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Question 1

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

[20]

Question 2

2.1.1 By dividing by 3,6

OR multiply by $\frac{1000}{(60)(60)}$ (some kind of correct conversion factor/ step) (1)

2.1.2 Average speed = total distance/ total time ✓

$$= 15 / (8 / 60) \checkmark$$

$$= 112,5 \text{ km} \cdot \text{h}^{-1} \checkmark$$

OR

$$= 15 \times 1000 / 8 \times 60 \checkmark$$

$$= 31,25 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (3)$$

2.1.3 Average speed = total distance/ total time

$$= 22,5 / (15 / 60) \checkmark$$

$$= 90 \text{ km} \cdot \text{h}^{-1} \checkmark$$

No she won't be fined ✓. (3)

2.2.1 positive (1)

2.2.2 Sparrow B moves in the opposite direction to C ✓, and slower than C ✓. (vice versa is also allowed) (2)

2.2.3 D (1)

2.2.4 ✓ horizontal line ✓ -ve acceleration (2)



2.2.5 - Slows down in a positive direction ✓

- Stops momentarily ✓

- Speeds up in a negative direction ✓

(3)

Question 3

3.1 $v_f^2 = v_i^2 + 2ax$ ✓

$0 = 5,6^2 + 2(-9,8)x$ ✓✓ (v_i and a must have opposite signs)

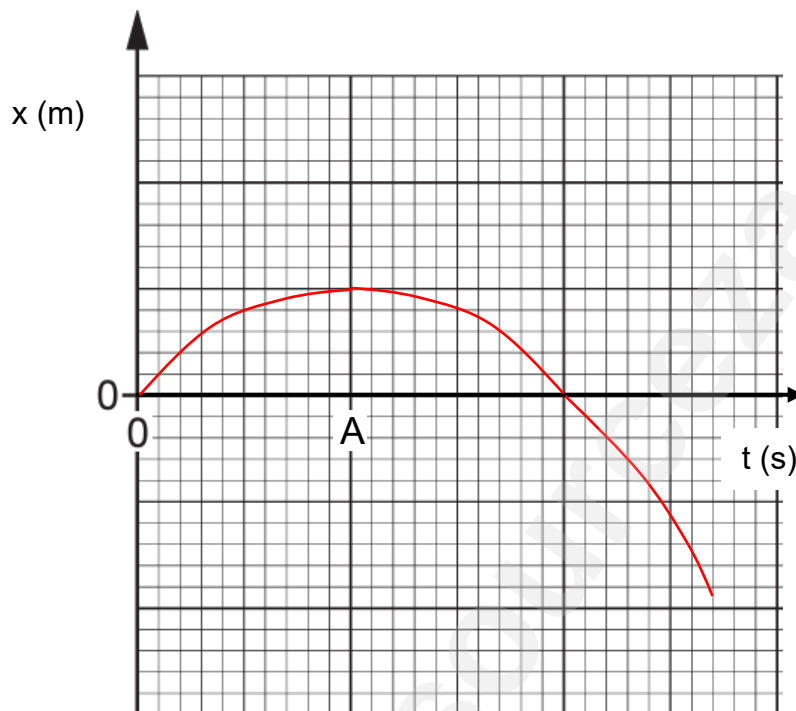
$x = 1,6 \text{ m} + \checkmark 3,1 \text{ m} = 4,7 \text{ m}$ (4)

3.2 $x = v_i t + \frac{1}{2} a t^2$ ✓

$-4,7 = 0 + \frac{1}{2}(-9,8)t^2$ ✓✓ (x and a must have the same sign and a must have same sign as in 3.1)

$t = 0,98 \text{ s}$ ✓ (4)

3.3



- ✓ y-axis label (not Δx)
- ✓ ref point correct
- ✓ shape 'upwards' and symmetrical (about A)
- ✓ shape 'downwards' showing a greater Δx down than the max Δx up
- 1 if downward direction does not correspond to calculation questions

(4)

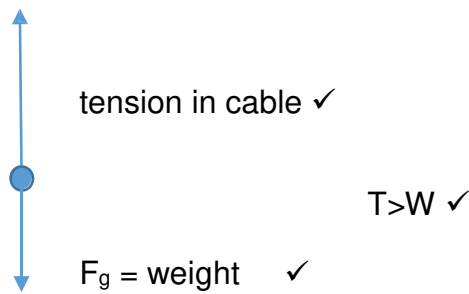
3.4 velocity (1)

