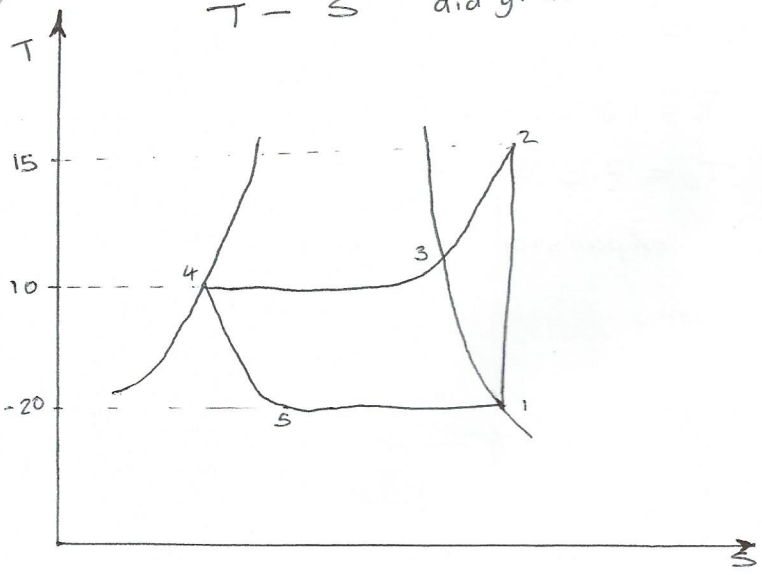
Question 3

T – S diagram



From Steam Tables

For Saturation temperature $-20^{\circ}C$

Pressure $0.1508\ MN/m^2$

specific enthalpy $h_f = 178\ KJ/kg$

$h_g = 178.7\ KJ/kg$

Specific entropy $S_f = 0.0751$

$S_g = 0.0708$

For Saturaturation Temp $10^{\circ}C$

Pressure $= 0.423$

specific enthalpy $h_f = 45.4$

$h_g = 191.7$

Specific entropy $S_f = 0.1752$

$S_g = 0.09$

$h_1 = 178.7\ KJ/kg$

$C_{pv} = 0.64\ KJ/kg\,K$

$T_2 = 15^{\circ}C = 288K$

$T_3 = 10^{\circ}C = 283K$

$h_{g3} = 191.7\ KJ/kg$

$h_2 = h_{g3} + C_{pv}(T_2 - T_3)$

$= 191.7 + 0.64(288 - 283)$

$= 191.7 + (0.64 \times 5)$

$h_2 = 194.9\ KJ/kg$

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~~$h_4 = 45.4\ KJ/kg$~~

$h_4 = 45.4\ KJ/kg = h_5$

$$COP = \frac{\text{refrigerative effect}}{\text{energy output}} = \frac{h_1 - h_5}{h_2 - h_1}$$

$$COP = \frac{178.7 - 45.4}{194.9 - 178.7} = 8.228$$

$$C.O.P = \underline{\underline{8.228}}$$