Answer on Question#38976 - Chemistry - Inorganic Chemistry

Task:
What volume (in L) of 1M HCl is needed to react completely with 0.6 grams of calcium metal?

Solution:
The chemical equation of the reaction is
$Ca + 2HCl = CaCl_2 + H_2$
The number of moles of Ca is
$n(Ca) = m(Ca)/MW(Ca) = 0.6 / 40 = 0.015$ mol
the number of moles of HCl is twice the number of moles of Ca
$n(HCl) = 2n(Ca) = 2 \cdot 0.015 = 0.030$ mol
Now we can find the volume of HCl solution
C(M) = n(mol)/V(L), where C is molar concentration
V(L) = n(mol)/C(M) = 0.030/ 1 = **0.030 L**
Answer: V(L) = **0.030 L**

Task:
Suppose that a temperature rise of 11 degrees Celcius was observed when 80.0 mL of 1.00 M HCl was mixed with 20.0 mL of 4.00 sodium hydroxide. What is the molar heat of neutralization?

Solution:
The chemical equation of the reaction is
$HCl + NaOH = NaCl + H_2O$
The number of moles of acid is
C(M) = n(mol)/V(L)
$n(HCl) = C(HCl) \cdot V(L) = 1.00 \cdot 0.080 = 0.080$ mol
The number of moles of base is
C(M) = n(mol)/V(L)
$n(NaOH) = C(NaOH) \cdot V(L) = 4.00 \cdot 0.020 = 0.080$ mol
The mass of acid is
$m(HCl) = n(mol) \cdot M(mol) = 0.080 \cdot 36.5 = 2.92$ g
The molar heat of neutralization is
$Q = m \cdot Cp \cdot \Delta T$
m – the mass of acid
Cp - The specific heat capacity of the aqueous solutions is 4.184 J $^oC^{-1}$ g^{-1}
$Q = m \cdot Cp \cdot \Delta T = 2.92 \cdot 4.184 \cdot 11 = 134.4$ J
To calculate the molar heat of neutralization we must divide the obtained value by the number of moles reacted:
$Q_m = Q/n = 134.4/0.08 = 1680$ J/mol

Answer: Q_m = 1680 J/mol