

Section A

Answer **ALL** questions

A1 Choose from the following elements to answer the questions below.

Argon bromine carbon hydrogen

Iodine iron neon sulphur

Each element can be used once, more than once, or not at all.

Name an element which

a) forms a basic oxide,

.....[1]

b) is a liquid at room temperature and pressure,

.....[1]

c) reacts with aqueous copper(II) sulphate to give a pink solid,

.....[1]

d) is formed during the electrolysis of concentrated aqueous sodium chloride,

.....[1]

e) has a giant molecular structure.

.....[1]

[Total: 5]

A2 Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, is a liquid fuel. Ethanol can be manufactured either from glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ or from ethene

a) Briefly describe the manufacture of ethanol from glucose.

Include the balanced equation in your answer.

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

b)

(i) Draw the displayed formula for ethene.

(ii) Name the substance that reacts with ethene to make ethanol.

.....

(iii) Give the conditions needed for this reaction.

.....

..... [4]

[Total: 8]

A3 Petroleum is a complex mixture of hydrocarbons. Petroleum is a source of many useful fuels.

a) What is meant by the term *hydrocarbon*?

.....
..... [1]

b) Petroleum is refined by fractional distillation.

(i) Complete the following table about the fractions obtained from petroleum. [2]

fraction	use
petrol (gasoline)	fuel for cars
paraffin (kerosene)	
diesel	fuel for diesel engines
bitumen	

(ii) Name one **other** fraction obtained from petroleum.

..... [1]

- c) Fractional distillation of petroleum does not produce sufficient of some fractions to match demand.

Cracking is used to convert large hydrocarbon molecules into smaller molecules that are more in demand.

A hydrocarbon of molecular formula $C_{12}H_{26}$ is cracked.

- (i) Suggest the formula of one **alkane** that may be produced.

.....

- (ii) Suggest the formula of one **alkene** that may be produced.

.....

- (iii) Describe a chemical test that can be used to distinguish between an alkene and an alkane.

chemical test

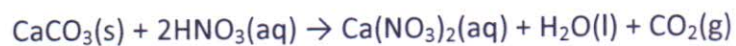
result with alkane

result with alkene[4]

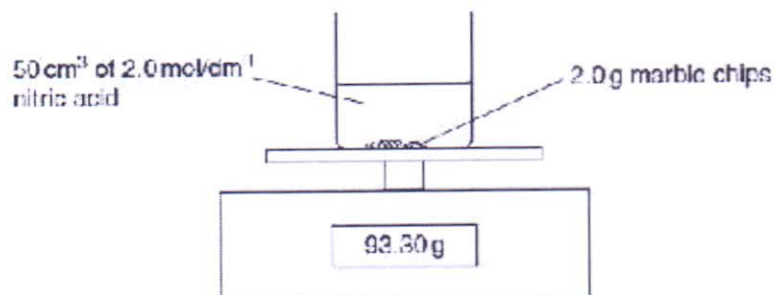
[Total: 8]

- A4** Marble statues are being damaged by acid rain. The chemical name for marble is calcium carbonate.

A student investigated the reaction between marble chips and nitric acid.



The diagram shows the apparatus the student used.



The student recorded the balance reading every minute.

The table shows the results.

time / minutes	balance reading / g
0	93.30
1	93.28
2	93.26
3	93.24
4	93.22
5	93.21
6	93.20
7	93.19
8	93.18
9	93.17
10	93.16
11	93.15
12	93.15
13	93.14
14	93.14

a) Explain why the balance reading decreases during the experiment.

.....
.....[1]

b) How can the student tell when the reaction has finished?

.....
.....[1]

c)

(i) Calculate the number of moles of nitric acid in 50 cm³ of
2.0 mol /dm³ solution. [1]

(ii) Calculate the number of moles of calcium carbonate in 2.0 g
of its sample. [1]

(iii) Which reagent, calcium carbonate or nitric acid, is in excess?

Explain your answer.

[3]

- d) The student repeats the experiment using the same quantities of calcium carbonate and nitric acid. This time the acid is at a higher temperature. Describe and explain, in terms of collisions between reacting particles, the effect of increasing the temperature on the rate of reaction.

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

[Total: 10]

A5 A student adds aqueous sodium hydroxide from a burette into 25.0 cm³ of dilute sulphuric acid. The student measures the pH value of the mixture during the addition of the sodium hydroxide.

a) Describe how the pH value changes.

.....[1]

b) Give an ionic equation to represent the neutralisation reaction between sodium hydroxide and sulphuric acid.

.....[1]

c) Sulphuric acid is a strong acid.

(i) What is meant by the term *acid*?

.....
.....

(ii) What is the difference between a strong acid and a weak acid?

