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Marking Guidelines Prelim 2021

Kinematics

Multiple Choice

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

Question 2**[271]**

2.1.1 The single vector which has the same effect as the original vectors acting together. ✓✓ (2)

2.1 $V = \frac{42,2}{3,6} \checkmark = \underline{\underline{11,72 \text{ m.s}^{-1}}} \checkmark$ (2)

2.1.3 $V_x = V \sin 60^\circ \checkmark$
 $= 12,87 \sin 60^\circ$
 $= \underline{\underline{11,15 \text{ km.h}^{-1}}} \checkmark$ (2)

2.1.4 $V_y = V \cos 60^\circ \checkmark$
 $= 12,87 \cos 60^\circ$
 $= 6,44 \text{ km.h}^{-1} \text{ South}$
 $R_y = 42, - 6,44 \checkmark$
 $= \underline{\underline{35,77 \text{ km.h}^{-1}}} \checkmark$ (3)

2.1.5 $V_R^2 = 35,77^2 + 11,15^2$
 $V_R = \underline{\underline{37,47 \text{ km.h}^{-1}}} \checkmark$

$$\tan \Theta = \frac{11,15}{35,77} \checkmark$$

$$\Theta = 17,31^\circ \checkmark$$

Resultant = 37.47 km.h⁻¹ at 17.31 ° West of North ✓ (4)

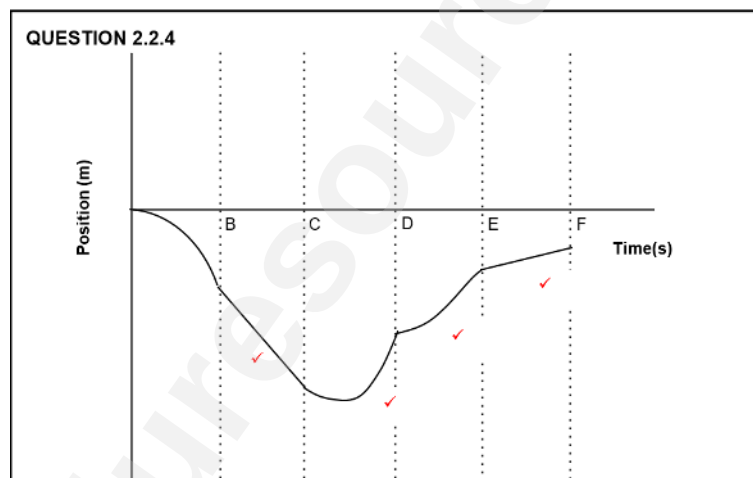
2.2.1 Rate of change of velocity. ✓✓ (2)

2.2.2 30 – 38 s (C-D) ✓ (2)

$$\begin{aligned} 2.2.3 \quad s &= \frac{1}{2}bh & s &= l \times b \\ &= \frac{1}{2}(2)(3) & &= 5 \times 3 \\ &= 3 \text{ m North } \checkmark & &= 15 \text{ m North } \checkmark \end{aligned}$$

$$\begin{aligned} \text{Final Displacement} &= 18 - 252 \checkmark \\ &= -234 \text{ m} \\ &= \underline{234 \text{ m South}} \checkmark \end{aligned} \quad (4)$$

2.2.4



(4)

Question 3

[22]

3.1 $v = 0$ ✓ $a = 9,8 \text{ m.s}^{-2}$ downwards ✓ (2)
 3.2 $\text{m}^2.\text{s}^{-2}$ ✓ **Downloaded from eduresourceza.com** (1)

