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

∴ 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

∴ 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.

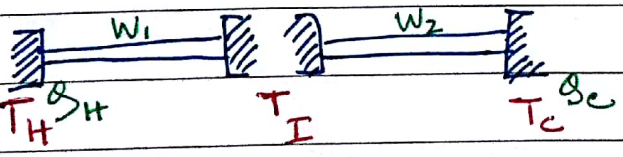
④ area $A = \pi \left(\frac{D}{2}\right)^2 = \pi \left(\frac{7.5}{2}\right)^2$, $v = 8.5$ m/s, $d = 1.26$ kg/m^3

$P = \frac{1}{2} c d A v^3$ $c \neq 1$ (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 $=$ ~~8.5 KW~~ 10.08 KW.

⑧



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

$W_1 = Q_H - Q_I$, $W_2 = Q_I - Q_C$ ∴ $Q_H - Q_I = Q_I - Q_C$

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 $\frac{1200}{T_I} - 1 = 1 - \frac{T_I}{300}$ $\frac{Q_I}{Q_C} = \frac{T_I}{T_C} = \frac{T_I}{300}$

or $T_I = 750$ K

M Tu W Th F S Su

D D M M Y Y Y Y

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

$\therefore 1 - \frac{Q_I}{Q_H} = 1 - \frac{Q_C}{Q_I}$ $\qquad \eta_2 = 1 - \frac{Q_C}{Q_I}$

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

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

(7) $\delta = \delta_0 \sin\left(\frac{360(284+n)}{365}\right)$.

April 26th 2018 is $31+28+31+26 = 116^{th}$ day of the year. So $n = 116$.

$\delta_0 = +23.44^\circ$

$\therefore \delta = +23.44^\circ \sin\left(\frac{360(284+116)}{365}\right)$

$= -22.717^\circ$

negative sign means the date is past vernal equinox.