

National 5 Chemistry

Identified Past Paper Questions from
SQA Credit and Intermediate 2 papers

Unit 3: Chemistry in Society

and problem solving

March 2014



Chemistry N5 Past Paper Questions

These questions have been taken from the 2013, 2012 and 2011 Standard Grade and Intermediate 2 Past Papers.

The questions are divided into 3 sections.

1. Unit 1 - Chemical Changes and Structure
2. Unit 2 - Nature's Chemistry
3. Unit 3 - Chemistry in Society

Although a lot of the questions are integrated across the units, questions have been separated into sub-sections separated into key areas. The stem of the question has been retained to give the context of the question. If practitioners require the full integrated question, they can refer to the original past paper on the SQA website.

Unit 3 - Chemistry in Society

Mandatory Course key areas:

Metals

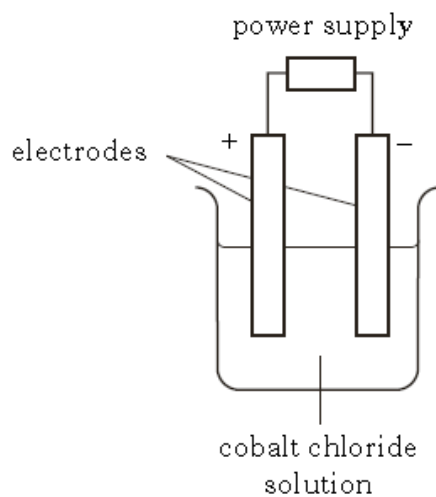
Nuclear Chemistry

Chemical Analysis

Chemistry in Society
Metals

Marks

1. A student set up the following experiment to electrolyse cobalt chloride solution.



- (a) What **type** of power supply **must** be used to electrolyse cobalt chloride solution?
- (b) Describe what would be **seen** at the positive electrode.
You may wish to use the data booklet to help you.

1

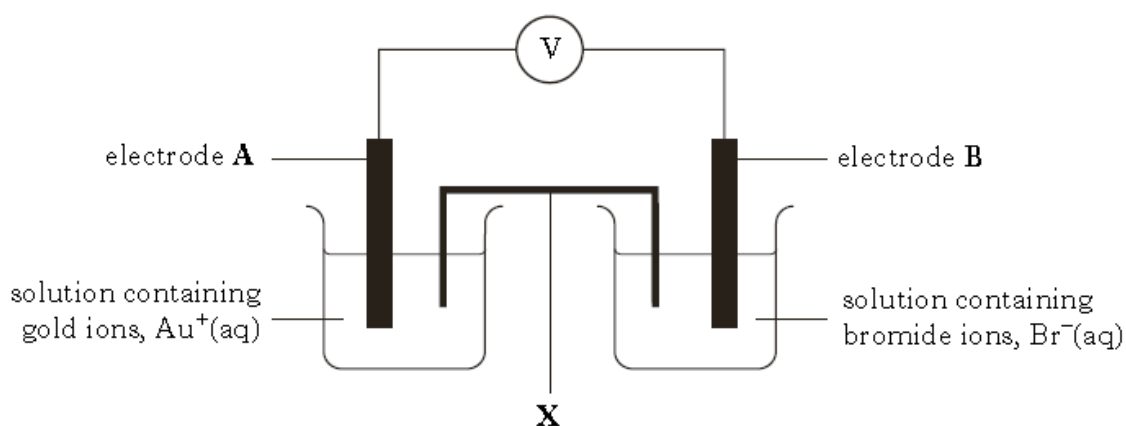
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Chemistry in Society

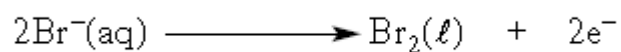
Metals

Marks

2. A technician set up the following cell.



The reaction taking place at electrode **B** is:



- (a) **On the diagram**, clearly mark the path and direction of electron flow. 1
- (b) Write the ion-electron equation for the reaction taking place at electrode **A**. 1
You may wish to use the data booklet to help you.
- (c) Name the piece of apparatus labelled **X**. 1

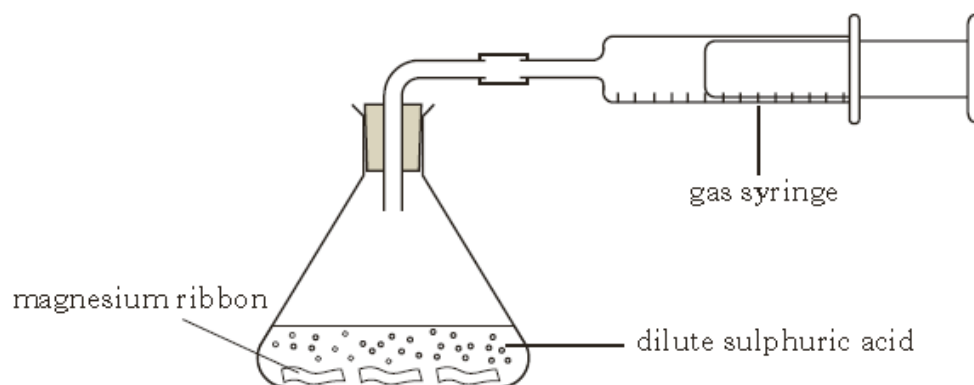
Chemistry in Society

Metals

Marks

3. Hydrogen gas is produced when magnesium reacts with dilute sulphuric acid.

1



The equation for the reaction is:



Circle the formula for the salt in the above equation.

