

**ZIMBABWE SCHOOL EXAMINATIONS COUNCIL**  
General Certificate of Education Advanced Level

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**MARKING SCHEME**

**JUNE 2013**

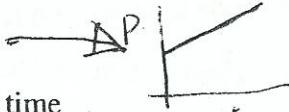
**PHYSICS**

**9188/5**

- 1 (a) (i)  $PV = nRT$   
 $\backslash \text{Volume}$   
 $n = \text{Number of moles}$   
 $R = \text{Universal gas constant}$   
 $T = \text{Temperature}$
- $\} 5 \text{ for 1 mark}$  B1
- (ii)  $T = \frac{mc^2}{3k} = \frac{32 \times 1.66 \times 10^{-27} \times (590)^2}{3 \times 1.38 \times 10^{-23}}$   $\Rightarrow \cancel{\frac{1}{2} m c^2} = 3NkT$  C1
- $= \underline{\underline{447 \text{ K}}}$
- (iii) Not valid / reliable / ~~not~~ realistic  
 equation valid for a very large number of molecules not one M1
- $T = \frac{m c^2}{3 N k}, N = 1$  A1  
 A1
- (b) (i)  $I_{400} = \frac{8}{400} = 0.02 \text{ A}$   $\Rightarrow I_{R_2} = \frac{E}{R_2}$  C1
- $I_V = \frac{8}{2000} = 0.004 \text{ A}$   $I_V = \frac{E}{R_V}$
- $V_{1600} = 1600 \times 0.024 = 38.4 \text{ V}$   $V_{R_2} = (I_{R_1} + I_{R_2}) R_2 = \underline{\underline{38.4 \text{ V}}}$  C1
- $E = 8 * 38.4 = 46.4 \text{ V}$  Potential divider A1
- (ii) Ohm's law obeyed  
 wire has zero resistance B1  
 constant temperature B1
- B1  
 [3 max 1]
- (c) (i)  $F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}$  terms explained A/W  
 ref to point charges / charges for centers of charges B1
- (ii) Electrostatic - attractive or repulsive (micro-particles) B1  
 Gravitational - attractive always (macro-bodies) B1
- (iii)  $F = \frac{-(1.6 \times 10^{-19})^2}{4\pi 8.85 \times 10^{-12} \times (10^{-10})^2} = \frac{+ (Q_p) (Q_p)}{4\pi \epsilon_0 r^2} \checkmark$  C1
- $= \underline{\underline{-2.3 \times 10^{-8} \text{ N}}}$  A1

- (d) (i) laminated core - reduce eddy currents  
 soft iron - reduces magnetic leakage / hysteresis  
 high conductivity (copper wire) - low resistance ✓ B2

- (ii) same as in primary coil  B1

- (e) (i) probability of decay per unit time  B1 ✓

$$t = \frac{1}{2} \text{ days} = 24 \times 3.5 \times 3600 \quad \text{Identify symbols: } \lambda = \frac{\ln 2}{t_1} \quad \text{at.} \quad \text{Q}$$

$$N = N_0 e^{-\lambda t} \quad \lambda = \frac{\ln 2}{t_1} \quad H = \frac{N_0}{N_A} C_i \quad \text{Q}$$

$$N = \frac{6.0 \times 6.02 \times 10^{23}}{220} e^{-\frac{\ln 2}{55.7} \times 302400}$$

- (iii) Short half-life: needs continuous replacement - A1 ✓

: poses less risk to health B1 { 1 ✓

etc [max B1]

Long half life: provides constant radiation for long B1 { 1 ✓

: danger of constant exposure etc B1

[max 1]

- 2 (a) (i) fusion : (small) nuclei combine to form a (more stable one)  $A\omega$   
 fission : split of (heavy) unstable nuclei (to small and) more stable nuclei  $/A\omega$  B1 B1
- (ii) High binding energy per nucleon means more stable.  
 The fission / fusion tends to produce nuclei of high BE per nucleon Stable B1
- (iii)  $X = 36$   
 $Y = 3$
- { 1 -  $O_{16}$   
 } —  $Fo(2) A_1$
- (iv) neutron has no charge so can reach the nucleus B1 ~~MITAO~~
- (v) Mass difference =  $235.044 + 1.009 - (143.073 + 89.080 + 3(1.009))$  C1  
 $= 0.873u$

$$\begin{aligned} \text{Energy} &= \frac{0.873u}{1u} \times 931 \text{ MeV} \\ &= 812.8 \text{ MeV} \end{aligned}$$

C1

A1

 $W = QV$ 

$$\begin{aligned} 1 \text{ eV} &= 1.6 \times 10^{-19} \text{ J} \\ 1 \text{ e} &= 1.6 \times 10^{-19} \text{ C} \\ 1 \text{ V} & \end{aligned}$$

- (b) (i) Thermal energy used to heat water to steam. B1
- The steam drives the turbines B1
- (ii) Advantage:
- production causes lower pollution than coal  
Q-value is high B1
  - Disadvantages
  - expensive to construct (so can't afford) B1
  - problems associated with disposal of waste B1
  - etc
- [max B1]

- (a) LED converts electrical to light whereas a buzzer converts electrical to sound energy

