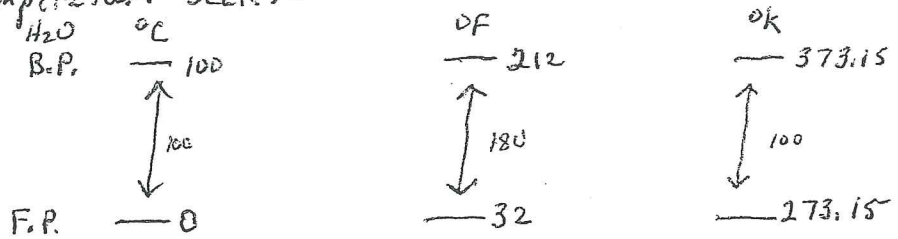
Heat and Temperature

1) Temperature – measure of the average kinetic energy of a system.

2) Thermometer – device used to measure temperature by observing how much a liquid expands or contracts in a closed tube that is sealed.

3) Temperature Scales –



4) Formulas For Conversions:

$^\circ C = \frac{5}{9}(^\circ F - 32)$ $^\circ F = \frac{9}{5}(^\circ C) + 32$ $^\circ k = ^\circ C + 273.15$

5) Examples

$10^\circ C = \_\_\_\_ ^\circ F$

$^\circ F = \frac{9}{5}(^\circ C) + 32$

$= \frac{9}{5}(10) + 32$

$= 18 + 32$

$= 50$

$= 50^\circ F$

$10^\circ F = \_\_\_\_ ^\circ C$

$^\circ C = \frac{5}{9}(^\circ F - 32)$

$= \frac{5}{9}(10 - 32)$

$= \frac{5}{9}(-22)$

$= -12.2$

$= -12.2^\circ C$

$10^\circ C = \_\_\_\_ ^\circ k$

$^\circ k = ^\circ C + 273.15$

$= 10 + 273.15$

$= 283.15$

$= 283.15^\circ K$

6) Absolute zero - the theoretically lowest temperature -273.15°c at which the kinetic energy of the idea gas molecule will be zero.

7) Energy transfer - will be indicated by a change in temperature of a system.

8) Heat - total kinetic energy of a system and is measured in Joule or calories.
Note: 1 cal = 4.19 J

9) Conduction - transfer of energy through direct contact.

10) Convection - transfer of heat energy by the matter or particle itself.

11) Radiation - transfer of energy in the form electromagnetic waves.
Note: This can happen in a vacuum.

12) Conductor - a substance through which energy will transfer easily.

13) Insulator - a substance that will not allow the transfer of energy.

14) Specific Heat - is the amount of energy required to raise the temperature of 1 Kg of that substance by 1°K.

15) Specific Heat formula:

$E = C\,m\,\Delta T$

E = energy = J

C = Sp. Heat = $\frac{J}{kg \cdot {}^\circ K}$

m = Mass = kg

ΔT = Temperature Change = $^\circ K$

$\Delta T = T_F - T_I$

Final Initial

16) Specific Heat (Calculations)

Example #1 How much energy must be transferred as heat to 400 kg of water to raise the water's temperature from 20.°C to 50.°C?

Given: $m = 400\ kg$ $\Delta T = 50.^\circ C - 20.^\circ C = 30.^\circ C$ $^\circ K = 30. + 273.15 = 303.15$ $C = 4186\ \frac{J}{kg\,^\circ K}$ (↑ Sp. Heat of water) $E =$ ____

$$E = C\,m\,\Delta T = \left(4186\ \frac{J}{kg\,^\circ K}\right)(400\ kg)(303.15\,^\circ K) = \boxed{5.08 \times 10^8\ J}$$

16 (Cont.) Example #2 What mass of water would be needed to change the temperature of a water bath from 10.00°C to 90.00°C using 25.0 J of energy?

Given: $E = 25.0\ J$ $\Delta T = 90.00^\circ C - 10.00^\circ C = 80.00^\circ C = 353.2^\circ K$ $C = 4186 \frac{J}{kg\ ^\circ K}$ $m = \_\_\_\_$

$$E = C\ m\ \Delta T$$

$$m = \frac{E}{C\ \Delta T} = \frac{25.0\ J}{\left(4186 \frac{J}{kg\ ^\circ K}\right)(353.2^\circ K)} = \boxed{1.69 \times 10^{-5}\ kg}$$

17) 1st Law of thermodynamics – total energy used in any process is conserved. (Law of Conservation of energy)

18) 2nd Law of thermodynamics – energy transferred as heat always moves from an object at a higher temperature to an object at a lower temperature.

19) Entropy – - measure of the randomness or disorder of a system.

20) Heat engine – chemical energy is converted to mechanical energy through the process of combustion.