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## Question 1

- 1.1. D ✓✓  
 1.2. C ✓✓  
 1.3. C ✓✓  
 1.4. C ✓✓  
 1.5. A ✓✓  
 1.6. B ✓✓  
 1.7. B ✓✓  
 1.8. C ✓✓  
 1.9. D ✓✓  
 1.10. C ✓✓ (20)

## Question 2

$$\begin{aligned} 2.1.1. \text{ Average Speed} &= \frac{\text{Distance}}{t} \checkmark \\ &= \frac{5}{0,75} \checkmark \\ &= 6,67 \text{ km/h} \checkmark (3) \end{aligned}$$

$$\begin{aligned} 2.1.2. t &= \frac{\text{Distance}}{\text{Speed}} \\ &= \frac{10}{4} \checkmark \\ &= 2,5 \text{ h} \checkmark (2) \end{aligned}$$

$$\begin{aligned} 2.1.3. \text{ Average Speed} &= \frac{\text{Distance}}{t} \\ &= \frac{6}{0,75} \checkmark \\ &= 8 \text{ km/h} \checkmark (3) \end{aligned}$$

$$2.2.1. \frac{180}{3,6} \checkmark = 50 \text{ m/s} \checkmark (2)$$

$$\begin{aligned} 2.2.2. x &= ut \checkmark \\ &= (50)(0,4) \checkmark \\ &= 20 \text{ m} \checkmark (3) \end{aligned}$$

$$\begin{aligned} 2.2.3. v^2 &= u^2 + 2ax \checkmark & x_{\text{total}} &= 156,25 + 20 & x &< 200 & \therefore \text{she stops in time} \checkmark \\ x &= \frac{(v^2 - u^2)}{2a} & &= 176,25 \text{ m} \checkmark \\ &= \frac{-(50)^2}{2(-8)} \checkmark \\ &= 156,25 \text{ m} \checkmark (6) \end{aligned}$$

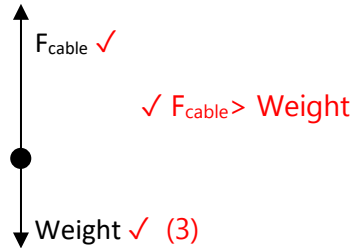
- 2.2.4. - The coefficient of static friction is greater than the coefficient of kinetic friction. ✓  
 - friction is greater when the surface of the tyre does not move across the road (when the car does not skid). ✓

- Greater force of friction  $\rightarrow$  greater rate of deceleration. ( $a \propto F_{\text{net}}$ ) ✓ (3)

$$\begin{aligned} 2.2.5. \quad v &= u + at \quad \checkmark \\ t &= \frac{v - u}{a} \\ &= \frac{0 - 50}{-g} \quad \checkmark \\ &= 6,25 \text{ s} \quad \checkmark \quad (4) \end{aligned}$$

### Question 33

3.1.

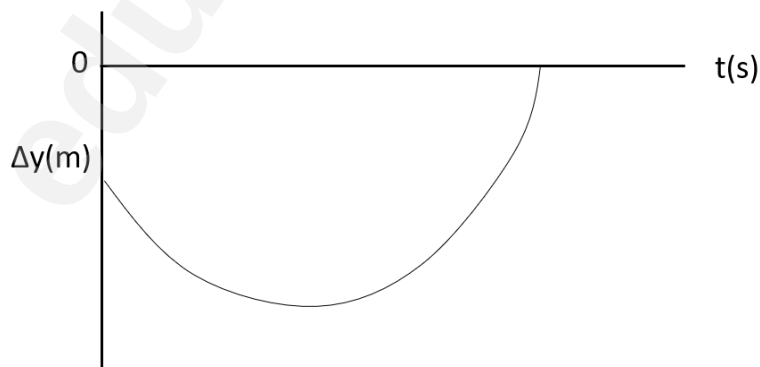


$$\begin{aligned} 3.1.2. \quad F_{\text{net}} &= ma \quad \checkmark \\ &= (65)(0,5) \quad \checkmark \\ &= 32,5 \text{ N} \quad \checkmark \text{ upward} \quad \checkmark \end{aligned}$$

- 3.1.3. - Newton's Second Law of Motion ✓
- 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. ✓ (3)

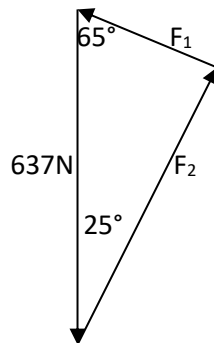
$$\begin{aligned} 3.1.4. \quad F_{\text{net}} &= F_{\text{cable}} + \text{Weight} \quad \checkmark \\ F_{\text{cable}} &= F_{\text{net}} - \text{Weight} \\ &= 32,5 - (-637) \quad \checkmark \\ &= 669,5 \text{ N} \quad \checkmark \text{ Upward} \quad \checkmark \quad (4) \end{aligned}$$

3.1.5.



