



GTR 12
Physical Sciences
Prelim Physics
Aug 2020
Memo

1.1 C ✓✓

1.2 A ✓✓

1.3 C ✓✓

1.4 B ✓✓

1.5 A ✓✓

1.6 A ✓✓

$f_k \leftarrow \bullet \rightarrow F = 0,6 \quad a = 0$

1.7 ~~(A)~~ ✓✓

0,0833 g

1.8 B ✓✓

1.9 D ✓✓

1.10 C ✓✓

2.1 The impact velocity is directly proportional to the drop height. ✓✓

2.2. Impact velocity ✓

2.5 gradient = $\frac{\Delta v^2}{\Delta \text{height}}$
= $\frac{20-5}{106-25}$ ✓
= $\frac{15}{81}$
= $0,185 \frac{\text{m}^2 \cdot \text{s}^{-2}}{\text{cm}}$
= $18,5 \text{ m} \cdot \text{s}^{-2}$ ✓

points from line NOT table

2.6 $v_f^2 = 2a \Delta x$ height = Δx

$\therefore \text{gradient} = 2a$ ✓

$\therefore 2a = 18,5$ ✓
 $a = 9,25 \text{ m} \cdot \text{s}^{-2}$ ✓

2.7. The presence of air resistance. ✓

ANSWER SHEET

NAME: _____

MEMO

QUESTION 2.3

Data for investigation of impact velocity vs height		
Height of drop (cm)	Impact velocity (m.s ⁻¹)	v ² (m ² .s ⁻²)
20	2.0	4,0
40	2.7	7,3
60	3.4	11,6
80	4.0	16,0
100	4.3	18,5
120	4.7	22,1

✓✓

3.1.1 The rate of change of velocity. ✓✓

$$\begin{aligned} 3.1.2 \quad a &= \text{gradient} = \frac{\Delta v}{\Delta t} \quad \checkmark \\ &= \frac{3,2 - 0}{0,5 - 0} \quad \checkmark \\ &= 6,4 \text{ m.s}^{-2} \quad \checkmark \end{aligned}$$

OR

$$\begin{aligned} V_f &= V_i + a \Delta t \\ 3,2 &= 0 + a(0,5) \\ a &= 6,4 \text{ m.s}^{-2} \end{aligned}$$

$$3.1.3 \quad g_{\text{Earth}} = \frac{GM_E}{r_E^2} \quad \checkmark$$

$$\begin{aligned} g_x &= \frac{GM_x}{r_x^2} \quad M_x = \frac{1}{2}M_E \\ &= \frac{G \frac{1}{2}M_E}{r_x^2} \quad \checkmark \end{aligned}$$

$$\frac{g_E}{g_x} = \frac{\frac{GM_E}{r_E^2}}{\frac{\frac{1}{2}GM_E}{r_x^2}} \quad \frac{\frac{1}{r_E^2}}{\frac{1}{2r_x^2}}$$

$$\frac{9,8}{6,4} \checkmark = \frac{2r_x^2}{r_E^2}$$

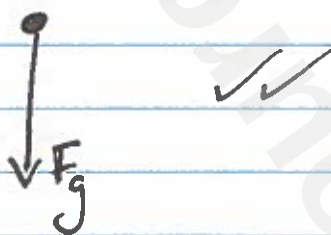
$$\frac{9,8}{2(6,4)} = \frac{r_x^2}{r_E^2}$$

$$\therefore \frac{r_x}{r_E} = 0,875 \quad \checkmark$$

3.1.4. $\Delta x = \frac{1}{2} b h$ ✓
 $= \frac{1}{2} (0,5)(3,2)$ ✓
 $= 0,8 \text{ m}$ ✓

OR $\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$
 $= \left(\frac{0 + 3,2}{2} \right) 0,5$
 $= 0,8 \text{ m}$

