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Clifton – Trials P1 2021 Model Answer

Question 1

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

10 x 2 = [20]

Question 2

- 2.1 155 m ✓ (1)
 2.2 Gift ✓ (1)
 2.3 Ave. v = instant. V ✓
 He is travelling at constant velocity ✓ (2)
 2.4 45 – 50 s: zero v ✓
 50 – 60 s: increasing velocity ✓ west ✓ (3)
 2.5 75 m ✓
 in front of his starting position ✓ (2)
 2.6 ave. v = $\frac{\Delta x}{\Delta t}$
 $= \frac{55}{110}$ ✓
 $= 0,5 \text{ m.s}^{-1}$ ✓ east ✓ (4)
 2.7 The rate of change of distance. ✓✓ (2)
 2.8 $v = \frac{\text{distance}}{t}$
 $= \frac{135}{30}$ ✓
 $= 4,5 \text{ m.s}^{-1}$ ✓ (3)

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Question 3

- 3.1 $9,8 \text{ m.s}^{-2}$ ✓ downwards ✓ (2)
 3.2 A change in position. ✓✓ (2)
 3.3 $\Delta x = \text{height} = 80 \text{ m}$ ✓✓ (2)
 3.4 $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $-76 = 15 \Delta t + \frac{1}{2} (-9,8) \Delta t^2$ ✓
 $\Delta t = 5,76 \text{ s}$ ✓ (-1 if signs muddled) (5)

3.5 $\Delta t \text{ for B} = 5,76 - 0,8 = 4,96 \text{ s}$ ✓

$v_f = v_i + a \Delta t$ ✓

$0 = v_i + (-9,8) \left(\frac{4,96}{2} \right)$ ✓

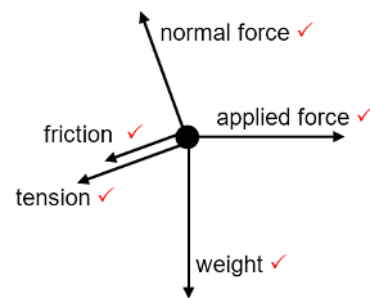
$v_i = 24,30 \text{ m.s}^{-1}$ ✓ (5)

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Question 4

- 4.1 The perpendicular force exerted by a surface on an object in contact with it. ✓✓ (2)
 4.2 $F_N = F_{g\perp} = mg \cos \theta$ ✓
 $F_N = (8,5)(9,8) \cos(36)$ ✓
 $F_N = 67,39 \text{ N}$ ✓ (3)
 4.3 An object continues in a state of rest or uniform (moving with constant) velocity unless it is acted upon by a net or resultant force. ✓✓ (2)
 4.4 For block A:
 $F_T = F_{g\parallel} + F_f$
 $F_T = mg \sin \theta + F_f$
 $F_T = (8,5)(9,8) \sin(36) + (68)$ ✓
 $F_T = 116,96 \text{ N}$ ✓ (3)

4.5



(5)

4.6 $F_{\parallel} = F_{g\parallel} + F_f + F_T$ ✓ (method)
 $F \cos \theta = mg \sin \theta + \mu_s F_N + F_T$
 $F \cos 36 = (8,5)(9,8) \sin(36) + (0,4)(F \sin 36 + 67,39) + (116,96)$ ✓
 $F = 184,75 \text{ N}$ ✓ right ✓ (7)

4.7.1 decrease ✓✓ (2)

4.7.2 decrease ✓✓ (2)

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Question 5

5.1 The net force acting on an object is equal to the rate of change of momentum. ✓✓ (2)

$$\begin{aligned} 5.2 \quad F_{\text{net}} \cdot \Delta t &= m \cdot \Delta v \quad \checkmark \\ &= 2200 \checkmark \cdot (4,3 - 0) \checkmark \\ &= 9460 \text{ N.s right} \checkmark \end{aligned} \quad (4)$$

$$\begin{aligned} 5.3 \quad \text{area} &= \text{Impulse } (F_{\text{net}} \cdot \Delta t) \\ \frac{1}{2}(0,54) \cdot F_{\text{max}} &= 9640 \checkmark \\ F_{\text{max}} &= 35\,037,04 \text{ N} \checkmark \end{aligned} \quad (3)$$

