5.3 Bond Enthalpy

Question Paper

Course	DP IB Chemistry
Section	5. Energetics / Thermochemistry
Topic	5.3 Bond Enthalpy
Difficulty	Hard

Time allowed: 50

Score: /39

Percentage: /100

Question 1a

a)
Define the term *average bond enthalpy*.

[2]

[2 marks]

Question 1b

b)
Determine the bond dissociation energy, in kJ mol^{-1}, for one mole of O–F bonds using the following equation and section 11 of the data booklet. Give your answer to 3 significant figures.

$$F_2(g) + ½O_2(g) \rightarrow OF_2(g) \quad \Delta H_r = +28 \text{ kJ mol}^{-1}$$

[3]

[3 marks]

Question 1c

c)
The reaction of ethanoyl chloride, CH_3COCl, and ethanol form an ester. State the equation for this reaction.

[2]

[2 marks]

Question 1d

d)
Use section 11 in the data booklet to deduce the energy required, in kJ mol^{-1}, to break the bonds.

[2]

[2 marks]

Question 1e

e)
Deduce the energy released, in kJ mol^{-1}, when the bonds are formed and therefore the enthalpy change for the reaction.

[3]

[3 marks]

Question 2a

a)
Methane reacts violently with fluorine to form carbon tetrafluoride and hydrogen fluoride

Formulate the equation for this reaction.

[2]

[2 marks]

Question 2b

b)
Use your answer to part a) and section 10 of the data booklet to calculate the following:

i)
The energy required, in kJ, to break the bonds for the reaction between methane and fluorine.

[1]

ii)
The energy released, in kJ, to form the bonds for the reaction between methane and fluorine.

[1]

iii)
The enthalpy change, ΔH_r, in kJ mol^{-1} for this reaction.

[2]

[4 marks]

Question 2c

c)
A student suggested that one reason for the high reactivity of fluorine is a weak F–F bond. State whether the student is correct. Justify your answer.

[2]

[2 marks]

Question 2d

d)
Sketch a labelled energy diagram for the reaction of methane and fluorine.

[3]

[3 marks]

Question 3a

a)

Hydrazine has the formula N_2H_4 and is used as a rocket fuel (e.g. for the Apollo moon rockets). It burns in the following reaction for which the enthalpy change is -583 kJ mol^{-1}.

$$N_2H_4(g) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

Sketch the Lewis structure of hydrazine, N_2H_4.

[2]

[2 marks]

Question 3b

b)

Use section 11 of the Data booklet and the information in part a) to deduce the bond enthalpy, in kJ mol^{-1}, for the N-N bond.

[3]

[3 marks]

Question 3c

c)
Outline why the value of enthalpy of reaction calculated from bond enthalpies is less accurate.

[1]

[1 mark]

Question 4a

a)
Ozone prevents UV radiation emitted from the Sun reaching the surface of the Earth. Draw the resonance Lewis structures of ozone.

[3]

[3 marks]

Question 4b

b)
By using equations, state the environmental impact of CFCs on the ozone layer.

[4]

[4 marks]

Question 4c

c)
The destruction of ozone is a significant environmental issue as ozone can absorb frequencies of ultraviolet radiation that oxygen can not.

Explain with reference to the structure and bonding of oxygen and ozone why this occurs.

[3]

[3 marks]