

Chemical Energetics

Question Paper 4

Level	IGCSE
Subject	Chemistry
ExamBoard	CIE
Topic	Chemical Energetics
Sub-Topic	
Paper	(Extended) Theory
Booklet	Question Paper 4

TimeAllowed: 93 minutes

Score: / 77

Percentage: /100

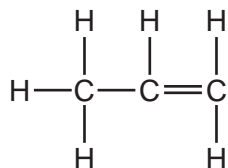
1 The alkenes are a series of unsaturated hydrocarbons. They have the general molecular formula C_nH_{2n} .

(a) Deduce the molecular formula of an alkene which has a relative molecular mass of 126. Show your working.

.....

..... [2]

(b) The structural formula of propene is drawn below.



(i) Draw a diagram showing the arrangement of the valency electrons in one molecule of this covalent compound.

Use x to represent an electron from an atom of carbon.

Use o to represent an electron from an atom of hydrogen.

[3]

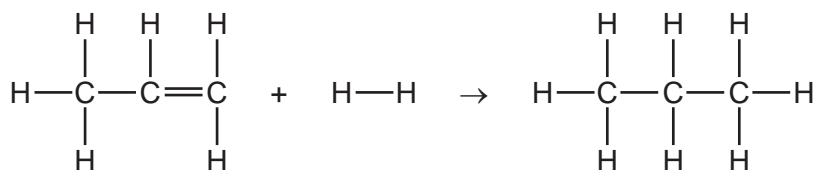
(ii) Draw the structure of the polymer formed from propene

[2]

- (iii) Bond energy is the amount of energy, in kJ, which must be supplied to break one mole of the bond.

bond	bond energy in kJ/mol
H—H	+436
C=C	+610
C—C	+346
C—H	+415

Use the data in the table to show that the following reaction is exothermic.



.....

 [3]

- (c) This question is concerned with some of the addition reactions of but-1-ene.

- (i) Name the product formed when but-1-ene reacts with water.

..... [1]

- (ii) Complete the equation.



- (iii) Deduce the formula of the compound which reacts with but-1-ene to form 1-iodobutane.

..... [1]

[Total: 14]

2 An ore of the important metal zinc is zinc blende, ZnS. This is changed into zinc oxide which is reduced to the impure metal by carbon reduction.

(a) (i) How is zinc oxide obtained from zinc sulfide?

.....
..... [2]

(ii) Write a balanced equation for the reduction of zinc oxide by carbon.

..... [1]

(iii) The major impurity in the zinc is cadmium. The boiling point of zinc is 907 °C and that of cadmium is 767 °C.

Name a technique which could be used to separate these two metals.

..... [2]

(b) In common with most metals, zinc is a good conductor of electricity. It is used as an electrode in cells.

(i) Give **two** other uses of zinc.

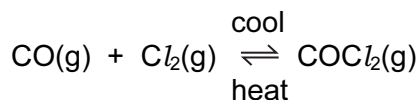
.....
..... [2]

(ii) Describe the metallic bonding in zinc and then explain why it is a good conductor of electricity.

.....
.....
.....
..... [4]

[Total: 11]

3 Carbonyl chloride, COCl_2 , is a colourless gas. It is made by the following reaction.



(a) When the pressure on the equilibrium mixture is decreased, the position of equilibrium moves to left.

(i) How does the concentration of each of the three chemicals change?

.....
 [2]

(ii) Explain why the position of equilibrium moves to left.

.....
 [2]

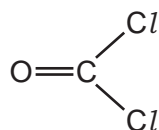
(b) Using the information given with the equation, is the forward reaction exothermic or endothermic? Give a reason for your choice.

.....
 [2]

(c) Carbonyl chloride reacts with water to form two acidic compounds. Suggest which acidic compounds are formed.

1.
 2. [2]

(d) The structural formula of carbonyl chloride is given below.



Draw a diagram that shows the arrangement of the valency electrons in one molecule of this covalent compound.

Use x for an electron from a chlorine atom.

Use o for an electron from a carbon atom.

Use ● for an electron from an oxygen atom.

4 Sulphuric acid is made by the Contact process in the following sequence of reactions.



(a) (i) How is sulphur dioxide made from sulphur?

..... [1]

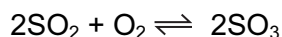
(ii) Sulphur dioxide has other uses.
Why is it used in the manufacture of paper?

..... [1]

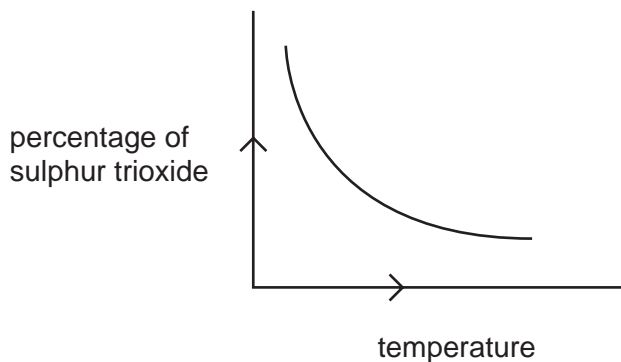
(iii) How does it preserve food?

