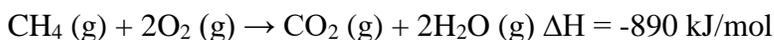


Questions on thermal chemistry

1. The amount of heat evolved when 16 g of copper was displaced from the solution by 2.4 g metal, Q, was 720 kJ. Calculate the heat of displacement. (Q = 24)
2. Iron reacts with copper(II) ions according to the equation.
$$\text{Cu}^{2+}(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{Fe}^{2+}(\text{aq}) \quad \Delta H = -151 \text{ kJ mol}^{-1}$$

Calculate the mass of iron that will cause a heat change of -170 kJ.

3. (a) When methane burns in oxygen, heat is produced. Write an equation for the combustion of methane in excess oxygen.
(b) The heat of combustion of methane is -890 kJ mol^{-1} . Calculate the volume of methane gas at s.t.p that when burned in excess oxygen would raise the temperature of 178 g of water by 10°C .
4. (a) Bio gas contains mainly methane. Name two raw materials that can be used to produce biogas.
(b) Methane burns in oxygen according to the equation:



Calculate the volume of methane at s.t.p. that will burn in excess oxygen to produce 2670kJ.

5. The enthalpy of combustion of carbon is -393 kJ mol^{-1} .
(a) Write an equation for the complete combustion of carbon.
(b) 80kg of charcoal cost 4,000/=. Calculate the cost of charcoal required to produce 16735kJ.
6. (a) Describe an experiment that can be carried out to determine the heat of combustion of ethanol. Draw a diagram to illustrate your answer.
(b) Would you expect the heat of combustion as determined in the experiment in (a) to be greater than, lower than or equal to the theoretical value. Give a reason for your answer.

(c) When 0.382 g of ethanol was burnt, the heat evolved raised the temperature of 100 g of water from 16.0°C to 43.0°C . Calculate the heat of combustion of ethanol.

(d) Name two products, other than water of incomplete combustion of ethanol.
7. (a) 50 cm^3 of 2 M hydrochloric acid and 50 cm^3 of 2 M sodium hydroxide, both at 22°C , were mixed in a plastic beaker. The mixture was stirred and its maximum temperature was 35°C . (specific heat capacity of the solution = $4.2 \text{ J/g }^\circ\text{C}$, density of the solution = 1 g/cm^3)
(i) Write an ionic equation for the reaction which took place.

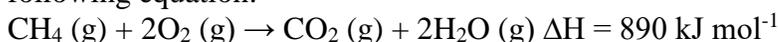
(ii) Calculate the heat of the reaction.

(b) 50 cm³ of 2 M ammonia solution was used instead of sodium hydroxide solution in (a). State whether the heat of the reaction was greater than, smaller than or equal to the value you have calculated in (a) (ii). Give a reason for your answer.

8. (a) Write an equation to show how ethanol can be prepared from glucose.
(b) State how a sample of ethanol obtained from the product of the reaction in (a) can be purified.

(c) When 23 g of ethanol was completely burnt, 13600 J of heat was produced. Calculate the molar heat of combustion of ethanol.

9. 7.5 g of methane, CH₄ was completely burnt in air. Methane burns in air according to the following equation:



Calculate the

(i) Mass of carbon dioxide formed.

(ii) Heat evolved.

10. When 6.4 g of zinc powder were added to 250 cm³ of a 0.1 M copper(II) sulphate solution in a plastic cup, 5.45 kJ of heat was liberated.

(a) Explain why a plastic cup was used instead of a metallic cup.

(b) Write an equation for the reaction between zinc powder and copper(II) sulphate.

(c) Calculate the

(i) Number of moles of zinc in 6.5 g of zinc powder.

(ii) Number of moles of zinc which reacted with copper(II) sulphate.

(iii) Heat energy produced when 1 mole of zinc reacts with 1 mole of copper(II) sulphate.

11. The formation of methanol from hydrogen and carbon monoxide is represented by the equation.



What would be the energy released in kJ mol⁻¹, when 3.2 g of methanol is formed?

12. An experiment was carried out to determine the molar heat of combustion of methanol. A small lamp containing methanol was weighed and then lit. The heat produced by the combustion of methanol was used to raise the temperature of 100 g of water in a metal can (ignore the heat required to raise the temperature of the metal can). The spirit lamp was weighed again after the experiment.

Results:

Mass of the spirit lamp + contents before heating = 36.17 g.

Mass of the spirit lamp + content after heating = 34.07 g.

Temperature of the water before the experiment = 20 °C.

Temperature of the water after the experiment = 80 °C.

- (a) What was the rise in temperature of water during the experiment?
- (b) Calculate the amount of heat obtained by the water during the experiment.
- (c) What mass of methanol was burnt during the experiment?
- (d) Calculate the heat of combustion of methanol.