Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) (i) (use of $P = VI$ gives) P (= 2.4 × 20) = 48 W **(1)**

(ii) incident (solar) power (= 1.4 × 2.5) = 3.5 (kW) **(1)**

efficiency = $\frac{48}{3500}$ **(1)**

= 0.014 **(1)** (or 1.4%)

[or efficiency = $\frac{48}{2.5}$ / 1400]

(allow C.E. for incorrect values of input and output power)

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(b) (i) in 1 s source emits 1.1×10^{14} particles **(1)**
energy emitted in 1 s = $1.1 \times 10^{14} \times 5.1 \times 1.6 \times 10^{-13}$ (J) **(1)** (= 90 J)

(ii) $T_{1/2} = \frac{\ln 2}{\lambda}$ + correct use or $\lambda = \frac{\ln 2}{90 \times 365 \times 24 \times 3600}$ **(1)**

= 2.44×10^{-10} s^{-1} **(1)**

[or $\lambda = \frac{\ln 2}{90}$ = 7.7×10^{-3} yr^{-1}]

(iii) no. of nuclei $\left(= \frac{\text{activity}}{\text{decay constant}} = \frac{11 \times 10^{14}}{2.44 \times 10^{-10}} \right) = 4.5(1) \times 10^{23}$ **(1)**

(allow C.E. for incorrect value of λ in (ii))

mass of isotope = $\frac{4.51 \times 10^{23} \times 0.239}{6.02 \times 10^{23}}$ **(1)**

= 0.18 kg **(1)**

(allow C.E. for incorrect no. of nuclei)

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[11]

Q2.

(a) (i) (in 1 s), E = 0.045 × 4200 × (47 – 15) **(1)**

= 6050 J

(ii) $P\left(=\frac{E}{t}\right)$ = 6.0 kW **(1)**

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(b) (i) (use of $P = VI$ gives) $I = \left(=\frac{6050}{230}\right)$ = 26 A **(1)** (26.3 A)

(allow C.E. for value of P from (a))

(ii) radius = 1.2×10^{-3} (m) **(1)**
cross-sectional area = $\pi(1.2 \times 10^{-3})2$ (or $4.5 \times 10^{-6}(m^2)$) **(1)**

$\frac{R}{l} = \frac{\rho}{A}$ **(1)**

$= \frac{1.7 \times 10^{-8}}{4.5 \times 10^{-6}}$ **(1)**

$= 3.8 \times 10^{-3}\ \Omega\ m^{-1}$

(allow C.E. for value of A)

(iii) $\frac{V}{l}\left(=\frac{IR}{l} = 26 \times 3.8 \times 10^{-3}\right)$ = 0.1 (V m^{-1}) (per wire)

two wires per cable gives pd per metre = 2 × 0.1 **(1)**
(= 0.20 V m^{-1}) **(1)**

(iv) maximum length = $\left(=\frac{6}{0.2}\right)$ = 30 m **(1)**

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[12]