

A Rational Approach

To

Learning O-Level Chemistry Principles

With

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A/O Level Chemistry

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A/O Level Chemistry

0333-4277385

Topic:

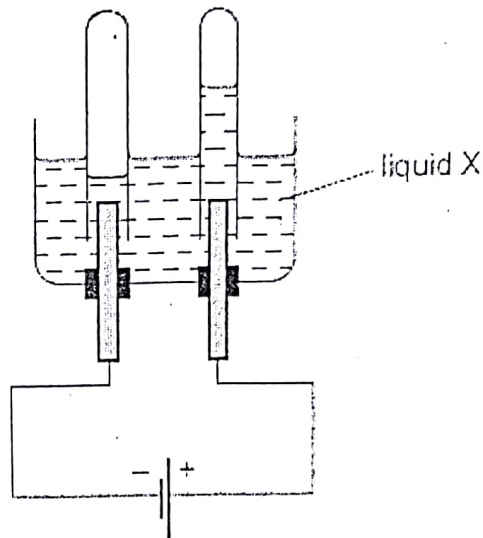
11 - C

Category:

WorkSheets

Electrolysis (MCQs)

1 The diagram shows the results of an electrolysis experiment using inert electrodes.



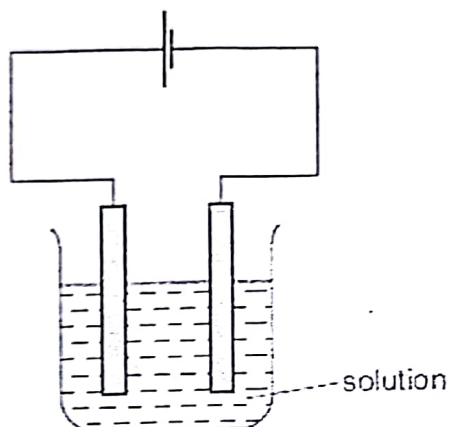
Which could be liquid X?

- A aqueous copper(II) sulfate
 - B concentrated aqueous sodium chloride
 - C dilute sulfuric acid
 - D ethanol
- 2 The conduction of electricity by metals is carried out by the movement of
- A electrons only.
 - B electrons and positive ions.
 - C negative ions only.
 - D negative ions and positive ions.
- 3 A metal consists of a lattice of positive ions in a 'sea of electrons'.

What changes, if any, take place to the electrons and positive ions in a metal wire when electric current is passed through it?

	electrons	positive ions
A	replaced by new electrons	replaced by new ions
B	replaced by new electrons	unchanged
C	unchanged	replaced by new ions
D	unchanged	unchanged

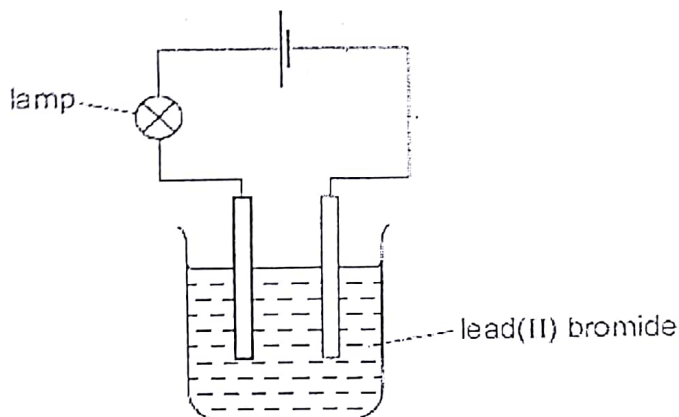
- 4 The diagram shows the electrolysis of a concentrated aqueous solution containing both copper(II) ions and sodium ions.



Which metal is deposited at the negative electrode and why?

	metal deposited	reason
A	copper	copper is less reactive than sodium
B	copper	copper is more reactive than hydrogen
C	sodium	copper is less reactive than hydrogen
D	sodium	copper is more reactive than sodium

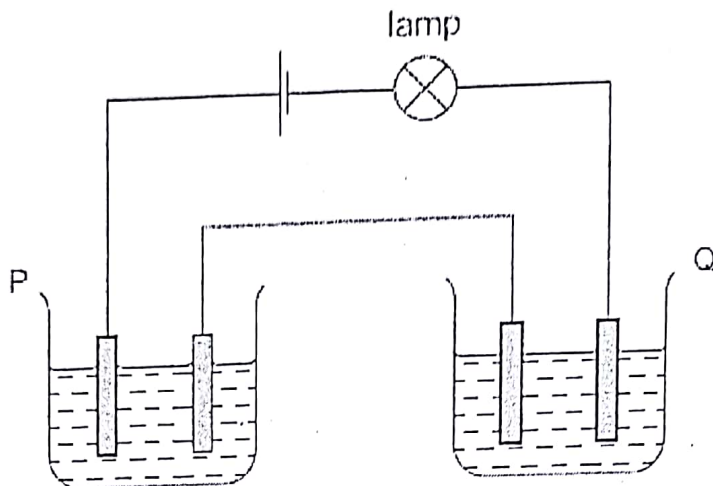
- 5 The diagram shows the apparatus used to electrolyse lead(II) bromide using inert electrodes.



Why does the lamp light up only when the lead(II) bromide is melted?

- A Bromine atoms in the lead(II) bromide are converted to ions when it is melted.
- B Electrons flow through the lead(II) bromide when it is melted.
- C The ions in lead(II) bromide are free to move only when the solid is melted.
- D There are no ions in solid lead(II) bromide.

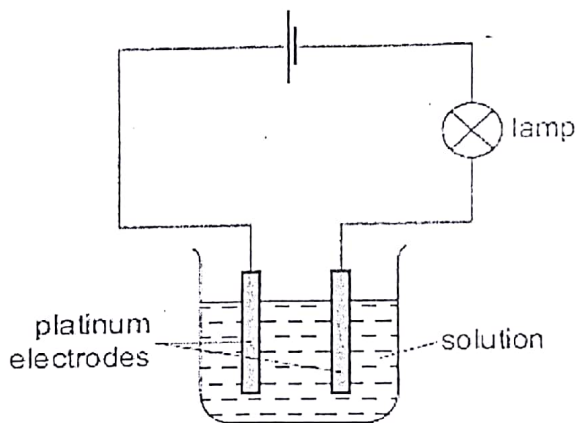
6 Two cells, P and Q, containing different liquids, were connected in series with a battery, a suitable lamp and inert electrodes, as shown in the diagram.



For which pair of liquids did the lamp light up?

	in P	in Q
A	concentrated sodium chloride solution	concentrated sugar solution
B	copper(II) sulfate solution	propanol
C	ethanol	molten lead(II) bromide
D	mercury	dilute hydrochloric acid

7 The diagram shows apparatus used to investigate the conductivity of different solutions.



Which substance, in aqueous solution of concentration 1 mol / dm^3 , would cause the lamp to give the brightest light?

- A ammonia
- B ethanoic acid
- C ethanol
- D sulfuric acid

8 Which reactions take place during the electrolysis of aqueous copper(II) sulfate with copper electrodes?

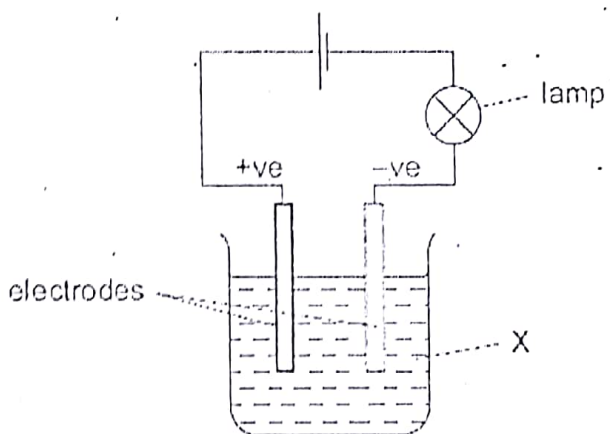
	reaction at positive electrode	reaction at negative electrode
A	$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$	$\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
B	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
C	$\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
D	$\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$	$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

9 A substance Q conducts electricity both when solid and molten.

What is Q?