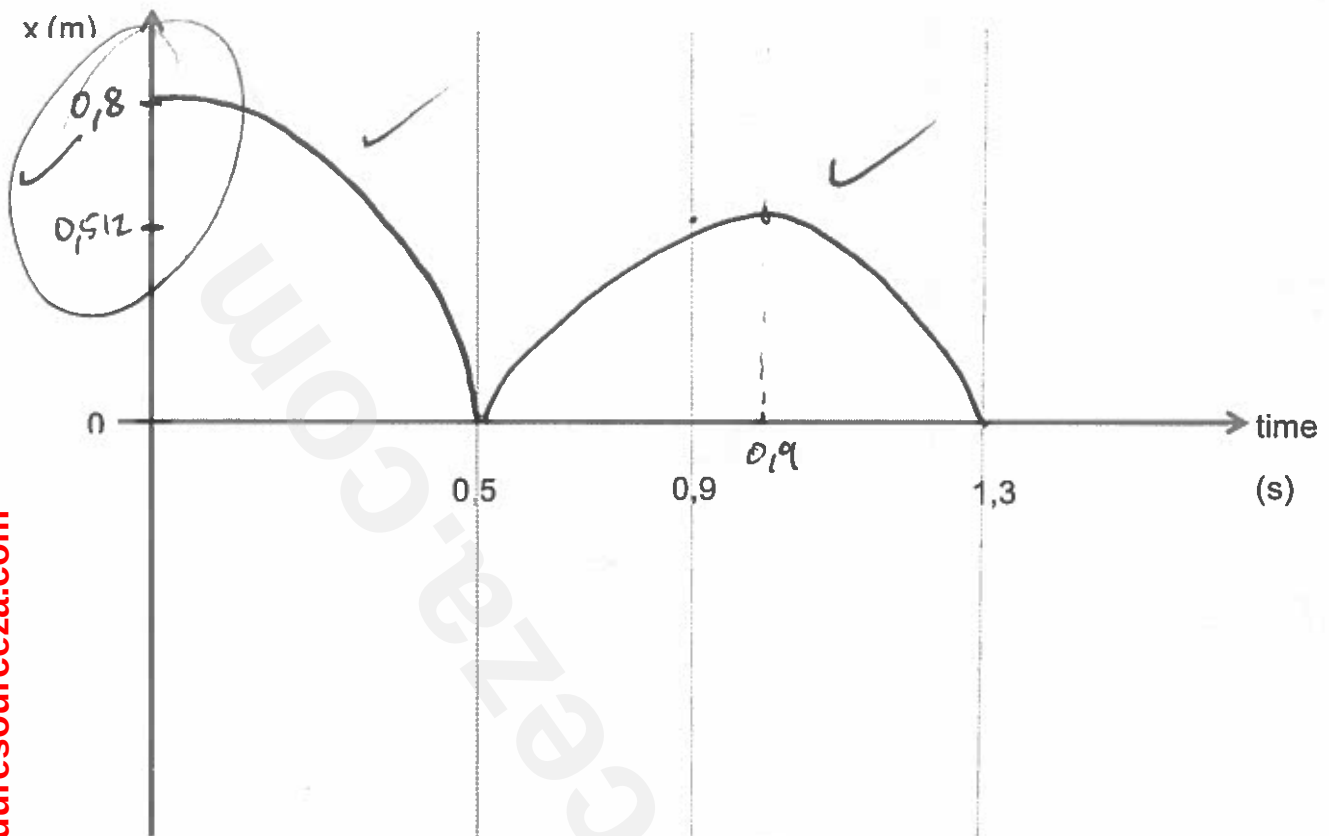
3.1.5



3.1.6. $2,56 \text{ m} \cdot \text{s}^{-1}$ ✓✓

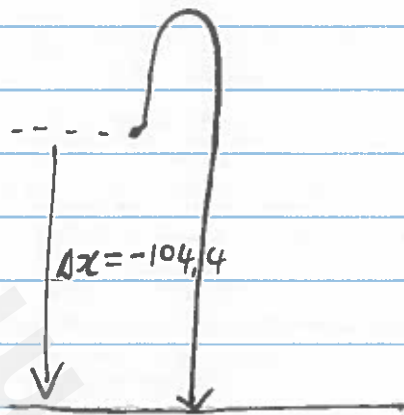
QUESTION 3.1.7

Position vs. time



$$\begin{aligned}\Delta x &= \frac{1}{2} b h \\ &= \frac{1}{2} (0.4) (2.56) \\ &= 0.512 \text{ m}\end{aligned}$$

3.2.1



$$g = -9,8$$

$$\Delta t = 6 \text{ s}$$

$$v_i = ?$$

$$\Delta x = v_i \Delta t + \frac{1}{2} g \Delta t^2 \quad \checkmark$$

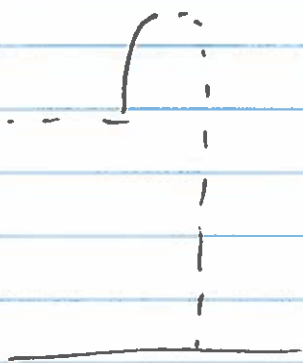
$$-104,4 \quad \checkmark = v_i (6) + \frac{1}{2} (-9,8) (6)^2 \quad \checkmark$$

$$v_i = 12 \text{ m.s}^{-1} \quad \checkmark$$

3.2.2

$$v_i = 12 \text{ m.s}^{-1}, \text{ upwards.} \quad \checkmark$$

3.2.3



$$v_i = 12$$

$$g = -9,8$$

$$v_f = 0$$

$$\Delta x = ?$$

$$v_f^2 = v_i^2 + 2a\Delta x \quad \checkmark$$

$$0 = (12)^2 + 2(-9,8)\Delta x \quad \checkmark$$

$$\Delta x = 7,35 \quad \checkmark$$

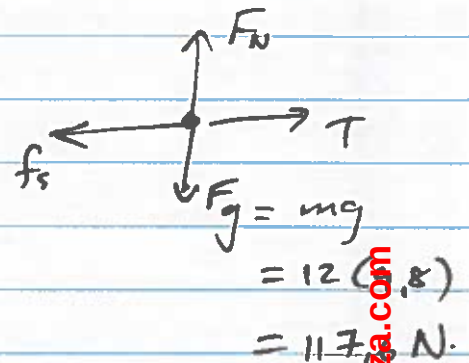
$$\therefore h_{\max} = 111,75 \text{ m} \quad \checkmark$$

