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QUESTION 1

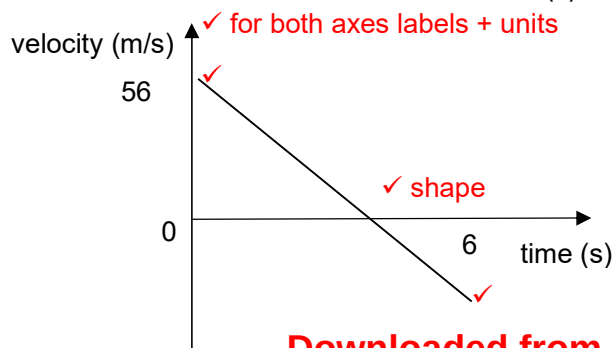
- 1.1 C ✓✓
 1.2 D ✓✓
 1.3 C ✓✓
 1.4 B ✓✓
 1.5 A ✓✓
 1.6 B ✓✓
 1.7 C ✓✓
 1.8 D ✓✓
 1.9 A ✓✓
 1.10 D ✓✓

[20]

QUESTION 2

- 2.1 Acceleration is the rate of change of velocity with time. ✓✓ (2)
 2.2 $g = 9,8 \text{ m.s}^{-2}$ ✓ downward ✓ (2)
 2.3 $s = 160 \text{ m}$ UPWARD +
 $u = ?$ $v^2 = u^2 + 2gs$
 $v = 0 \text{ m.s}^{-1}$ $0 = u^2 + 2(-9,8)(160)$ ✓✓
 $g = -9,8 \text{ m.s}^{-2}$ $u^2 = 3136$
 $t = -$ $u = 56 \text{ m.s}^{-1}$ ✓ up ✓ (4)
 2.4 $s = ?$ UPWARD +
 $u = 56 \text{ m.s}^{-1}$ $s = ut + \frac{1}{2}at^2$
 $v = -$ $s = (56)(6) + \frac{1}{2}(-9,8)(6^2)$ ✓
 $g = -9,8 \text{ m.s}^{-2}$ $s = 336 - 176,4$
 $t = 6 \text{ s}$ $s = 159,6 \text{ m}$ ✓ (above deck) (3)

2.5 (4)



2.6 Hits the ground ✓ (1)

2.7 Height = area = $\frac{1}{2}(0,4)(3,92)$ ✓✓
 $= 0,78 \text{ m}$ ✓

OR

$s = ?$ DOWN +

$u = 0 \text{ m.s}^{-1}$ $s = ut + \frac{1}{2}at^2$

$v = -$ $s = 0 + \frac{1}{2}(9,8)(0,4^2)$ ✓✓

$g = 9,8 \text{ m.s}^{-2}$ $s = 0,78 \text{ m}$ ✓ (3)

$t = 0,4 \text{ s}$

2.8 acc = gradient = $\frac{(-1,5) - (3,92)}{0,1}$ ✓

$= -54,2$

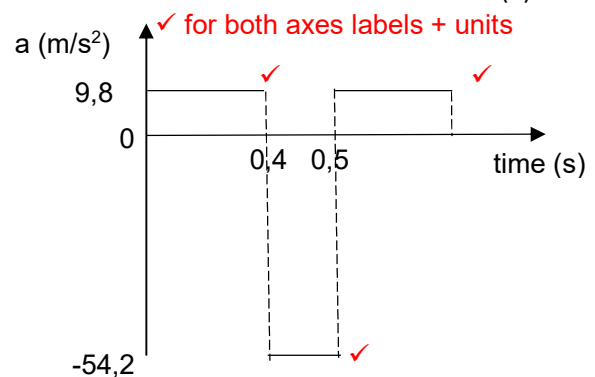
$= 54,2 \text{ m.s}^{-2}$ ✓ upward ✓

OR $v = u + at$

$a = \frac{-1,5 - 3,92}{0,1}$ ✓

$= 54,2 \text{ m.s}^{-2}$ ✓ upward ✓ (4)

2.9 (4)



2.10 Average velocity is the rate of change of displacement with time. ✓✓ (2)

2.11 $v_A = 12 - 3 = 9 \text{ km/h}$ ✓ East ✓ (3)