- A an alloy
- B a hydrocarbon
- C a metal oxide
- D a salt

10 When the experiment shown is set up, the bulb lights, but there are no decomposition products at the electrodes.



What is X?

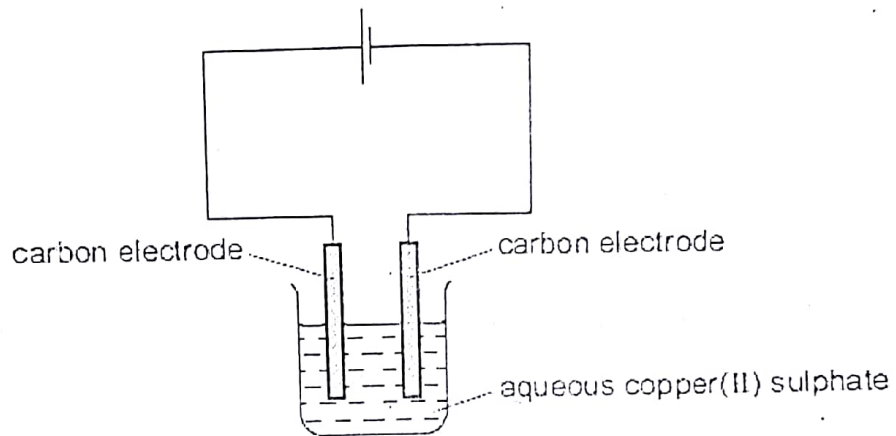
- A aqueous sodium chloride
- B bromine
- C molten sodium chloride
- D mercury

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11 What are the products formed at the electrodes during the electrolysis of molten magnesium chloride between carbon electrodes?

	positive electrode	negative electrode
A	oxygen	magnesium
B	magnesium	chlorine
C	chlorine	magnesium
D	chlorine	hydrogen

12 Aqueous copper(II) sulphate is electrolysed using inert electrodes as shown.



Which ionic equations show the reactions at the electrodes?

- 1 $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
- 2 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
- 3 $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
- 4 $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$

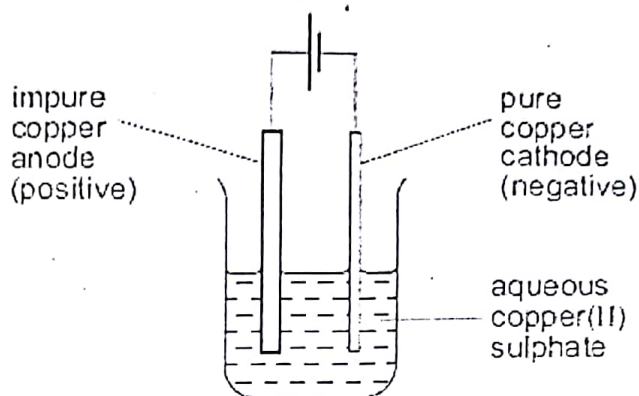
- A 1 and 2 only B 1 and 4 only C 2 and 3 only D 3 and 4 only

13 When dilute sulphuric acid is electrolysed between platinum electrodes, which statement is correct?

- 1 Hydrogen is released at the cathode.
- 2 Oxygen is released at the anode.
- 3 Sulphur is released at the anode.
- 4 The acid becomes more dilute.

- A 1 and 2 B 1 and 3 C 2 and 4 D 4 only

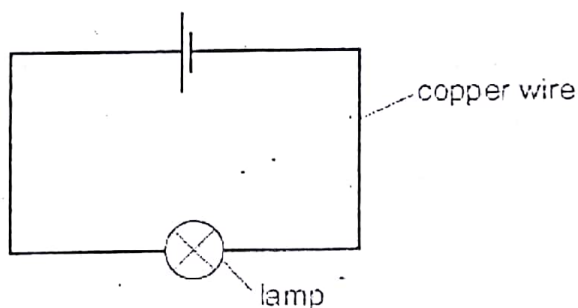
- 14 A sample of copper contains a metal impurity which is below copper in the reactivity series. The diagram shows the apparatus used for refining the sample.



The loss in mass of the anode (positive electrode) is 50 g and the gain in mass of the cathode (negative electrode) is 45 g.

What is the percentage purity of this sample of copper?

- A 10.0% B 11.1% C 90.0% D 95.0%
- 15 An electrical circuit is set up using copper wire.



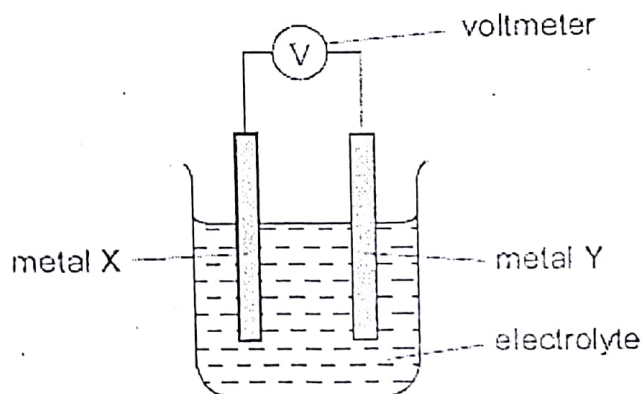
Which process takes place in the copper wire?

- A Electrons move along the wire to the negative terminal, positive ions stay in position.
- B Electrons move along the wire to the positive terminal, positive ions move to the negative terminal.
- C Electrons move along the wire to the positive terminal, positive ions stay in position.
- D Negative ions move along the wire to the positive terminal, positive ions move to the negative terminal.

16 Which statement is correct about the electrolysis of an aqueous solution of copper(II) sulphate with platinum electrodes?

- A Oxygen is given off at the positive electrode.
- B The mass of the negative electrode remains constant.
- C The mass of the positive electrode decreases.
- D There is no change in the colour of the solution.

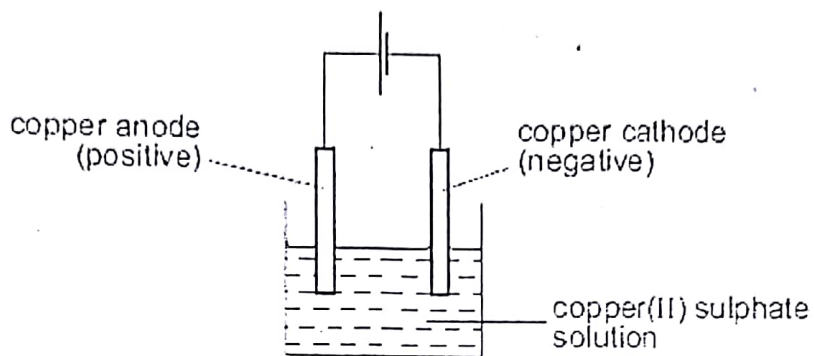
17 The diagram shows a simple cell.



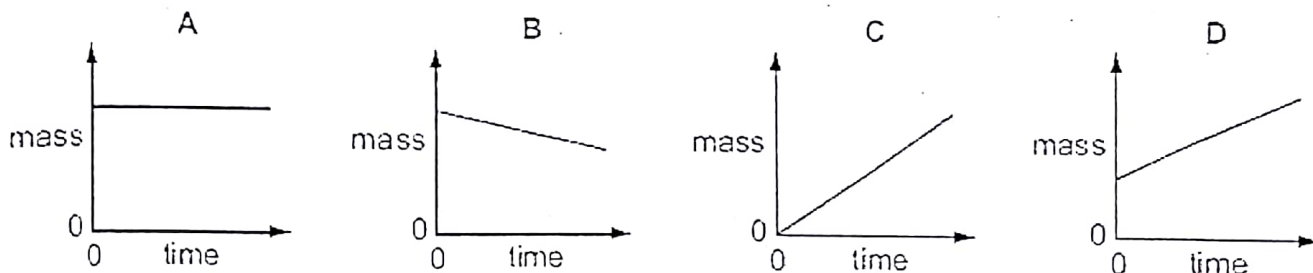
Which two metals produce the highest reading on the voltmeter?