3.3 $v^2 = u^2 + 2gs$

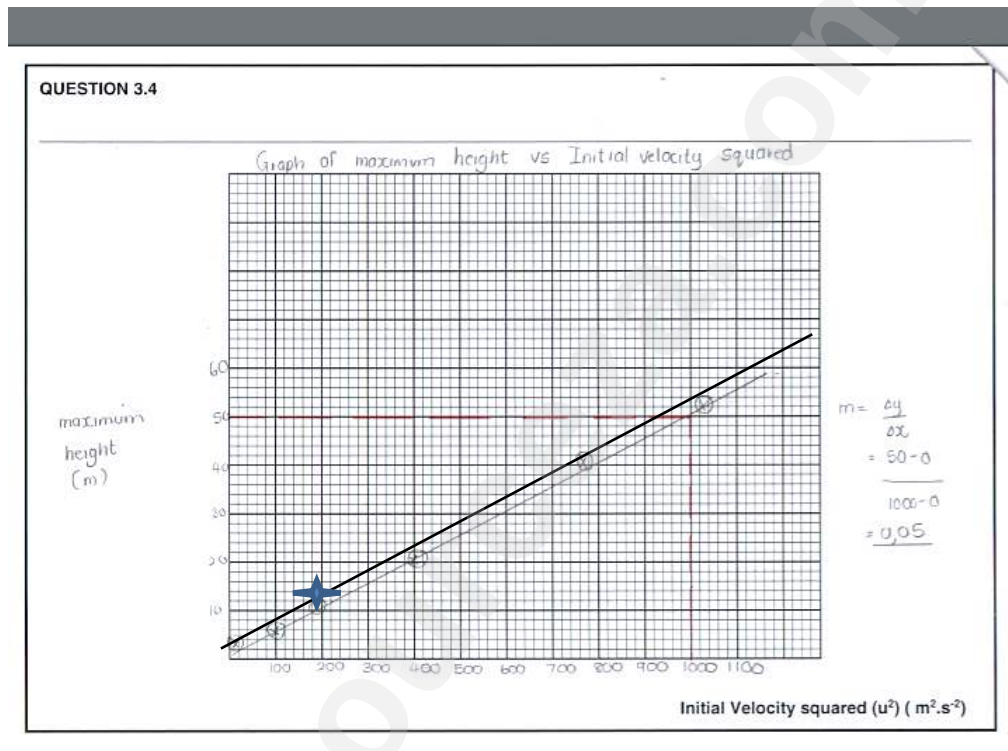
$u^2 = -2 \checkmark gs \checkmark$

(2)

(2)

- 3.4 Title of graph $\checkmark$, Scale, $\checkmark$ point plotted correctly, $\checkmark$ Axes labelled with units, $\checkmark$ Heading $\checkmark$ LOB $\checkmark$

(6)



3.5 $m = \frac{\Delta y}{\Delta x} \checkmark$ $\checkmark$ Shown on graph

$= \frac{26 - 0}{500 - 0} \checkmark$

$= \underline{0,052} \checkmark$

(4)

3.6 $g = \frac{1}{2} m \checkmark$

$-2g = \frac{1}{0,052}$

$g = \underline{9,62 m.s^{-2}} \checkmark$

(2)

3.7 % error = $\frac{\text{theoretical} - \text{calculated}}{\text{theoretical}} \times 100$

 = $\frac{9.8 - 9.62}{9.8} \times 100$ ✓

 = 1.84 % ✓

 = % accuracy = 98.16 ✓ (3)

3.8 Air resistance would cause the value of g to be lower than 9.8. ✓✓ (2)

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QUESTION 4**[22]**

- 4.1. When a net force is applied to an object of mass it accelerates in the direction of the net force. ✓ The acceleration is directly proportional to the net force and inversely proportional to the mass. ✓ (2)

OR

✓✓ The net force acting on an object is equal to the rate of change of momentum.

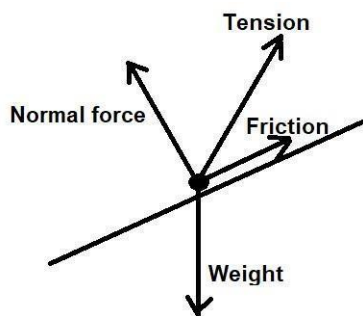
4.2 $F_{\text{net}} = ma$ ✓

$$T - F_g = ma$$

$$T - (2 \times 9,8) = 2 (1,5) \quad \checkmark$$

$$T = \underline{22,6 \text{ N}} \quad \checkmark \quad (3)$$

4.3

label

one for each force with ✓✓

✓✓ Normal force must be smaller than the weight

(4)

