M Tu W Th F S Su

D D M M Y Y Y Y

(1) $MM = 1.1\% A + 0.55\% S$

$= 1.1 \times 13.2 + 0.55 \times 0.1 = 14.575$

$\% M = 6.8$, then $\% O = \frac{16}{18} \times \% M = 6.044\%$

(2) $N = N_0 e^{-\lambda t}$ or $15 = 100 e^{-10\lambda}$ or $\ln \frac{100}{15} = 10\lambda$

or $\lambda = \frac{1}{10} \ln \frac{100}{15} = \frac{2.303}{10} \log_{10} \frac{100}{15} = 0.1897$

$\therefore$ Half life $= \frac{0.6931}{\lambda} = \frac{0.6931}{0.1897} = 3.65$ days.

(3) Original capacity $= 2.4$ Wh, power $= 60 \mu W = 60 \times 10^{-6}$ W

$\therefore$ Years $= \frac{2.4}{60 \times 10^{-6}}$ hours $= \frac{2.4 \times 10^{6}}{60 \times 8000}$ years $= 5$ years.

if malfunction print is true, then years $= \frac{1.4 \times 10^{6}}{60 \times 8000}$

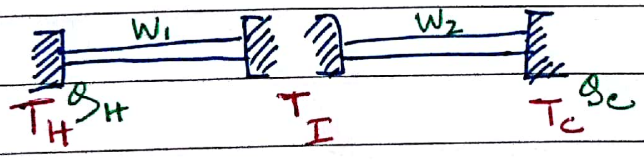
$= 2.9167$ years $=$ 2 years 11 months.

(4) area $A = \pi \left(\frac{D}{2}\right)^2 = \pi \left(\frac{7.5}{2}\right)^2$, $v = 8.5$ m/s, $d = 1.26$ kg/m^3

$P = \frac{1}{2} c d A v^3$ $\qquad c \neq 1$ (100% maximum efficiency) $= 0.59$

$= 0.5 \times 0.59 \times 1.26 \times 3.14 \times \left(\frac{7.5}{2}\right)^2 \times 8.5^3$

$= 1.0085 \times 10^4$ W $=$ ~~85.5 kW~~ 10.08 kW.

(8) 

(i) when work output is equal, $W_1 = W_2$

$W_1 = Q_H - Q_I$, $W_2 = Q_I - Q_c$ $\therefore Q_H - Q_I = Q_I - Q_c$

or $\frac{Q_H}{Q_I} - 1 = 1 - \frac{Q_c}{Q_I}$. Now, $\frac{Q_H}{Q_I} = \frac{T_H}{T_I} = \frac{1200}{T_I}$

or $\frac{1200}{T_I} - 1 = 1 - \frac{T_I}{300}$ $\qquad \frac{Q_I}{Q_c} = \frac{T_I}{T_c} = \frac{T_I}{300}$

or $T_I = 750$ K

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(ii) when efficiencies are equal, $\eta_1 = 1 - \frac{Q_I}{Q_H}$

$\eta_2 = 1 - \frac{Q_c}{Q_I}$

$\therefore 1 - \frac{Q_I}{Q_H} = 1 - \frac{Q_c}{Q_I}$

or $\cancel{1} - \frac{T_I}{T_H} = \cancel{1} - \frac{T_c}{T_I}$ or $T_I^2 = T_H T_c$

or $T_I = \sqrt{T_H T_c} = \underline{600\,K}$