Power → Fall-21

MATH Solve

(I) → (C)

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(i)

given,

Input power, $P_i = 4200$ J/S

output ″ , $P_o = EI$

$= 120 \times 32.2$

$\therefore P_o = 3864$ J/S

$\therefore$ efficiency, $\eta = \frac{P_o}{P_i} \times 100\%$

$= \frac{\cancel{4200}\ 3864}{\cancel{3864}\ 4200} \times 100\%$

$= 0.92\ \%$ (Ans).

(ii) Power lost, $P_L = P_i - P_o$

$= 4200 - 3864 = 336$

energy is lost per minute (60 s) operation

$\therefore$ energy Lost $= P_L \times t$

$= 336 \times 60 = 20160$ J (Ans).

2 → b

Solve:-

weight of water, $W = 94 \, m^3/sec$

$= 94 \times 1000$

$= 94000 \, kg/sec$

water Head, $H = 39 \, m$

$g = 9.81$

$\therefore$ work done/sec $= W \times H$

$= \cancel{94000 \times 39}$

$= (94000 \times 9.81) \times 39$

$= 35.963 \times 10^3 \, W$

$= 35.963 \, KW$

(i) Firm capacity = plant efficiency × Gross plant capacity

$= 80\% \times 35.963$

$= 0.8 \times 35.963$

$= 28.770 \, KW$

Ans

(ii) yearly gross output = Firm capacity × Hours in early

$= 28.770 \times 8760$

$= \cancel{25.20} \; 252 \times 10^6 \, kWh$

Ans

③ → ⓑ

Solve

number of atoms in 2kg fuel $= \frac{2}{235} \times (6.023 \times 10^{26})$

$= 5.126 \times 10^{24}$

These atoms in fission on 30 days.

$= \frac{5.126 \times 10^{24}}{30 \times 24 \times 60 \times 60}$

$= 1.977 \times 10^{18}$

energy released per fission = 200 MeV

$= (200 \times 10^{6}) \times (1.6 \times 10^{-19})$

$= 3.2 \times 10^{-11}$

∴ power output, $P_0 = (3.2 \times 10^{-11}) \times (1.977 \times 10^{18})$

$= \cancel{632}.\ 63.2 \times 10^{6}$ W

$= 63.2$ MW Ans

④ → ⓑ

Solve.

Energy supplied to each working day.

$= (100 \times 2) * (50 \times 6)$ MWh

$= \cancel{3}\ 200 + 300$ MWh

$= 500$ MWh

Station operates for $= (365 - 45)$ ~~days~~

$= 320$ days in years

∴ energy supplied / hours $= (500 \times 320)$

$= 16{,}0000$ MWh

∴ Annual load factor $= \frac{\text{minimum supplied per annum}}{\text{maximum demand MW} * \text{working hours}}$

$= \frac{16{,}0000}{100 \times (320 \times 24)} \times 100$

$= 20.8\ \%$ Ans

6 → b

Solve:-

Initial cost of equipment, $P = $ Rs 15,60,000

Salvage " + " value, $S = $ Rs 60,000

Useful life, $n = 25$ years

(i) Straight line method,

Annual depreciation, $= \dfrac{P-S}{n}$

$= \dfrac{15,60,000 - 60,000}{25}$

$= 60,000$

∴ value of equipment after 20 years

$= P - $ Annual depreciation $\times 20$

$= 15,60,000 - (60,000 \times 20)$

$=$ Rs 36,0000

(ii) Diminishing value method,

Annual unit depreciation, $x = 1 - \left(\frac{S}{P}\right)^{\frac{1}{n}}$

$= 1 - \left(\frac{60,000}{15,60,000}\right)^{\frac{1}{25}}$

$= 1 - 0.877$

$= 0.123$

∴ value of equipment after 20 years

$= P - (1-x)^{20}$

$= 15,60,000 - (1 - 0.123)^{20}$

$=$ Rs 1,15,615

(iii) Rate of interest, $5\% = 0.05$

Annual deposit sinking fund is,

$$q = (P - S)\left[\frac{r}{(1+r)^{n}-1}\right]$$

$$= (15,60,000 - 60,000)\left[\frac{0.05}{(1+0.5)^{25}-1}\right]$$

$= 1500000 \times$ ~~1.98×10⁻⁵~~ 0.021

$=$ Rs 31,433

$\therefore$ ~~Value of equipment after~~ 20 years, sinking fund at the end of

$$= 9 \times \frac{(1+r)^{20}-1}{r}$$

$$= 31,433 \times \frac{(1+0.05)^{20}-1}{0.05}$$

$$= Rs\ 10,39,362$$

$\therefore$ value of plant after 20 year.

$$= (15,60,000 - 10,39,362)$$

$$= Rs\ 520638$$

Ans.

(7) → (c)

assume the load factor and power factor unity.

$$\therefore \text{maximum demand} = \frac{220 \times 20 \times 1}{1000}$$

$$= 4.4$$

(i) unit consumed 500 hours $= 4.4 \times 500$

$= 2200$ kWh

charges of 22000 kWh $= Rs\ 0.2 \times 2200$

$= Rs\ 440$

Remaining unit $= 8760 - 2200$

$= 6560$ kWh

charges of 6560 kWh $= Rs\ 0.1 \times 6560$

$= Rs\ 656$

$\therefore$ annual bill $= (440 + 656) = Rs\ 1096$

(ii) equivalent flat Rate $= Rs\ \frac{1096}{8760}$

$= Rs\ 0.125 = 12.5$ paise.