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Grade 12 Memo
Paper I (All Sections)

Question 1: Multiple Choice

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

Question 2

2.1.1 A change ✓ in position ✓. (2)

2.1.2 12 m ✓ West ✓ (2)

2.1.3 $Av \text{ vel} = \frac{\Delta x}{\Delta t} = \frac{5}{30} \checkmark = 0,17 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ West } \checkmark$ (3)

2.21 $30 \text{ m} \cdot \text{s}^{-1} = 108 \text{ km} \cdot \text{h}^{-1} \checkmark \therefore \underline{\text{DOES}}$ exceed ✓

OR

$100 \text{ km} \cdot \text{h}^{-1} = 27,78 \checkmark \text{ m} \cdot \text{s}^{-1} (30 > 27,78) \therefore \underline{\text{DOES}}$ exceed ✓ (2)

2.2.2 $a = \text{gradient} = \frac{\Delta v}{\Delta t} = \frac{24-20}{12-0} \checkmark$ (must show Δ) OR $v_f = v_i + at$

$= 0,33 \text{ m} \cdot \text{s}^{-2} \checkmark \text{ South } \checkmark$ $24 = 20 + a(12)$ (3)

$$2.2.3 \text{ Car Q : } \left(\frac{1}{2} b \times h\right) = 6 \times 30 \\ = 180 \text{ m } \checkmark$$

$$\text{Car P : } \left(\frac{1}{2} b \times h\right) + (\ell \times b) \\ = (6 \times 4) + (20 \times 12) \\ = 264 \text{ m } \checkmark \\ 264 - 180 \checkmark = 84 \text{ m } \checkmark$$

OR

$$\text{Car Q : } \Delta x = \left(\frac{V_f + V_i}{2}\right) t \\ = \left(\frac{30+0}{2}\right) \cdot 12 \\ = 180 \text{ m } \checkmark$$

$$\text{Car P : } \Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2 \\ = 20 \cdot (12) + \frac{1}{2} (0,33)(12)^2 \\ = 263,76 \text{ m } \checkmark \\ 263,76 - 180 \checkmark (\text{method}) = 83,76 \text{ m } \checkmark$$

(4)

$$\text{OR } V_f^2 = V_i^2 + 2a\Delta x \checkmark \\ 24^2 = (20)^2 + 2(0,33)\Delta x \checkmark \\ = 266,67 \\ x = 266,67 - 180 = 86,67 \text{ m}$$

2.2.4 Both travel a distance x $\Delta x \times \Delta t$

$$\text{Car Q} \\ x + 84 = 30t \checkmark \\ x = 30t - 84$$

$$\text{Car P} \\ x = 24t \checkmark$$

$$30t - 84 = 24t \\ 6t = 84 \\ \therefore t = 14s \\ \therefore 14 + 12 \checkmark = 26 \text{ s } \checkmark \text{ OR } (13,96 + 12) \xrightarrow{\text{from 2.2.3}} 25.96 \text{ s } \checkmark$$

(4)

$$2.3.1 \quad V_f^2 = V_i^2 + 2a\Delta x \checkmark \\ 0 = (5,6)^2 + 2(-9,8)\Delta x \checkmark \\ x = 1,6 \text{ m } \checkmark$$

(3)

2.3.2 Rate of change of position $\checkmark \checkmark$
OR rate of change of displacement
OR rate of displacement

(2)

$$2.3.3 \quad 6,8 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ down } \checkmark$$

(2)

2.3.4 Δx = area under graph (down)

$$\begin{aligned} &= \frac{1}{2} b \times h \\ &= 1 \times -6,8 \\ &= -6,8 \text{ m} \end{aligned}$$

Area under graph (up)

$$\begin{aligned} &= \frac{1}{2} b \times h = 0,05 \div 3,4 \\ &= 1,7 \text{ m} \end{aligned}$$

$$\Delta x = -6,8 \checkmark + 1,7 = 5,1 \text{ m} \checkmark \text{ down} \checkmark$$

(3)

