https://answersun.com/download/solutions-manual-of-transport-processes-of-unit-operations-by-geankoplis-1st-edition/

PART I- TRANSPORT PROCESSES: MOMENTUM, HEAT, AND MASS

(1.2-1)

Eq.(1.3-4) $K = 353.2 = °C + 273.15$ $°C = 80.05 = \boxed{80°C}$

Eq.(1.3-2) $°C = 80.0 = (1/1.8)(°F - 32)$ $°F = \boxed{176°F}$

Eq.(1.3-3) $°R = °F + 460 = 176 + 460$ $°R = \boxed{636°R}$

(1.2-2)

Eq.(1.3-2) $°C = (1/1.8)(°F - 32) = (1/1.8)(155 - 32) = \boxed{68.33°C}$

Eq.(1.3-4) $K = °C + 273.15 = 68.33 + 273.15 = \boxed{341.5\ K}$

Eq.(1.3-3) $°R = °F + 460 = 155 + 460 = \boxed{615\ °R}$

(1.3-1)

$MW(O_2) = 32.00, \quad MW(N_2) = 28.02$

$MW(\text{air}) = 0.21(32.00) + 0.79(28.02) = \boxed{28.9\ kg/kg\ mol}$

(1.3-2)

$2CO + O_2 \rightarrow 2CO_2$

MW 28.01 32.00 44.01

$\text{Moles } CO = \dfrac{56.0\ kg}{28.01\ kg/kg\ mol} = 2.00\ kg\ mol$

$\text{moles } O_2 = 1.00, \quad 1.00(32.00) = \boxed{32.0\ kg\ O_2} \quad 2.00(44.0) = \boxed{88.0\ kg\ CO_2}$

(1.3-3)

Gas	g	MW	g mol	Mol frac
N_2	20	28.02	0.7138	0.1648 mol frac
O_2	83	32.00	2.5938	0.5990
CO_2	45	44.01	1.0225	0.2362
Total	148 g		4.3301 g mol	1.0000

$\text{average mol wt} = \dfrac{148\ g}{4.3301\ g\ mol} = \boxed{34.2\ g/g\ mol \quad 34.2\ kg/kg\ mol}$

Download full file from answersun.com

https://answersun.com/download/solutions-manual-of-transport-processes-of-unit-operations-by-geankoplis-1st-edition

(1.4-1)

$P = 2.4$ mm Hg

From appendix A.1

$1 \text{ atm} = 760 \text{ mm Hg}$

$$P = \frac{2.4 \text{ mm Hg}}{760 \text{ mm Hg/atm}} = \boxed{3.16 \times 10^{-3} \text{ atm}}$$

$1 \text{ atm} = 33.90 \times 12 \text{ in. } H_2O \text{ (at } 4°C)$

$$P = \frac{2.4}{760} \text{ atm} \left(33.90 \times 12 \frac{\text{in. } H_2O}{\text{atm}}\right) = \boxed{1.285 \text{ in. } H_2O}$$

$1 \ \mu m = 10^{-3} \text{ mm}$

$$P = \frac{2.4 \text{ mm}}{10^{-3} \text{ mm}/\mu m} = \boxed{2{,}400 \ \mu m \text{ Hg}}$$

$1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa}$

$$P = \frac{2.4}{760} \text{ atm} \left(1.01325 \times 10^5 \frac{\text{Pa}}{\text{atm}}\right) = \boxed{320 \text{ Pa}}$$

(1.4-2)

$V_1 = 65.0 \text{ ft}^3$, $T_1 = 460 + 90 = 550 °R$, $T_2 = 460 + 65 = 525 °R$

From appendix A.1, $1 \text{ atm} = 14.696$ psia

$p_1 = 29.0 + 14.696 = 43.696$ psia, $p_2 = 75.0 + 14.696 = 89.696$ psia

$p_1 = 43.696/14.696 = 2.975$ atm, $p_2 = 89.696/14.696 = 6.104$ atm

Eq.(1.4-2)

$$V_2 = V_1 \frac{p_1}{p_2} = 65.0 \frac{(2.975)}{(6.104)} = \boxed{30.24 \text{ ft}^3}$$

$R = 0.7302 \text{ ft}^3 \cdot \text{atm/lb mol} \cdot °R$, MW of $N_2 = 28.01$

Eq.(1.4-1)

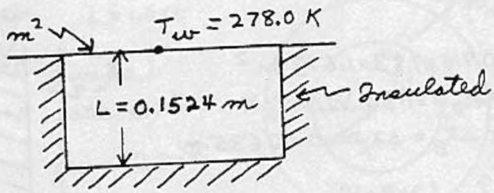
$$n = pV/RT = (2.975)(65.0)/(0.7302)(550) = \boxed{0.4815 \text{ lb mol}}$$

$$\text{Density, } \rho = (0.4815)(28.01)/30.24 = \boxed{0.446 \ lb_m/ft^3}$$

Download full file from answersun.com

https://answersun.com/download/solutions-manual-of-transport-processes-of-unit-operations-by-geankoplis-1st-ed

(4.3-12)



$\rho = 641\ kg/m^3$

$k = 0.346\ W/m\cdot K = 0.346\ J/s\cdot m\cdot K$

$$\dot{q} = 0.070\frac{kJ}{kg\cdot h}\left(641\frac{kg}{m^3}\right) = 44.87\frac{kJ}{h\cdot m^3}$$