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

$$\begin{aligned} 5.5 \quad W &= \Delta E_k \quad \checkmark \\ &= \frac{1}{2}(2200) \cdot (2,8)^2 \checkmark - \frac{1}{2}(2200) \cdot (4,3)^2 \checkmark \\ &= -11715 \text{ J} \checkmark \end{aligned} \quad (4)$$

$$\begin{aligned} 5.6 \quad \Sigma p_{\text{before}} &= \Sigma p_{\text{after}} \\ (2200) \cdot (2,8) \checkmark + (3000) \cdot (-0,8) \checkmark &= 5200 \cdot v \checkmark \\ v &= 0,72 \text{ m.s}^{-1} \checkmark \end{aligned} \quad (4)$$

$$\begin{aligned} 5.7 \quad W &= F_{\text{lift}} \cdot \Delta x \quad \checkmark \\ &= (29400) \cdot (9) \checkmark \\ &= 264600 \text{ J} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 5.8 \quad P &= F \cdot v \quad \checkmark \\ &= (29400) \cdot (0,4) \checkmark \\ &= 11760 \text{ W} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 5.9 \quad \text{efficiency} &= \frac{\text{power output}}{\text{power input}} \checkmark \\ \frac{90}{100} &= \frac{11760}{\text{power input}} \checkmark \\ \text{Power input} &= 13066,67 \text{ W} \checkmark \end{aligned} \quad (3)$$

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Question 6

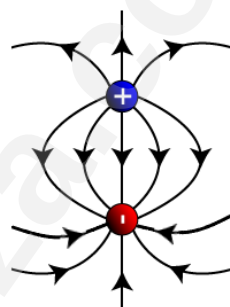
6.1.1 The force acting per unit mass. ✓✓ (2)

6.1.2 From the definition:
gravitational field = F/m ✓
But $g = F/m$
∴ gravitational field = g } ✓ (2)

$$\begin{aligned} 6.1.3 \quad g &= \frac{G \cdot M}{r^2} \checkmark \\ &= \frac{(6,7 \times 10^{-11}) \cdot (6 \times 10^{24})}{(400 \times 10^3 + 6,4 \times 10^6)^2} \checkmark \\ &= 8,69 \text{ m.s}^{-2} \checkmark \end{aligned} \quad (5)$$

6.2.1 A region in space in which an electric charge experiences a force. ✓✓ (2)

6.2.2 pattern ✓
direction of arrows ✓
more lines around negative charge ✓ (3)



$$\begin{aligned} 6.2.3 \quad E &= \frac{kQ_1}{r^2} \checkmark \\ &= \frac{(9 \times 10^9) \cdot (+3 \times 10^{-6})}{(0,04)^2} \checkmark \\ &= 16875000 \text{ N.C}^{-1} \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 6.2.4 \quad E &= \frac{kQ_2}{r^2} \\ &= \frac{(9 \times 10^9) \cdot (4 \times 10^{-6})}{(0,05)^2} \checkmark \\ &= 14400000 \text{ N.C}^{-1} \checkmark \end{aligned}$$

$$\tan \theta = \frac{3}{4} \quad \therefore \theta = 36,87^\circ \checkmark$$

$$\begin{aligned} \text{Horizontal component of } E_{q2} &= \\ 1,44 \times 10^7 \cdot \cos 36,87^\circ &= 11519984,57 \text{ N.C}^{-1} \checkmark \end{aligned}$$

$$\begin{aligned} \text{Vertical component of } E_{q2} &= \\ 1,44 \times 10^7 \cdot \sin 36,87^\circ &= 8640020,58 \text{ N.C}^{-1} \checkmark \end{aligned}$$

$$\begin{aligned} E_{\text{net}} &= \\ \sqrt{(16875000 - 11519984,57)^2 + (8640020,58)^2} \checkmark \\ &= 10164946,92 \text{ N.C}^{-1} \checkmark \end{aligned} \quad (7)$$

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Question 7

$$7.1.1 \quad R = \frac{\text{product}}{\text{sum}} \checkmark$$

$$= \frac{10 \times 15}{10+15} \checkmark$$

$$= 6 \, \Omega \checkmark \quad (3)$$

$$7.1.2 \quad W = \frac{V^2}{R} t \checkmark$$

$$576 \checkmark = \frac{V^2}{15} \cdot 60 \checkmark$$

$$V_{\text{bulb}} = 12 \, \text{V}$$

$$\therefore V_2 = 12 \, \text{V} \checkmark \quad (4)$$

$$7.1.3 \quad R_p = \frac{V_p}{I} \checkmark$$

$$6 = \frac{12}{I} \checkmark^{\text{coe}}$$

$$I = 2 \, \text{A} \checkmark \quad (3)$$

$$7.1.4 \quad \text{Total energy supplied per coulomb of charge by the cell} \checkmark \checkmark \quad (2)$$

$$7.1.5 \quad \text{emf} = I(R_{\text{ex}} + r) \checkmark$$

$$24 \checkmark = 2(R + 6 + 1,5) \checkmark^{\text{coe}}$$

$$R = 4,5 \, \Omega \checkmark \quad (4)$$

7.2.1 Current through a conductor is directly proportional to the potential difference across the conductor at constant temperature. $\checkmark \checkmark \quad (2)$

