G12 Physics Mock 2022 Paper 2 (Solutions)

Section E2: Atomic World

Multiple-choice questions

1	2	3	4	5	6	7	8
A	B	D	C	B	B	B	C

Structured question

(a) (i) L_1: 1.80 eV ; L_2: 3.80 eV ($E_{\text{in eV}} = hf/e$) — 1A (for all correct)

(ii) (1) It is because even the most energetic electron cannot escape from the metal surface for L_2. — 1A
(OR It is because the photon energy < work function of the metal) — (1A)

(2) rate of photoelectrons emission $= \frac{i}{e} = \frac{0.2\times10^{-6}}{1.6\times10^{-19}} = 1.25 \times 10^{12}$ s^{-1} — 1M
number of photon emitter per second $= 1.25 \times 10^{12} \times 1200$
$= 1.5 \times 10^{15}$ s^{-1} — 1A

(iii) L_1: 0 μA ; L_2: 0.80 μA (current proportional to light intensity for L_2) — 2A (@1A)

(iv) $K_{max} = \frac{hc}{\lambda} - W$

$\frac{1}{2}(9.11 \times 10^{-31})v_{max}^2 = \frac{(6.63 \times 10^{-34})(3 \times 10^8)}{110 \times 10^{-9}} - (2.3)(1.6 \times 10^{-19})$ — 1M

$v_{max} = 1778134 = 1.78 \times 10^6$ m s^{-1} — 1A

(b) The varying size of the soundtrack leads to a varying intensity (or amount) of light shining onto the photocell. — 1A

A varying (photoelectric) current and hence a sound signal is then produced — 1A

Section E3: Energy and Use of Energy

Multiple-choice questions

1	2	3	4	5	6	7	8
B	C	A	B	D	C	A	D

Structured question

(a) (i) No. / It is a non-renewable energy source. 1A

Nuclear power does not come from natural resource / process. OR
The supply of nuclear power is exhaustible / cannot be replenished constantly. 1A

(ii) Energy is released when the U-235 captures a (slow-moving) neutron and splits into two lighter nuclei (with higher binding energy per nucleon). 1A

Two (or three) neutrons are produced by a fission process. The chain reaction takes place when these neutrons are captured by another uranium-235 nucleus. 1A

(iii) Pressurized water has a higher boiling point (> 300°C at ~153 atm). OR
The water can be heated to a higher temperature without boiling. OR
The pressurized water absorbs / transfers energy more effectively. 1A

(iv) Accept any ONE below and other reasonable answer 1A
- minimize the amount of radioactivity released to the environment in an accident
- better reactor design to avoid overheating and meltdowns of reactors
- protection of power station against natural disaster (eg tsunami)
- better protection of workers from radiation hazards

(v) Energy released per hour =

$$178 \times \frac{0.145}{(235)(1.661 \times 10^{-27})} = 6.612 \times 10^{25} \text{ MeV}$$ 1M

Power output in MW =

$$\frac{E}{t} = \frac{(6.612 \times 10^{25})(1.6 \times 10^{-19})}{3600} \times 30\% = 881.6 \approx 882 \text{ MW}$$ 1A

(b) $$P = \frac{1}{2}\rho A v^3 = \left[(\frac{1}{2})(1.25)(\pi \times 30^2)(12^3)\right] \times 5 \times 0.4 \times 0.75 = 4580442 \text{ W} = 4.58 \text{ MW}$$ 1A

Since 4.58 MW > 4 MW, the proposal can fulfil the required power supply. 1A