ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

JUNE 2013

PHYSICS

9188/5

1 (a) (i) $PV = nRT$

Volume
Pressure

n = Number of moles
R = Universal gas constant
T = Temperature

} 5 for 1 mark — B1

(ii) $T = \frac{mc^2}{3K} = \frac{32 \times 1.66 \times 10^{-27} \times (590)^2}{3 \times 1.38 \times 10^{-23}}$ — $\Rightarrow \frac{1}{2}m\langle c^2\rangle = \frac{3}{2}NkT$ — C1

= 447 K ; $T = \frac{m\langle c^2\rangle}{3Nk}$; N = 1 — A1

(iii) Not valid / reliable / Not realistic — A1

equation valid for a very large number of molecules not one — M1

(b) (i) $I_{400} = 8/400 = 0.02$ A — $\Rightarrow I_{R_1} = \frac{V_R}{R_1}$ — C1

$I_V = 8/2000 = 0.004$ A — $I_V = \frac{V_R}{R_V}$

$V_{1600} = 1600 \times 0.024 = 38.4$ V — $V_{R_2} = (I_{R_1} + I_{R_V}) R_2 = 38.4V$ — C1 } C2

$E = 8 + 38.4 = 46.4$ V — Potential divider — A1

(ii) Ohm's law obeyed — B1

(R) negligible r_i (given)

wire has zero resistance — B1

constant temperature — B1

[3 max 1]

(c) (i) $F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}$ terms explained A/W — B1

ref to point charges / for charges ref to centers of charges

(ii) Electrostatic – attractive or repulsive btwn +ves + –ves (micros particles) — B1

Gravitational – attractive always (macro – bodies meso –) } (R) — B1

(iii) $F = \frac{-(1.6 \times 10^{-19})^2}{4\pi 8.85 \times 10^{-12} \times (10^{-10})^2} = \frac{+Q_e Q_p}{4\pi\varepsilon_o r^2}$ ✓ — C1

$= -2.3 \times 10^{-8}$ N — A1

(d) (i) laminated core – reduce eddy currents — B2

high conductivity copper wire – low resistance — B2

(ii) same as in primary coil — B1

(e) (i) probability of decay per unit time — B1

(ii) $3\frac{1}{2}$ days $= 24 \times 3.5 \times 3\,600$

$$N = \frac{6.0 \times 6.02 \times 10^{23}}{220} e^{-\frac{\ln 2}{55.7} \times 302\,400}$$ — C1

$= 0$ — A1

(iii) Short half-life: needs continuous replacement — B1

: poses less risk to health — B1

etc — [max B1]

Long half life: provides constant radiation for long — B1

: danger of constant exposure etc — B1

[max 1]

2 (a) (i) *fusion* : (small) nuclei combine to form a (more stable one) AW

fission : split of (heavy) unstable nuclei (to small and) more stable nuclei) / AW B1 B1

(ii) High binding energy per nucleon means more stable

The fission / fusion tends to produce nuclei of high BE per nucleon B1

Stable

(iii) X = 36

Y = 3

1 – other — for (2) A1

(iv) neutron has no charge so can reach the nucleus B1 ~~M1A0~~

(v) Mass difference = 235.044 + 1.009 – (143.073 + 89.080 + 3(1.009)) C1

= 0.873u

Energy = $\frac{0.873\text{ u}}{1\text{ u}} \times 931\text{ MeV}$ C1

= 812.8 MeV A1

W = QV.

↓

1eV = 1,6 × 10^{-19} J

1e = 1,6 × 10^{-19} C,

1V

(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 B1

Q – value is high

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 where as 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. $V_i = \frac{-RiV_o}{R_O} = \frac{-V_o}{A}$

$= \frac{-3.20}{10 \times 10^6} \times 10 \times 10^3$ — C1

$= -3.2 \times 10^{-3}\,V$ — A1

(= −3.2 mV)

2. $\frac{130}{100} = \frac{V_{130} - V_0}{V_{100} - V_0}$ — C1

$V_{130} = \frac{130 \times 3.20}{100}$ — C1

$= 4.16\,V$ — 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 = constant	B1
			terms explained	~~B1~~
	(b)	(i)	1. liquid at wider part has low speed (A) → (B)	B1
			∴ has high pressure associated with it	B1
			liquid at narrow part has high speed	B1
			∴ has low pressure associated with it	B1
			2. $P_1 - P_2 = 0.30 \times 13600 \times 9.81 \equiv h\rho g = \frac{1}{2}\rho(v_1^2 - v_2^2)$	C1
			$V_2 = \frac{A_1V_1}{A_2} = \frac{r_1^2V_1}{r_2^2}$ $A_1v_1 = A_2v_2$; $\pi r_1^2 v_1 = \pi r_2^2 v_2$; $r_2 = \frac{r_1 v_1}{v_2}$	C1
			$40024.8 = \frac{1}{2} \times 1000 \times 100\left(\frac{(5.25 \times 10^{-2})^2}{r_2^2} - 1\right)$	C1
			diameter = ~~3.30 × 10⁻² m~~ 9.06×10^{-2}	A1
		(ii)	This increases the speed of water at nozzle	B1
			A larger area can be covered	B1

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

$A_1v_1 = A_2v_2$ --- (2) $A = \pi\left(\frac{d}{2}\right)^2$

$\pi\left(\frac{d_1}{2}\right)^2 v_1 = \pi\left(\frac{d_2}{2}\right)^2 v_2$

$\frac{d_1^2}{4} v_1 = \frac{d_2^2}{4} v_2$ but $v_2^2 = v_1^2 - 2gh$

$d_2^2 = \frac{d_1^2 v_1^2}{v_2}$

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

$= \frac{2\left(\frac{10.5}{2}\right)^2 \cdot 10\,m/s}{\sqrt{10^2 - 2 \cdot 10 \cdot 0.3}}$

$= \frac{d_1^2 v_1}{\sqrt{v_1^2 - 2gh}}$

$= \frac{(0.105)^2 \cdot 10}{\sqrt{10^2 - 2 \cdot 9.81 \cdot 0.3}}$

$= 9.70\,m \times 10^{-2}$

Check

5 (a) existence of charge in intergral multiples of a basic charge. unit / 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. hence find r — B2 B1

(ii) EQ = mg $F_g - F_e = 0$ $Ene = mg$ — B3

$\frac{1400}{0.014} \times Q = 4.9 \times 10^{-15} \times 9.81$ $n = \frac{mg}{Ee}$ — C1

$Q = 4.8669 \times 10^{-19}$ C — C1

number of electrons $\frac{4.8}{1.6}$ = 3 — A1

(iii) upthrust not negligible / drag force ∃ — B1
more electric field needed to stop the drop — M1

(c) Highest common factor — C1

2.2×10^{-19}C — A1