Chemistry in Society

Metals

Marks

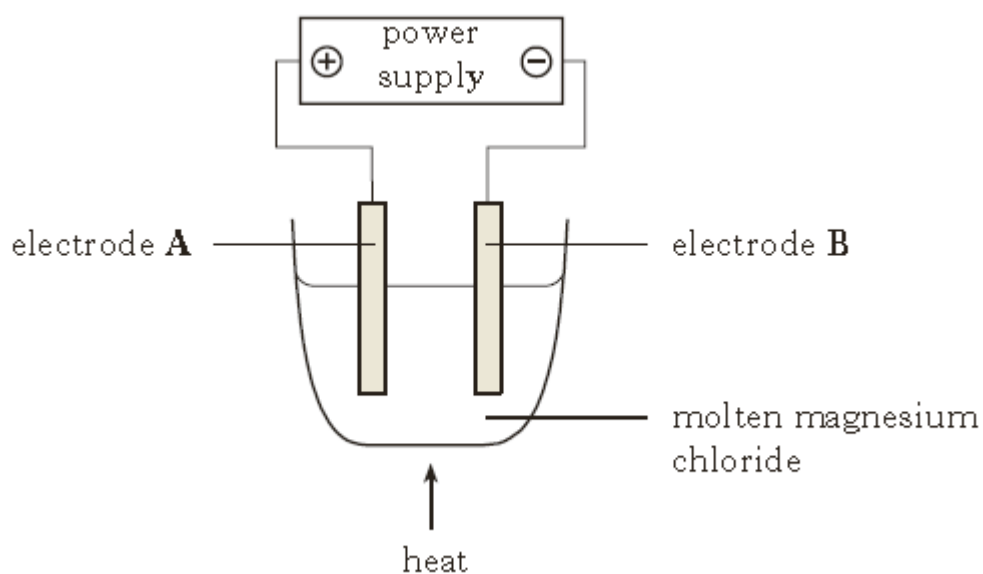
4. Titanium is an important metal used in aircraft manufacture.
(a) Titanium can be produced from titanium chloride as shown.

1



Name the type of chemical reaction represented by the equation.

(b) The magnesium chloride produced can be electrolysed as shown.



(i) At which electrode would magnesium be produced, **A** or **B**?

1

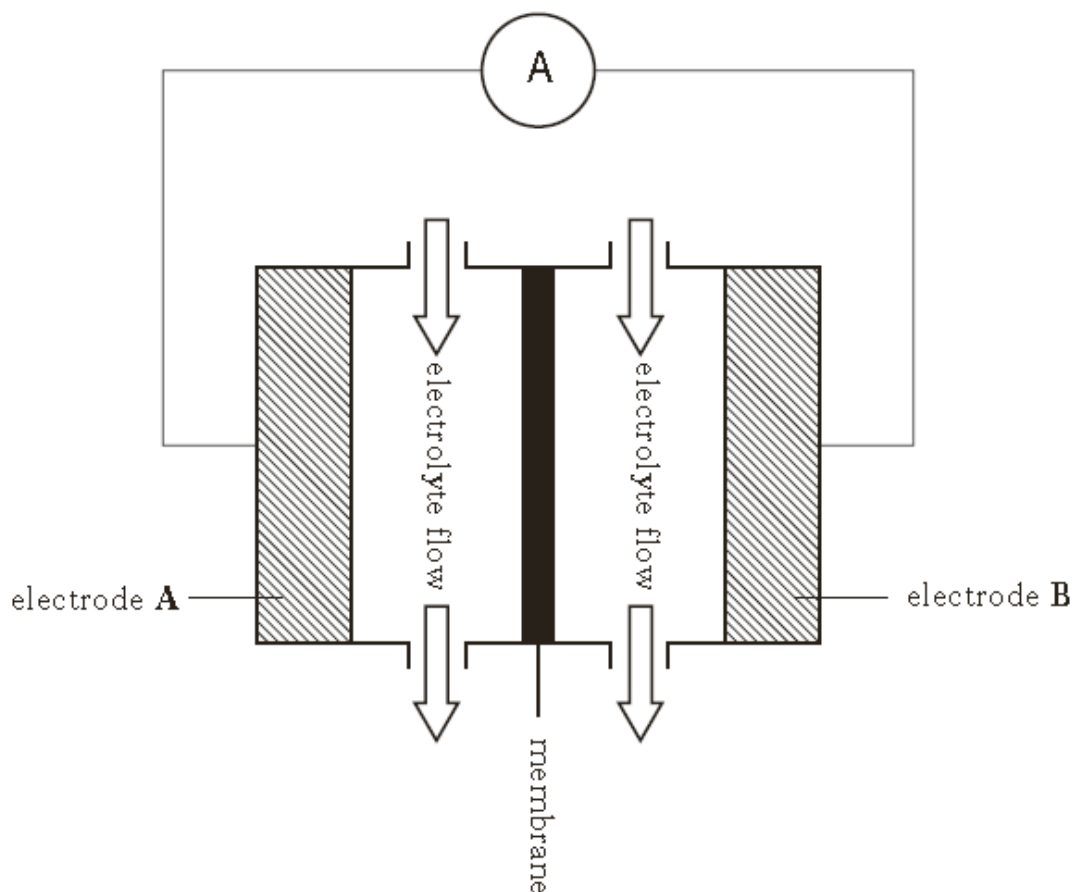
(ii) Write the ion-electron equation for the formation of chlorine.
You may wish to use the data booklet to help you.

1

Chemistry in Society
Metals

Marks

5. In Australia flow cells are used to store the energy from solar cells.



- (a) The reaction taking place at electrode **A** when the cell is providing electricity is:

1



Name the type of chemical reaction taking place at electrode **A**.

- (b) **On the diagram**, clearly mark the path and direction of electron flow.

1

- (c) Name the non-metal that conducts electricity, which could be used as an electrode.

