Home Work Problem Set # 10

James J. Griffin
301-405-6115

Solutions by

Set 10 Ch 13 CQ 13, 27, 34; Ex 7, 13, 18 & Ch 14 CQ 3, 5; Ex 1, 5.

13 CQ 13 Heat is an energy which flows from one object to another by virtue of a temperature difference. Temperature is a measure of the average kinetic energy of the particles of a system, but it is not an energy.

13 C.Q 27 Water freezes in a mixture of ice and water when heat is removed from the mixture, and ice melts when heat is added to the mixture.

13.CQ 34 This liquid would be inconvenient for boiling, since it would evaporate more quickly than water (which requires 539 cal to vaporize one gram as compared with only 10 cal/gm for this liquid)... One would have to keep adding liquid to the pot to keep it from boiling dry... or to start with a big potfull... of this "new liquid".

13 Ex 7

$$\Delta U = Q + W = 28 - 12 = 16\,J$$

This is the same problem assigned previously

13. Ex 13 Liquid X delivers heat to Liquid Y in amount

$Q = m_x (2\,cal/gm)$ then $\Delta T_x = \frac{-Q}{c_x m_x} = \frac{2\,m_x\,cal}{(2\,cal/gm\,°c)\cdot m_x\,gm} =$ $\boxed{-1°C = \Delta T_x}$

Also $\Delta T_y = \frac{+Q}{c_y m_y} = \frac{2\,m_x\,cal}{(1\,cal/gm\,°c)\cdot m_y\,gm} = \frac{2.6}{1.3}\,°c =$ $\boxed{+4°C = \Delta T_y}$

James J. Griffin
301-405-6115

13 Ex 18 $Q = m \cdot L$ where L = Latent heat of fusion of Water $= \frac{79.8\,cal}{gm} = \frac{334\,kJ}{kg}$

$= 1\,kg \cdot \frac{79.8\,cal}{1\,gm}$ (10^3 gm) $= 7.98 \times 10^4\,cal \approx$ **30 kCal**

OR $= 1\,kg \cdot \frac{334\,kJ}{kg} =$ **334 kJ** (1 cal = 4.186 J)

14 CQ 3 Because the extraction of heat from sea water to form ice requires either that work be done or that a heat reservoir colder than the ice be provided. Since no such cold reservoir is available, the heat will not spontaneously flow out to cool the water. If the heat is extracted by doing mechanical work, more work is always required than can possibly be generated by the heat energy extracted, — by virtue of the Second law of Thermodynamics.

14 CQ 5 (86) **Second law** requires $\eta = \frac{W}{Q} < 1 - \frac{T_C}{T_H} = 1 - \frac{4}{10} = 0.6$

Then of $1000\,J = Q$ = energy extracted from HOT 800K region, at most $0.600 \times 1000 = 600\,J$ can be extracted as Mech Work Mechanical Work. The rest, **400 J** at least, of the energy must be delivered to the cool reservoir.

14 Ex 1 $Q_{IN} = W + Q_{out} = 300\,kJ + 400\,kJ =$ **700 kJ** = Required Input Energy

14 Ex 5 $\eta = W/Q_{IN} = 50/200 = 0.25$ **= 25%** = Efficiency.

— End HW #10