$$\begin{aligned} 3.2.4 \quad \Delta x &= v_i \cdot \Delta t \quad \checkmark \\ &= 12 (6) \quad \checkmark \\ &= 72 \text{ m} \end{aligned}$$

$$h_{\text{balloon}} = 176,4 \text{ m} \quad \checkmark$$

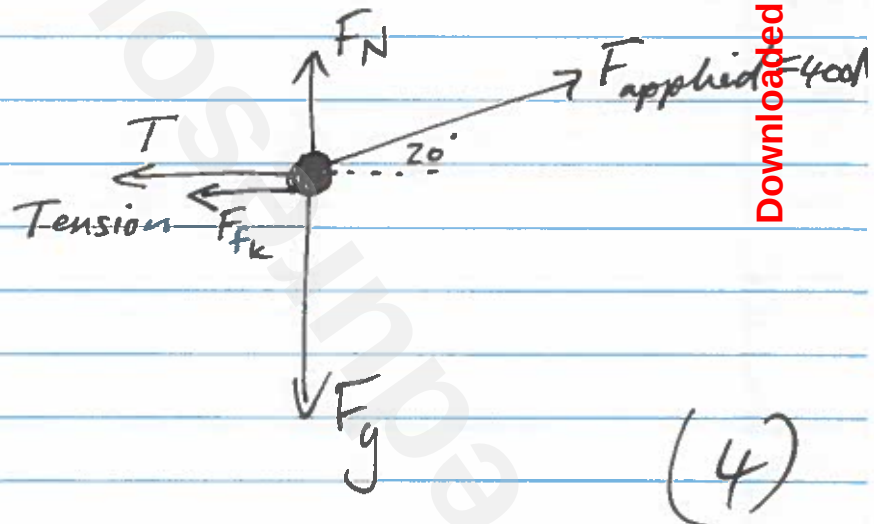
4.1 An object continues in a state of rest or uniform velocity unless it is acted upon by a net force. ✓✓

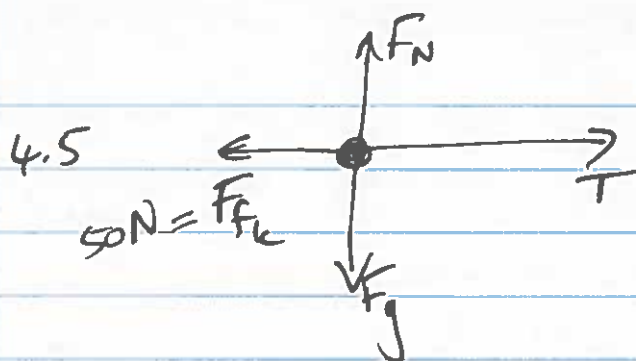
$$\begin{aligned} 4.2 \quad f_{s \max} &= \mu_s F_N \quad \checkmark \\ &= 0,7 (117,6) \quad \checkmark \\ &= 82,32 \text{ N} \quad \checkmark \end{aligned}$$



$$4.3 \quad T = 82,32 \text{ N} \quad \checkmark$$

4.4.





$$F_{\text{net}} = T - f_k \quad \checkmark$$

$$ma = T - 50$$

$$12a = T - 50 \quad \checkmark$$

$$12a + 50 = T$$

$$F_{\text{net}} = F \cos 20^\circ - T - f_k \quad \checkmark$$

$$ma = 400 \cos 20^\circ - T - 91,83$$

$$36a = 375,88 - T - 91,83$$

$$36a = 284,05 - T \quad \checkmark$$

$$T = 284,05 - 36a$$

$$12a + 50 = 284,05 - 36a$$

$$48a = 234,05$$

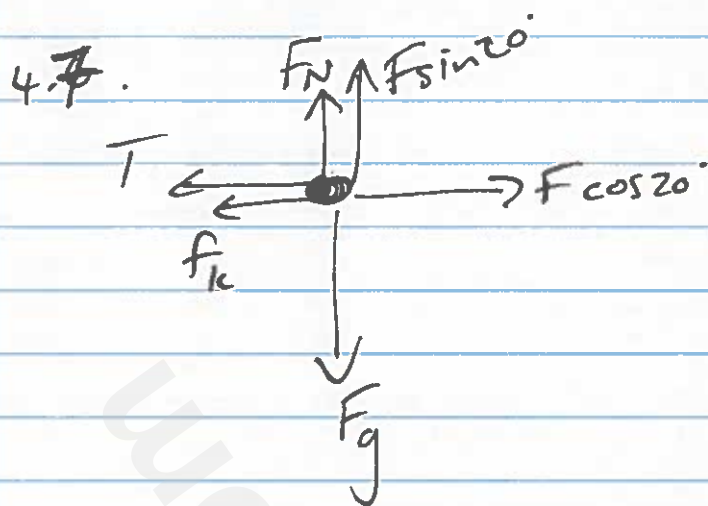
$$a = 4,88 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