1

Chemistry in Society

Metals

Marks

6. The composition of a 250g magnet is shown.

1

Metal	aluminium	nickel	cobalt	copper	titanium	iron
% by mass	10	25	20	4	1	40

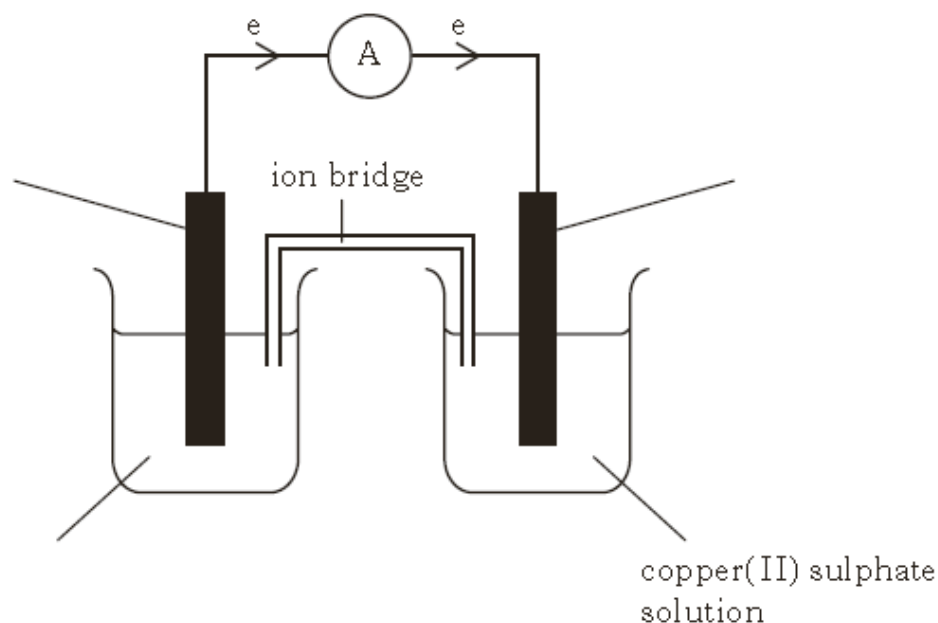
Calculate the mass, in grams, of aluminium in the magnet.
Show your working clearly.

Marks

7. Zinc displaces copper from copper(II) sulphate solution.
The equation for the reaction is:



- (a) Circle the spectator ion in the above equation. 1
(b) Write the ion-electron equation for the **oxidation** step in this reaction. 1
You may wish to use the data booklet to help you.
(c) The reaction can also be carried out in a cell.



- (i) Complete the **three labels** on the diagram. 1
(ii) What is the purpose of the ion bridge? 1

Chemistry in Society

Metals

8. Mercury can be extracted from the ore cinnabar, **HgS**.
Calculate the percentage by mass of mercury in cinnabar.

Marks

2

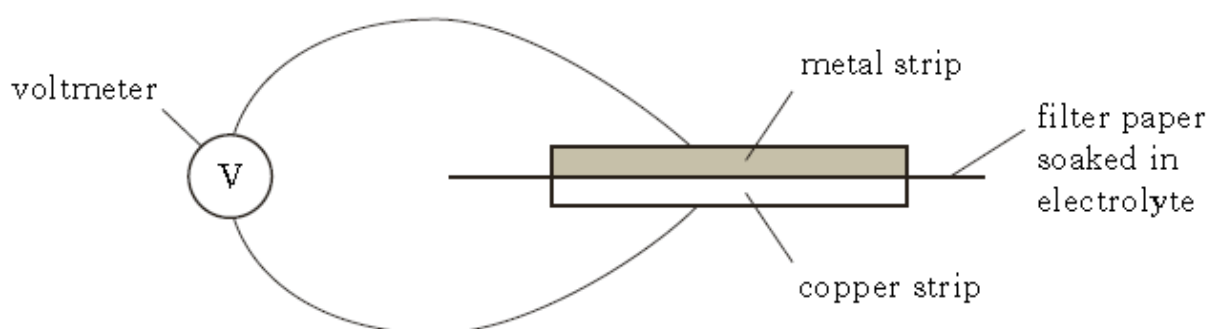
9. Metals can be extracted from metal compounds by heat alone, heating with carbon or by electrolysis.
Name the type of chemical reaction which takes place when a metal is extracted from its compound.

Marks

1

10. The voltage obtained when different pairs of metal strips are connected in a cell varies and this leads to the electrochemical series.
Using the apparatus below, a student investigated the electrochemical series. Copper and four other metal strips were used in this investigation.

Marks



The results are shown.

Metal strip	Voltage (V)	Direction of electron flow
1	0.6	metal 1 to copper
2	0.2	copper to metal 2
3	0.9	metal 3 to copper
4	0.1	copper to metal 4

- (a) Which of the metals used is highest in the electrochemical series? 1
- (b) Which **two** of the metals used would produce the highest voltage when connected in a cell? 1
- (c) What would be the reading on the voltmeter if both strips of metal were copper? 1

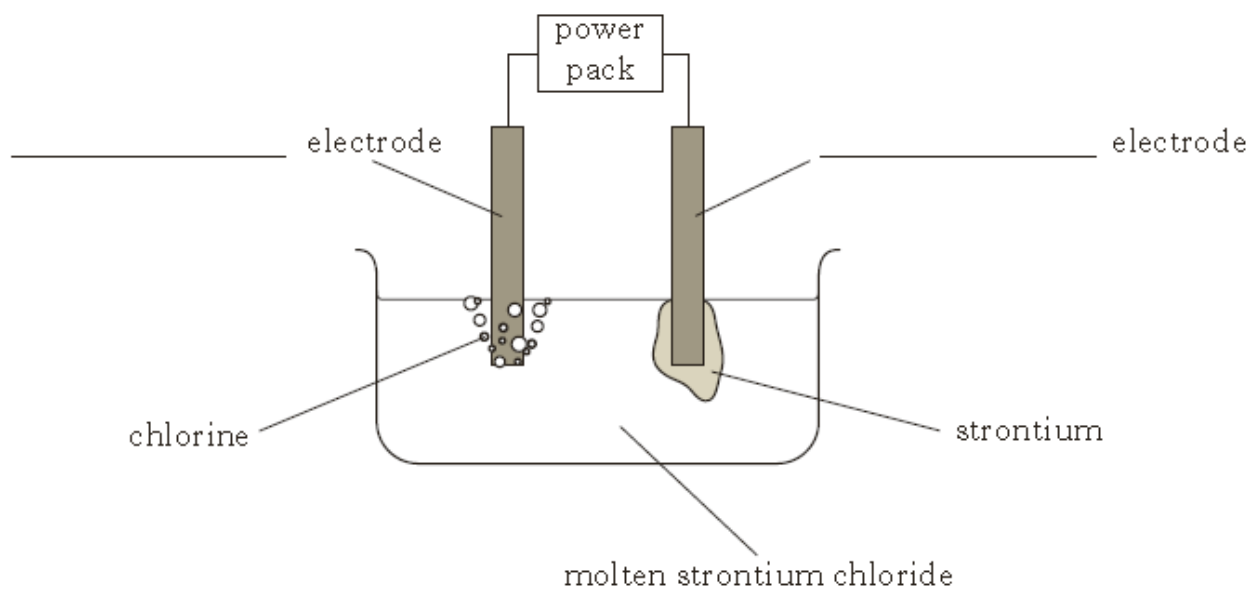
Chemistry in Society

Metals

Marks

11. Strontium can be extracted from the compound strontium chloride using electrolysis. Label the diagram to show the **charge** on each electrode.

