PQ 1 Q and A

Specific Heat

Q1

- Calculate the amount of heat needed to increase the temperature of 250g of water from 20^oC to 56^oC.
- $q = m \times C_g \times (T_f - T_i)$
  $m = 250g$
  $C_g = 4.18\ J\ ^oC^{-1}\ g^{-1}$ (from table above)
  $T_f = 56^oC$
  $T_i = 20^oC$
- $q = 250 \times 4.18 \times (56 - 20)$
  $q = 250 \times 4.18 \times 36$
  $q = 37\ 620\ J = 38\ kJ$

Q2

- Calculate the specific heat capacity of copper given that 204.75 J of energy raises the temperature of 15g of copper from 25^o to 60^o.
- $q = m \times C_g \times (T_f - T_i)$
  $q = 204.75$ J
  $m = 15$g
  $T_i = 25^oC$
  $T_f = 60^oC$
- $204.75 = 15 \times C_g \times (60 - 25)$
  $204.75 = 15 \times C_g \times 35$
  $204.75 = 525 \times C_g$
  $C_g = 204.75 \div 204.75 = 0.39$ J^oC^{-1} g^{-1}

Q3

- 216 J of energy is required to raise the temperature of aluminium from 15^o to 35^{o}C. Calculate the mass of aluminium. (Specific Heat Capacity of aluminium is 0.90 J^{o}C^{-1}g^{-1}).
- $q = m \times C_g \times (T_f - T_i)$
  q = 216 J
  C_g = 0.90 J^{o}C^{-1}g^{-1}
  T_i = 15^{o}C
  T_f = 35^{o}C
- 216 = m x 0.90 x (35 - 15)
  216 = m x 0.90 x 20
  216 = m x 18
  m = 216 ÷ 18 = 12g

Q5

- The initial temperature of 150g of ethanol was 22^oC. What will be the final temperature of the ethanol if 3240 J was needed to raise the temperature of the ethanol?
(Specific heat capacity of ethanol is 2.44 $J^oC^{-1}g^{-1}$).
- $q = m \times C_g \times (T_f - T_i)$
$q = 3240$ J
$m = 150g$
$C_g = 2.44\ J^oC^{-1}g^{-1}$
$T_i = 22^oC$
- $3240 = 150 \times 2.44 \times (T_f - 22)$
$3240 = 366\ (T_f - 22)$
$8.85 = T_f - 22$
$T_f = 30.9^oC$

Q6

- How much energy is needed to increase the temperature of 500 g of lead from 20 ºC to 45 ºC? The specific heat capacity of lead is 128 J/kg/ºC.
- Mass of lead = 500 ÷ 1000 = 0.5 kg
- Temperature change = 45 – 20 = 25 ºC
- energy needed = 0.5 × 128 × 25 = **1600 J** (1.6 kJ)

Q7

- How much energy is needed to melt 10 g of ice? The specific latent heat of melting for water is 334,000 J/kg.
- mass of ice = 10 ÷ 1000 = 0.01 kg
- energy needed = 0.01 × 334000 = **3340 J** (3.34 kJ)

Q8

- **How much heat is needed to raise the temperature of a block of copper (0.5 kg) from 0°C to 100° C ?** (for copper, c = 386 J / kg K)
- Applying the formula:
- Q = 386 * 0.5 * 100 = 19300 J or 19.3 kJ
- *Comments: It is important to observe the SI units. The mass is in kg and the heat energy in J. Normally the temperature is converted into K,, but because we are taking the difference (or the variation), it doesn't matter what units are used (if kelvin or celsius).*

Q9

- **How much heat is needed to raise the temperature of 0.5 kg of water from 0°C to 100° C?** (for lead, c = 128 J / kg K)
- Q = 4186*0.5*100 = 209300 J or 209.3 kJ
- *Comments: Note that this is more than 1o times the energy needed in the case of copper!*

Q10

- **What would be the final temperature of a mixture of 100 g of water at 90°C and 600 g of water at 20°C ?**
- The amount of heat that will be transferred from the hotter water is:
- 4186*0.1*(90-Tf)
- The amount of heat that will be transferred to the cooler water is:
- 4186*0.6*(Tf-20)
- Because these two quantities must be equal, we have an equation:
- 4186*0.1*(90-Tf) = 4186*0.6*(Tf-20)
- We need to find Tf:
- 418.6 * (90-Tf)=2511.6 * (Tf-20)
- Getting rid of the parenthesis:
- 37674-418.6Tf=2511.6Tf-50232
- -2930.2Tf = -87906
- Tf = 30° C