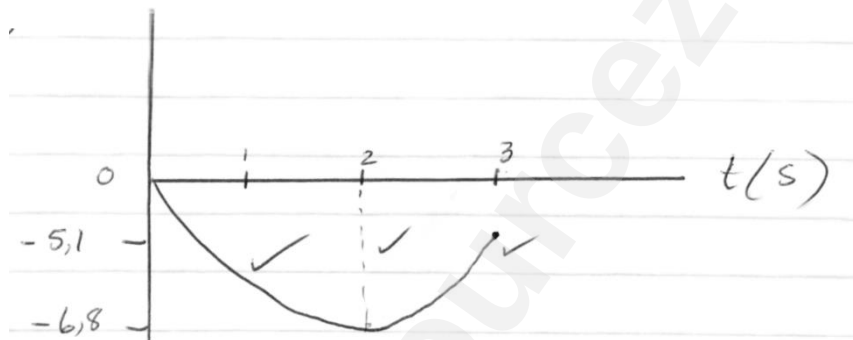
OR $V_f^2 = V_i^2 + 2a\Delta x \checkmark$

$$3,4^2 = (6,8)^2 + 2(-9,8)\Delta x \checkmark$$

$$x = 5,1 \text{ m down} \checkmark$$

(3)

2.3.5



(3)

Must use correct reference direction from original graph i.e. down was negative
Could draw graph from 10 m above water as point of reference – then bottom of curve at 3,2 m and end at 4,9 m down.

$$\begin{aligned} 2.3.6 \quad a = \text{gradient} &= \frac{\Delta v}{\Delta t} = \frac{0 - (-6,8)}{2 - 0} \checkmark \\ &= +3,4 \text{ m} \cdot \text{s}^{-2} \checkmark \end{aligned}$$

$$\text{OR } v_f = v_i + at$$

$$0 = -6,8 + a(2)$$

(2)

2.3.7 $T - Fg = ma \checkmark$

$$\begin{aligned} \therefore T &= \left(\frac{15}{9,8} \times 3,4 \right) + 15 \checkmark \\ &= 20,2 \text{ N} \checkmark \end{aligned}$$

(3)

2.3.8 $\Delta x = 10 - 5,1 = 4,9 \text{ m}$ (dir. is up, so is -)

$$\begin{aligned} V_f^2 &= V_i^2 + 2a\Delta x \checkmark \\ &= (3,4)^2 + 2(-9,8)(-4,9) \checkmark \\ &= 107,6 \end{aligned}$$

$$\therefore V_f = 10,37 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(3)

2.3.9 Newton's 3rd Law $\checkmark$ False $\checkmark$. They experience the same force $\checkmark$ as they exert the same force on each other.

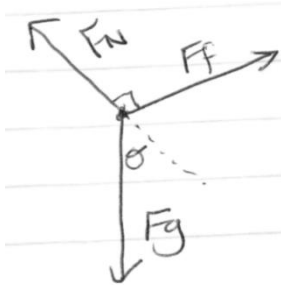
(3)

[44]

Question 3

3.1.1 An object continues in a state of rest ✓ or uniform velocity unless acted on by
✓ a net or resultant force. (2)

3.1.2

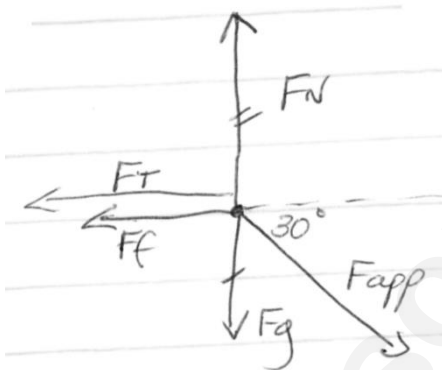


$\theta = 35,5^\circ$ ✓
 F_N = normal ✓
 F_f = friction ✓
 F_g = weight ✓

3.1.3 $F_f = F_g \parallel = mg \sin 35,5^\circ$
 $F_N = F_g \perp = mg \cos 35,5^\circ$ ✓

