$= 3,4\ A$ ✓

6.2.2

POSITIVE MARKING

$V_{3\Omega} = IR$

$= 3,4(3)$ ✓

$= 10,2\ V$

$V_{II} = 22,3 - 10,2$ ✓

$= 12,1V$

$P_{18\Omega} = \frac{V^2}{R}$ ✓

$P_{18\Omega} = \frac{(12,1)^2}{18}$ ✓

$= 8,13\ W$

6.2.3

POSITIVE MARKING

$I_{6\Omega} = \frac{V}{R}$ ✓

$= \frac{12,1}{6}$ ✓

$= 2,02\ A$

$I_{18\Omega} = \frac{V}{R}$

$= \frac{12,1}{18}$ ✓

$= 0,67\ A$

$I_R = I_{tot} - I_{6\Omega} - I_{18\Omega}$

$= 3,4 - 2,02 - 0,67$

$= 0,71\ A$ ✓

6.3 Increase

As the total resistance increases, the total current decreases ($R \propto 1/I$)

Vp increases and thus Power increases ($P \propto V^2$)

6.4 $W = P.t$ ✓

$= 3\ (2)$ ✓

$= 6\ kWh$

Cost = W x price

$= 6000\ (2,72)$ ✓

$= R16,32$ ✓ (4)

Question 7 – ohm's law

7.1 Internal resistance in the opposition to the flow of charge in a cell/ an ammeter (in an electric circuit.) (2 or 0)

7.2

7.2.1 3 V ✓ (1)

7.2.2 'lost' volts = 3,0 – 2,0 = 1 V ✓ ✓ OR 1 V ✓✓ (2)

7.2.3 r can be found by finding the gradient of the graph

$$\text{gradient} = \frac{\Delta I}{\Delta V} \checkmark$$

$$= \frac{0,4 - 0,6}{1 - 0} \checkmark$$

$$= \frac{-0,2}{1}$$

$$= -0,2\ \Omega^{-1}$$

$$R_{int} = 5\ \Omega \checkmark$$

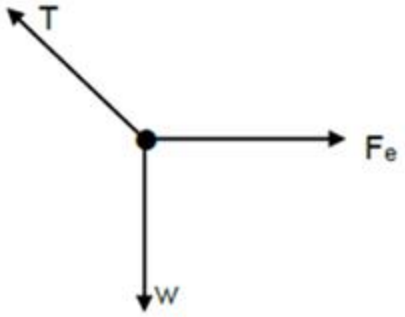
(other correct values from the graph can be used for the calculation) (3)

[8]

Question 8 – electrostatic force

8.1.1 The magnitude of the electrostatic force exerted by point charge (at rest) on another (stationary) point charge is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. ✓✓ (2)

8.1.2



Accepted labels	
T✓	Tension/F_T/$F_{wire\ on\ insulator}$
F_e✓	Electrostatic force / coulomb's force
w✓	F_g/mg/weight/gravitational force

8.1.3

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(6 \times 10^{-7})(9 \times 10^{-7}) \checkmark}{(0,15)^2}$$

$$= (0,22\ N) \checkmark \text{ Left} \qquad (3)$$

8.1.4

$T_x = Fe = 0,216\ N$

$w = mg$

$= \underline{(8 \times 10\text{-}2)(9,8)}$ ✓

$= 0,784\ N$

$T_y = w = 0,784\ N$

$\tan\theta = \frac{T_x}{T_y}$

$= \frac{0,216}{0,784}$ ✓

$\theta = 15,4^{\circ}$ ✓

8.1.5 $Ft^2 = Fg^2 + Fxy^2$

$= 0,784^2 + 0,22^2$ ✓

$= 0,81\ N$ ✓

Or

Cos 74, 6= $\frac{0,22}{Ft}$

Or

Sin 15,4 = $\frac{0,22}{Ft}$

Or

Cos 15,4 = $\frac{0,784}{Ft}$

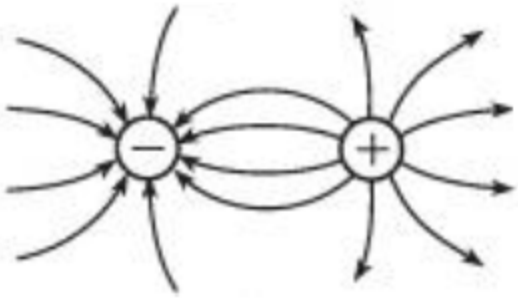
Or

Sin 74,6 = $\frac{0,784}{Ft}$

Ft = 0,83 N

Question 9

9.1



Direction from positive to negative. *Rigting van positief na negatief.*	✓
Field lines start on spheres and do not cross. Correct shape as shown.	✓

(2)

9.2.1 Qnew = $\frac{Q1+Q2}{2}$

= $\frac{-4,5\ x\ 10^{-5}\ +9,5\ x\ 10^{-5}}{2}$ ✓

= + 2,5 x 10^{-5} C ✓

(2)

Remember – the only time to include -minus sign in electrostatics is when calculating **Qnew and**

Be careful now – the **charges have touched** and now you must use the new charges **(Qnew)** when doing the next calculation

9.2.2 Eax = $\frac{kQ1}{r^2}$ ✓

= $\frac{9\ x\ 10^{9}\ 2,5\ x\ 10^{-5}}{0,45^2}$ ✓

= 1111111,11 N.C^{-1} left

Ebx = $\frac{kQ1}{r^2}$

= $\frac{9\ x\ 10^{9}\ 2,5\ x\ 10^{-5}}{0,1^2}$ ✓

= 22500000 N.C^{-1} right

Enet = Ebx – Eax

= 22500000 + 1111111,11 ✓m

= 2,36 x 10^{7} N.C^{-1} right ✓

(5)

Question 10 – electric field

10.1

$E_{net} = E_1 - E_2$

$0 = E_1 - E_2$ ✓

$E_1 = E_2$

- $E = \frac{KQ}{r^2}$ ✓

$$\frac{(9 \times 10^9)(16 \times 10^{-7})}{(3{,}0 + x)^2} \checkmark = \frac{(9 \times 10^9)(4 \times 10^{-7})}{x^2} \checkmark$$

$$\frac{x^2}{(3{,}0 + x)^2} = \frac{1}{4}$$

$$\frac{x}{3{,}0 + x} = \frac{1}{2}$$

$x = 3{,}0$ m ✓ (5)