$$T = 12(4,88) + 50$$

$$= 108,51 \text{ N} \quad \checkmark$$

4.6 Perpendicular force exerted by a surface on an object in contact with it.

✓✓



$$F_N + F \sin 20^\circ = F_g \quad \checkmark \quad (F_{\text{net vert}} = 0)$$

$$F_N + 400 \sin 20^\circ = mg$$

$$F_N + 136,81 = 36(9,8) \quad \checkmark$$

$$F_N = 215,99 \text{ N} \quad \checkmark$$

4.8

$$F_{f_k} = \mu_k F_N \quad \checkmark$$

$$91,83 = \mu_k (215,99) \quad \checkmark$$

$$\mu_k = 0,425 \quad \checkmark$$



$$m = 1,2$$

$$\boxed{Y}$$

$$V = 12,4$$

$$m = 0,5$$

$$\boxed{X}$$

$$V = 0$$



$$m = 1,2$$

$$\boxed{Y}$$

$$V = 5,8$$

$$m = 0,5$$

$$\boxed{X.}$$

$$V.$$

5.1

$$P_{tot i} = P_{tot f} \checkmark$$

$$m_Y V_{Yi} + m_X V_{Xi} = m_Y V_{Yf} + m_X V_{Xf}.$$

$$(1,2)(12,4) + 0 \checkmark = 1,2(5,8) + 0,5 V_{Xf} \checkmark$$

$$V_{Xf} = 15,84 \text{ m.s}^{-1}, \text{ East.} \checkmark$$

5.2 $\Delta p = m \Delta V$

$$= m_Y (V_{fy} - V_{iy}) \checkmark$$

$$= 1,2 (5,8 - 12,4) \checkmark$$

$$= -7,92$$

$$\therefore \Delta p_Y = 7,92 \text{ kg.m.s}^{-1}, \text{ West.} \checkmark$$

5.3 The net force on an object is equal to the rate of change in momentum of the object ✓

$$5.4 \quad F_{\text{net}} = \frac{\Delta p}{\Delta t} \quad \checkmark$$
$$= \frac{-7.92}{9.80 \times 10^{-3}} \quad \checkmark$$

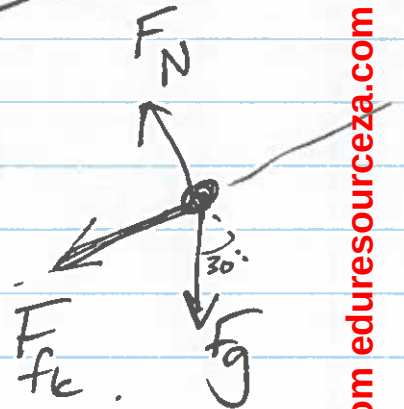
$$= -99$$

$$\therefore F_{\text{xy}} = 99 \text{ N, West} \quad \checkmark$$

6.1.1 The work done by the net force on an object is equal to the change in kinetic energy of the object ✓✓

$$\begin{aligned}
 6.1.2 \quad E_k &= \frac{1}{2}mv^2 \quad \checkmark \\
 &= \frac{1}{2}(500)(9,5)^2 \quad \checkmark \\
 &= \underline{\underline{22562,5 \text{ J}}} \quad \checkmark
 \end{aligned}$$

6.1.3



$$W_{\text{net}} = \Delta E_k \quad \checkmark$$

$$W_{F_g} + W_f + W_N = \Delta E_k$$

$$-\Delta E_p + W_f + 0 = E_{kf} - E_{ki}$$

$$-(E_{pf} - E_{pi}) + W_f = \underline{\underline{0 - 22562,5}} \quad \checkmark$$

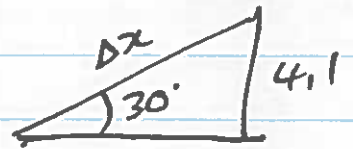
$$-mgh_f + W_f = -24010$$

$$\begin{aligned}
 &\underline{\underline{- (500)(9,8)(4,1) + W_f}} \quad \checkmark = -24010 \\
 &\underline{\underline{-20090 + W_f}} = -24010
 \end{aligned}$$

$$\begin{aligned}
 W_f &= -\underline{\underline{3920 \text{ J}}} \quad \checkmark \\
 &\quad -2472,5 \text{ J}
 \end{aligned}$$

