

# 5.3 Bond Enthalpy

## Question Paper

|            |                                 |
|------------|---------------------------------|
| Course     | DPIB 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*.

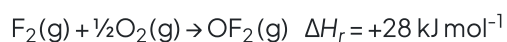
[2]

[2 marks]

### Question 1b

b)

Determine the bond dissociation energy, in  $\text{kJ mol}^{-1}$ , 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.



[3]

[3 marks]

### Question 1c

c)

The reaction of ethanoyl chloride,  $\text{CH}_3\text{COCl}$ , 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  $\text{kJ mol}^{-1}$ , to break the bonds.

[2]

**[2 marks]****Question 1e**

e)

Deduce the energy released, in  $\text{kJ mol}^{-1}$ , 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,  $\Delta H_r$ , in  $\text{kJ mol}^{-1}$  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)

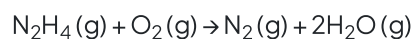
Sketch a labelled energy diagram for the reaction of methane and fluorine.

[3]

**[3 marks]****Question 3a**

a)

Hydrazine has the formula  $\text{N}_2\text{H}_4$  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  $-583 \text{ kJ mol}^{-1}$ .



Sketch the Lewis structure of hydrazine,  $\text{N}_2\text{H}_4$ .

[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  $\text{kJ mol}^{-1}$ , 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]**