	X	Y
A	magnesium	copper
B	magnesium	iron
C	zinc	copper
D	zinc	iron

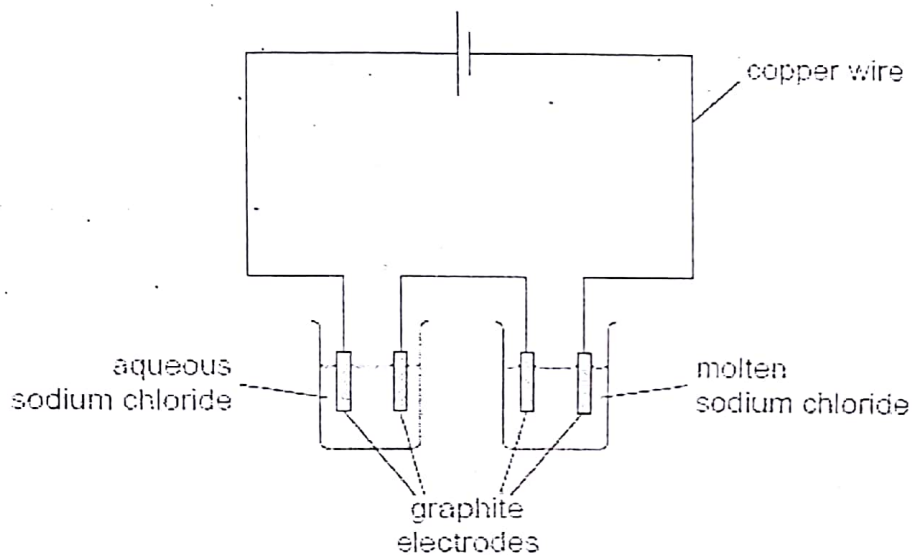
18 The diagram shows the electrolysis of aqueous copper(II) sulphate using copper electrodes.



Which graph shows how the mass of the cathode changes during electrolysis?



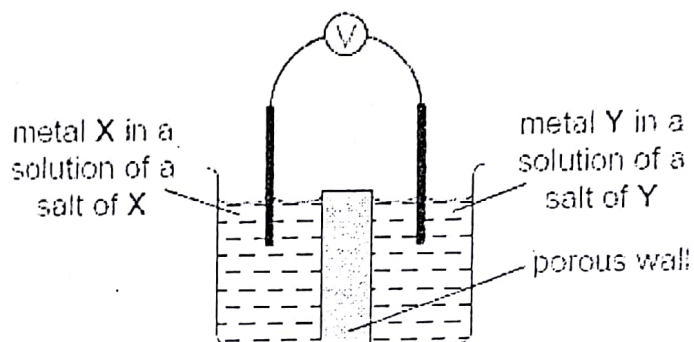
19 The diagram shows the electrolysis of aqueous sodium chloride and of molten sodium chloride.



Which substance has both positive ions and mobile electrons?

- A aqueous sodium chloride
- B copper wire
- C graphite electrodes
- D molten sodium chloride

20 Which pair of metals X and Y will produce the highest voltage when used as electrodes in a simple cell?



	metal X	metal Y
A	copper	silver
B	magnesium	silver
C	magnesium	zinc
D	zinc	copper

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- (ii) Other than acting as catalysts state two properties which are specific to transition elements.

.....

.....

[Total: 10]

2 Electrolysis involves the decomposition of a compound by the passage of an electric current.

- (a) (i) Complete the table, which relates to the electrolysis of different solutions using inert electrodes.

electrolyte	ions in electrolyte	product at anode	product at cathode
dilute aqueous potassium nitrate	K^+ , H^+ , OH^- and NO_3^-	oxygen	hydrogen
concentrated aqueous sodium chloride	Na^+ , H^+ , OH^- and Cl^-	chlorine	hydrogen
dilute aqueous copper(II) sulfate	Cu^{2+} , SO_4^{2-} , H^+ and OH^-
dilute sulfuric acid	oxygen	hydrogen

- (ii) Explain why the electrolysis of concentrated aqueous sodium chloride liberates hydrogen rather than sodium at the cathode.

.....

.....

- (iii) The electrolysis of dilute aqueous sodium chloride liberates oxygen at the anode. Suggest why the electrolysis of concentrated aqueous sodium chloride liberates chlorine rather than oxygen.

.....

.....

(b) Aqueous copper(II) sulfate was electrolysed using copper electrodes. The copper anode lost mass as copper(II) ions were formed and the copper cathode gained mass as copper atoms were formed.

(i) State one industrial application of this electrolysis.

.....[1]

(ii) The results of an experiment involving the electrolysis of aqueous copper(II) sulfate are shown below.

temperature of electrolyte / °C	current used / amps	time of electrolysis / s	mass of copper formed at the cathode / g
20	1.0	1000	0.329
20	2.0	1000	0.658
20	2.0	2000	1.320
25	2.0	2000	1.320
30	1.0	1000	0.329

Use the information in the table to describe how each of the variables affects the mass of copper formed at the cathode.

temperature

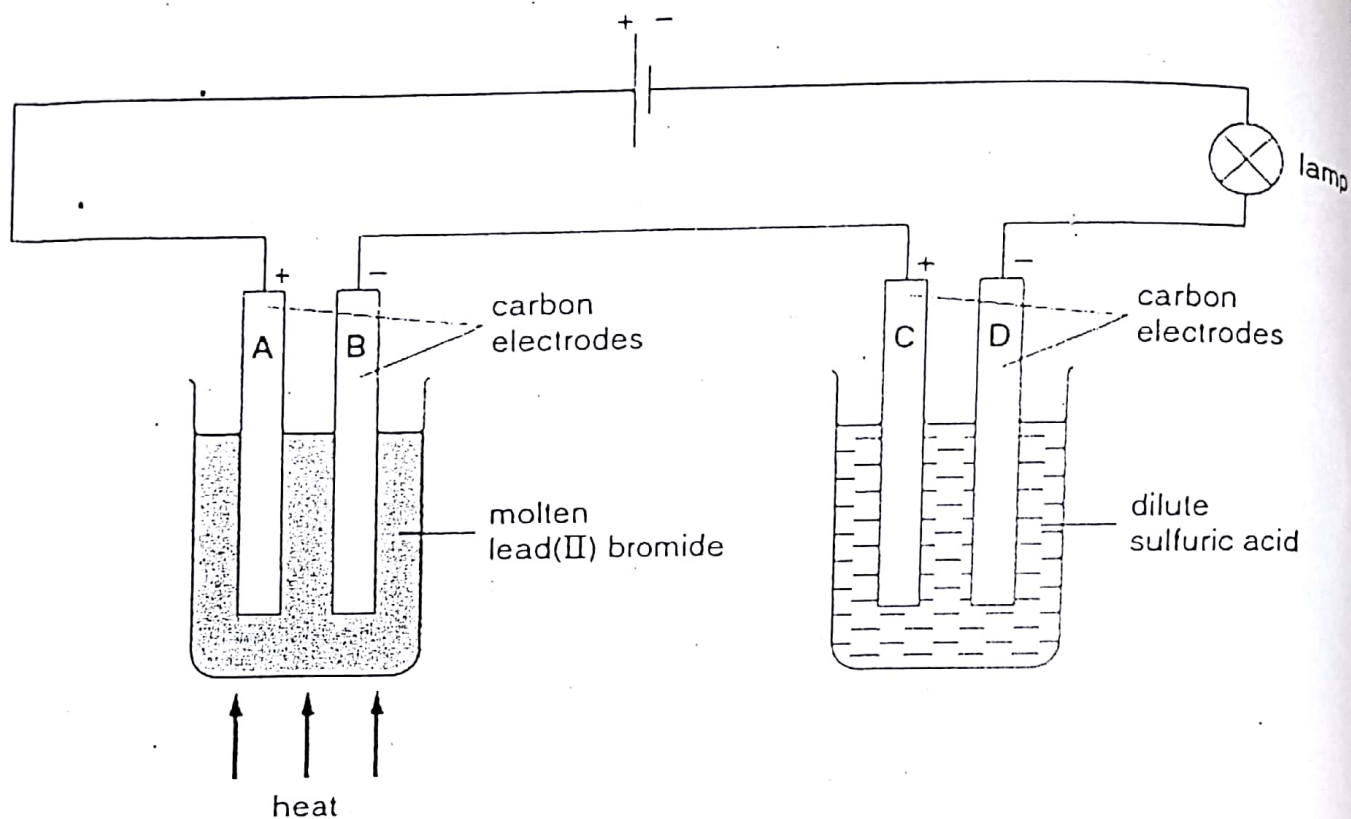
current

time

[3]

[Total: 9]

3 A student electrolysed molten lead(II) bromide and dilute sulfuric acid in the apparatus shown below.



(a) What was produced at the electrodes A, B, C and D?