6.1.4

$$W_f = F_f \cdot \Delta x \cdot \cos \theta \quad \checkmark$$



$$-\frac{3920}{2472,5} \checkmark = F_f \cdot 8,2 \cos 180^\circ \checkmark$$

$$\sin 30^\circ = \frac{4,1}{\Delta x}$$

$$F_f = \frac{301,52}{478,05} \text{ N} \quad \checkmark$$

$$\Delta x = \frac{4,1}{\sin 30}$$



$$= 8,2 \text{ m}$$

6.2.1 $E_p = mgh$

$$= 1 (9,8) (120)$$

$$= 1176 \text{ J} \quad \checkmark$$

$$E_k = 0,4 E_p \quad \checkmark$$

$$\frac{1}{2} m v^2 = 0,4 (1176) \quad \checkmark$$

$$\frac{1}{2} (1) v^2 = 470,4$$

$$v = 30,67 \text{ m.s}^{-1}$$

6.2.2 $\text{efficiency} = \frac{P_{\text{out}}}{P_{\text{in}}} \quad \checkmark$

$$0,8 = \frac{110 \text{ kW}}{P_{\text{in}}}$$

$$P_{\text{in}} = 137,5 \text{ kW} \quad \checkmark$$

In one second:

$$\begin{aligned}W_{in} &= P_{in} \Delta t \\&= (137500)(1) \\&= 137500 \text{ J} \checkmark \text{ of } E_k \text{ in @ wheel.}\end{aligned}$$

$$E_k, \text{ kg of water} = 470,4 \text{ J}$$

$$\frac{137500}{470,4}$$

$$\therefore m = 292,3 \text{ kg} \checkmark \text{ of water reaches wheel per second.}$$

$$\text{OR. } W = P \Delta t \checkmark$$

$$W = 110\,000 \text{ (1)}$$

$$= 110\,000 \text{ J per second.} \checkmark$$

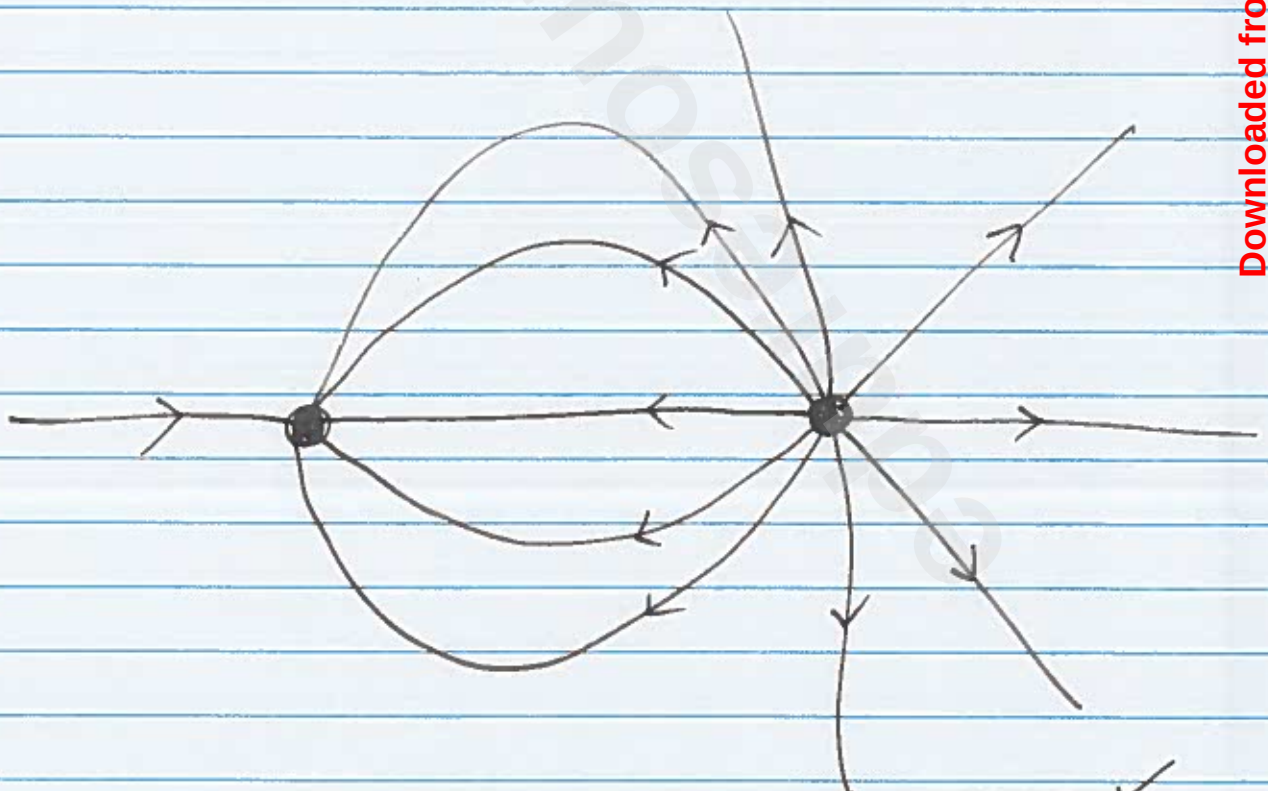
$$80\% \text{ of } 470,4 \text{ J of } E_k$$

$$= 376,32 \text{ J. per kg.} \checkmark$$

$$\frac{110\,000 \text{ J.s}^{-1}}{376,32 \text{ J.kg}^{-1}} = 292,3 \text{ kg.s}^{-1} \checkmark$$

7.1.1 A region of space where an electric charge will experience a force. ✓✓

7.1.3. Two point charges in free space or air exert forces on each other. ✓
The force is directly proportional to the product of the charges and ✓
inversely proportional to the square of the distance between the charges. ✓



pattern shape ✓
direction ✓
more lines (right)

7.1.4.