3.5.1 the same (1)

3.5.2 the same (1)

Question 4

4.1.1



(3)

4.1.2 $F_{\text{net}} = m a$ ✓

$$T - F_g = m a$$

$$T - (1350 \times 9,8) \checkmark = 1350 \times 2,3 \checkmark$$

$$T = 16335 \text{ N up } \checkmark$$

(4)

4.1.3 $T_{\text{max}} = 18\,000 \text{ N } \checkmark$

$$18\,000 - m_{\text{max}} (9,8) = m_{\text{max}} (2,3) \checkmark$$

$$18\,000 = 2,3 m + 9,8 m$$

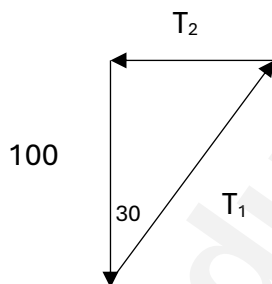
$$18\,000 = 12,1 m$$

$$m_{\text{max}} = 1487,6 \text{ kg } \checkmark$$

$$\text{therefore max cargo} = 1487,6 - 1350 = 137,6 \text{ kg } \checkmark$$

(4)

4.2.1



$$T_1 > T_2 \checkmark \quad \text{angle correct } \checkmark \quad T_2 \text{ at } \perp \text{ to } 100 \text{ N } \checkmark$$

(3)

$$4.2.2 \quad T_1 \cos 30^\circ = 100 \checkmark$$

$$\therefore T_1 = 115,47 \text{ N } \checkmark$$

(2)

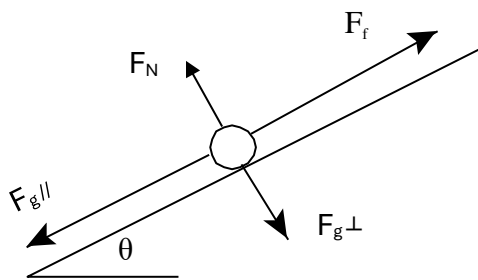
$$4.2.3 \quad T_1 \sin 30^\circ = T_2$$

$$\therefore T_2 = 115,47 \sin 30 \checkmark = 57,7 \text{ N } \checkmark$$

(2)

4.2.4 decrease.

(1)



All forces correct & labelled correctly

✓✓

 θ correct ✓

(3)

4.3.2 $F_f = \mu F_N$

$$F_f = 0,8 \times m \times 9,8 \times \cos \theta \quad \checkmark \text{ (subs)}$$

$$= 7,84 m \cos \theta \quad \checkmark$$

(2)

4.3.3 $F_{g//} = m \times 9,8 \times \sin \theta$

(1)

4.3.4 Equate the two equations ✓

$$7,84 m \cos \theta = 9,8 m \sin \theta$$

$$\frac{7,84}{9,8} = \frac{\sin \theta}{\cos \theta}$$

$$\frac{7,84}{9,8} = \tan \theta$$

$$\theta = 38,7^\circ \quad \checkmark \text{ (round up to 39)}$$

(3)

Question 5

5.1 Power is the rate at which work is done/ or the rate at which energy is transferred.

(2)

5.2 $P = \frac{W}{t} \quad \checkmark$

$$P = \frac{mgh}{t}$$

$$P = \frac{0,45 \times 9,8 \times 1,2}{30} \quad \checkmark \checkmark$$

$$P = 0,18 \text{ W} \quad \checkmark$$

OR $P = Fv$

$$P = F_g \cdot \frac{x}{t}$$

$$P = 0,45 (9,8) \cdot \frac{1,2}{30}$$

$$P = 0,18 \text{ W}$$

(4)

5.3 An isolated system is one that has no net external force acting on it. (1)

5.4.1 The principle of conservation of mechanical energy states that in the absence of air resistance or any external forces, the mechanical energy of an object is constant. (not conserved). (2)

5.4.2 $E_{\text{ptop}} = E_{\text{kbottom}}$ ✓
 $9,8 \times 1,2 = \frac{1}{2} v^2$ ✓✓
 $v = 4,85 \text{ m} \cdot \text{s}^{-1}$ ✓ (4)

5.4.3 $p_{\text{before}} = p_{\text{after}}$ ✓
 $4,85 (65,45) + 0 = -3,2 (65,45) + 2m$ ✓
 $m = 263,43 \text{ kg}$ ✓ (4)