- A
- B
- C
- D [4]

(b) What, if anything, happened to the brightness of the lamp when the following changes were made to the experiment?

(i) Water was added to the dilute sulfuric acid. [1]

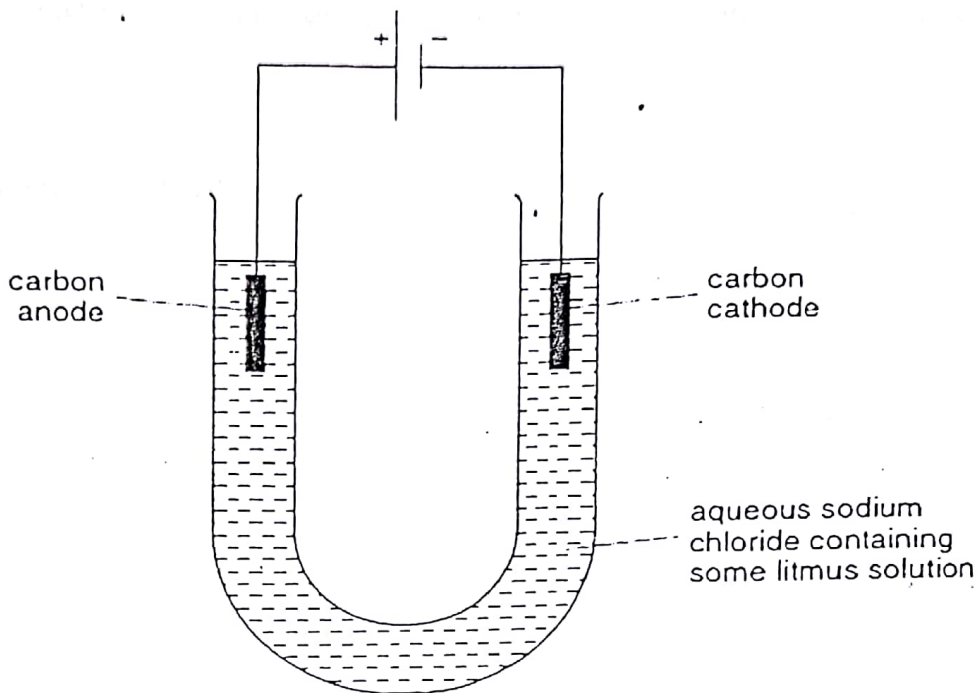
(ii) The heating was stopped and the apparatus was left to cool. Explain your answer.

..... [2]

[Total: 7]

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4 A student electrolysed concentrated aqueous sodium chloride using the apparatus below. The solution also contained litmus solution.



- (a) (i) Name the gas produced at the anode (positive electrode).
[1]
- (ii) Suggest what happened to the colour of the solution around the anode as the electrolysis proceeded.
[1]
- (iii) Why did this change take place?
[1]
- (b) (i) Name the gas produced at the cathode (negative electrode).
[1]
- (ii) Give a test for this gas.
[1]
- (iii) What happened to the colour of the solution around the cathode as the electrolysis proceeded?
[1]
- (iv) Why did this change take place?
[1]

(c) The solution was replaced by a dilute solution of an acid. Suggest which acid would produce the same gases as those produced with concentrated aqueous sodium chloride.

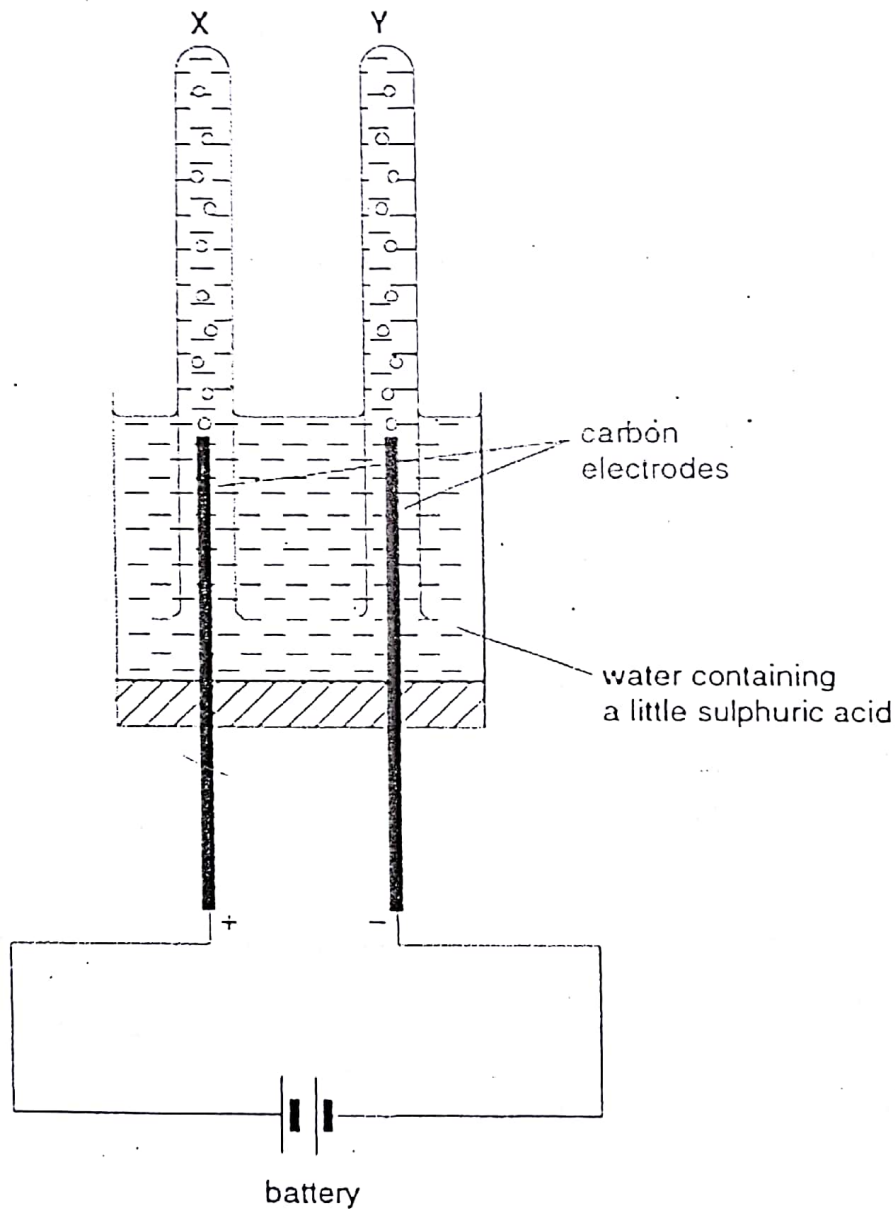
.....[1]

(d) Under what conditions does the electrolysis of sodium chloride produce sodium at one of the electrodes?

.....[1]

[Total: 9]

5 The apparatus below was used to electrolyse water.



(a) (i) Why was a small volume of sulphuric acid added to the water?

.....

