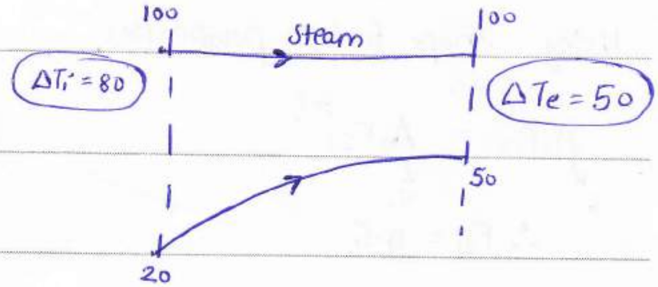
FROM	1 markers	2 markers	Numbering
ME - 1	Q10	Q37, Q38	As per question papers
ME - 2	Q18, Q19	Q46, Q47	uploaded on website

ME - 1

Q10 Ans. 63.82°C



$$LMTD = \Delta T_m = \frac{\Delta T_i - \Delta T_e}{\ln\left(\frac{\Delta T_i}{\Delta T_e}\right)}$$

i) Above expression true for both counter-flow and parallel flow exchangers

ii) Both CF and PF assumptions give same results for evaporators or condensers (this case).

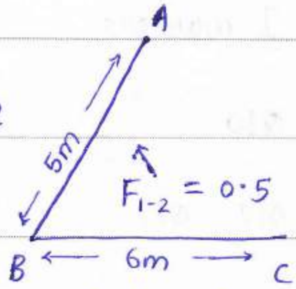
Putting in values $\Delta T_m = \frac{80 - 20}{\ln\left(\frac{80}{20}\right)} = 63.82^\circ C$

x ———— x ———— x ———— x ———— x

37 Study diagram carefully

(To find)

Net Heat transfer rate from AB to surroundings per unit depth of plate (note underlinings).



Using shape factor properties,

$A_1 F_{12} = A_2 F_{21}$ ($F_{12} \to 0.5$, $F_{21} \to ?$, $A_1 \to 6$, $A_2 \to 5$)

$\therefore F_{21} = 0.6$

$F_{2-1} + F_{2-2} + F_{2\text{-surroundings}} = 1$

$F_{2-1} \to 0.6$, $F_{2-2} \to 0$ (flat surface) $\therefore F_{2-sur} = 0.4$ → what we need!

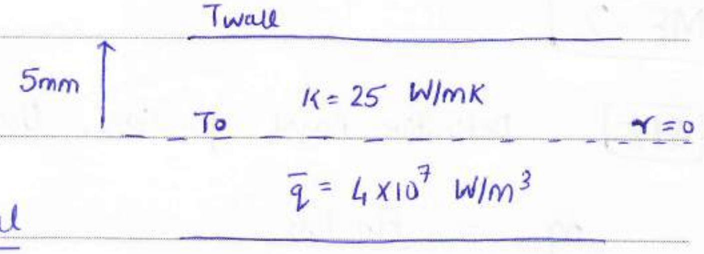
Net heat transfer $= \sigma F_{2-sur} A_2 (T_2^4 - T_{sur}^4)$

$(5.67\times10^{-8}) \times (0.4)\ (5\times1)\ (600^4 - 300^4)$

$= (13.78\ kW$ Ans.)

x ——— x ——— x ——— x ——— x

38 Check diagram,



Using standard result for uniform heat generation in cylindrical rod under steady state condition (note assumptions)

$$T_0 - T_{wall} = \frac{\bar{q}R^2}{4K}\left[1 - \left(\frac{r}{R}\right)^2\right]$$

Putting given values of $\bar{q}$, R, k and $r = 0$ (at centre)

$$\boxed{T_0 - T_{wall} = 10\ K}$$. Ans

x ——— x ——— x ——— x ——— x

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ME-2

Q18 Definition based question. Use efficiency, not effectiveness because

$$\eta_{fin} = \frac{\text{Fin loss}}{\text{Loss IF entire fin were at base T.}}$$

$$0.75 = \frac{6W}{Fin_{base\ T}} \quad \therefore \boxed{Fin_{base\ T} = 8W.} \text{ .Ans}$$

x ——— x ——— x ——— x ——— x

Q19 Emissive power = $\sigma A T^4$ or $\propto T^4$

So, $P \propto T^4$ $\quad P_{new} \propto (2T)^4$

$\propto 16T^4$

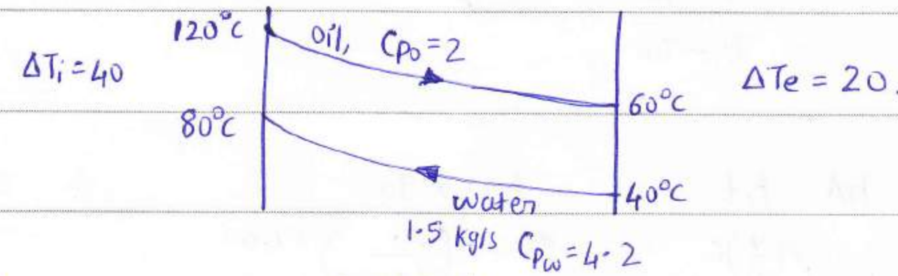
$\boxed{P_{new} = 16P}$. Ans

x ——— x ——— x ——— x ——— x

Q46 Check diagram for data

We use equation

$Q = UA\Delta T_m$ ... ①



U given - 400 W/m²K

Counter - flow

$$LMTD = \Delta T_m = \frac{\Delta T_i - \Delta T_e}{\ln\left(\frac{\Delta T_i}{\Delta T_e}\right)} = \frac{40-20}{\ln\left(\frac{40}{20}\right)} = 28.86\,^\circ C.$$

$$Q = \dot{m}_w \cdot C_{P_w} \cdot \Delta T_w = 1.5 \times 4.2 \times 40 = 252 \text{ kJ/s}.$$

Putting, Q, ΔT_m, U in ①, we get

$$A = 21.83 \text{ m}^2$$. Ans

x ——— x ——— x ——— x ——— x

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Q47 Lumped capacity concept

$$\frac{T - T_\infty}{T_i - T_\infty} = e^{\frac{-hAt}{\rho V C}}$$ (assumed you know the notations)

$$\frac{ht}{\rho\left(\frac{V}{A}\right)C} = \frac{200 \times 90}{9000 \times \left(\frac{30}{3 \times 1000}\right) \times 400} = 0.5$$

$\left(\frac{R}{3}\right)$ in metres

or, $$\frac{T - 20}{220 - 20} = e^{-0.5}$$

$$\boxed{T = 141.3^\circ C}$$. Ans

× ——— × ——— × ——— × ——— × ———