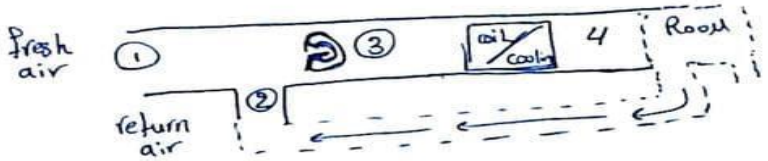
Ex1/ An air conditioner mixes 2 m^3/s of fresh air with 6.25 m^3/s of indoor return air if the condition of the outside air is (DBT = 4°C, WBT = 2°C) and indoor air (DBT = 25°C, RH = 50%) find the properties after mixing.

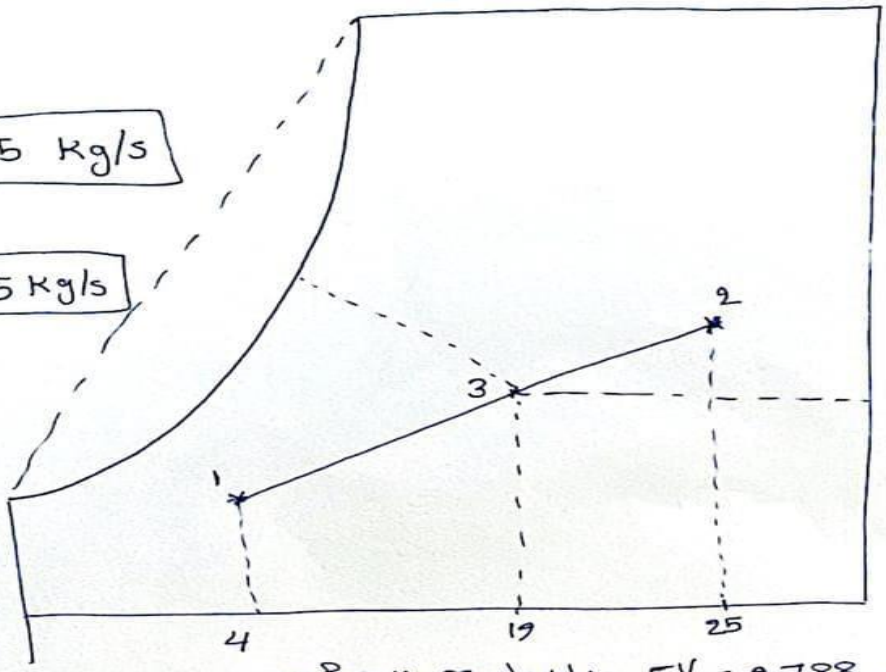
Sol/



$$\dot{m}_1 = \frac{\dot{V}_1}{v_1} = \frac{2}{0.788} = \boxed{2.5 \text{ kg/s}}$$

$$\dot{m}_2 = \frac{6.25}{0.859} = \boxed{7.275 \text{ kg/s}}$$

$$\dot{m}_3 = \dot{m}_1 + \dot{m}_2 = 2.5 + 7.275 = \boxed{9.8139 \text{ kg/s}}$$



$$h_3 m_3 = h_1 m_1 + h_2 m_2$$
$$= 13 * 2.5 + 50 * 7.275$$
$$h_3 * 9.813 = 396.75$$
$$\boxed{h_3 = 40.431 \text{ kJ/kg}}$$

* From psychrometric

$V_1 = 0.788 \ m^3/kg$
$V_2 = 0.859 \ m^3/kg$
$h_1 = 13 \ kJ/kg$
$h_2 = 50 \ kJ/kg$

From psychromatric chart at $h_3 = 40.43\ kJ/kg$

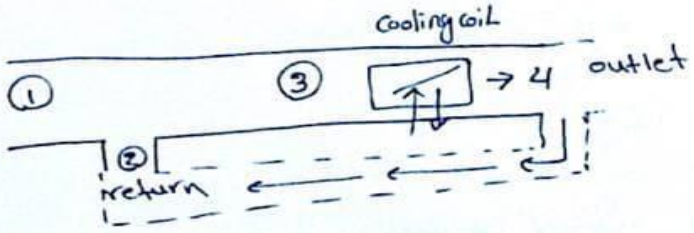
Find point 3 which represented properties after mixing