1



Chemistry in Society
Metals

Marks

12. Titanium metal is used to make dental braces.

1



Titanium is extracted from its ore in the Kroll process. One step in this process involves the displacement of titanium chloride by sodium metal. The equation is shown.



During the displacement, sodium atoms, Na, form sodium ions, Na^+ . Write the ion-electron equation for this change.

Chemistry in Society
Metals

Marks

13. Copper is a good conductor of electricity because

1

A the atoms are free to vibrate

B the atoms are in close contact

C the atoms have the electron arrangement 2, 8, 18, 1

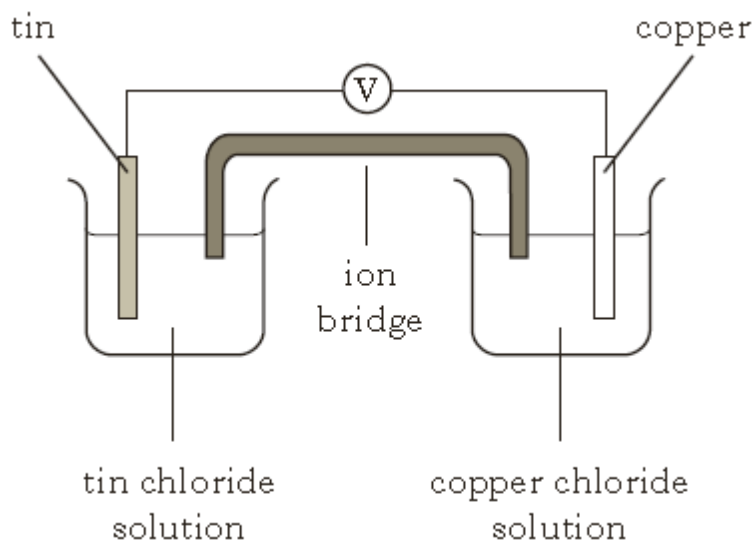
D electrons can move readily from one atom to the next.

Chemistry in Society
Metals

Marks

14.

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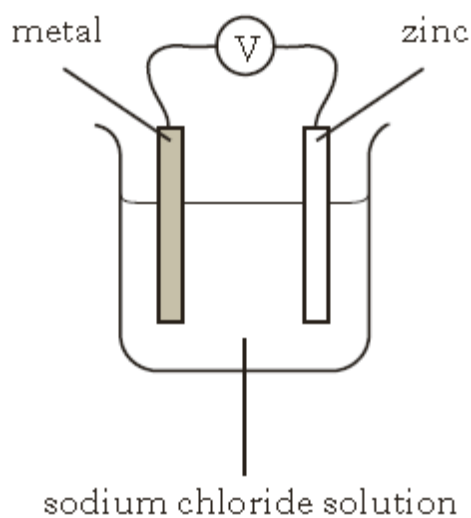


In the cell shown electrons flow through

- A the solution from copper to tin
- B the solution from tin to copper
- C the wires from copper to tin
- D the wires from tin to copper.

15.

1



Which of the following metals, when linked to zinc, would give the highest cell voltage?
(You may wish to use the data booklet to help you.)

- A Copper
- B Iron
- C Magnesium
- D Tin

16. When a metal element reacts to form a compound the metal is

1

- A displaced
- B oxidised
- C precipitated
- D reduced.

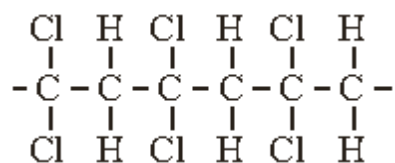
Chemistry in Society

Properties of Plastics

Marks

- 17 Polyvinylidichloride (PVDC) is a plastic used in food packaging.
The structure of part of a PVDC molecule is shown.

1



Draw the **full** structural formula for the monomer used to make PVDC.

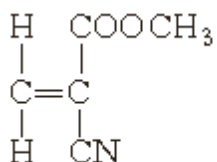
Chemistry in Society

Properties of Plastics

Marks

18. The monomer in superglue has the following structure.

1



Draw a section of the polymer, showing **three** monomer units joined together.

Chemistry in Society

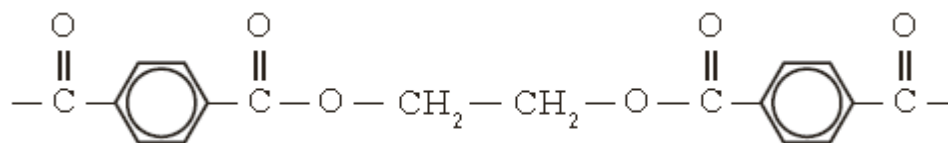
Properties of Plastics

Marks

19. Polyethene terephthalate (PET) is used to make plastic bottles which can easily be recycled by heating and reshaping.

1

A section of the PET structure is shown.



Which line in the table best describes PET?

