QUIZ3- CHAPTER 18
DATE: 13/02/20

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1. A square hole 8.00 cm along each side is cut in a sheet of metal. If the temperature of the sheet is increased by 50 K, the area of the hole increases by 0.11 $cm^2$. Find the coefficient of linear expansion $\alpha$ of the metal.

$$\Delta A = A(2\alpha)\Delta T$$

$$\alpha = \frac{\Delta A}{2A\Delta T} = \frac{0.11\ cm^2}{2 \times 64\ cm^2 \times 50} = \frac{0.11}{6400}$$

$$\boxed{\alpha = 1.72 \times 10^{-5}\ /C^\circ}$$

or $\alpha = 1.72 \times 10^{-5}\ /K$

2. A 15 g ice cube at −10 °C is placed in an aluminum cup whose initial temperature is 70 °C. The system comes to an equilibrium temperature of 20 °C. What is the mass of the cup? ($c_{Al}$ = 900 J/kg.K)

$$Q_{\text{lost by Al}} + Q_{\text{gained by ice}} = 0$$

$$m_{Al} c_{Al} (T_f - T_i) + m_{ice} c_{ice} (T_f - T_i) + m L_f + m_w c_w (T_f - T_i) = 0$$

$$0 = m_{Al} \times 900(20-70) + 0.015 \times 2256 \times (0+10) + 0.015 \times 333 \times 10^3 + 0.015 \times 4187 \times (20-0)$$

$$-45000 m_{Al} + 338 + 4995 + 1256 = 0$$

$$\boxed{m_{Al} = 0.146\ Kg}$$

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1. A gas is compressed from 700 $cm^3$ to 100 $cm^3$ at a constant pressure of 400 kPa. At the same time, 200 J of heat energy is transferred out of gas. What is change in the internal energy of the gas during this process?

$$\Delta E_{int} = Q - W$$

$$W = P\Delta V = 400\times10^{3} \times (100-700)\times10^{-6} = -240\,J$$

$$Q = -200\,J$$

$$\Delta E_{int} = -200 - (-240) = \boxed{40\,J}$$

2. A metal rod has a length of 7.50 m at 5 °C and a length of 7.80 m at 85 °C. What is the temperature of the rod when its length is 7.32 m?

$$\Delta L = L_i \alpha \Delta T \Rightarrow \alpha = \frac{\Delta L}{L_i \Delta T} = \frac{7.8-7.5}{7.5\times(85-5)}$$

$$\alpha = 5.0\times10^{-4}\,/C^\circ$$

$$\Delta L = L_i \alpha \Delta T \Rightarrow \Delta T = \frac{\Delta L}{\alpha L_i} = T_f - T_i$$

$$T_f - 5 = \frac{7.32-7.5}{5\times10^{-4}\times7.5} = -48$$

$$\boxed{T_f = -43\,^\circ C}$$

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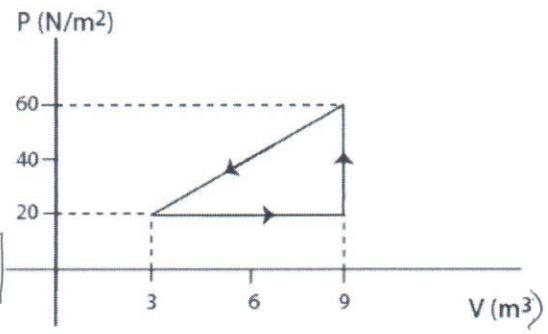
1. A gas within a closed chamber is taken through the cycle as shown in the P-V diagram in the figure. Calculate the net energy added as heat and the change in the internal energy of the gas per cycle.

(a) Calculate the work done by or on the system per cycle.

Work = area enclosed by the cycle

Cycle counterclockwise $\Rightarrow W < 0$

$W = -\frac{1}{2}(40 \times 6) = \boxed{-120\,J}$




(b) Calculate the net heat energy gained or lost by the system per cycle.

Since $\Delta E_{int} = Q - W = 0$ for a cycle $\Rightarrow Q = W$

$\boxed{Q = -120\,J}$

2. Calculate how much heat is lost in 12 hours through a glass window 2.0 m x 1.5 m in area and thickness of 3.2 mm, if the temperatures at the inner and outer surfaces are 25° C and – 4° C, respectively. Coefficient of thermal conductivity of the glass is equal to 0.84 W/m.K.

$$P_{Cond} = \frac{Q}{t} = \frac{k A (T_H - T_C)}{L} = \frac{0.84 \times 2 \times 1.5 \times 29}{3.2 \times 10^{-3}}$$

$$= 22.8\ kW$$

$$Q = P_{cond} \times t = 22.8 \times 12 \times 3600 = 985\ MJ$$

$10^6$