(ii) Name the gas collected in tube X and give a test for this gas.

gas

test

(iii) Name the gas collected in tube Y and give a test for this gas.

gas

test

[5]

(b) State how the volume of gas collected in tube X compares with the volume of gas collected in tube Y.

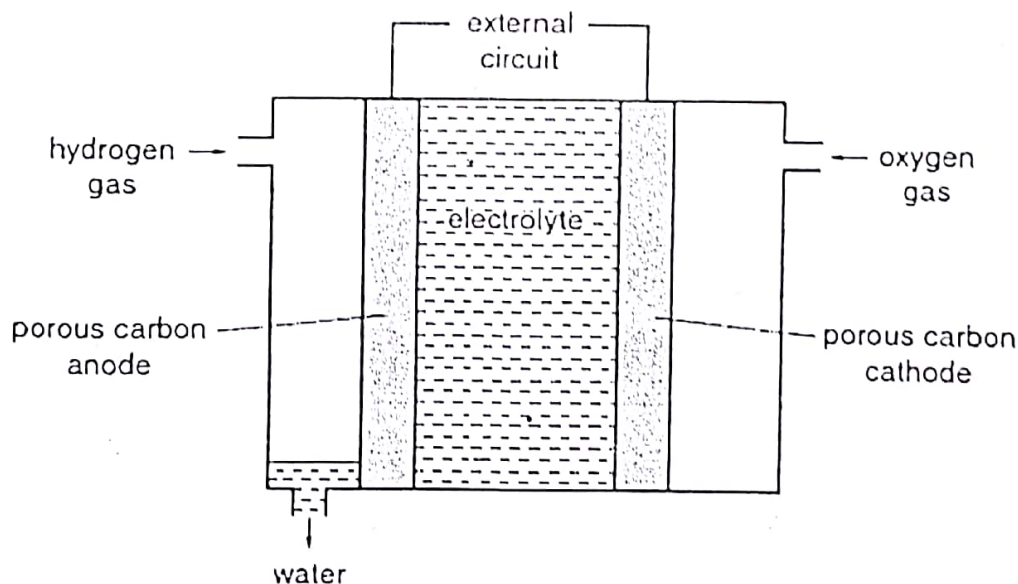
..... [1]

6 One of the first buses to use hydrogen as a fuel was operated in Erlangen, Germany, in 1996. The hydrogen was stored in thick pressurised tanks on the roof of the bus.

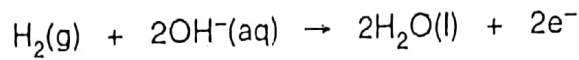
(a) Describe two advantages of using hydrogen as a fuel rather than petrol. [2]

(b) Suggest one disadvantage of using hydrogen as a fuel. [1]

(c) Some buses use hydrogen to generate electrical energy from a fuel cell. The structure of a typical fuel cell is shown.



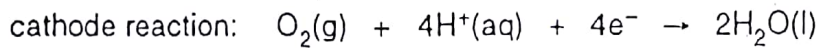
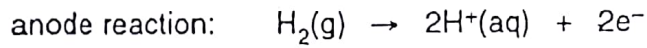
- (i) The equation for the reaction at the anode is shown.



What type of reaction is this? Explain your answer.

- (ii) At the cathode oxygen reacts with water to form hydroxide ions. Write an ionic equation for this reaction.

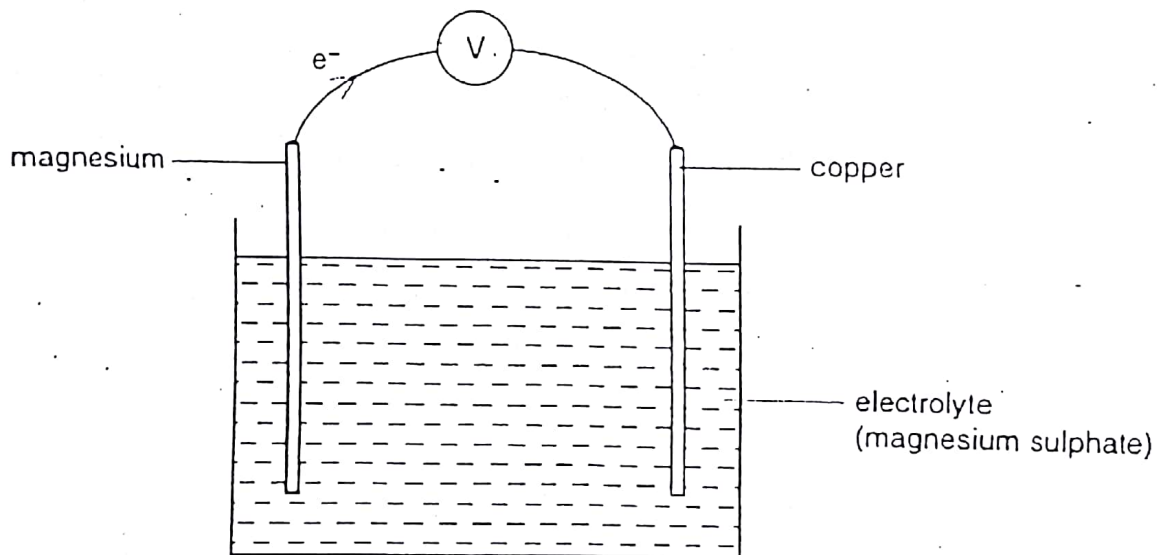
- (d) In some fuel cells an acidic electrolyte is used.



- (i) Write an overall equation for the reaction occurring in this fuel cell.

- (ii) Suggest a suitable electrolyte for this fuel cell.

- (e) An electric current can also be generated by a simple electrochemical cell such as the one shown.



- (i) Explain why the flow of electrons is in the direction shown in the diagram.
- (ii) Suggest why silver nitrate would not be a good electrolyte to use in this cell.

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[Total: 10]

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Properties of Metals MCQs

1. The conduction of electricity by metals is carried out by the movement of

- A electrons only.
- B electrons and positive ions.
- C negative ions only.
- D negative ions and positive ions.

2. The tests below were carried out on a solution containing ions of the metal X.

test	observation
add sodium chloride solution	no change
add sodium sulfate solution	no change
add sodium hydroxide solution	a precipitate was formed, soluble in excess of the hydroxide

What is metal X?

- A calcium
- B iron
- C lead
- D zinc

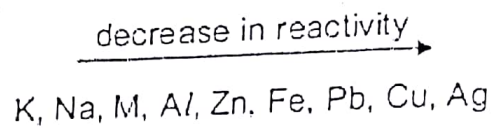
3. Which property is common to calcium, potassium and sodium?

- A Their atoms all lose two electrons when they form ions.
- B They all form carbonates which are insoluble in water.
- C They are all less dense than water.
- D They are all metallic.

4. Which set of the electronic structures are only found in metals?

- | | | | |
|---|---------|---------|-------------|
| A | 2, 1 | 2, 8, 1 | 2, 8, 8, 1 |
| B | 2, 5 | 2, 6 | 2, 7 |
| C | 2, 7 | 2, 8, 7 | 2, 8, 18, 7 |
| D | 2, 8, 3 | 2, 8, 4 | 2, 8, 5 |

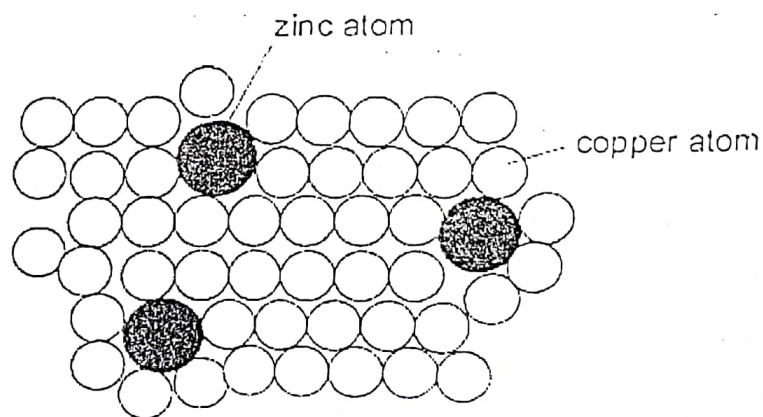
5. The position of metal M in the reactivity series is shown.