..... [1]

(b) The equation for a stage of the Contact process is



The percentage of sulphur trioxide in the equilibrium mixture varies with temperature.



(i) How does the percentage of sulphur trioxide in the equilibrium mixture vary as the temperature increases? Circle the correct answer.

increases **stays the same** **decreases** [1]

(ii) Is the forward reaction in the equilibrium $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ exothermic or endothermic? Give a reason for your choice.

.....
..... [2]

(iii) Explain, mentioning both rate and percentage yield, why the temperature used in the Contact process is 450°C.

.....
..... [2]

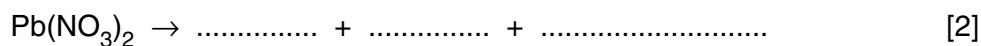
(iv) Describe how the sulphur trioxide is changed into concentrated sulphuric acid.

.....
..... [2]

5 Nitrogen dioxide, NO_2 , is a dark brown gas.

(a) Most metal nitrates decompose when heated to form the metal oxide, nitrogen dioxide and oxygen.

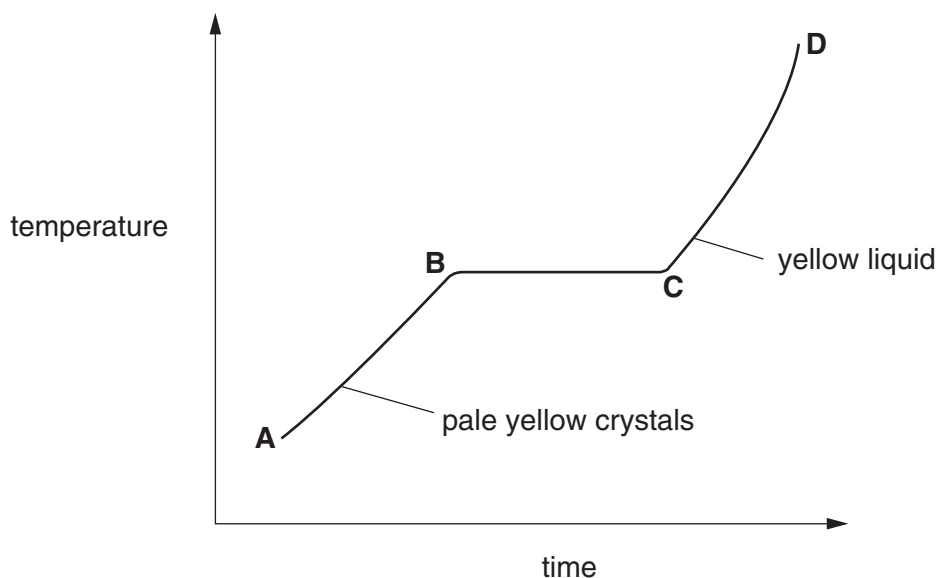
(i) Write a symbol equation for the decomposition of lead(II) nitrate.



(ii) Potassium nitrate does not form nitrogen dioxide on heating. Write the word equation for its decomposition.

.....[1]

(b) When nitrogen dioxide is cooled, it forms a yellow liquid and then pale yellow crystals. These crystals are heated and the temperature is measured every minute. The following graph can be drawn.



(i) Describe the arrangement and movement of the molecules in the region A–B.

.....

(ii) Name the change that occurs in the region **B–C**

.....[4]

(c) Nitrogen dioxide and other oxides of nitrogen are formed in car engines.

(i) Explain how these oxides are formed.

.....
.....

(ii) How are they removed from the exhaust gases?

.....
.....[4]

(d) Nitrogen dioxide, oxygen and water react to form dilute nitric acid.

Describe how lead(II) nitrate crystals could be prepared from dilute nitric acid and lead(II) oxide.

.....
.....
.....[3]

6 The first three elements in Period 6 of the Periodic Table of the Elements are caesium, barium and lanthanum.

(a) How many **more** protons, electrons and neutrons are there in one atom of lanthanum than in one atom of caesium. Use your copy of the Periodic Table of the Elements to help you.

number of protons

number of electrons

number of neutrons [3]

(b) All three metals can be obtained by the electrolysis of a molten halide. The electrolysis of the aqueous halides does not produce the metal.

(i) Complete the equation for the reduction of lanthanum ions at the negative electrode (cathode).



(ii) Name the **three** products formed by the electrolysis of aqueous caesium bromide.

.....
.....[4]

(c) All three metals react with cold water. Complete the word equation for these reactions.

metal + water → + [2]

(d) Barium chloride is an ionic compound. Draw a diagram that shows the formula of the compound, the charges on the ions and gives the arrangement of the valency electrons around the negative ion.

The electron distribution of a barium atom is 2.8.18.18.8.2

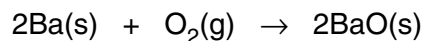
Use x to represent an electron from a barium atom.

Use o to represent an electron from a chlorine atom.

- (e) Describe, by means of a simple diagram, the lattice structure of an ionic compound, such as caesium chloride.

[2]

- (f) The reactions of these metals with oxygen are exothermic.



- (i) Give an example of bond forming in this reaction.

.....

- (ii) Explain using the idea of bond breaking and forming why this reaction is exothermic.

.....

.....[3]