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \frac{(9 \times 10^9)(4 \times 10^{-9})(9 \times 10^{-9})}{(0,08)^2} \checkmark$$

$$= 5,06 \times 10^{-5} \text{ N, right} \checkmark$$

7.2 $E_{@P \text{ due to B}} = \frac{kQ_B}{r^2} \checkmark$

$$= \frac{(9 \times 10^9)(28 \times 10^{-12})}{(0,012)^2} \checkmark$$

$$= 1750 \text{ N.C}^{-1} \text{ down.}$$

$$E_{\text{net}} = E_B - E_A \checkmark$$

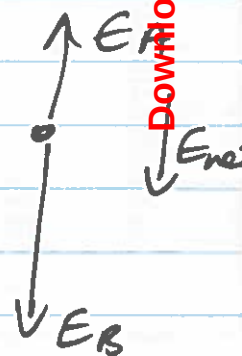
$$805 = 1750 - E_A$$

$$E_A = 945$$

$$\frac{kQ_A}{r^2} = 945$$

$$\frac{9 \times 10^9 Q_A}{(0,02)^2} = 945 \checkmark$$

$$\therefore Q_A = -4,2 \times 10^{-11} \text{ C} \checkmark$$



Gr 12

Physics.

Definitions & Laws.

UNITS

DIRECTIONS.

Write formula — use data sheet.

Start each Q on new page
↳ leave space.

8.1 Total energy supplied per coulomb of charge by the battery. ✓

8.2 13 V ✓

8.3.1 $I = \frac{V}{R}$ ✓

$$= \frac{10,5}{5,6} \quad \checkmark$$

$$= 1,875 \text{ A} \quad \checkmark$$

8.3.2. $\text{emf} = I (R_{\text{ext}} + r)$ ✓

$$13 = 1,875 (5,6 + r) \quad \checkmark$$

$$r = 1,33 \, \Omega \quad \checkmark$$

8.3.3. $W = I^2 r \Delta t$ ✓

$$= (1,875)^2 (1,33) (120) \quad \checkmark$$

$$= 561,1 \text{ J} \quad \checkmark$$

$$\text{or } W = \frac{V_{\text{int}}^2}{r} \Delta t$$

$$= \frac{(2,5)^2}{1,33} (120)$$

$$= 563,91 \text{ J}$$

$$564,1 \text{ J}$$

8.4.1 R_{ext} decrease ✓

I increase ✓ (given)

✓ V_{int} increase $V_{int} = I \cdot r$ (r is constant)

✓
$$\begin{cases} V_{ext} = \text{emf} - V_{int} \\ \therefore V_{ext} \text{ decrease.} \end{cases} \quad \text{emf is constant}$$

~~8.4.2. $\text{emf} = I (R_{ext} + r)$~~

~~$13 = 4 (R_{ext} + 1,33)$ ✓~~

~~$R_{ext} = 1,92$ ✓~~

~~$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$~~

~~$\frac{1}{1,92} = \frac{1}{2x} + \frac{1}{5,6}$ ✓~~

~~$x = 1,46 \Omega$ ✓~~

8.4.2

$$\begin{aligned} V &= IR \\ &= (1,75)(5,6) \\ &= 9,8 \text{ V} \end{aligned}$$

$$\text{emf} = V_{\text{ext}} + V_{\text{int}}$$

$$13 = 9,8 + V_{\text{int}}$$

$$V_{\text{int}} = 3,2$$

$$I_r = 3,2$$

$$I(1,33) = 3,2$$

$$I = 2,406 \text{ A}$$

$$I_{2x} = \frac{V}{R}$$

$$(2,406 - 1,75) = \frac{9,8}{R}$$

$$0,656 = \frac{9,8}{R}$$

$$R = 14,94 \Omega$$

$$2x = 14,94 \Omega$$

$$x = 7,47 \Omega$$

9.1.1 Anti clockwise ✓✓

9.1.2 It changes the direction of the current in the coil every half rotation. ✓✓

This allows the coil to always experience torque in the same direction.