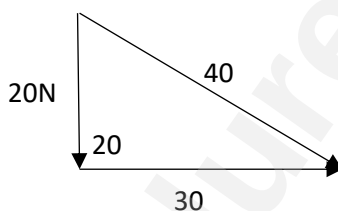
$$\mu_s = \frac{F_f}{F_N} = \frac{mg \sin 35,5^\circ}{mg \cos 35,5^\circ} \checkmark = 0,71 \quad \checkmark \quad (3)$$

3.2.1



F_{app} = applied force with correct angle
 $\theta = 30^\circ$ ✓
 F_N = normal ✓
 F_g = weight ✓
 F_t = tension ✓
 F_f = friction ✓
 $F_N > F_g$ ✓

3.2.2



$$F_n = \sin 30^\circ \times 40$$

$$F_N = 20 + \checkmark (2 \times 9,8)$$

$$= 39,6 \text{ N} \quad \checkmark$$

$$F_f = \mu_k \times F_N \checkmark = 0,25 \times 39,6$$

$$= 9,9 \text{ N} \quad \checkmark$$

3.2.3 $F_{net} = ma$
 4 kg
 $T - 9,8 = 4a$

$$T = 4a + 9,8$$

2 kg

$$\cos 30^\circ \times 40 \checkmark - 9,9 \text{ (coe from 3.2.2)} - T = 2a$$

$$24,74 - T = 2a$$

$$\therefore T = 24,74 - 2a$$

$$4a + 9,8 \checkmark = 24,74 - 2a \quad \checkmark$$

$$6a = 24,74 - 9,8$$

$$6a = 14,94$$

$$a = 2,49 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

$$\therefore T = 24,74 - 2(2,49)$$

$$= 19,76 \text{ N} \quad \checkmark$$

(5)
[24]

Question 4

4.1 The total linear momentum ✓ of an isolated system remains constant ✓ (2)

4.2 $p_{before} = p_{after}$

$$\begin{aligned} (0,3 \times 1,2) + (0,6 \times -1,8) &= (0,3 \times -2,8) + (0,6v) \\ 0,36 - 1,08 &= -0,84 + 0,6V \\ V &= 0,2 \text{ m} \cdot \text{s}^{-1} \end{aligned} \quad (3)$$

4.3 $Ek_{before} = \left(\frac{1}{2}mv^2\right)_P + \left(\frac{1}{2}mv^2\right)_Q$
 $= 0,15 \times (1,2)^2 + 0,3 \times (1,8)^2$
 $= 1,188 \text{ J}$

$$\begin{aligned} Ek_{after} &= 0,15 \times (2,8)^2 + 0,3 \times (0,2)^2 \text{ (coe from 4.2)} \\ &= 1,118 \text{ J} \\ \therefore Ek_{before} &= Ek_{after} \checkmark \therefore \text{elastic} \checkmark \end{aligned} \quad (4)$$

4.4 $F_{net} = m(vf - vi)$ OR
 $= \frac{0,3(-2,8-1,2)}{0,005}$ $\frac{0,6(0,2-(-1,8))}{0,005}$
 $= (-)240 \text{ N}$ $= 240 \text{ N}$ (3)

[12]**Question 5**

5.1.1 $(Ep + Ek)_{top} = (Ep + Ek)_p$
 $(5 \times 9,8 \times 5) + 0 = 0 + 2,5 \cdot V^2$
 $245 = 2,5V^2$
 $\therefore V = 9,9 \text{ m} \cdot \text{s}^{-1}$ (3)

5.1.2 No frictional force acting ✓ (PQ a frictionless surface) $\therefore$ no work done to overcome friction $\therefore$ no E lost $\therefore$ no change in Ek ✓ (2)

OR

PQ is a horizontal, frictionless ✓ surface $\therefore$ Ek not converted to Ep ✓

5.1.3 $Wf = \Delta Ek + \Delta Ep$
 $Ff \cdot \Delta x = \Delta Ek + \Delta Ep$
 $\checkmark - 18 \cdot \Delta x = (0 - 245 \checkmark) + 147 \checkmark$
 $\therefore \Delta x = \frac{-98}{-18}$
 $= 5,44 \text{ m}$ (4)