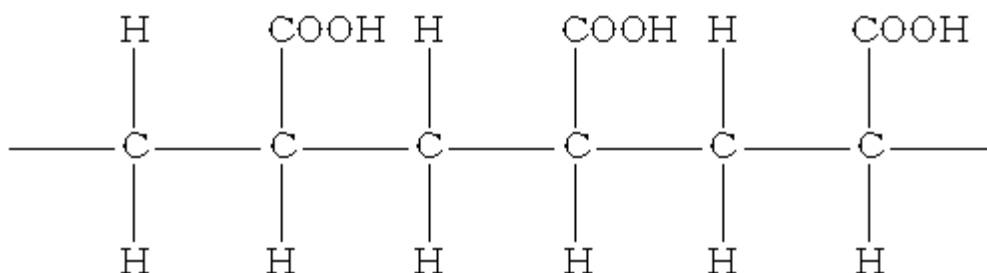
	Type of polymer	Property
A	addition	thermoplastic
B	condensation	thermosetting
C	addition	thermosetting
D	condensation	thermoplastic

Chemistry in Society

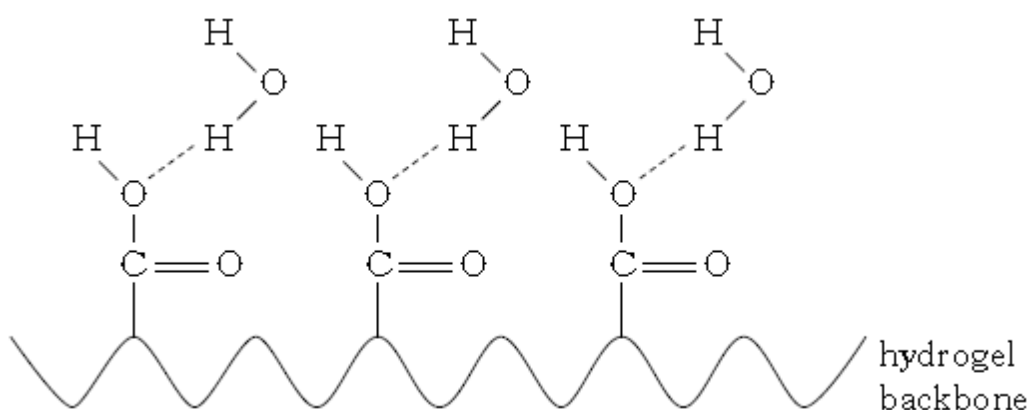
Properties of Plastics

Marks

20. Synthetic nappies contain hydrogel polymers which attract and absorb water molecules. The following is part of the structure of a hydrogel polymer.



- (a) Draw the monomer from which this polymer is made. 1
- (b) The diagram below shows how water molecules are attracted to the hydrogel. 1



What type of bonding must be present **in the water molecules**, which allows them to be attracted to the hydrogel?

Chemistry in Society
Properties of Plastics

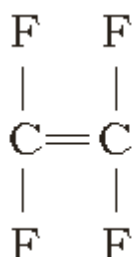
Marks

21. Some waterproof clothing contains a thin layer of the plastic PTFE.



- (a) PTFE is a polymer made from the monomer shown.

1



Draw a section of the PTFE polymer, showing three monomer units joined together.

- (b) Name this type of polymerisation reaction.

1

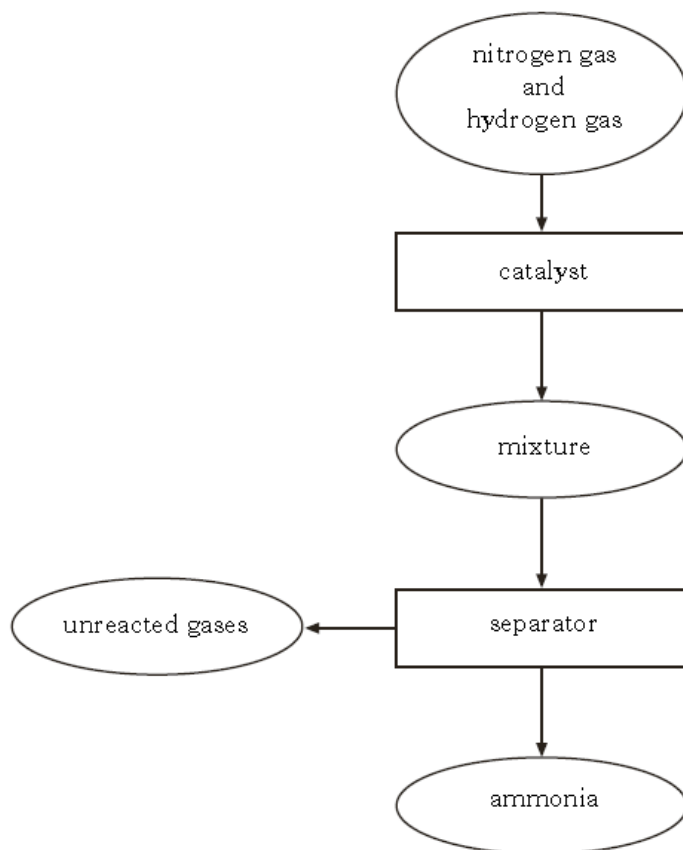
Chemistry in Society
Fertilisers

Marks

22. Catalysts can be used in different processes.

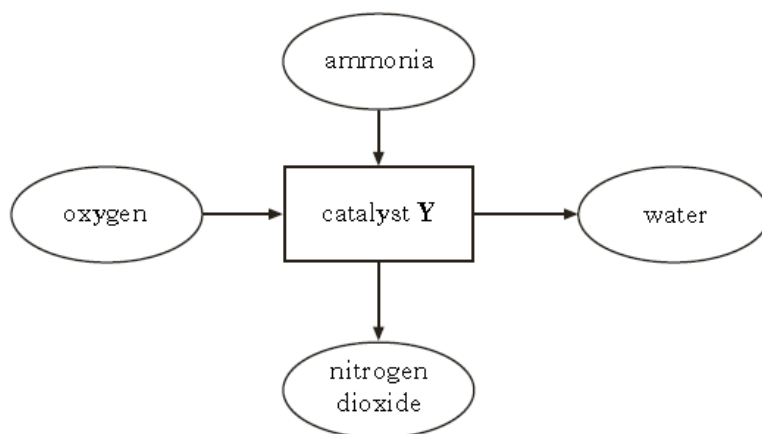
(a) The flow diagram shows the steps involved in the Haber process.

1



On the flow diagram above draw an arrow to show how the process is made more economical.

(b) Ammonia can be used to produce nitrogen dioxide as shown.



- (i) Name catalyst **Y**. 1
- (ii) Why is it **not** necessary to continue to supply heat once the reaction has started? 1

Chemistry in Society

Properties of Plastics

Marks

23. Ammonia is produced in the Haber process.
Temperature is another factor which affects the percentage yield of ammonia.