9.1.3 $F = BIl \sin \theta$. ← must show

Increase the magnetic field strength B ✓

Increase the current I ✓

Increase the number of turns of wire in the coil, this will increase l ✓

$$9.2.1 \quad \frac{V_s}{V_p} = \frac{N_s}{N_p} \quad \checkmark$$

$$\frac{6}{240} = \frac{N_s}{8000} \quad \checkmark$$

$$N_s = 200 \quad \checkmark$$

$$9.2.2 \quad P = VI \quad \checkmark$$

$$= (240)(0,05) \quad \checkmark$$

$$= 12 \text{ W} \quad \checkmark$$

$$9.2.3 \quad \text{efficiency} = \frac{P_{\text{out}}}{P_{\text{in}}}$$

$$0,85 = \frac{P_{\text{out}}}{12}$$

$$P_{\text{out}} = 10,2 \text{ W} \quad \checkmark$$

$$VI = 10,2$$

$$6I = 10,2$$

$$I = 1,7 \text{ A} \quad \checkmark$$



9.3.1 The emf induced is directly proportional to the rate of change of magnetic flux. ✓✓

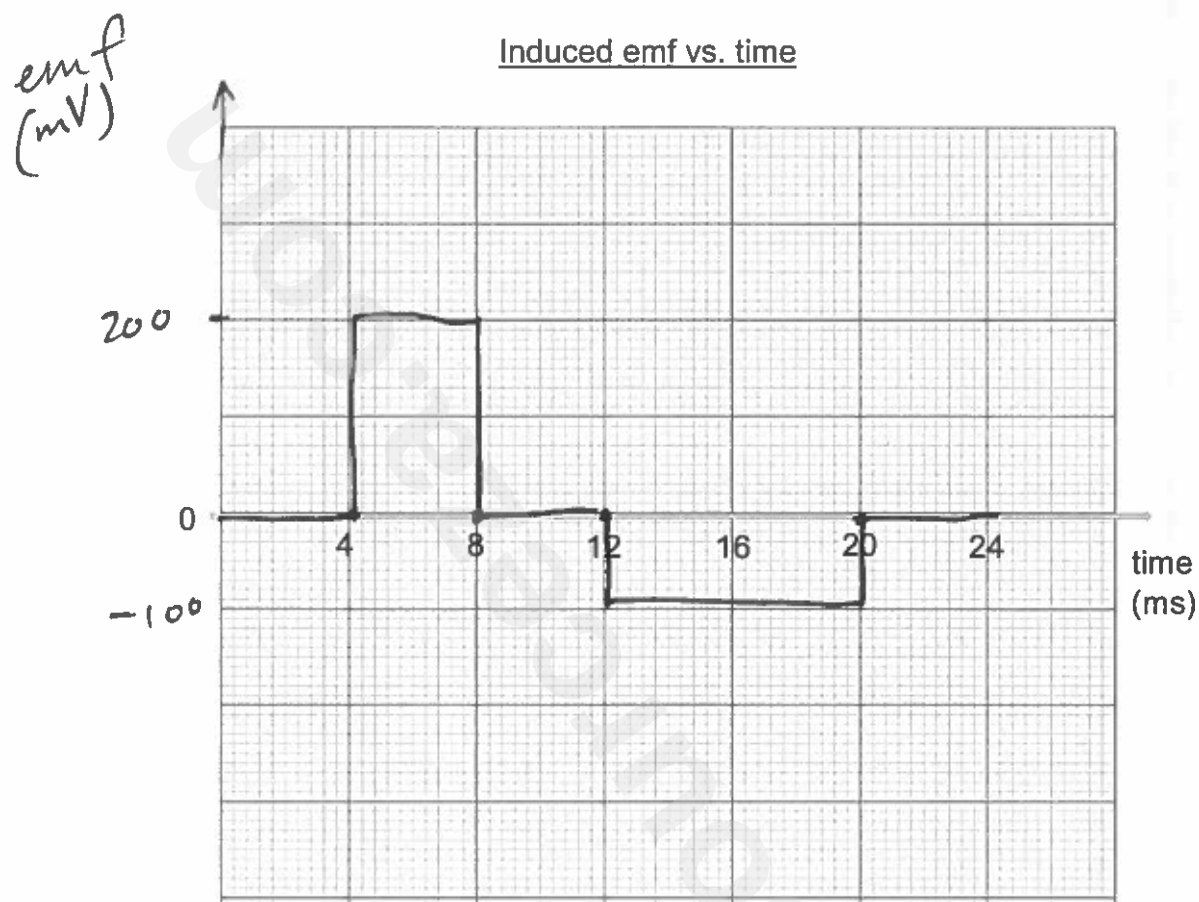
9.3.2 The current in the primary coil causes a magnetic field around the coil. There is magnetic flux through the secondary coil. ✓

When the current in P changes it causes a change in the magnetic flux through S which induces an emf in S according to Faraday's Law. ✓