4.4

$$F_{\text{net}} = ma$$

$$F_{gx} - F_f - T_x = ma$$

$$m(9,8)\sin 30^\circ - 4 - 22,6\cos 15^\circ = m(1,5) \quad \checkmark$$

$$4,9m - 4 - 21,83 = 1,5m$$

$$3,4m = 25,83$$

$$m = \underline{7,6 \text{ kg}} \quad \checkmark \quad (5)$$

4.5

$$F_f = \mu F_N \quad \checkmark$$

$$F_f = \mu (F_{gy} - T_y) \quad \checkmark$$

$$4 \checkmark = \mu (7,6 \times 9,8 \cos 30 \checkmark - 22,6 \sin 15 \quad)$$

$$4 = \mu (64,48 - 5,85)$$

$$\mu = \underline{0,07} \quad \checkmark \quad (5)$$

4.6 Remain the same. $\checkmark$ (1)

4.7 Friction is only dependent on the type of surface (coefficient) $\checkmark$ and the Normal Force of the surface $\checkmark$ on the object. The surface area does not affect the frictional force. (2)

QUESTION 5

[25 MARKS]

5.1 The total linear momentum of an isolated system remains constant. (2)

5.2 momentum before = momentum after ✓

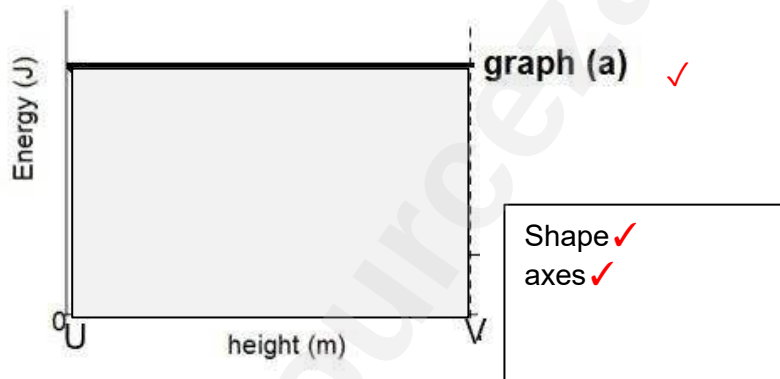
$$m_A u_A + m_B u_B = m_A v_A + m_B v_B$$

$$1,5u_A \checkmark + 0 = 1,5(-0,5) \checkmark + 3(2,25) \checkmark$$

$$u_A = \underline{4\text{m}\cdot\text{s}^{-1}} \checkmark$$

(5)

5.3.



(2)

5.4 $E_{\text{mech } u} = E_{\text{mech } v} \checkmark$

$$mgh + \frac{1}{2}mv^2 = mgh + \frac{1}{2}mv^2 \checkmark \quad (4)$$

$$1,5 \times 9,8 \times h = \frac{1}{2} 1,5 (4)^2 \checkmark$$

$$h = \underline{0,82 \text{ m}} \checkmark$$

5.5 $J = F_{\text{net}} \Delta t = m(v-u)$

$$F_{\text{net}} = \underline{3(2,25-0)} \checkmark \quad (\text{subs})$$

$$\underline{0,01} \checkmark$$

$$= \underline{675 \text{ N}} \checkmark \quad (3)$$

5.6 Work done by a net force on an object is equal to the change in the kinetic energy of the object. ✓✓ (2)

5.7 $\Delta E_k = W_{\text{net}}$ ✓

$$\frac{1}{2} mv_2 - \frac{1}{2} mu_2 = -W_{\text{friction}} - W_{\text{gll}} \quad \checkmark$$

$$0 - \frac{1}{2} mu_2 = -F_f \times s_{xy} - mgh$$

$$0 - \left(\frac{1}{2}\right)(3)(2,25_2) \text{ (subs)} \checkmark = -20,2(s_{xy}) \checkmark - (3)(9,8) \quad (12 \times 10^{-2})$$

✓ (conversion)