B1

- (b) - for no saturation

B1

- potential at inverting should be equal to that at non-inverting

B1

- non-inverting is earthed so inverting should be at earth potential

B1

$$(c) (i) 1. V_i = \frac{-R_i V_o}{R_o} = \frac{-V_o}{A}$$

$$\zeta_1 = \frac{V_o}{V_i} = -\frac{R_f}{R_i}$$

$$= \frac{-3.20}{10 \times 10^6} \times 10 \times 10^3$$

$$V_i = -\frac{V_o \zeta_1}{R_f}$$

C1

$$= -3.2 \times 10^{-3} \text{ V}$$

A1

$$(-3.2 \text{ mV})$$

$$2. \frac{130}{100} = \frac{V_{130} - V_o}{V_{100} - V_o}$$

$$\Delta \theta = \frac{X_{130} - X_o}{X_{100} - X_o} \times 100\% \\ (\Delta \theta = \frac{V_{130} - V_o}{V_{100} - V_o} \times 100\%)$$

$$V_{130} = \frac{130 \times 3.20}{100}$$

C1

$$= 4.16 \text{ V}$$

A1

- (ii) - In Fig. 3.1 it amplifies the small input p.d. across thermocouple

B1

- Voltage follower gives output equal to input

B1

- Small p.d. input for voltage follower would require a very sensitive voltmeter

B1

4 (a)  $Av = \text{constant}$   
terms explained

B1

B1

B1

B1

B1

B1

C1

C1

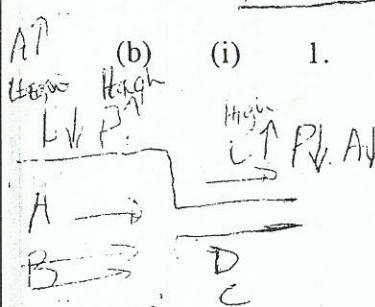
C1

C1

A1

A1

B1



(b) (i) 1. liquid at wider part has low speed (A)  $\rightarrow$  (B)

$\therefore$  has high pressure associated with it } B1

liquid at narrow part has high speed } D K B1

$\therefore$  has low pressure associated with it } B1

$$2. P_1 - P_2 = 0.30 \times 13600 \times 9.81 = h\rho g = \frac{1}{2} \rho (v_1^2 - v_2^2)$$

$$V_2 = \frac{A_1 V_1}{A_2} = \frac{r_1^2 V_1}{r_2^2}$$

$$A_1 V_1 = A_2 V_2$$

$$\pi r_1^2 v_1 = \pi r_2^2 v_2$$

$$r_2 = \frac{r_1 v_1}{v_2}$$

$$40024.8 = \frac{1}{2} \times 1000 \times 100 \left( \frac{(5.25 \times 10^{-2})^2}{r_2^2} - 1 \right)$$

$$\text{diameter} = \underline{\underline{\frac{9.06 \times 10^{-2}}{3.56 \times 10^{-2}} \text{m}}}$$

(ii) This increases the speed of water at nozzle

A larger area can be covered

$$\Delta P = \rho g h = \frac{1}{2} \rho (v_1^2 - v_2^2) \quad \dots \quad (1)$$

$$A_1 V_1 = A_2 V_2 \quad \dots \quad (2) \quad A = \pi \left( \frac{d}{2} \right)^2$$

$$\pi \left( \frac{d}{2} \right)^2 V_1 = \pi \left( \frac{d}{2} \right)^2 V_2$$

$$d_2 = 2r_2 = 2 \frac{r_1 v_1}{\sqrt{v_1^2 - 2gh}}$$

$$= 2 \cdot \left( \frac{10.5}{2} \right)^2 \cdot 10 \text{ m/s}$$

$$\frac{d_2^2 V_1}{A} = \frac{d_2^2 V_2}{A} \quad \text{but } V_2^2 = V_1^2 - 2gh$$

$$d_2^2 = \frac{d_1^2 V_1^2}{V_2^2}$$

$$= \frac{d_2^2 V_1}{V_1^2 - 2gh}$$

$$= \frac{(0.105)^2 \cdot 10}{10^2 - 2 \cdot 10 \cdot 0.3}$$

$$= 0.170 \text{ m}^2$$

Check

(a) existence of charge in integral multiples of a basic charge. / A w

B1

(b) (i) Stoke's law  $\left( 6\pi\eta rv = \frac{4}{3}\pi r^3 \delta g \right)$

B1

With no electric field one drop is timed on a number of division on a scale in the microscope at terminal velocity (v) determine terminal velocity v.

B2

B1

(ii)  $EQ = mg$   $F_g - F_e = 0$  hence find  $r$   
 $E_{ne} = mg$   
 $\frac{1400}{0.014} \times Q = 4.9 \times 10^{-15} \times 9.81$   $n = \frac{mg}{Ee}$

C1

$Q = 4.8669 \times 10^{-19} \text{ C}$

C1

number of electrons  $\frac{4.8}{1.6} = 3$

A1

(iii) upthrust not negligible / drag force  $\exists$   
more electric field needed to stop the drop

B1

M1

(c) Highest common factor  $\textcircled{\times}$

C1

$2.2 \times 10^{-19} \text{ C}$

A1