5.4.4 $F = \frac{65,45(-3,2 - 4,85)}{0,7}$ ✓
 $= -752,68 \text{ N}$ ✓
 $= 752,68 \text{ N away from platform B}$ ✓. (5)

5.4.5 It would be the same / equal ✓ but in the opposite direction ✓. (2)

Question 6

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

6.2 zero (1)

6.3 $W_{\text{net}} = F_R \Delta d$ ✓ (formula mark)
 $0 = (F_{g//} - F_f)$
 $0 = (3 \times 9,8 \sin \theta - 14,7) d$ ✓✓ (subs) $d \sin \theta = 1$ thus $\sin \theta = 1/d$ ✓ (calc)
 $0 = 29,4(1/d)(d) - 14,7d$
 $d = 2 \text{ m}$ ✓

OR $W_{\text{net}} = W_{Ff} + W_{g//}$ ✓
 $0 = F_f \Delta d + F_g \sin \theta \Delta d$
 $0 = 14,7 \cdot d + 3 \times 9,8 (1/d)(d)$ ✓✓
 $d = 2 \text{ m}$ ✓
(max 3/5 if cannot get $\sin \theta = 1/d$, but still credit for thought process)

OR $E_{pB} + E_{KB} = E_{KC} + E_{\text{lost}} (W_{Ff})$ ✓
 $3 \times 9,8 \times 1 + \frac{1}{2} 3 (6,26)^2 = \frac{1}{2} 3 (6,26)^2 + 14,7 \cdot d$ ✓✓✓ (subs)
 $d = 2 \text{ m}$ ✓ (5)

OR $W = F \cdot x$
 $E_k = F_f \cdot d$
 $3 \times 9,8 \times 1 = 14,7 \cdot d$
 $d = 2 \text{ m}$ ✓ (5)

Question 7

$$7.1.1 \quad 33,8 - 29,8 \text{ (calc)} = 4 \text{ cm } \checkmark = 0,04 \text{ m (conv)} \checkmark \quad (2)$$

$$7.1.2 \quad E = \frac{kQ}{r^2} \checkmark$$

$$850 = \frac{9 \times 10^9 \times Q}{(0,04)^2} \checkmark \checkmark \text{ subs (coe)}$$

$$Q = 1,51 \times 10^{-10} \text{ C } \checkmark \quad (4)$$

7.1.3 Two point charges exert forces on each other $\checkmark$. The force is directly proportional to the product of the charges and inversely proportional to the square of the distance between the charges $\checkmark$. (2)

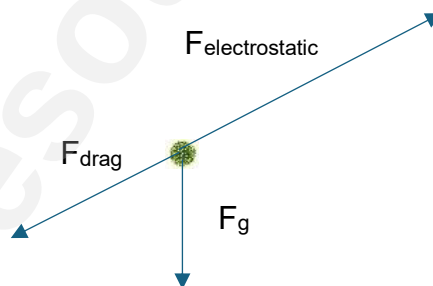
$$7.1.4 \quad F = \frac{kq_1q_2}{r^2} \checkmark$$

$$= \frac{9 \times 10^9 \times 32 \times 10^{-12} \times 1,51 \times 10^{-10}}{(0,04)^2} \checkmark \text{ (conv)} \checkmark \text{ subs and coe}$$

$$= 2,7 \times 10^{-8} \text{ N } \checkmark \quad (5)$$

7.1.5 attractive (1)

7.1.6 $F_{\text{electrostatic}}$ must be much longer than F_f $\checkmark$ or F_{drag} . F_{drag} must be roughly opposite $F_{\text{electrostatic}}$. $\checkmark$ F_g must be vertically downwards $\checkmark$. (3)