Which method will be used to extract M from its ore?

- A electrolysis of its aqueous sulfate
- B electrolysis of its molten oxide
- C reduction of its oxide by heating with coke
- D reduction of its oxide by heating with hydrogen

6. The diagram shows the structure of brass.



Why is brass harder than pure copper?

- A The zinc atoms form strong covalent bonds with copper atoms.
- B The zinc atoms prevent layers of copper atoms from slipping over each other easily.
- C The zinc atoms prevent the 'sea of electrons' from moving freely in the solid.
- D Zinc atoms have more electrons than copper atoms.

7. When zinc is added to a solution of a metal sulfate, the metal is deposited and zinc ions are produced in solution.

Which metal is deposited?

- A calcium
- B copper
- C magnesium
- D potassium

8. Which element is sodium?

	melling point in °C	electrical conduction	density in g/cm ³
A	1535	good	7.86
B	1083	good	8.92
C	113	poor	2.07
D	98	good	0.97

9. An alloy of copper and zinc is added to an excess of dilute hydrochloric acid.

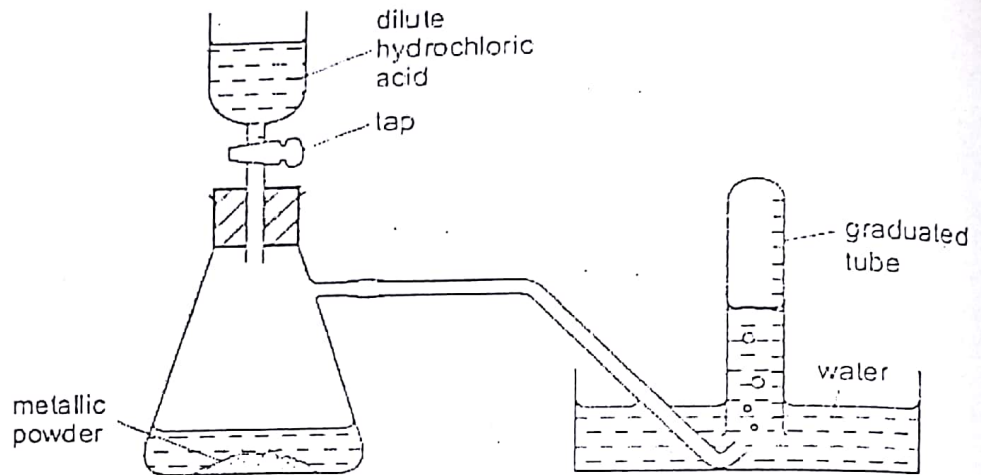
Which observations are correct?

	residue	filtrate
A	grey	blue solution
B	none	blue solution
C	none	colourless solution
D	red-brown	colourless solution

10. Which substances react together to give hydrogen?

- A calcium oxide and water
- B copper and dilute sulfuric acid
- C copper and steam
- D magnesium and steam

11. The diagram shows apparatus for measuring the volume of hydrogen given off when an equal mass of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H ₂	least volume of H ₂
A	magnesium	zinc
B	magnesium	the mixture
C	zinc	magnesium
D	zinc	the mixture

12. The carbonate of metal X is a white solid.

It decomposes when heated to form carbon dioxide and a yellow solid oxide.

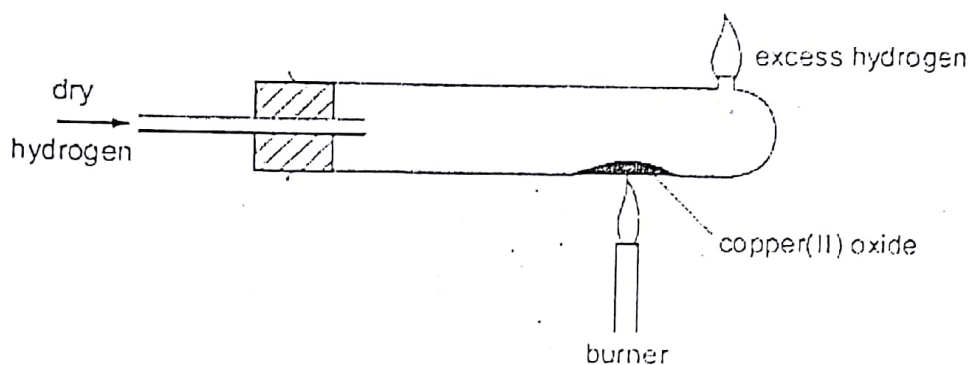
What is metal X?

- A copper
- B iron
- C lead
- D sodium

13. Which oxide is most readily reduced to the metal by heating in a stream of hydrogen?

- A calcium oxide
- B lead(II) oxide
- C sodium oxide
- D zinc oxide

14. The diagram shows copper(II) oxide being reduced, by hydrogen, to copper. After reduction is complete, the burner is turned off but the flow of hydrogen is continued until the tube is cool.



Why is the hydrogen allowed to flow through the tube during cooling?

- A to allow the tube to cool slowly
 - B to lessen the risk of explosion in the hot tube
 - C to prevent the copper from reacting with the air
 - D to remove any traces of water left in the tube
15. A coin is analysed by dissolving it in nitric acid. To the resulting solution an excess of aqueous ammonia is added and the mixture is filtered.

A brown precipitate remains in the filter paper and a deep blue solution is obtained as the filtrate.

Which metals does the coin contain?

- A aluminium and copper
- B copper and iron
- C iron and lead
- D lead and zinc

16. Caesium, Cs, is an element in Group I of the Periodic Table.

Which statements about Caesium are true?

- 1 Caesium conducts electricity both when solid and when molten.
- 2 Caesium reacts explosively with water.
- 3 Caesium reacts with water and forms a solution of $\text{pH} < 7$.

- A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

17. The list shows some properties of metals.

- 1 Metals are good conductors of electricity.
- 2 Metals form ions by the loss of electrons.
- 3 Metals have high melting points.

Mercury is a metallic element.

Which of these statements do not apply to mercury?

- A 1 only B 1 and 2 C 2 and 3 D 3 only

18. Solid Y is insoluble in water. It gives off a gas when heated and also when reacted with sulfuric acid.

What is Y?

- A copper(II) carbonate
B sodium carbonate
C sodium nitrate
D zinc oxide

19. What is the ionic equation for the reaction between zinc and aqueous copper(II) sulfate

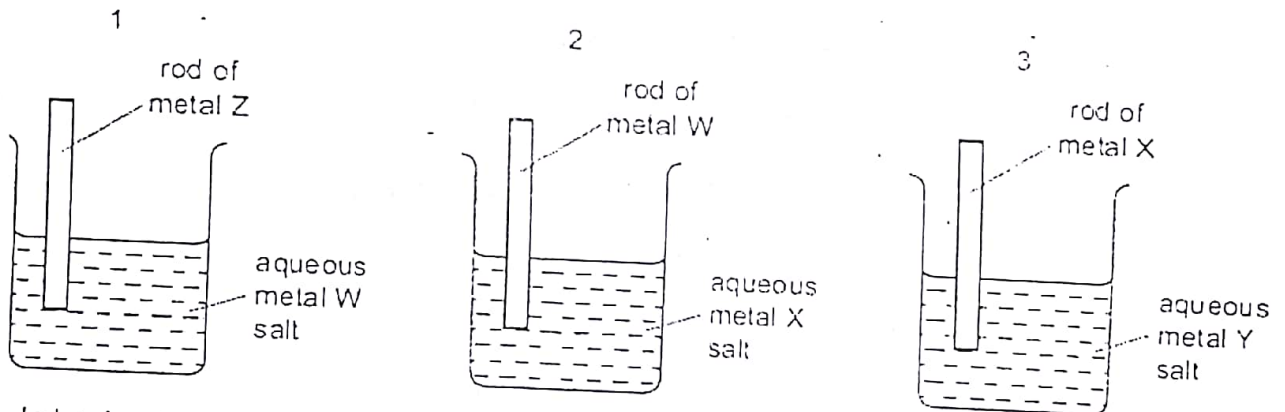
- A $Zn^{2+}(aq) + Cu(s) \rightarrow Zn(s) + Cu^{2+}(aq)$
- B $Zn^{2+}(aq) + SO_4^{2-}(aq) \rightarrow ZnSO_4(s)$
- C $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
- D $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

20. The element chromium liberates hydrogen from dilute hydrochloric acid although it does not react with cold water. When a piece of chromium is placed in lead(II) nitrate solution, crystals of lead appear.