2.12 $t_A = \frac{s}{v} = \frac{4,5}{9} = 0,5 \text{ h}$ ✓

$t_B = \frac{s}{v} = \frac{6}{18} = 0,33 \text{ h}$ ✓

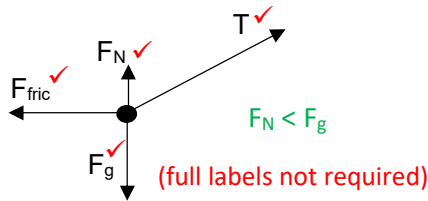
B reaches S first. ✓ (5)

[37]

QUESTION 3

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

3.2.1



F_N is the upward push of the surface on the block (Normal Force)

F_{fric} is the backward force of friction on the block

F_g is the downward pull of the earth on the block (Weight)

T is the tension of the string acting on the block at 15° to the horizontal (4)

3.2.2 $F_{net} = T + F_g$
 $(2)(1,32) \checkmark = T + (2)(9,8) \text{ N} \checkmark$
 $T = -16,96 \text{ N} = 16,96 \text{ N} \quad (3)$

3.2.3 $F_{net} = T_{hor} + F_{fric} \quad (\text{Right} +)$
 $ma = T \cos 15^\circ + F_{fric}$
 $(8)(1,32) \checkmark = 16,96 \cos 15^\circ \checkmark + F_{fric}$
 $F_{fric} = 10,56 - 18,93$
 $= -5,82$
 $= 5,82 \text{ N} \checkmark \text{ in opp dir to motion} \checkmark (4)$

- 3.3 The angle between T and horizontal increases, so the vertical component of T increases ✓
 Normal force decrease ✓
 Frictional force decreases ✓ ($F_{fric} = \mu F_N$) (3)
 (accept any 3 points – must progress logically)

- 3.4 T is greater, so the vertical component of T increases ✓ → Normal force decrease ✓
 Frictional force decreases ✓ ($F_{fric} = \mu F_N$) (3)

3.5 $P = Fv = mgv = (10)(9,8)(0,4) \checkmark \checkmark$
 $= 39,2 \text{ W} \checkmark \quad (3)$

3.6 $s = 1,2 \text{ m}$ DOWN +
 $u = -0,4 \text{ m.s}^{-1}$ $v^2 = u^2 + 2gs \quad \checkmark \checkmark$
 $v = ?$ $v^2 = (-0,4)^2 + 2(-9,8)(1,2)$
 $g = 9,8 \text{ m.s}^{-2}$ $v^2 = 23,68$
 $t = -$ $v = 4,87 \text{ m.s}^{-1} \checkmark \text{ down} \checkmark$
 (4)

QUESTION 4

4.1 $CD = 0,9 / \sin 30^\circ \checkmark = 1,8 \text{ m} \checkmark \quad (2)$

- 4.2 The work done by the net force is equal to the change in kinetic energy. ✓✓ (2)

4.3 $E_k = F_{net} s$
 $E_k = (400 + mg \sin 30^\circ)(1,8)$
 $E_k = (400 + 367,5)(1,8) \checkmark \checkmark \checkmark$
 $E_k = 1381,5 \text{ J} \checkmark \quad (4)$

OR

$E_k = E_p + \text{Work against friction}$
 $= mgh + F_s$
 $= (75)(9,8)(0,9) \checkmark + (400)(1,8) \checkmark$
 $= 1381,5 \text{ J} \checkmark$

- 4.4 No change. ✓ Frictionless and horizontal. ✓ (2)

4.5 $E_p (\text{top}) = E_k (\text{bottom})$
 $mgh = 1381,5$
 $(75)(9,8)h \checkmark = 1381,5 \checkmark$
 $h = 1,88 \text{ m} \checkmark \quad (3)$

4.6 $\frac{1}{2} m v^2 = E_k$
 $\frac{1}{2} (75) v^2 \checkmark = 1381,5 \checkmark$
 $v^2 = 36,84$
 $v = 6,07 \text{ m.s}^{-1} \checkmark \quad (3)$

- 4.7 The total linear momentum of an isolated system is conserved. ✓✓ (2)

4.8 $m_s u_s + m_r u_r = m_s v_s + m_r v_r \quad (\text{Stan dir} +)$
 $(75)(2,5) + (70)(-3) = (75) v_s + (70)(0,25)$
 $v_s = -0,53 = 0,53 \text{ m.s}^{-1} \checkmark \text{ in opp dir} \checkmark \quad (5)$