1

Temperature/°C	Percentage yield of ammonia
200	88
300	67
400	49
500	18

Suggest a reason why 500 °C is the temperature chosen to operate an industrial ammonia plant rather than 200 °C.

Chemistry in Society

Properties of Plastics

Marks

24. Potassium hydroxide reacts with sulphuric acid to form potassium sulphate, which can be used as a fertiliser.

1

Calculate the percentage, by mass, of potassium in potassium sulphate, K_2SO_4 .
Show your working clearly.

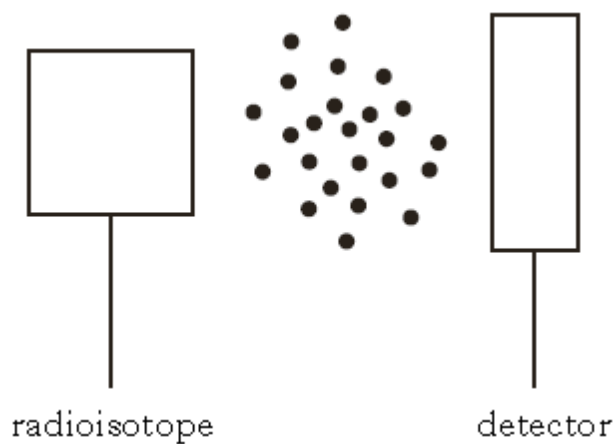
Chemistry in Society

Nuclear Chemistry

Marks

25. Some smoke detectors make use of radiation which is very easily stopped by tiny smoke particles moving between the radioactive source and the detector.

1



The most suitable type of radioisotope for a smoke detector would be

- A an alpha-emitter with a long half-life
- B a gamma-emitter with a short half-life
- C an alpha-emitter with a short half-life
- D a gamma-emitter with a long half-life.

Chemistry in Society
Nuclear Chemistry

Marks

26. The element iodine has only one isotope that is stable. Several of the radioactive isotopes of iodine have medical uses. Iodine-131, for example, is used in the study of the thyroid gland and it decays by beta emission.

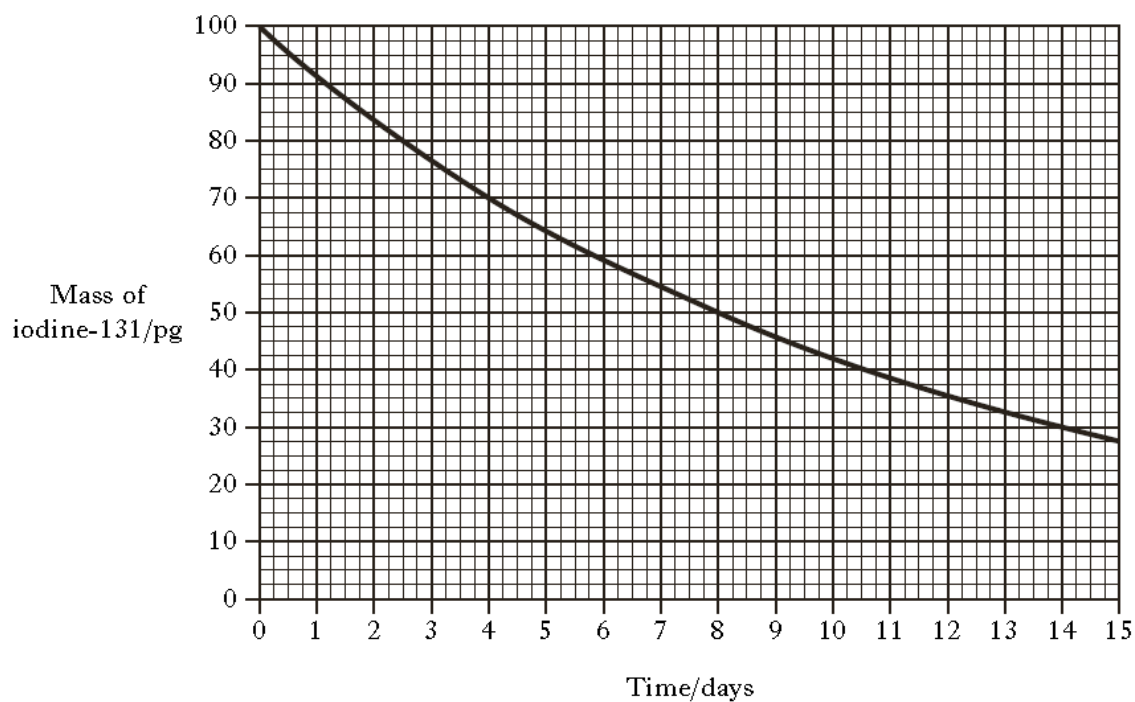
- (a) Complete the balanced nuclear equation for the beta decay of iodine-131.

1



- (b) The graph shows how the mass of iodine-131 in a sample changes over a period of time.

1



What is the half-life of this isotope?

Chemistry in Society
Nuclear Chemistry

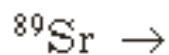
Marks

27. Phosphorus-32 and strontium-89 are two radioisotopes used to study how far mosquitoes travel.

- (a) Strontium-89 decays by emission of a beta particle.

1

Complete the nuclear equation for the decay of strontium-89.



- (b) In an experiment, 10 g of strontium-89 chloride was added to a sugar solution used to feed mosquitoes.

1

The strontium-89 chloride solution was fed to the mosquitoes in a laboratory at 20 °C.

When the mosquitoes were released, the outdoor temperature was found to be 35 °C.

What effect would the increase in temperature have on the half-life of the strontium-89?

- (c) A mosquito fed on a solution containing phosphorus-32 is released.