ANSWER SHEET

NAME: Memo

QUESTION 9.3.3

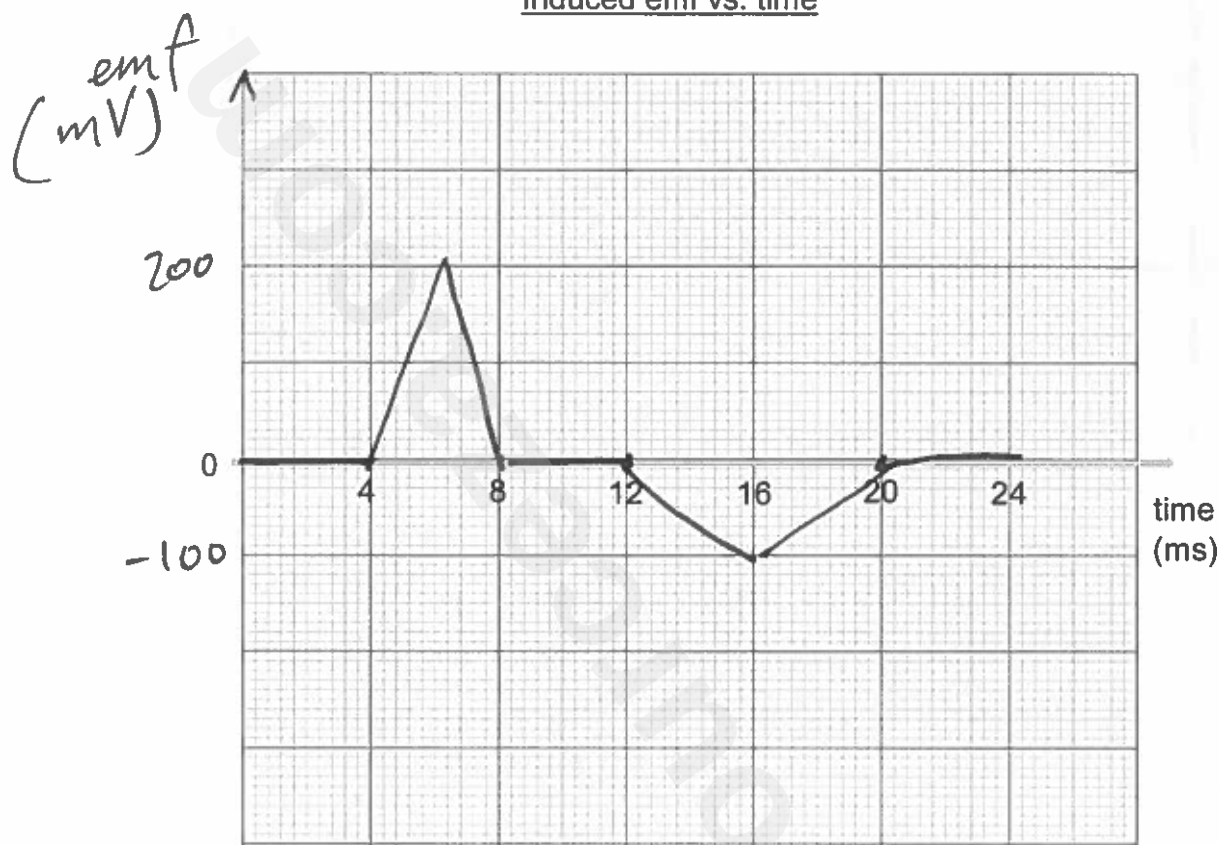


ANSWER SHEET

NAME: Memo

QUESTION 9.3.3

Induced emf vs. time



10.1 Infrared ✓

$$\begin{aligned} 10.2 \quad E_{\text{photon}} &= -1,51 - (-13,6) \\ &= 12,09 \text{ eV} \quad \checkmark \\ &= 1,9344 \times 10^{-18} \text{ J} \end{aligned}$$

$$\begin{aligned} E &= \frac{hc}{\lambda} \quad \checkmark \\ 1,9344 &= \frac{(6,6 \times 10^{-34})(3 \times 10^8)}{\lambda} \end{aligned}$$

$$\lambda = 1,02 \times 10^{-7} \text{ m} \quad \checkmark$$

10.3 Minimum amount of energy needed to emit an electron from the surface of caesium ✓✓

$$\begin{aligned} 10.4 \quad W_0 &= hf_0 \quad \checkmark \\ &= 6,6 \times 10^{-34} (5,1 \times 10^{14}) \quad \checkmark \\ &= 3,37 \times 10^{-19} \text{ J} \quad \checkmark \end{aligned}$$

$$10.5 \quad 2,1 \text{ eV} \quad \checkmark$$

$$10.6 \quad E = W_0 + E_k \quad \checkmark$$

$$12,1 = 2,1 + E_k$$

$$1,936 \times 10^{-18}$$

$$3,36 \times 10^{-19}$$

$$10 \text{ eV} = E_k$$

$$1,6 \times 10^{-18} = \frac{1}{2} m v^2$$

$$1,6 \times 10^{-18} \checkmark = \frac{1}{2} (9,1 \times 10^{-31}) v^2 \checkmark$$

$$v = 1,88 \times 10^6 \text{ m.s}^{-1} \checkmark$$