- 4.9 An inelastic collision is one in which momentum is conserved but kinetic energy is not conserved. ✓✓ (2)

4.10 $E_k (\text{before}) = \frac{1}{2} m u_s^2 + \frac{1}{2} m u_r^2$
 $= \frac{1}{2} (75)(2,5)^2 + \frac{1}{2} (70)(-3)^2 \checkmark$
 $= 234,375 + 315 = 549,4 \text{ J} \checkmark$
 $E_k (\text{after}) = \frac{1}{2} m v_s^2 + \frac{1}{2} m v_r^2$
 $= \frac{1}{2} (75)(-0,53)^2 + \frac{1}{2} (70)(0,25)^2 \checkmark$
 $= 10,534 + 2,1875 = 12,7 \text{ J} \checkmark$

Kinetic energy is not conserved so inelastic collision ✓

(5)

$$4.11 \quad F_{\text{net}} = \frac{mv - mu}{t} = \frac{(70)(0,25) - (70)(-3)}{0,4} \checkmark$$

$$= \frac{490}{0,4} = 568,75 \text{ N} \checkmark \text{ in Stan's orig dir} \checkmark$$

$$(4)$$

4.12 The forces will be equal but opposite. $\checkmark$
 Newton's Third Law $\checkmark$ (2)
[36]

QUESTION 5

5.1.1 The force of attraction between two masses is directly proportional to the product of the masses, and inversely proportional to the square of the distance between their centres. $\checkmark\checkmark$ (2)

$$5.1.2 \quad F = \frac{Gm_1m_2}{r^2}$$

$$= \frac{(6,7 \times 10^{-11})(5,6 \times 10^{26})(2125)}{(140\,000\,000)^2} \checkmark$$

$$= \frac{7,973 \times 10^{19}}{1,96 \times 10^{16}} \checkmark$$

$$= 4,07 \times 10^3 \text{ N} \checkmark \quad (3)$$

$$5.1.3 \quad g = \frac{GM}{r^2}$$

$$= \frac{(6,7 \times 10^{-11})(5,6 \times 10^{26})}{(1,96 \times 10^{16})} \checkmark$$

$$= 1,91 \text{ N.m}^{-1} \text{ or m.s}^{-2} \checkmark \quad (3)$$

5.2.1 Electric Field Strength is the force per unit charge experienced by a charge in an electric field. $\checkmark\checkmark$ (2)

$$5.2.2 \quad E_{\text{AP}} = kQ = \frac{(9 \times 10^9)(1,5 \times 10^{-6})}{(0,40)^2} \checkmark$$

$$= 8,44 \times 10^4 \text{ N/C to right} \checkmark$$

$$E_{\text{BP}} = kQ = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,3)^2} \checkmark$$

$$= 2,00 \times 10^5 \text{ N/C to right} \checkmark$$

$$E_{\text{net}} = (2,00 \times 10^5) + (0,844 \times 10^5)$$

$$= 2,84 \times 10^5 \text{ N/C} \checkmark \text{ (to the right.)} \quad (5)$$

$$5.2.3 \quad F = Eq = (2,84 \times 10^5)(3,0 \times 10^{-9}) \checkmark\checkmark$$

$$= 8,52 \times 10^{-4} \text{ N} \checkmark \quad (3)$$

[18]**QUESTION 6**

6.1.1 Emf is the total work done per unit charge moved through the cell. $\checkmark\checkmark$ (2)

6.1.2 Current through the 4Ω resistor will be $0,4 \text{ A}$. $\checkmark$ So, total current = $0,6 \text{ A}$ $\checkmark$ (2)

$$6.1.3 \quad R_z = \frac{V}{I} = \frac{15,4}{0,6} \checkmark = 25,7 \Omega \checkmark \quad (3)$$

$$6.1.4 \quad R_{\text{total}} = \frac{(4 \times 8)}{(4 + 8)} \checkmark + 25,7 \checkmark$$

$$= 2,7 + 25,7 = 28,4 \Omega \checkmark \quad (3)$$

$$6.1.5 \quad E = IR + Ir$$

$$18 \checkmark = (0,6)(28,4) \checkmark + (0,6)r$$

$$0,6r = 0,96$$

$$r = 1,6 \Omega \checkmark \quad (3)$$

$$6.1.6 \quad W = I^2Rt = (0,6)^2(1,6)(2 \times 60) \checkmark\checkmark$$

$$= 69,12 \text{ J} \checkmark \quad (3)$$

6.1.7 (a) Increase $\checkmark$ (1)