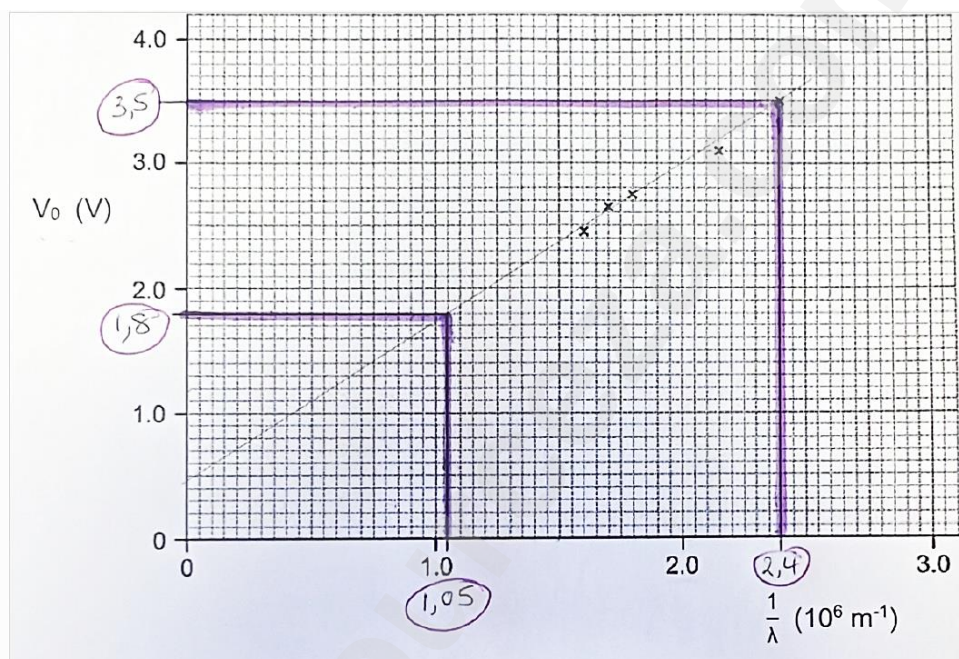
Question 8

8.1.1 LOBF extending to y-axis and beyond last point. (1)

8.1.2 Accuracy refers to how close the measured value is to the true value ✓. The correct apparatus must be used in the correct manner. ✓ (2)

8.1.3 The voltmeter was faulty. OR

Should have taken readings 3 times to check that the correct answer was coming out. (1)



8.2

$$m = \frac{\Delta y}{\Delta x} = \frac{3,5 - 1,8}{2,4 - 1,05 \times 10^6} \checkmark = 1,26 \times 10^{-6} \checkmark \quad \checkmark \text{ shown on graph} \quad (4)$$

8.3

$$m = \frac{hc}{e} \text{ (from the equation)} = 1,26 \times 10^{-6} \checkmark$$

$$\frac{h \times 3 \times 10^8}{1,6 \times 10^{-19}} \checkmark \text{ (subs)} = 1,26 \times 10^{-6}$$

$$h = 6,7 \times 10^{-34} \checkmark \quad (3)$$

Question 9

9.1 potential difference is the work done per unit positive charge $V = W/q$ (2)

9.2 emf is defined as the total energy supplied per coulomb of charge by the cell. (2)

9.3 12 V (1)

9.4 Zero (1)

9.5 $\frac{1}{R_p} = \frac{1}{10} + \frac{1}{15} \checkmark$
 $R_p = 6 \Omega \checkmark$ (2)

9.6 on the diagram. (1)

9.7 $\text{emf} = I(R + r)$
 $12 = I(6 + R + 0,2) \checkmark\checkmark\checkmark \text{ (subs)}$
 $12 = I(6,2 + R)$
 $12 = I(6,2 + 3/I)$
 $12 = 6,2 I + 3$
 $I = 1,45 \text{ A} \checkmark$ (5)

$R = \frac{V}{I}$
 $R = \frac{3}{I} \checkmark$

9.8 $V_{//} = IR_{//}$
 $= 1,45 \times 6 \checkmark \text{ (coe subs)}$
 $V_{\text{ext}} = 8,71 + 3$
 $= 11,71 \text{ V} \checkmark \text{ (process mark)}$
 $V_{\text{lost}} = 12 - 11,71$
 $= 0,29 \text{ V} \checkmark$

OR $V_{\text{lost}} = I \times r_{\text{int}}$
 $= (1,45)(0,2) \checkmark\checkmark \text{ (coe subs)}$
 $= 0,29 \text{ V} \checkmark$ (3)

9.9 $P = VI \checkmark$
 $= 12 \times 1,45 \text{ (coe)} \checkmark$
 $= 17,4 \text{ W} \checkmark$ (3)

Question 10

10.1.1

- Number of turns on the coil
- The rate of change in magnetic flux
- OR the time taken to complete a revolution (any two) (2)