What is the order of decreasing reactivity of the metals lead, calcium and chromium?

- A calcium, chromium, lead
- B calcium, lead, chromium
- C chromium, calcium, lead
- D lead, chromium, calcium

21. Three different beakers are set up as shown.



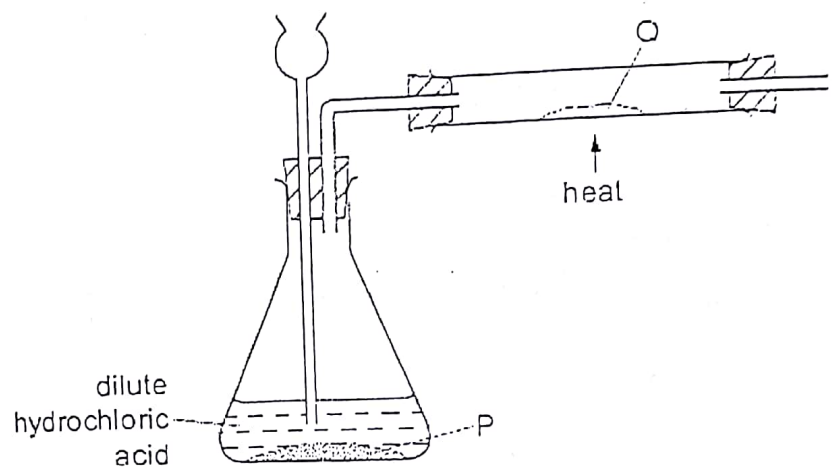
In beaker 1 metal W is displaced from solution.
 In beaker 2 metal X is displaced from solution.
 In beaker 3 metal Y is displaced from solution.

What is the order of decreasing reactivity of the four metals?

	most reactive	→			least reactive
A	W	X	Y	Z	
B	Z	W	X	Y	
C	Z	X	W	Y	
D	X	Y	W	Z	

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22. The diagram shows the apparatus used in an experiment to reduce substance Q with the gas generated in the flask.



What are substances P and Q?

	P	Q
A	copper	copper(II) oxide
B	lead	lead(II) oxide
C	magnesium	zinc oxide
D	zinc	copper(II) oxide

23. Which substance leaves a black solid when heated?

- A calcium carbonate
- B copper(II) carbonate
- C potassium carbonate
- D zinc carbonate

24. Which metal can react rapidly with steam, but reacts only very slowly with cold water?

- A calcium
- B copper
- C iron
- D potassium

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25. A coil of clean copper wire is suspended in aqueous silver nitrate. Crystals of silver are deposited on the copper wire.

Which statement is not correct?

- A The copper is oxidised.
- B The total mass of the crystals of silver increases gradually.
- C The total number of positive ions in the solution is unchanged.
- D The solution turns blue.

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Properties of Metals (Theory)

1. Many inks contain salts of the metals potassium, iron, cobalt and nickel in addition to ethanoic acid and gallic acid.

(a) (i) State two differences in the physical properties of the metals potassium and iron.

.....
 [2]

(ii) State one difference in the chemical properties of potassium and iron.

.....
 [1]

(b) Analysis of 21.25g of gallic acid showed that it contained 10.50g of carbon, 0.75g of hydrogen and 10.00g of oxygen.

Show that the empirical formula of gallic acid is $C_7H_6O_5$.

[3]

(c) Gallic acid can be used as a photographic developer. It reduces silver ions to silver.

(i) Write an equation for the reduction of silver ions to silver.

[1]

(ii) Explain why this is a reduction reaction.

..... [1]

(d) The blue colour of ink is due to the reaction between gallic acid and iron(III) ions.

Describe a standard test for iron(III) ions.

test.....
 result..... [2]

2. 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

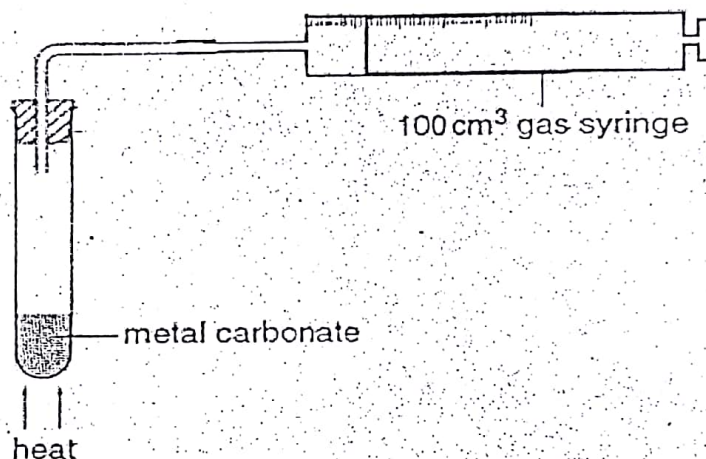
chemical test

[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.~~

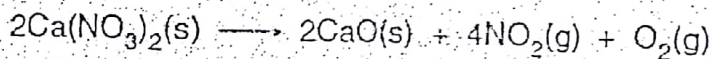
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[3]

- 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 gas produced when this sample is completely decomposed.

..... moles [1]

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[Total: 7]

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3. This question is about calcium compounds.

(a) Write the equation for the thermal decomposition of calcium carbonate. One of the products of this reaction is calcium oxide. [1]

(b) When water is added to calcium oxide, calcium hydroxide is formed.

(i) Write the equation for the reaction between water and calcium oxide. [1]

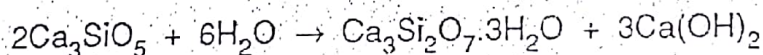
(ii) Solid calcium hydroxide reacts slowly with carbon dioxide. Name the calcium containing product of this reaction. [1]

(c) State one large scale use of calcium hydroxide. [1]

(d) Cement is made by heating calcium carbonate and clay together at a very high temperature.

One of the compounds produced is a form of calcium silicate, Ca_3SiO_5 .

In the presence of water a chemical reaction takes place that helps in the setting of cement.



Calculate the mass of calcium hydroxide formed from 912 g of Ca_3SiO_5 .

.....

.....

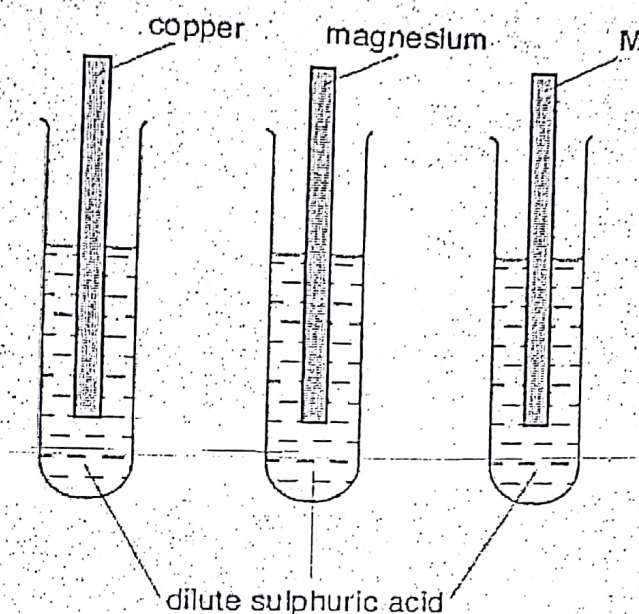
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4. A student did experiments to compare the reactivities of different metals. M and N are unknown metals. He was asked to suggest the identity of the two metals, M and N.