(b) Reading on V_1 is V_{term}
 $V_{\text{term}} = E - Ir$
 E and r remain constant
 If S is opened, R increases $\checkmark$
 If R increases, I decreases $\checkmark$
 If I decreases, Ir decreases $\checkmark$
 Therefore, V_{term} increases. $\checkmark$ (4)

$$6.2.1 \quad P = \frac{V^2}{R} = \frac{(240)^2}{1200} \checkmark = 48 \Omega \checkmark \quad (3)$$

$$6.2.2 \quad W = (1,2 \text{ kW})(10/60) \checkmark = 0,2 \text{ kWh} \checkmark$$

$$\text{Cost} = (0,2)(R1,80) = R0,36 \checkmark \quad (3)$$

6.2.3 It would take longer $\checkmark$ to make your toast with the 800W toaster because the rate at which it converts energy is less. $\checkmark$
 (2)
[29]

QUESTION 7

7.1 Kinetic (mechanical) energy to Electrical energy ✓ (1)

7.2 The induced emf is proportional to the rate of change of magnetic flux. ✓✓ (2)

7.3 By rotating the magnet, you create a changing magnetic flux ✓ which induces a changing EMF in the coil. ✓ (2)

7.4 Y HGE ✓ L DBA ✓ X (2)

7.5 Graph (iii) ✓ (1)

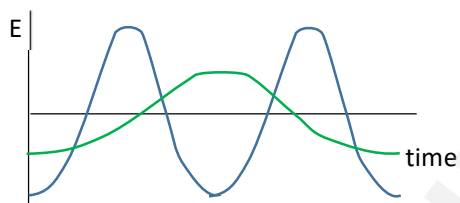
7.6 Ride faster ✓ (1)

7.7.1 $1 \rightarrow 2$ ✓ (1)

7.7.2 D ✓ (1)

7.7.3 2 ✓ (1)

7.7.4 and 7.7.5 on answer sheet (2) and (2)



[16]

QUESTION 8

8.1 The Work Function is the minimum amount of energy required for an electron to escape from a metal. ✓✓ (2)

8.2 Potassium has higher threshold frequency, ✓ and so therefore has greater Work Function ✓ $W_0 = hf_0$. (2)

$$8.3 \quad E = \frac{hc}{\lambda} = \frac{(6,6 \times 10^{-34})(3 \times 10^8)}{550 \times 10^{-9}} \quad \checkmark$$

$$= 3,6 \times 10^{-19} \text{ J} \quad \checkmark$$

$$W_0 = hf_0 = (6,6 \times 10^{-34})(5,55 \times 10^{14})$$

$$= 3,663 \times 10^{-19} \text{ J} \quad \checkmark$$

So, photoelectric effect will NOT take place. ✓ $W_0 > E$. (4)

OR

Frequency of incident photon (UV light)

$$f = c / \lambda = (3 \times 10^8) / (550 \times 10^{-9}) \quad \checkmark \checkmark$$

$$= 5,45 \times 10^{14} \text{ Hz} \quad \checkmark$$

This is less than the threshold frequency so no photoelectric effect takes place. ✓

$$8.4 \quad E_{k \max} = E - W_0$$

$$= (6,6 \times 10^{-34})[(5,45 \times 10^{14}) - (5,07 \times 10^{14})] \quad \checkmark \checkmark$$

$$= 3,6 \times 10^{-19} - 3,35 \times 10^{-19}$$

$$= 2,508 \times 10^{-20} \text{ J} \quad \checkmark \quad (3)$$

8.5 No change ✓ (1)

8.6 Gamma Radiation has higher frequency so more energy. ✓ Therefore, electrons will have greater velocity, ✓ therefore current will be higher. ✓ (3)

$$8.7 \quad E = -0,5 - (-3) = 2,5 \text{ eV} \quad \checkmark$$

$$\frac{hc}{\lambda} = E$$

$$\lambda = \frac{hc}{E} = \frac{(4,125 \times 10^{-15})(3 \times 10^8)}{2,5} \quad \checkmark$$

$$= 4,95 \times 10^{-7} \text{ m} \quad (3)$$

$$= 495 \text{ nm} \quad \checkmark$$

[18]