✓ Labels    ✓✓ Shape    ✓ Orientation    (4)

3.2.



$$F_1 = 637 \cos 65^\circ \checkmark \checkmark$$

OR

$$F_1 = 637 \sin 25^\circ$$

$$= 269,21 \text{ N } \checkmark$$

$$= 269,21 \text{ N}$$

$$F_2 = 637 \sin 65^\circ \checkmark \checkmark$$

$$F_2 = 637 \cos 25^\circ$$

$$= 577,32 \text{ N } \checkmark (6)$$

$$= 577,32 \text{ N}$$

#### Question 4

4.1.1.  $E_p = mgh \checkmark$

$$= (65)(9,8)(4) \checkmark$$

$$= 2548 \text{ J } \checkmark (3)$$

4.1.2.  $E_m = E_k + E_{\text{canvas}} \checkmark$

$$E_{\text{canvas}} = E_m - E_k$$

$$= 2548 \checkmark - (0,5)(65)(6^2) \checkmark$$

$$= 1378 \text{ J } \checkmark (4)$$

4.1.3. – Bending her knees increases the time that it takes for her to come to rest  $\checkmark$

- while  $\Delta p$  remains constant.  $\checkmark$

-  $F_{\text{net}} \propto 1/t \checkmark$

- Decreasing the magnitude of the force acting on her  $\checkmark (4)$

4.1.4.  $F\Delta t = \Delta p \checkmark$

$$F = \frac{\Delta p}{\Delta t}$$

$$= \frac{m(v-u)}{\Delta t}$$

$$= \frac{65(0-6)}{0,3} \checkmark \checkmark$$

$$= -1300$$

$$F = 1300 \text{ N } \checkmark \text{ opposite to motion } \checkmark (5)$$

4.2.1.  $\mu = F_f/F_N \checkmark$

$$0,38 = F \cos 40^\circ / (300 \times 9,8 + F \sin 40^\circ) \checkmark$$

$$F = 2141,11 \text{ N } \checkmark$$

$$F_f = F \cos 40^\circ$$

$$= 2141,11 \cos 40^\circ \checkmark$$

$$= 1640,19 \text{ N } \checkmark (5)$$

4.2.2.  $F = F_f / \cos 40^\circ \checkmark$

$$= 1640,19 / \cos 40^\circ \checkmark$$

$$= 2141,12 \text{ N Right } \checkmark (3)$$

$$4.2.3. F_{\text{kinetic friction}} = (1640.19)(^{90}/_{100}) \checkmark$$

$$= 1476.17 \text{ N opposite to motion } \checkmark (2)$$

4.2.4. - work done by a net force on an object  $\checkmark$   
 - is equal to the change in the kinetic energy of the object  $\checkmark (2)$

$$4.2.5. \Delta E_k = F_{\text{net}} \Delta x$$

$$\frac{1}{2}mv^2 = F_{\text{net}} \Delta x \checkmark$$

$$v = \sqrt{(2F_{\text{net}} \Delta x / m)}$$

$$= \sqrt{(2(1640.19 - 1476.17) \checkmark \checkmark (12) \checkmark / 300) \checkmark}$$

$$= 6.56 \text{ m/s } \checkmark (6)$$

$$4.2.6. \Delta x = ((v+u)/2) \Delta t \checkmark$$

$$\Delta t = 2\Delta x / (v+u)$$

$$= 2(12) \checkmark / (6.56+0) \checkmark$$

$$= 3.66 \text{ s } \checkmark$$

The agent manages to push the bomb into the water in time.  $\checkmark (5)$

### Question 5

5.1. - Law of conservation of Momentum  $\checkmark$   
 - The total linear momentum of an isolated system  $\checkmark$   
 - remains constant.  $\checkmark (3)$

$$5.2. p_{\text{after}} = p_{\text{before}} \checkmark$$

$$(m_{\text{bullet}} + m_{\text{block}})v_a = m_{\text{bullet}}v_{\text{bullet}}$$

$$v = m_{\text{bullet}}v_{\text{bullet}} / (m_{\text{bullet}} + m_{\text{block}})$$

$$= (0.045)(500) \checkmark / (0.045 + 2.5) \checkmark$$

$$= 8.84 \text{ m/s } \checkmark \text{ to the right } \checkmark (5)$$

5.3. Law of conservation of mechanical energy.  $\checkmark (1)$

$$5.4. E_{m(\text{top})} = E_{m(\text{bottom})} \checkmark$$

$$mgh = \frac{1}{2}mv^2$$

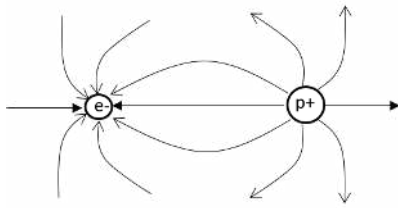
$$h = (((0.5)(8.84)^2) \checkmark / (9.8)) \checkmark$$

$$= 3.99 \text{ m } \checkmark (4)$$

### Question 6

6.1. - Two point charges in free space or air exert forces on each other. The force is directly proportional to the product of the charges  $\checkmark$   
 - and inversely proportional to the square of the distance between the charges  $\checkmark (2)$

6.2.



✓ shape

✓ direction (2)

6.3.