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

d) Dilute sulphuric acid reacts with magnesium to give hydrogen.

Give the equation for this reaction.

.....[1]

[Total: 6]

A6 The carbonates of many metallic elements decompose when heated.

- a) Name the gas produced during the decomposition of a metal carbonate and describe a chemical test for this gas.

gas produced

chemical test

.....[2]

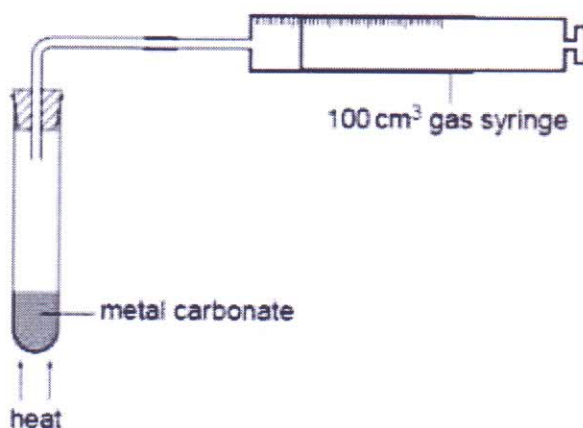
- b) Calcium oxide is manufactured by the decomposition of calcium carbonate.

Write the equation for this decomposition.

.....[1]

- c) A student investigates the decomposition of five different metal carbonates.

The diagram shows the apparatus the student uses.



The student heats a 0.010 mol sample of each carbonate using the blue flame of the same Bunsen burner. She measures the time it takes for 100 cm³ of gas to be collected in the gas syringe. The table shows her results.

carbonate	time taken to collect 100 cm ³ of gas /s
metal U carbonate	25
metal V carbonate	100
metal X carbonate	300
metal Y carbonate	no gas produced after 1000 seconds
metal Z carbonate	50

The student used calcium carbonate, copper(II) carbonate, magnesium carbonate, sodium carbonate and zinc carbonate.

Complete the table to show the identity of each metal **U**, **V**, **X**, **Y** and **Z**.

metal	name of metal
U
V
X
Y
Z

Explain how you used the student's results to identify each metal.

.....

 [3]

d) The nitrates of metallic elements also decompose when heated.

Calcium nitrate decomposes to form calcium oxide, nitrogen dioxide and oxygen.



A 0.010 mol sample of calcium nitrate is heated. Calculate the number of moles of gases produced when this sample is completely decomposed.

..... moles [2]

[Total: 8]

SECTION B

Answer any **three** questions from this section

The total marks of this section are **30**.

B1 The typical composition of solid domestic waste in a city is shown below.

type of solid waste	percentage by mass
glass	9
metals	8
organic waste including food	22
paper	38
plastics	9
textiles	2
other	12

a) The most abundant metals in the solid waste are aluminium, copper and iron.

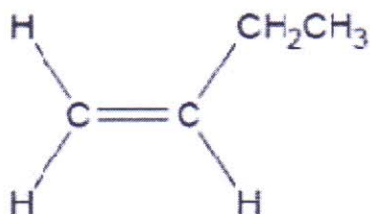
Describe **two** advantages of recycling these metals.

.....

.....

.....[2]

b) One of the polymer molecules in the plastic waste is made from the monomer shown below.



Draw the partial structure of the **polymer** formed from this monomer showing two repeats.

[2]

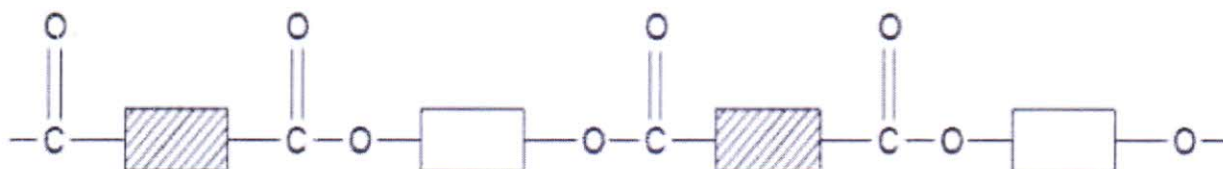
- c) Many of the polymers found in the plastic waste are non-biodegradable.

Describe **two** pollution problems caused by the disposal of non-biodegradable polymers.

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

- d) *Terylene* and nylon are two of the textiles present in the solid waste.

The partial structure of *Terylene* is shown below.



(i) *Terylene* is a polyester.

What type of polymerisation is used to make *Terylene*?

.....[1]

(ii) Complete the diagram below to show the partial structure for nylon.



[2]

(iii) Give the name of one **type** of food that has molecules containing the same linkages as *Terylene*.