5.1.4 $\sin \theta = \frac{3}{5,44} \checkmark$
 $\therefore \theta = 33,47^\circ \checkmark$ (2)

$$5.2.1 \quad P = \frac{W}{t} \checkmark = \frac{\Delta Ep}{t} = \frac{12 \times 9,8 \times 3 \checkmark}{60 \checkmark} \\ = 5,88 \text{ W} \checkmark \quad (4)$$

$$5.2.2 \quad \% \text{ eff} = \frac{\text{output}}{\text{input}} \times 100 \\ = \frac{5,88}{8} \checkmark \times 100 = 73,5 \% \checkmark \quad (2)$$

[17]

Question 6

6.1.1 The force acting $\checkmark$ per unit mass $\checkmark$ (2)

$$6.1.2 \quad F = mg \checkmark \\ = 6,2 \times 10^{12} \times 2,2 \checkmark \\ = 1,36 \times 10^{13} \text{ N} \checkmark \quad (3)$$

$$6.1.3 \quad g = \frac{GM}{r^2} \checkmark \\ 2,2 = \frac{6,7 \times 10^{-11} \cdot M \checkmark}{(3,1 \times 10^6 + 2,4 \times 10^7)^2 \checkmark} \\ \therefore M = 2,41 \times 10^{25} \text{ kg} \checkmark \quad (4)$$

6.2.1



pattern $\checkmark$
arrows $\checkmark$
more lines on A $\checkmark$

(3)

$$6.2.2 \quad E_A = \frac{KQ_A}{r^2} = \frac{9 \times 10^9 \times 7 \times 10^{-9} \checkmark}{(0,03)^2 \checkmark} \\ = 70\,000 \text{ N} \cdot \text{C}^{-1} \checkmark (\text{left}) \\ E_B = \frac{KQ_B}{r^2} = \frac{9 \times 10^9 \times 4,5 \times 10^{-9}}{(0,03)^2} \\ = 45\,000 \text{ N} \cdot \text{C}^{-1} \checkmark (\text{right})$$

$$E_{\text{net}} = 70\,000 - 45\,000 \\ = 25\,000 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ left} \checkmark \quad (6)$$