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

$$8.20 \times 10^{-8} \checkmark = (9 \times 10^9)(1.6 \times 10^{-19})(1.6 \times 10^{-19})/r^2 \checkmark$$

$$= 5.3 \times 10^{-11} \text{ m} \checkmark$$

$$= 53 \text{ pm} \checkmark (5)$$

6.4.  $1.03 \times 10^{-7} \text{ N} \quad \checkmark \checkmark (2)$

### Question 7

7.1. 3J of energy supplied ✓

Per 1C of charge passing through the cell ✓ (2)

7.2. 9V ✓ (1)

7.3.  $R_p = (1/r_1 + 1/r_2)^{-1} \checkmark$

$$= (1/2 + 1/10)^{-1} \checkmark \checkmark$$

$$= 1,67 \, \Omega \checkmark (4)$$

7.4. Controls the current in the circuit by changing the resistance of the circuit. ✓ (1)

7.5.  $R_{\text{total}} = \text{emf}/I \quad \checkmark$

$$= 9/2 \quad \checkmark$$

$$= 4,5\Omega \quad \checkmark$$

$$R_{\text{total}} = R_{\text{rheostat}} + R_p + r$$

$$R_{\text{Rheostat}} = 4,5 - (1,67 + 0,6) \checkmark$$

$$= 2,23 \, \Omega \quad \checkmark (5)$$

7.6.  $I_{10} = IR_p \checkmark / R_{10} \checkmark$

$$= (2)(1,67) \checkmark / 10 \checkmark$$

$$= 0,33 \text{ A } \checkmark (5)$$

$$7.7. P = V^2/R \checkmark$$

$$= (2 \times 1,67)^2/2 \checkmark \checkmark$$

$$= 5,58 \text{ W } \checkmark (4)$$

$$7.8. \text{ Cost} = P t_{\text{price}} \checkmark$$

$$= (5,58 \times 10^{-3}) \checkmark (8)(170) \checkmark$$

$$= 7,6 \text{ c } \checkmark (4)$$

$$7.9. R_T \text{ increases } \checkmark$$

$$I_T \text{ decreases } \checkmark$$

$$V_{\text{Rheostat}} \text{ and } V_{\text{lost}} \text{ decreases } \checkmark$$

$$V_{\text{bulb}} \text{ increases } \checkmark$$

$$W \propto V^2 \checkmark$$

$$\text{Bulb brighter. } \checkmark (6)$$

### Question 5

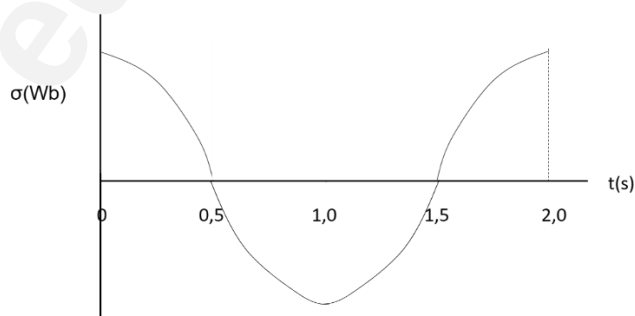
- 8.1. - the product of the number of turns on the coil  $\checkmark$   
 - and the flux through the coil  $\checkmark (2)$

- 8.2. Direct current  $\checkmark (1)$

- 8.3. Split ring should be replaced with slip rings.  $\checkmark (1)$

- 8.4. Mechanical (kinetic)  $\checkmark$  to electrical  $\checkmark (2)$

- 8.5.



$\checkmark$  Labels

✓✓✓ shape (4)

8.6. Emf ✓ (1)

8.7. - the emf induced is directly proportional to the rate of change ✓  
 - of magnetic flux ✓ (2)

8.8.

$$Emf = \frac{-N\Delta\Phi}{\Delta t} \quad \checkmark$$

- The time per revolution halved ✓ (2)
- Which means the emf doubles.

8.9. – increase number of turns on the coil ✓

- increase the strength of the magnetic field. ✓ (2)

### Question 9

9.1. – excited electrons fall to lower energy levels ✓

- releasing quantised amounts of energy ✓
- in the form of light with specific frequencies. ✓ (3)

9.2.

$$c = f\lambda \quad \checkmark$$

$$3 \times 10^8 = f (457 \times 10^{-9}) \quad \checkmark$$

$$f = 6.56 \times 10^{14} \text{ Hz} \quad \checkmark (3)$$

9.3.1. - the minimum amount of energy needed ✓

- to emit an electron from the surface of a metal ✓ (2)

9.3.2.  $2.46 \times 1,6 \times 10^{-19}$  ✓

$$= 3.94 \times 10^{-19} \text{ J} \quad \checkmark (2)$$

9.3.3.

$$hf = W_0 + E_k \quad \checkmark$$

$$(6.6 \times 10^{-34})(6.56 \times 10^{14}) \quad \checkmark = 3.94 \times 10^{-19} + E_k \quad \checkmark$$

$$E_k = 3.90 \times 10^{-20} \text{ J} \quad \checkmark (4)$$

6.3.4. More photoelectrons are released ✓ (1)

6.3.5- Greater intensity means more photons ✓

- which means more collisions between electrons and photons. ✓ (2)

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