Past-paper walk-through

Intermolecular forces, electronegativity and bond properties ▪ 3.6

eXercise

Questions in this set

- 9701/14 N25 Q7 ▪ 1 mark
- 9701/22 N25 Q3 ▪ 14 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 7

9701/14 N25 ▪ Q7 ▪ 1 mark

7 The boiling point of water, H_2O, is higher than that of hydrogen sulfide, H_2S.

Which statement explains this difference in boiling points?

A The bond energy of O–H is greater than the bond energy of S–H.

B The intermolecular forces in H_2O are weaker than the intermolecular forces in H_2S.

C The S–H bond in H_2S is longer than the O–H bond in H_2O.

D There is significant intermolecular hydrogen bonding in H_2O but **not** in H_2S.

Solution 7

Answer: **D**

Why

- Oxygen is far more electronegative than sulfur, so the O–H bond is strongly polar.
- That allows hydrogen bonding between water molecules – much stronger than the forces in H_2S.
- Boiling point is set by the *intermolecular* forces, not by the strength of the bonds inside the molecule.

Question 3

9701/22 N25 ▪ Q3 ▪ 14 marks

3 The alkanes are a homologous series of organic molecules. Alkanes are generally unreactive and are commonly used as fuels.

(a) Define homologous series.

Question 3

(b) Give two reasons to explain the general unreactivity of alkanes.

Question 3

Question 3

[2]

(c) Alkanes with low relative molecular mass, M_r, are more useful than those found in heavier crude oil fractions.

Name the process that is used to obtain alkanes with low M_r from heavier crude oil fractions.

Question 3

(d) Hexane, C_6H_{14}, has four structural isomers.

Fig. 3.1 shows hexane and two of its structural isomers.

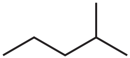
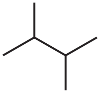
hexane	**A**	**B**	**C**	**D**
				

Fig. 3.1

(i) Complete Fig. 3.1 by drawing structures for **C** and **D**, the other two structural isomers of hexane. [2]

(ii) **A**, **B** and hexane have different boiling points.

Question 3

Question 3

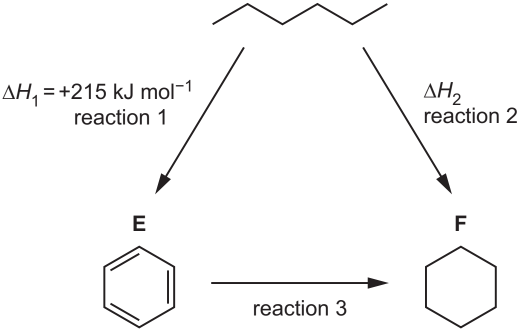
Arrange **A**, **B** and hexane in order of increasing boiling point.

Explain your answer.

Question 3

[3]

(e) Hexane can be converted into compounds **E** and **F** at high temperature and pressure. Fig. 3.2 shows the reaction scheme involving hexane, **E** and **F**.



Question 3

Fig. 3.2

Question 3

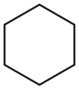
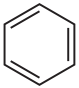
Fig. 3.2

(i) Identify a suitable reagent for reaction 3.

Question 3

(ii) Use the data in Fig. 3.2 and in Table 3.1 to calculate the enthalpy change of reaction 2, ΔH_2.

Table 3.1

compound	enthalpy change of formation, ΔH_f / kJ mol^{-1}
	−156
	+48

Question 3

Question 3

Question 3

(iii) Write an equation for the complete combustion of hexane.

Question 3

[Total: 14]

Solution 3

(a)

Mark scheme

- M1 (family of molecules / compounds / series with) same general formula
- OR (family of molecules where) molecular formula differs (only) by (units of) CH2(n). M2
- similar chemical properties / reactions
- 2

Solution 3

(b)

Mark scheme

- M1 strong C—H (bonds) M2
- non-polar (C—H / molecule / bonds)
- 2

Solution 3

(c)

Mark scheme

- cracking
- 1

Solution 3

(d)(i)

Mark scheme

- 2

(d)(ii)

Mark scheme

- M1 B $<$ A $<$ hexane. M2
- hexane / unbranched has stronger / more IMFs M3
- hexane / unbranched requires most / more energy
- 3

Solution 3

(e)(i)

Mark scheme

- H2 ((g)) OR hydrogen (gas)
- 1

Solution 3

(e)(ii)

Mark scheme

- M1 $+215 + (–156) – (+48) =$ M2
- $+11$ kJ mol–1
- 2

Solution 3

(e)(iii)

Mark scheme

- $C_6H_{14} + 9\frac{1}{2}O_2 \rightarrow 6CO_2 + 7H_2O$
- 1