$$\underline{s_{xy} = 0,20 \text{ m}} \quad \checkmark \quad (6)$$

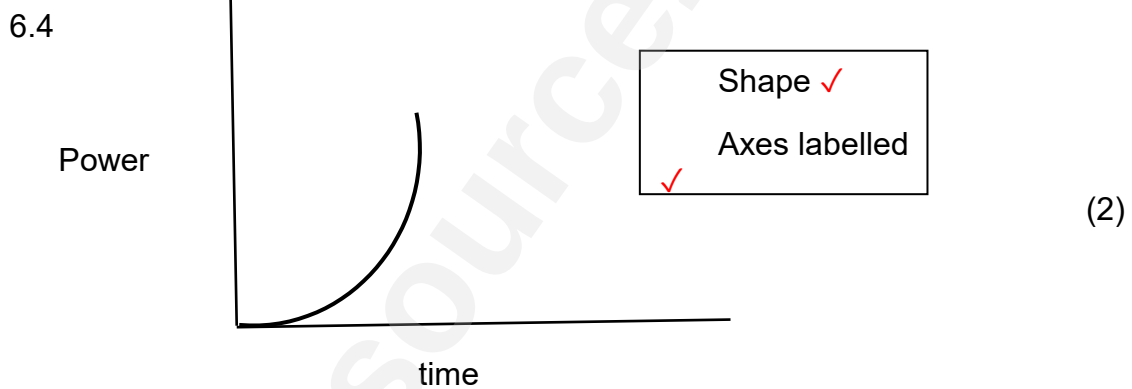
QUESTION 6

26 marks

6.1 Rate of flow of charge ✓ (1)

6.2 $P = I^2 R$
 $P = 2^2 (10) ✓$
 $P = \underline{40 \text{ W}} ✓$ (3)

6.3 $\text{emf} = I(R+r) ✓$
 $30 ✓ = 2(10 + R + 1) ✓$
 $R = \underline{4 \Omega} ✓$ (4)



6.5 $\text{Cost} = \text{kw} \times \text{hr} \times \text{cost}$
 $= 40/1000 ✓ \times 45/60 ✓ \times 1,70$
 $= \underline{0,051 = 51 \text{ c}} ✓$ (3)

6.6 $1/R_{||} = 1/5 + 1/2$

$R_{||} = 1,43 \, \Omega$ ✓

$R_{tot} = 10 + 1,43$

$R_{tot} = 11,43 \, \Omega$ ✓

$emf = I(R+r)$

$= I(11,43 + 1)$ ✓

$I = 2,41 \, A$ ✓

(4)

6.7

$V_{||} = R_{||}I$ ✓

$V_{||} = (1,43) (2,41)$ ✓

$V_{||} = 3,45 \, V$ ✓

(4)

6.8 R_{total} decreases ✓

I_{total} increases ✓

$V_{rheostat}$ and V_{lost} decreases ✓

V_{bulb} increases

Power is directly proportional to voltage squared ✓, bulb burns brighter ✓

(5)

QUESTION 7

[26 Marks]

7.1.1 Gravitational field strength is *the force acting per unit mass*. ✓✓

(2)

7.1.2 gravitational field strength on earth, $g = 9.8 \text{ N/kg}$

gravitational field strength on mars $= (0.38) \cdot (9.8)$ ✓
 $= 3.72 \text{ N/kg}$ ✓

$$g = \frac{GM_{\text{mars}}}{r^2} \quad \checkmark$$

$$r^2 = \frac{GM}{g}$$

$$= \frac{(6.7 \times 10^{-11}) \cdot (6.42 \times 10^{23})}{3.72} \quad \checkmark$$

$$r = 3398600,21 \text{ m}$$

$$= \underline{3.4 \times 10^6 \text{ m}} \quad \checkmark$$

(5)

7.1.3 a. $F = \frac{Gm_1m_2}{R^2}$

Mass of Zhurong, $M_z = \frac{(5.1 \times 10^{-18}) \cdot (1.8 \times 10^6)^2}{(6.7 \times 10^{11})(1025)} \quad \checkmark$

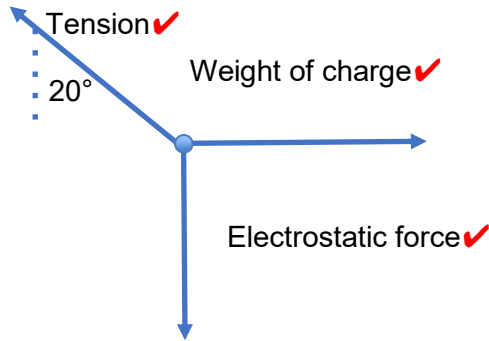
$$\underline{M_z = 240,61 \text{ kg}} \quad \checkmark$$

(3)

- b. Half the mass will half the weight ✓ Double the radius, divide the weight by 4 ✓ the weight of Perseverance on the new planet will be 8 x more its value on Mars. ✓