$\phi_3 = 60\%$, $T_{DB} = 19^\circ C$, $T_{WB} = 14^\circ C$

Ans-

Ex2/ An air conditioner mixes moist air from outside with DBT 41°C, WBT = 20°C with returned air from room at DBT = 28°C RH = 60% with 20,000 L/s and 15,000 L/s respectively and then cooled to 20°C find the properties of air after mixing and the amount of heat transfer after cooling.

Sol/



$\dot{V}_1 = 20{,}000$ L/s $\Rightarrow$ $20\ m^3/s$

$\dot{V}_2 = 15{,}000$ L/s $\Rightarrow$ $15\ m^3/s$

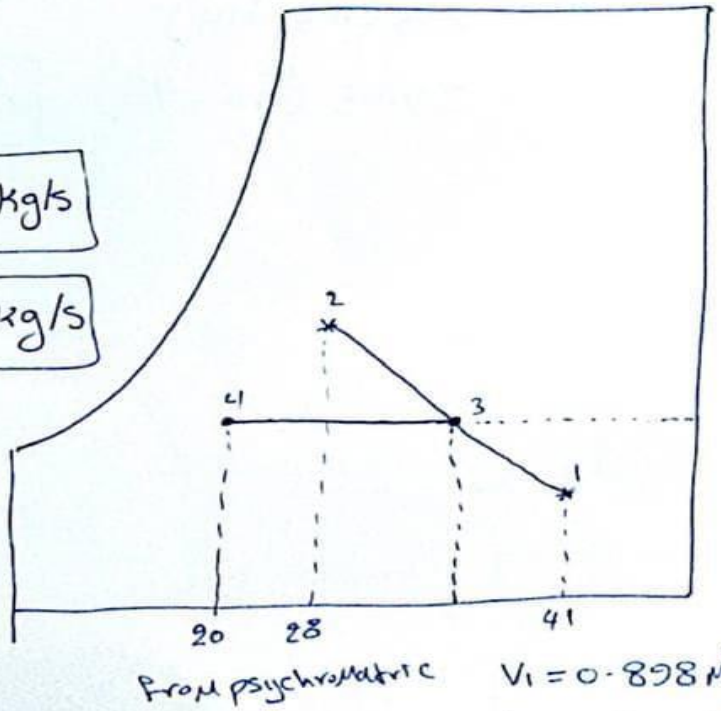
$$\dot{m}_1 = \frac{\dot{V}_1}{v_1} = \frac{20}{0.898} = \boxed{22.27\ kg/s}$$

$$\dot{m}_2 = \frac{\dot{V}_2}{v_2} = \frac{15}{0.873} = \boxed{17.18\ kg/s}$$

$$\dot{m}_3 = \dot{m}_1 + \dot{m}_2$$

$$= 22.27 + 17.18$$

$$= 39.45\ kg/s$$



From psychrometric

$v_1 = 0.898\ m^3/kg$

$v_2 = 0.873\ m^3/kg$

$h_1 = 57\ kJ/kg$

$h_2 = 64\ kJ/kg$

$\dot{m}_3 h_3 = \dot{m}_1 h_1 + \dot{m}_2 h_2$

$= 57 * 22.27 + 64 * 17.18$

$\boxed{h_3 = 60.048 \text{ KJ/kg}}$

* at h_3 we find properties of air at mixing

$T_{d3} = \checkmark$, $\phi_3 = \checkmark$, $\omega_3 = \checkmark$, ...

* after cooling $T_d = 20^\circ C$ Then

$h_4 = \boxed{40 \text{ KJ/kg}}$

The amount heat transfer after cooling

$\dot{Q}_c = \dot{m}_3 (h_3 - h_4)$

$= 39.45 (60 - 43) = \boxed{670.72 \text{ kW}}$ ans.