6.2.3 Right $\checkmark \checkmark$ (2)

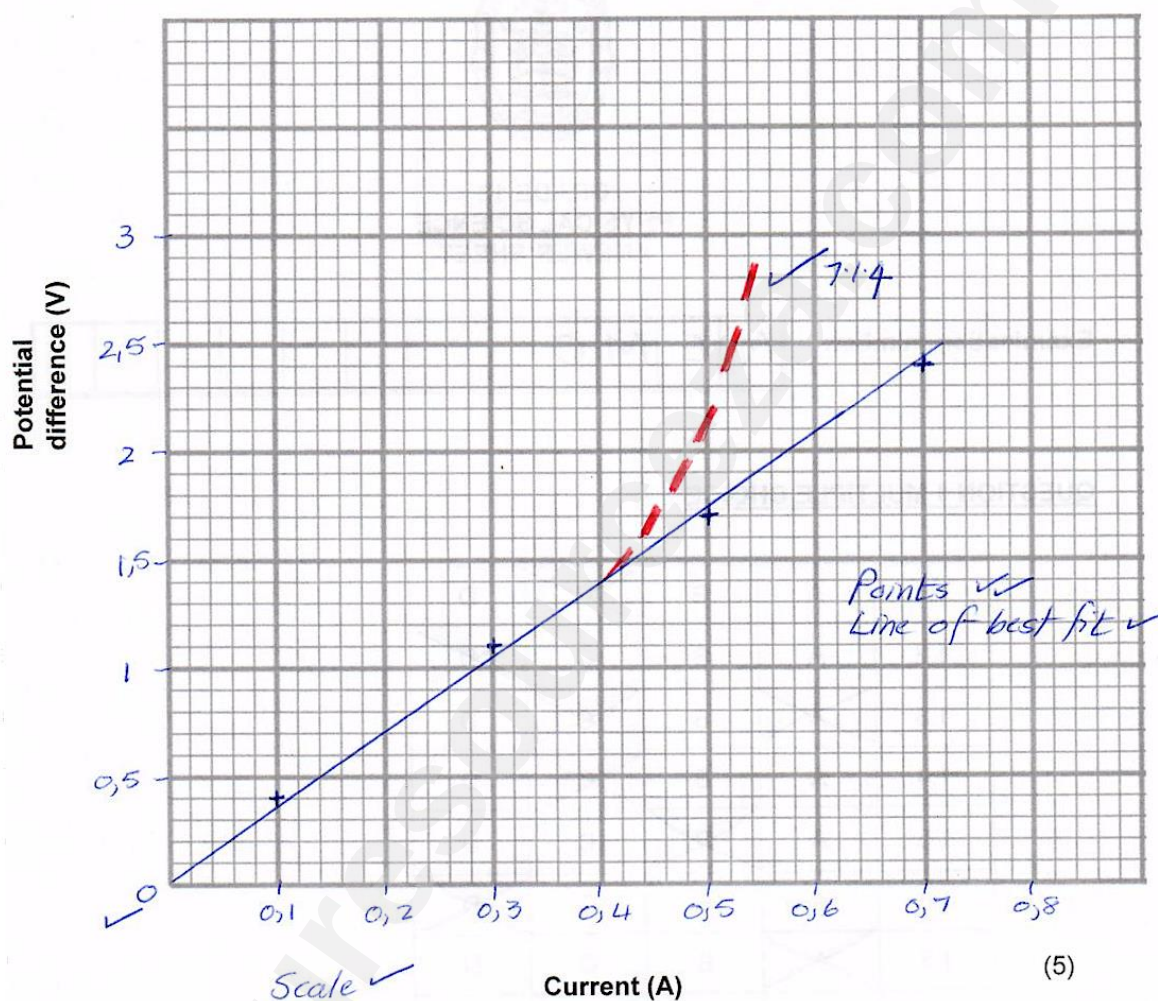
[20]

Question 7

7.1.1 Current through a conductor is directly proportional to the potential difference across the conductor at constant temperature ✓ (2)

7.1.2

Graph to show the relationship between potential difference and current through resistor R.



7.1.3 Resistance = gradient = $\frac{\Delta V}{\Delta I}$ ✓
 $= \frac{1.4 - 0.5}{0.4 - 0.14}$ ✓ (must use points on the line)
 $= 3.46 \Omega$ ✓ (3)

7.1.4 Answer sheet (above).

7.1.5 $t = \frac{Q}{I} = \frac{7.5}{0.5}$ ✓ = 150 s ✓ (3)

7.2.1 $EMF = I(R + r)$ ✓
 $12 = I(11 + 11)$ ✓
 $I = \frac{12}{22} = 0.55 A$ ✓ (3)

$$7.2.2 \quad \frac{1}{11} = \frac{1}{24} + \frac{1}{R} \checkmark$$

$$\frac{1}{R} = \frac{1}{11} - \frac{1}{24} = \frac{13}{264} \therefore R = \frac{264}{13} = 20,13 \, \Omega \checkmark \quad (3)$$

$$7.2.3 \quad V = IR$$

$$= 0,55 \times 11 \checkmark$$

$$= 6,05 \, V \checkmark \quad (2)$$

$$7.2.4 \quad P = VI \checkmark \quad \text{OR} \quad P = \frac{V^2}{R}$$

$$= 12 \times 0,55 \checkmark \quad = \frac{12^2}{22} = 6,55 \, W$$

$$= 6,55 \, W \checkmark \quad \text{OR}$$

$$P = I^2 R$$

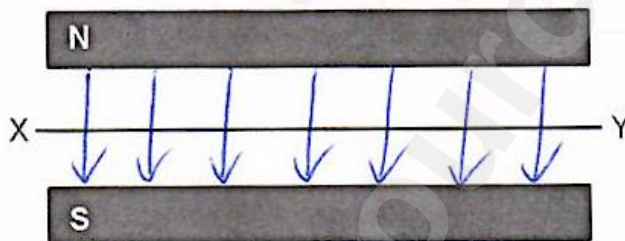
$$= (0,55)^2 \times 22$$

$$= 6,6 \, W \quad (3)$$

[26]