Eq.(4.3-27)

$$T_0 = \frac{\dot{q}L^2}{2k} + T_w = \frac{(44.87\times1000)(0.1524)^2}{(2)(0.346)(3600)} + 278.0$$

$$T_0 = 0.418 + 278.0$$

$$\boxed{T_0 = 278.42\ K}$$

Eq.(4.3-28)

$$\dot{q}_T = \dot{q}\ (\text{volume})$$

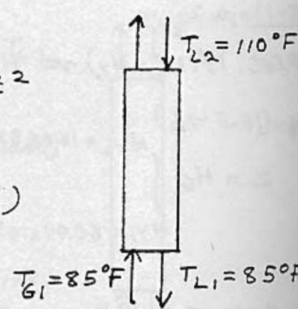
$$\dot{q}_T = \frac{(44.87\times1000)}{3600}(0.1524\times0.186)$$

$$\boxed{\dot{q}_T = 0.353 W}$$

(1.22 btu/h)

Download full file from answersun.com

https://answersun.com/download/solutions-manual-of-transport-processes-of-unit-operations-by-geankoplis-1st-e



(10.5-2)

$L = 2000\ lb_m/h\cdot ft^2 \quad G = 1400\ lb_m\ air/h\cdot ft^2$

$K_G a = 6.90\ lb\ mol/h\cdot ft^3\cdot atm$

$T_{wet\ bulb}$ inlet air $= 75°F$

$H_1 = 0.0165$ lb water/lb dry air (Fig. 9.3-2)

Eq (9.3-8).

$H_y = (0.24 + 0.45H)(T - T_0\ °F) + H\lambda_0$

$H_{y1} = (0.24 + 0.45 \times 0.0165)(85 - 32) + 1075.4(0.0165) = 30.8\ \frac{btu}{lb_m\ dry\ air}$

(a) Minimum air rate

Saturated enthalpies from Table 10.5-1 are plotted as H_y vs T_L. The point $H_{y1} = 30.8$ and $T_{L1} = 85°F$ is plotted.

The line for minimum G is plotted where the operating line becomes tangent as shown. At $T_{L2} = 110°F$, a value of $H_{y2} = 84.3$ is read off mins operating line.

Eq (10.5-2)

$G(H_{y2} - H_{y1}) = L c_L (T_{L2} - T_{L1}) \qquad c_L = 1.00\ btu/lb_m\cdot °F$

$G(84.3 - 30.8) = 2000(1.0)(110 - 85)$

$G_{min} = 935\ lb_m\ air/h\cdot ft^2\ (4241\ kg/h\cdot m^2)$

(b) Use operating G = 1400

$1400(H_{y2} - 30.8) = 2000(1.0)(110 - 85) \qquad H_{y2} = 66.7\ btu/lb_m$

Plot point H_{y2}, T_{L2}. Draw operating line. Read off values of H_y^* and H_y at given T_L values.

Make a plot of $\frac{1}{H^* - H_y}$ versus H_y. Graphically integrate

T_L	H_y^*	H_y	$H^* - H_y$	$\frac{1}{H^* - H_y}$
85	41.8	30.8	11.0	0.0908
90	48	38	10.0	0.100
95	55.3	45.2	10.1	0.099
100	63.7	52.4	11.3	0.0885
105	73.6	59.5	14.1	0.0710
110	84.5	66.7	17.8	0.0562

Eq. (10.5-18)

$$\int_{H_{y1}=30.8}^{H_{y2}=66.7} \frac{dH_y}{H_y^* - H_y} = 3.12\ (\text{area})$$

Eq. (10.5-18)

$$z = \frac{G}{M_B K_G a P} \int_{H_{y1}}^{H_{y2}} \frac{dH_y}{H_y^* - H_y} = \frac{1400}{29(6.90)(1.00)}(3.12)$$

$z = 21.8\ ft\ (6.64\ m)$

Download full file from answersun.com

https://answersun.com/download/solutions-manual-of-transport-processes-of-unit-operations-by-geankoplis-1st-editi

(13.9-1)

(a) Solution of 0.50 g mol NaCl/kg H_2O

Table A.2-3, ρ = 997.0 kg H_2O/m^3

$n = (2)(0.50 \times 10^{-3})$ kg mol (2 ions)

$$V_m = \frac{1.00 \text{ kg } H_2O}{997.0 \text{ kg } H_2O/m^3}$$

Eq. (13.9-1)

$$\pi = \frac{nRT}{V_m} = \frac{(2 \times 0.5 \times 10^{-3})(82.057 \times 10^{-3})(298.15)}{(1.0/997.0)}$$

π (Predicted) = 24.39 atm   π (Exp.) = 22.55 atm

(b) Solution of 1.0 g sucrose/kg H_2O

$$n = \frac{1.0 \text{ g} \times 10^{-3} \text{ kg}}{342.3 \text{ kg/kg mol}} = 2.921 \times 10^{-6} \text{ kg mol sucrose}$$

Eq. (13.9-1)

$$\pi = \frac{(2.921 \times 10^{-6})(82.057 \times 10^{-3})(298.15)}{(1.0/997.0)} = \boxed{0.0713 \text{ atm} = \pi(\text{Pred})}$$

π (Exp) = 0.0714 atm

(c) Solution of 1.0 g $MgCl_2$/kg H_2O

$$n = \frac{1.0 \times 10^{-3} \text{ kg}}{95.23 \text{ kg/kg mol}}(3) = 3.150 \times 10^{-5} \text{ kg mol} \quad (3 \text{ ions})$$

Eq. (13.9-1)

$$\pi = \frac{(3.150 \times 10^{-5})(82.05 \times 10^{-3})(298.15)}{(1/997.0)}$$

π (Predicted) = 0.768 atm   π (Exp) = 0.660 atm

Download full file from answersun.com