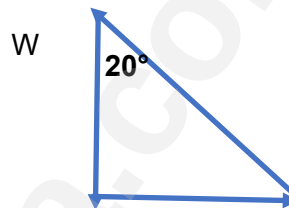
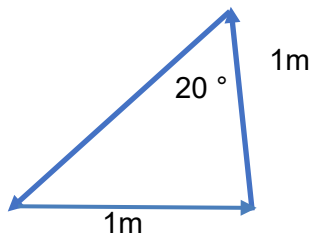
(3)

7.2.1



(3)

7.2.2 $F_E = \tan 20^\circ \times 0,05 \times 9,8$ REMOVED
 $= \underline{0,178 \text{ N}}$



$\sin 20 = 1/2r$
 $\underline{r = 0,68\text{m}}$

$F = k q^2/r^2$

$0,178 = 9 \times 10^9 \times q^2/1$
 $\underline{q = 4,45 \times 10^{-6} \text{ C}}$ (6)

7.3 Force per unit positive charge. (2)

7.4 $E = \frac{kq}{r^2}$
 $= \frac{9 \times 10^9 \times 4,45 \times 10^{-6}}{0,5 \times 10^{-92}}$
 $= \underline{1,6 \times 10^{23} \text{ N.C}^{-1}}$

Question 8 Electrodynamics

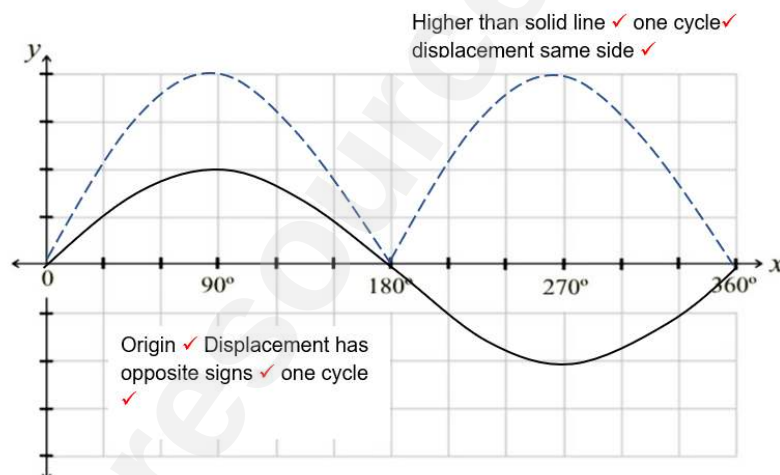
[21]

- 8.1 Vector ✓ it has magnitude and direction. ✓ (2)
- 8.2 $\phi = BA \cos\theta$ In the position shown $\theta = \text{zero}$ ✓ which means that the flux is at its maximum ✓ (2)
- 8.3 split ring ✓ (1)
- 8.4 WXYZ ✓ (2)
- 8.5 The emf induced is directly proportional to the rate of change of magnetic flux. ✓✓ (2)
- 8.6 $E = -N \Delta \phi / \Delta t$ ✓

Emf is inversely proportional to time.

If the coil is rotated faster the time will decrease hence a greater emf will be induced. ✓

QUESTION 8.7 and 8.8.3



- 8.7 (3)
- 8.8.1 diodes ✓ (1)
- 8.8.2 Converts AC current into DC ✓ current by a process known as full wave rectification. ✓ (2)
- 8.8.3 On answer sheet. (3)

9.1 minimum frequency of incident radiation ✓ at which electrons will be emitted from a particular metal . ✓ (2)

9.2 $f = c/\lambda = 3 \times 10^8 / 15 \times 10^{-9} \checkmark = 2 \times 10^{15} \text{ Hz}$

$5\text{eV} = 5 \times 1,6 \times 10^{-19} \text{ J} = 8,0 \times 10^{-19} \text{ J} \checkmark$

$E_k = hf - W \checkmark$

$= 6,63 \times 10^{-34} \times 2 \times 10^{15} - 8,0 \times 10^{-19}$

$= 5,26 \times 10^{-19} \text{ J} \checkmark$

$E_k = 5,26 \times 10^{-19} / 1,6 \times 10^{-19} = 3,3 \text{ eV} \checkmark$ (5)

9.3 At a lower light intensity the number of electrons that are ejected are fewer ✓ because the number of photons per unit area decreases. ✓ (2)