1

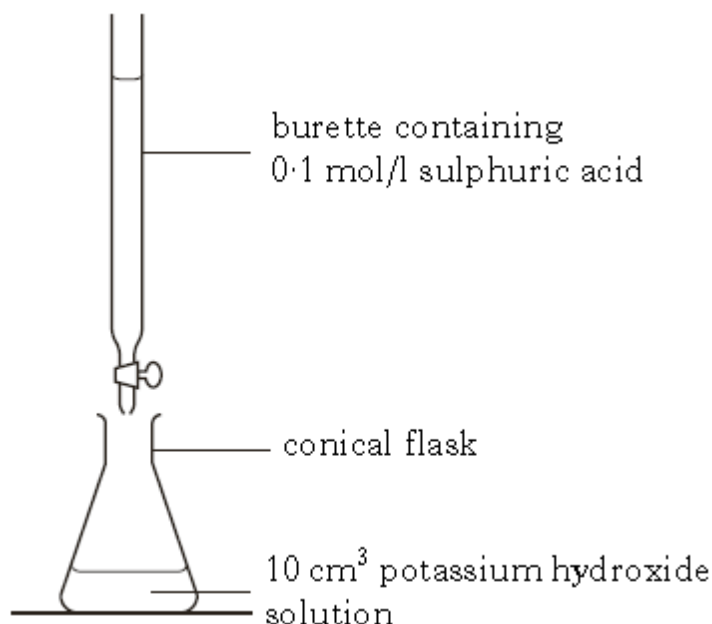
Phosphorus-32 has a half-life of 14 days.

When the mosquito is recaptured 28 days later, what fraction of the phosphorus-32 will remain?

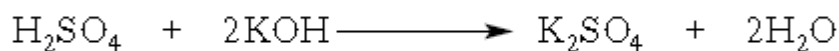
Chemistry in Society
Chemical Analysis

Marks

28. Potassium sulphate can be produced by titrating potassium hydroxide solution with dilute sulphuric acid.



- (a) What must be added to the conical flask to show the end-point of the titration? 1
- (b) The equation for the reaction is: 2

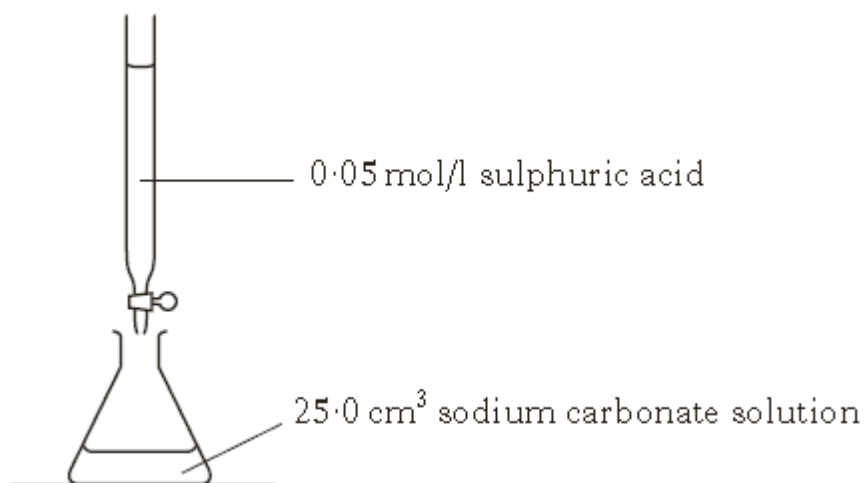


The number of moles of sulphuric acid used was 0.002 moles. Using this, calculate the number of moles of potassium hydroxide in the 10cm³ sample of potassium hydroxide solution.

Chemistry in Society
Chemical Analysis

Marks

29. Another experiment involved determining the concentration of sodium carbonate solution by titration.



The results showed that 20 cm³ of sulphuric acid was required to neutralise the sodium carbonate solution.

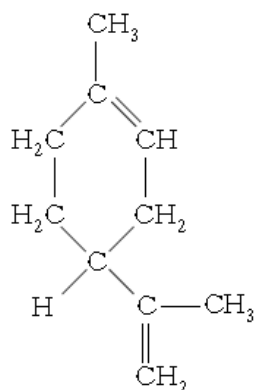
One mole of sulphuric acid reacts with one mole of sodium carbonate.

0.001 moles of sulphuric acid reacted, calculate the concentration, in mol/l, of the sodium carbonate solution.

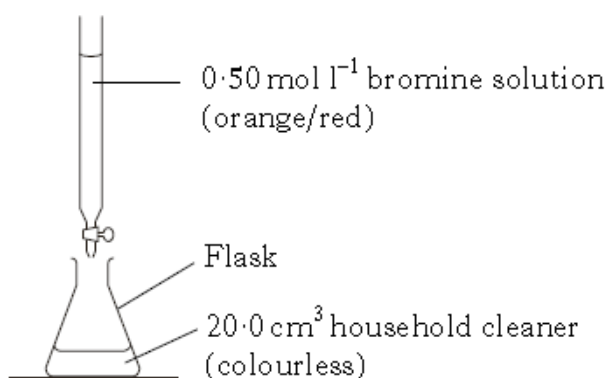
Chemistry in Society
Chemical Analysis

Marks

30. Some household cleaners contain the chemical limonene which gives them a lemon smell. The structure of limonene is shown below.

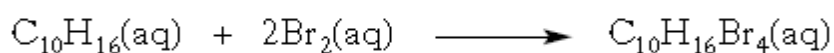


Using bromine solution, a student carried out titrations to determine the concentration of limonene in a household cleaner.



Titration	Initial burette reading (cm ³)	Final burette reading (cm ³)	Titre (cm ³)
1	0.5	17.1	16.6
2	0.2	16.3	16.1
3	0.1	16.0	15.9

- (a) What average volume should be used in calculating the concentration of limonene? 1
- (b) The equation for the reaction between limonene and bromine solution is shown. 3



Calculate the concentration of limonene in the household cleaner in mol l⁻¹.

Problem Solving**Not linked to any particular key area**

Marks

31. The table below shows the relationship between the percentage of ethanol and the density of alcoholic drinks.

Percentage of ethanol (%)	40	50	60	70	80
Density of alcoholic drink (g/cm^3)	0.928	0.907	0.886	0.865	0.844

- (a) Write a general statement describing how the percentage of ethanol affects the density of the alcoholic drink. 1
- (b) The density of a particular brand of alcoholic drink is 0.970 g/cm^3 . 1
Predict the percentage of ethanol in this alcoholic drink.