10.1.2

- (a) This device would need a split ring commutator✓ and a power supply✓. (2)
- (b) When a current flows through the coil it will produce a magnetic field (at right angles to the coil) which interacts with the permanent magnetic field (B) in which the wire is placed. The interaction creates a force at right angles to the field (B) and the coil rotates.
- ✓ for the induced field interacting (at right angles) with the field (B) between the magnets
- ✓ for the interaction of the 2 fields creating a ✓ force in the sides of the coil that are perpendicular to B (which causes turning motion in a coil.) (3)

10.2.1 B to A (1)

10.2.2 From bottom brush to top brush. (1)

10.2.3 The light bulb flashes because the current magnitude and direction in the external circuit changes every half turn✓ as the coil changes from having maximum to minimum flux across its surface ✓ the emf generated (and hence the current) in the coil also changes in magnitude and direction✓. (3)

10.2.4

- Max flux in the coil occurs when the angle θ is at zero degrees to the normal to the coil ✓ according to the formula: $\phi_B = BA\cos\theta$ ✓
- The coil in the picture is at an angle greater than zero, but less than 90° to the normal to the coil ✓, so it does not experience max flux. (3)

10.3.1 Lenz's law states that the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux. (2)

10.3.2 X to Y (2)

10.3.3 The magnetic flux through the loop does not change ✓ and an emf is only induced in a wire when magnetic flux changes over time (rate of change in magnetic flux). ✓ (2)

Question 11

11.1.1 The line corresponds to energy emitted due to a specific electron transition between orbitals/energy levels ✓.

Orbital energy levels are unique for each element ✓. (2)

$$11.1.2 \quad E = \frac{hc}{\lambda} \quad \checkmark$$

$$E = \frac{(6,6 \times 10^{-34}) \times (3 \times 10^8)}{142 \times 10^{-9}} \quad \checkmark \quad (\text{subs})$$

$$E = 1,39 \times 10^{-18} \text{ J} \quad \checkmark$$

$$E = \frac{1,39 \times 10^{-18}}{1,6 \times 10^{-19}} \quad \checkmark \quad (\text{subs})$$

$$= 8,7 \text{ eV} \quad \checkmark$$

Hence between levels 5 and 3 ✓. (6)

11.2.1 The gradient of these lines corresponds to Planck's constant. (1)

$$11.2.2 \quad 4 \times 10^{14} \text{ Hz} \quad (1)$$

$$11.2.3 \quad W_0 = 2,14 \times 1,6 \times 10^{-19} = 3,42 \times 10^{-19} \text{ J.} \quad \checkmark$$

$$E = hf \quad \checkmark$$

$$= 6,6 \times 10^{-34} \times 4 \times 10^{14} \quad \checkmark \quad (\text{subs coe})$$

$$= 2,64 \times 10^{-19} \text{ J} \quad \checkmark \quad \text{electrons will thus not be emitted} \quad \checkmark$$

OR

$$W_0 = 2,14 \times 1,6 \times 10^{-19} = 3,42 \times 10^{-19} \text{ J.} \quad \checkmark$$

$$W_0 = hf_0 \quad \checkmark$$

$$3,42 \times 10^{-19} = 6,6 \times 10^{-34} \times f_0 \quad \checkmark \quad (\text{subs coe})$$

$$= 5,18 \times 10^{14} \text{ Hz} \quad \checkmark \quad \text{electrons will thus not be emitted} \quad \checkmark \quad (5)$$

$$11.2.4 \quad E_K = \frac{1}{2} mv^2 \quad \checkmark$$

$$= \frac{1}{2} (9,1 \times 10^{-31})(726273)^2 \quad \checkmark \checkmark$$

$$= \frac{2,4 \times 10^{-19} \text{ J}}{1,6 \times 10^{-19}}$$

$$= 1,5 \text{ eV} \quad \checkmark \quad \text{Place on the line and extrapolate to frequency.} - 12,8 \times 10^{14} \text{ Hz} \quad \checkmark$$

OR

$$E = hf_0 + E_{K \text{ max}} \quad \checkmark$$

$$hf = h(8,54 \times 10^{14}) + \frac{1}{2} (9,1 \times 10^{-31})(726273)^2$$

$$6,6 \times 10^{-34} f = 6,6 \times 10^{-34} (8,54 \times 10^{14}) + 2,4 \times 10^{-19} \quad \checkmark \checkmark \checkmark \quad (\text{subs})$$

$$f = 1,22 \times 10^{15} \text{ Hz} \quad \checkmark$$

$$= 12,2 \times 10^{14} \text{ Hz} \quad \text{Downloaded from eduresourceza.com} \quad (5)$$