7.2.2 Current (A) $\checkmark \checkmark \quad (2)$

7.2.3 (4,0 $\checkmark$; 6,4 $\checkmark$) $\quad (2)$

7.2.4 The temperature of the conductor increases at high currents, causing an increase in resistance. $\checkmark \checkmark \quad (2)$

$$7.2.5 \quad \text{gradient} = \frac{\Delta I}{\Delta V} \checkmark = \frac{1}{R}$$

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

$$\therefore \frac{1}{R} = 1,6$$

$$R = 0,63 \, \Omega \checkmark \quad (4)$$

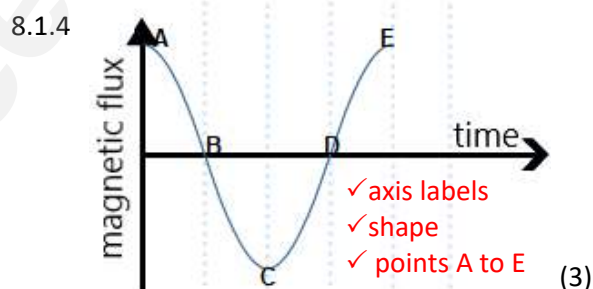
Question 8

8.1.1 Mechanical energy $\checkmark$ to Electrical energy $\checkmark \quad (2)$

8.1.2a Faraday's law of electromagnetic induction $\checkmark$ must say in full $\quad (1)$

8.1.2b the product of the number of turns on the coil and the flux through the coil (NΦ) $\checkmark \checkmark \quad (2)$

8.1.3 Increase strength of magnetic field $\checkmark \checkmark$
or
Increase loop area of the coil $\checkmark \checkmark$
or
Use curved magnets $\checkmark$ to ensure that the angle between the magnetic field and the normal to the plane of the coil is $0^\circ \checkmark \quad (2)$



8.2.1 The current in the primary coil must change uniformly (be AC) to set a changing magnetic field through the iron core $\checkmark$ in order to induce a current in the secondary coil. $\checkmark \quad (2)$

8.2.2 step up transformer $\checkmark \quad (1)$

$$8.2.3 \quad \frac{N_s}{N_p} = \frac{V_s}{V_p} \checkmark$$

$$\frac{N_s}{600} = \frac{200}{24} \checkmark$$

$$N_s = 5\,500 \text{ turns} \checkmark \quad (3)$$

8.2.4 Sound $\checkmark \quad (1)$

$$8.2.5 \quad \text{efficiency} = \frac{\text{power output}}{\text{power input}}$$

$$\frac{90}{100} = \frac{\text{power output}}{2000} \checkmark$$

$$\text{Power input} = 1800 \text{ W} \checkmark$$

$$P = VI \checkmark$$

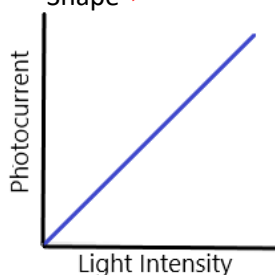
$$1800 = 220 \times I \checkmark$$

$$I = 8,18 \text{ A} \checkmark \quad (5)$$

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Question 9

9.1.1 labels on axis $\checkmark$
Shape $\checkmark$



(2)

9.1.2 remains the same $\checkmark \checkmark$ (2)

9.2.1 $6,5 \times 10^{14} \text{ Hz}$ $\checkmark \checkmark$ (2)

$$9.2.2 \quad W_o = h \cdot f_o \checkmark$$

$$= (6,6 \times 10^{-34}) \cdot (6,5 \times 10^{14}) \checkmark \text{coe}$$

$$= 4,29 \times 10^{-19} \text{ J} \checkmark \quad (3)$$

$$9.3.1 \quad 4,95 \times (1,6 \times 10^{-19}) \checkmark$$

$$= 7,92 \times 10^{-19} \text{ J} \checkmark \quad (2)$$

$$9.3.2 \quad E = \frac{hc}{\lambda} \checkmark$$

$$7,92 \times 10^{-19} = \frac{(6,6 \times 10^{-34}) \times (3 \times 10^8)}{\lambda} \checkmark \text{coe}$$

$$\lambda = 2,5 \times 10^{-7} \text{ m} \checkmark \quad (3)$$

$$9.3.3 \quad E = W_o + E_k \checkmark$$

$$(7,92 \times 10^{-19} = 4,29 \times 10^{-19}) + \frac{1}{2} \cdot (9,1 \times 10^{-31}) \cdot v^2 \checkmark$$

$$v = 893197,74 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (4)$$

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Total marks: 200