Problem Solving**Not linked to any particular key area**

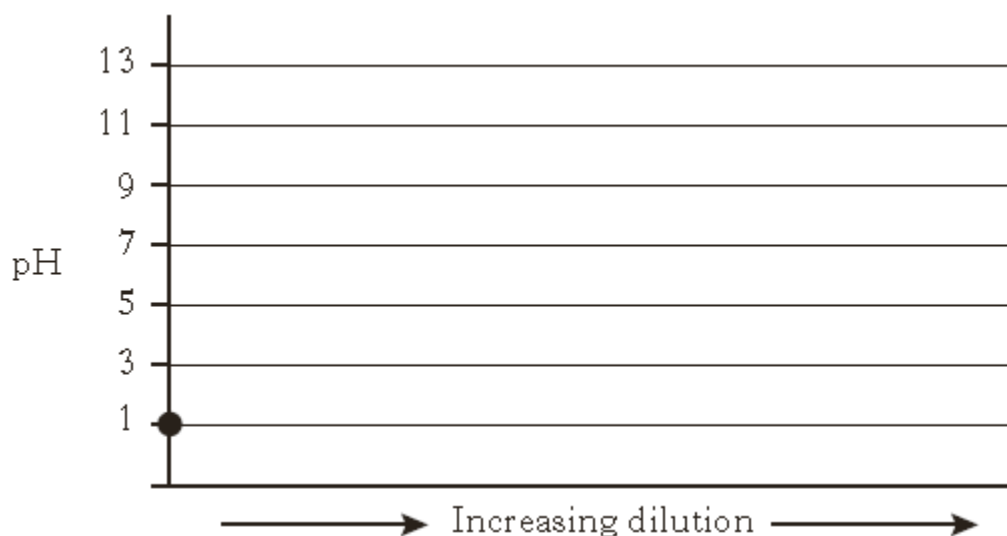
Marks

32. A solution of 0.1 mol/l hydrochloric acid has a pH of 1.

- (a) What colour would universal indicator turn when added to a solution of hydrochloric acid? 1

- (b) Starting at pH 1, draw a line to show how the pH of this acid changes when diluted with water.

1



Problem Solving

Not linked to any particular key area

Marks

33. A student investigated how the concentration of sodium chloride in water affected the freezing point.

- (a) What type of bond is broken in sodium chloride when it dissolves in water? 1
- (b) The table shows information about the freezing point of different sodium chloride solutions. 1

Concentration of sodium chloride solution (mol/l)	0	0.09	0.18	0.27	0.37	0.46
Freezing point (°C)	0	-0.2	-0.5	-0.8	-1.1	-1.5

Describe the relationship between the concentration and freezing point.

- (c) Predict the freezing point of a 0.55 mol/l sodium chloride solution. 1

Problem Solving

Not linked to any particular key area

Marks

34. A student investigated how the concentration of sodium chloride in water affected the freezing point.

1



The little pen-tailed tree shrew, found in the jungles of West Malaysia, feeds on nectar from the Bertam palm tree. This nectar contains glucose which ferments, producing solutions of up to 3.8% alcohol. Therefore, the tree shrew regularly drinks a solution which is equivalent to a man drinking 9 units of alcohol per day. It seems that the tree shrew never gets drunk because it is able to breakdown the alcohol much quicker than humans can.

Using information in the passage above, calculate the volume of alcohol solution the tree shrew drinks each day.

$$\text{Volume of alcohol solution} = \frac{\text{units of alcohol} \times 1.25}{\% \text{ of alcohol}}$$

Problem Solving**Not linked to any particular key area**

Marks

35. Some indicators can have different colours when in solutions of different pH values. The tables give information about two indicators, bromothymol blue and methyl orange.

Bromothymol blue	
Colour	pH
yellow	below 6.0
blue	above 7.6

Methyl orange	
Colour	pH
red	below 3.1
yellow	above 4.4

The pH of three solutions was investigated using both indicators.

The results are shown below.

Substance	Colour with bromothymol blue	Colour with methyl orange
A	yellow	red
B	yellow	yellow
C	blue	yellow

- (a) Which solution is alkaline?
(b) Suggest a pH value for solution B.

1

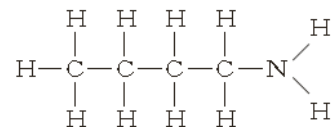
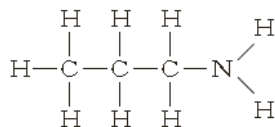
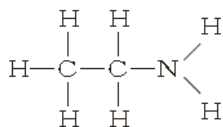
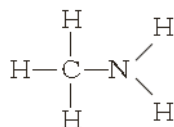
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Problem Solving**Not linked to any particular key area**

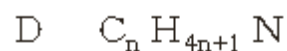
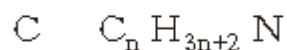
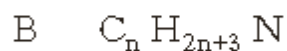
Marks

36. The first four members of the amine homologous series are:

1



What is the general formula for this homologous series?

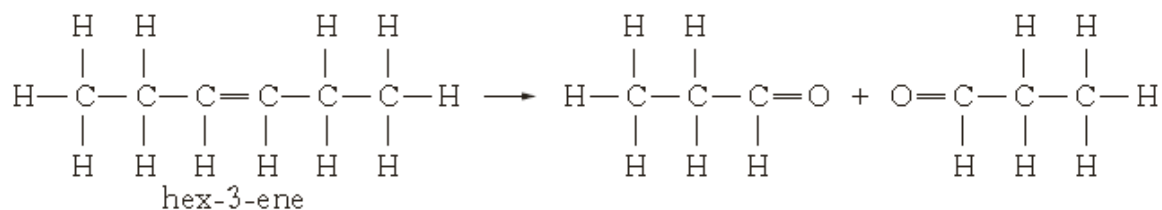
**Problem Solving****Not linked to any particular key area**

Marks

37. Alkenes can undergo different reactions.

1

In ozonolysis an alkene reacts with ozone forming two molecules. The ozonolysis of hex-3-ene is shown.



Draw the products formed by the ozonolysis of hex-2-ene.