Question 8

8.1.1



(2)

8.1.2 X-Y $\checkmark$ (1)

8.2.1 The product of the number of turns on the coil and the flux through the coil $\checkmark\checkmark$ (2)

$$8.2.2 \quad emf = -N \frac{\Delta\phi}{\Delta t} \checkmark$$

- A louder sound means a greater current (more emf induced) $\checkmark$
- Can pluck the string faster $\checkmark$, so there is a greater rate of change $\checkmark$ of flux linkage. (4)

8.3 By connecting to an alternating current supply in the primary coil, there is a changing magnetic flux linkage $\checkmark$ in the secondary coil $\checkmark$ which induces a p.d $\checkmark$ in the secondary coil. (3)

8.4.1 A component that only allows current $\checkmark$ to flow in one direction $\checkmark$ (2)

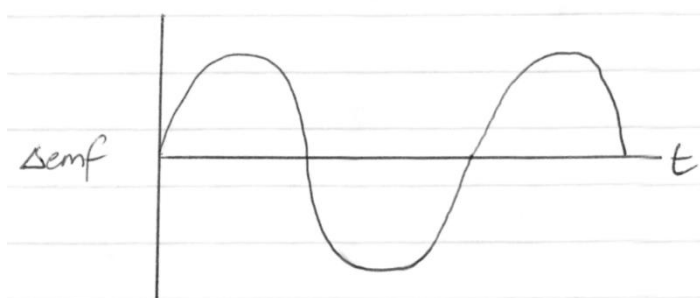
8.4.2 Converts AC $\checkmark$ to DC $\checkmark$ (2)

8.4.3 B $\checkmark$ and D $\checkmark$ (2)

8.4.4 $X \rightarrow Y$ ✓

(1)

8.4.5

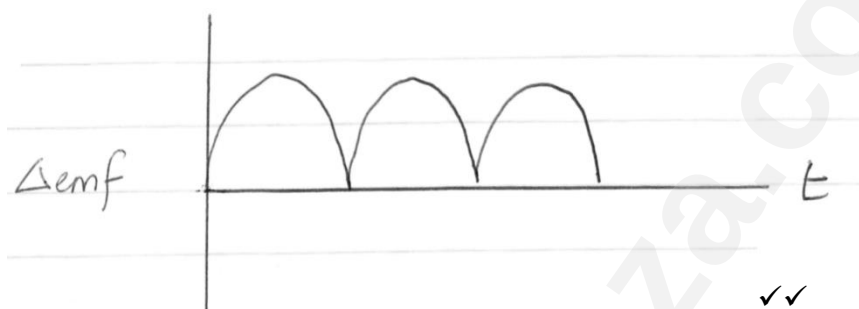


✓✓

These two must correlate with no. of cycles.

(2)

8.4.6



✓✓

(2)

[23]

Question 9

9.1 The minimum amount of energy ✓ needed to emit an electron from the surface of the metal ✓

(2)

9.2 $W_o = hf_o$ ✓
 $= 6,6 \times 10^{-34} \times 1,05 \times 10^{15}$ ✓
 $= 6,93 \times 10^{-19} \text{ J}$ ✓
 $\therefore$ metal $\times$ is zinc ✓

(4)

9.3 $E = W_o + Ek \text{ (max)}$

$$\therefore \frac{hc}{\lambda} = W_o + \frac{1}{2}mv^2$$

$$\frac{6,6 \times 10^{-34} \times 3 \times 10^8}{475 \times 10^{-9}} = W_o + \frac{1}{2}(9,1 \times 10^{-31}) \times (2,77 \times 10^5)^2$$

$$\therefore W_o = 4,17 \times 10^{-19} - 3,49 \times 10^{-20}$$

$$= 3,82 \times 10^{-19} \text{ J}$$

$\therefore$ metal is SODIUM ✓

(6)

9.4 i) no change ✓
 ii) increase ✓

(2)

[14]