.....[1]

[Total: 10]

- B2** The table gives some information about the first five members of the carboxylic acid Homologous series.

carboxylic acid	formula	boiling point/°C
methanoic acid	HCO ₂ H	101
ethanoic acid	CH ₃ CO ₂ H	118
propanoic acid	C ₂ H ₅ CO ₂ H	141
butanoic acid		166
pentanoic acid	C ₄ H ₉ CO ₂ H	

a)

- (i) Estimate the boiling point of pentanoic acid.

.....[1]

- (ii) Draw the structure of butanoic acid. Show all atoms and bonds.

[1]

- (iii) Ethanoic acid reacts with sodium.

Write an equation for this reaction.

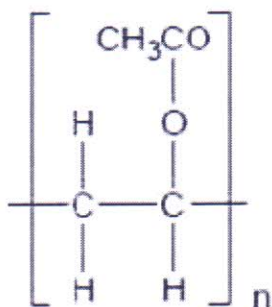
..... [1]

b) Carboxylic acids react with alcohols to form esters.

- (i) Name the ester formed when ethanoic acid reacts with ethanol.

..... [1]

- (ii) The diagram shows the repeat unit of poly (ethenyl ethanoate)



Draw the structure of the monomer used to make poly (ethenyl ethanoate). [1]

- c) Carboxylic acid **X** contains 55.8% carbon, 7.0% hydrogen and 37.2% oxygen.
(i) Calculate the empirical formula of **X**. [2]

(ii) A molecule of carboxylic acid **X** contains four carbon atoms. What is its molecular formula?

.....[1]

(iii) Carboxylic acid **X** is an unsaturated compound.

Give a test for an unsaturated compound.

test

observation[2]

[Total: 10]

B3 Glass contains silicon (IV) oxide and a number of metal oxides.

a) The structure of silicon (IV) oxide is shown below.



Key:
● silicon atom
○ oxygen atom

(i) Describe **two** similarities in the structure of silicon (IV) oxide and diamond.

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

(ii) Explain why silicon (IV) oxide has a high melting point.

..... [2]

(iii) Explain why silicon (IV) oxide does not conduct electricity.

..... [1]

b) Explain how silicon (IV) oxide is different from graphite in terms of conductivity and hardness.

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

c) Sodium oxide is an ionic compound.

[3]

Draw a 'dot-and-cross' diagram to show

- the arrangement of the outer shell electrons,
- the charges on the ions and
- the formula of sodium oxide.

[Total: 10]

B4 Nitric oxide, NO, is an atmospheric pollutant formed inside car engines by the reaction between nitrogen and oxygen.



This reaction is endothermic.

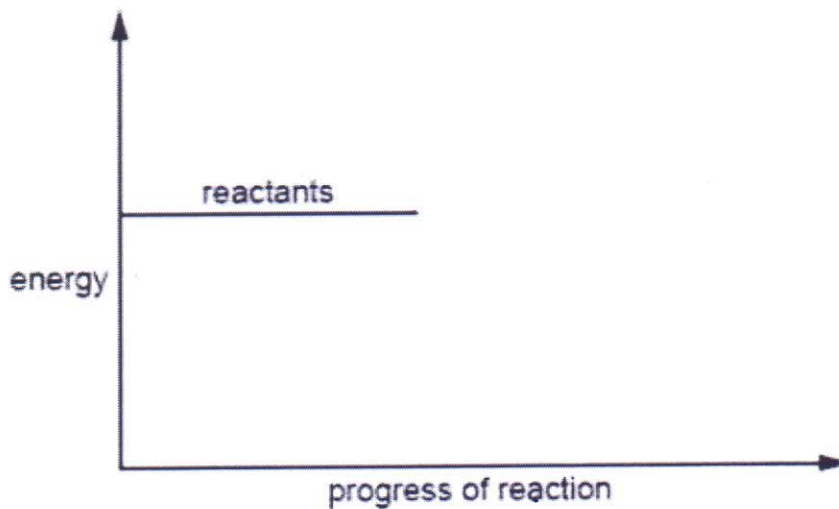
a) Explain the meaning of the term *endothermic*.

.....
..... [1]

b) Complete the energy profile diagram for the reaction between nitrogen and oxygen.

On your diagram label the

- product,
- activation energy, E_a ,
- enthalpy change for the reaction, ΔH .



[3]

- c) Calculate the mass of nitric oxide formed when 100 g of nitrogen reacts completely with oxygen.

mass of nitric oxide = g [3]

- d) Explain how the speed of reaction between nitrogen and oxygen changes when the pressure of the gaseous mixture is increased from 1 atmosphere to 10 atmospheres.

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

[Total: 10]