1) An organic compound "A" is known to contain only carbon, hydrogen and oxygen. . The
   compound contains, by mass, 13.5% of
   hydrogen and 64.8% of carbon. Below are
   the ^{1}HNMR and IR spectra of the compound.
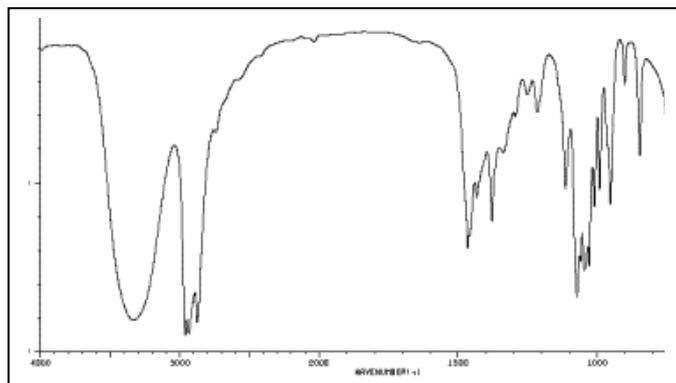
a) What is the empirical formula of the
   compound?
   $C_4H_{10}O$

b) What is the molecular formula of the
   compound if it's molar mass 74.12 g mol$^-$
   $C_4H_{10}O$
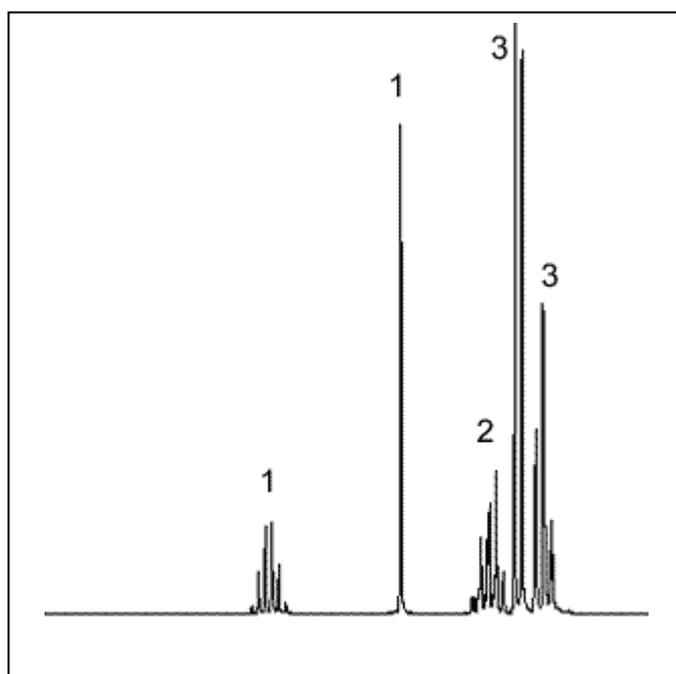
c) Give the semi-structural formula of the
   compound.
   $CH_3CH(OH)CH_2CH_3$

d) Write a combustion reaction for
   compound "A" in its liquid state.
   $2C_4H_{10}O(l) +13 O_2(g) => 8CO_2(g) + 10H_2O(g)$

e) 7.412 grams of liquid compound "A" was
   burnt in excess oxygen in a bomb
   calorimeter containing 100.0 grams of
   water at 25.0 °C. If the temperature of
   the water reached a maximum of 88.9 °C
   calculate the molar heat of combustion,
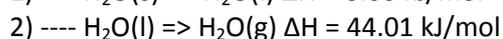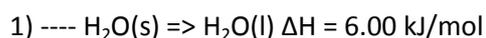   in kJ/mol, of compound "A".

   Step 1 Calculate the mol of compound "A"
   => 7.412 / 74.12 = 0.1000
   Step 2 Calculate the amount of energy released.
   => E = 4.18 X 100.0 X 63.9 = 26.7 kJ
   Step 3 Calculate the molar heat of combustion
   => 26.71/ 0.1000 = 267.1 kJ/mol

2) Consider the following equations

1) ---- $H_2O(s) => H_2O(l)$ ΔH = 6.00 kJ/mol
2) ---- $H_2O(l) => H_2O(g)$ ΔH = 44.01 kJ/mol

    i.   Find the ΔH for the reaction $H_2O(g) => H_2O(l)$
Reverse equation 2 and change the sign of the ΔH
=> $H_2O(g) => H_2O(l)$ ΔH = -44.01 kJ/mol

    ii.   What is the amount of energy in kJ that must be supplied to evaporate 98.5 grams of water
Step 1 Find the mol of water
=> 98.5 / 18.0 = 5.47
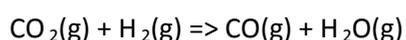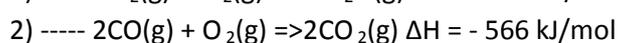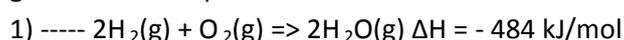Step 2 Find the amount of energy.

$H_2O(l) => H_2O(g)$ ΔH = 44.01 kJ/mol
=> Energy to evaporate 5.47 mol of water is 5.47 X 44 kJ/mol =241 kJ
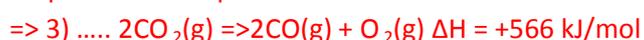
3) Find the ΔH of the reaction below
$CO_2(g) + H_2(g) => CO(g) + H_2O(g)$
given the two equations below.
1) ----- $2H_2(g) + O_2(g) => 2H_2O(g)$ ΔH = - 484 kJ/mol
2) ----- $2CO(g) + O_2(g) => 2CO_2(g)$ ΔH = - 566 kJ/mol
Step 1 Reverse equation 2
=> 3) ..... $2CO_2(g) => 2CO(g) + O_2(g)$ ΔH = +566 kJ/mol
Step 2 Add equations 1 and 3
=> 4)..... $2CO_2(g) + 2H_2(g) => 2CO(g) + 2H_2O(g)$ ΔH = +82 kJ/mol
Step 3 Mulitply equation 4 by ½
=> $CO_2(g) + H_2(g) => CO(g) + H_2O(g)$ ΔH = +41 kJ/mol