(a) Strips of different metals were placed in test-tubes half-filled with dilute sulphuric acid.



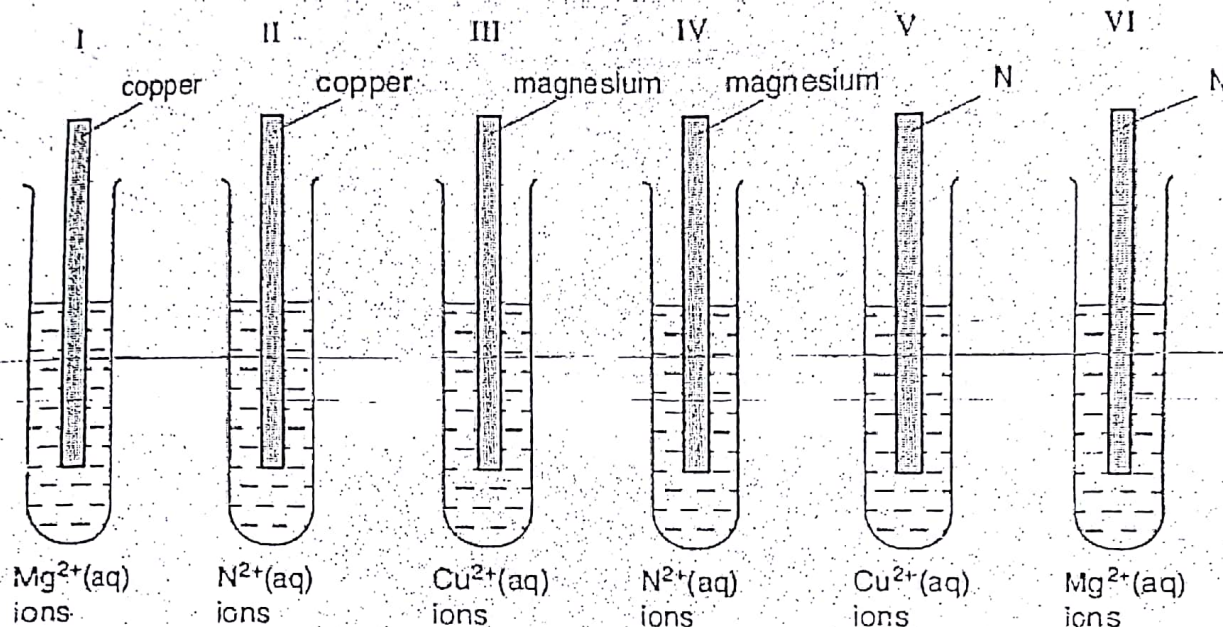
A gas was produced in one of the test tubes only.

- (i) Name the gas.
- (ii) Give a test for the gas.
- (iii) Which metal reacted with acid?
- (iv) Suggest, giving a reason, the identity of metal M.

[5]

(b) Six tubes were arranged as in the diagrams below. Each tube contained a piece of one metal half immersed in an aqueous solution containing ions of one of the other two metals.

There was a deposit in only three tubes including tube V.
There was not a deposit in tube VI.



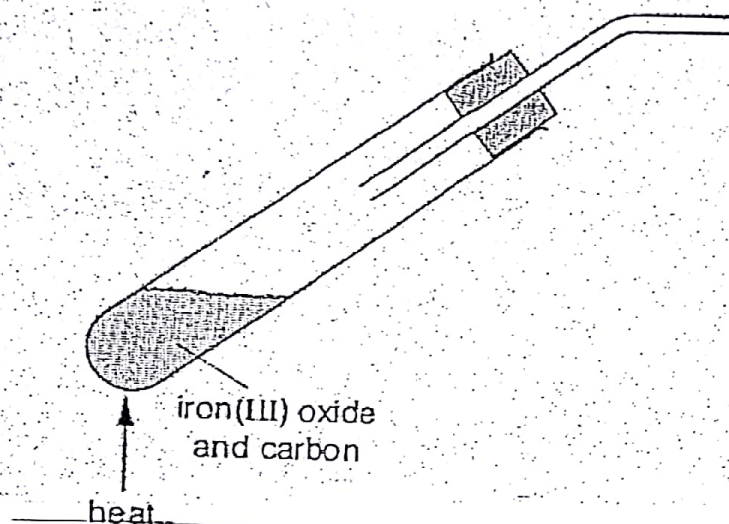
(i) In which three tubes was a deposit seen on the strip of metal?

(ii) Suggest, with a reason, what metal N could be.

(iii) Name the type of reaction which took place in tube V.

(iv) Name the products formed on heating the carbonate of N and write an equation for the reaction.

(c) A sample of iron oxide, Fe_2O_3 , was heated with carbon.



A reaction occurred and a gas was produced.

- (i) Name the gas that was produced.

- (ii) Give a test for this gas.

- (iii) Give an equation for the reaction.

[4]

5. A student was given a test-tube containing a small piece of sodium in oil.

- (a) Why was the sodium in oil?

.....[1]

The piece of sodium was transferred from the test-tube to a beaker half-filled with water. The reaction produced a gas.

(b) Name this gas and give a test to confirm the presence of this gas.

gas

test and observation

(c) Give two observations that were made when the sodium reacted with the water.

1.

2.

(d) Name the solution that remained in the beaker when the reaction had finished.

(e) A piece of litmus paper was placed in this solution. What was the colour of the litmus paper in this solution?

(f) Write an equation for the reaction between sodium and water.

Section B

6. Magnesium carbonate decomposes when it is heated.



In an experiment, 10.5 g of magnesium carbonate was heated to a constant mass.

(a) Sketch a graph to show how the volume of carbon dioxide collected changes with time. Explain your answer. [3]

(b) Calculate the maximum volume of carbon dioxide, at room temperature and pressure, that can be formed from 10.5 g of magnesium carbonate. [3]

(c) The experiment was repeated under the same conditions using zinc carbonate instead of magnesium carbonate.

- (i) Describe how the rates of the reactions would be different. Explain your answer.
- (ii) The same mass (10.5 g) of zinc carbonate was used. Would the total volume of carbon dioxide formed be the same? Explain your answer. [4]

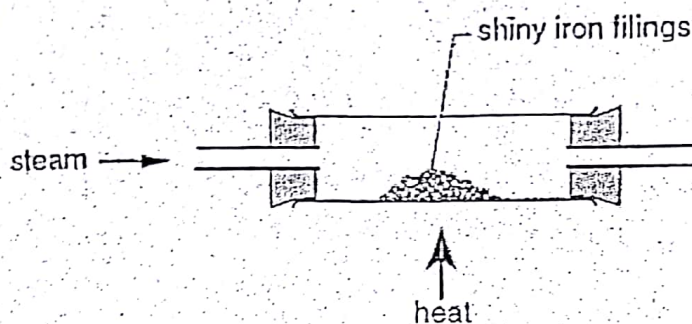
[Total: 10 marks]

7. Nickel is a transition element. It is manufactured in a four-stage process from nickel(II) sulphide, NiS.
- Stage 1 – nickel(II) sulphide is heated in air to form nickel(II) oxide and sulphur dioxide.
 - Stage 2 – nickel(II) oxide is heated with carbon to give impure nickel.
 - Stage 3 – impure nickel is reacted with carbon monoxide to make nickel tetracarbonyl, Ni(CO)₄.
 - Stage 4 – nickel tetracarbonyl is decomposed to give pure nickel.
- (a) (i) Construct the balanced equation for the reaction in stage 1.
- (ii) Calculate the mass of sulphur dioxide that is formed when 182 kg of nickel sulphide is heated in air. [3]
- (b) Nickel tetracarbonyl is a liquid with a boiling point of 43 °C. Suggest, with a reason, the type of bonding in nickel tetracarbonyl. [2]
- (c) Suggest one possible environmental consequence of the manufacture of nickel. [1]
- (d) Give an example of the use of nickel as a catalyst. [1]
- (e) In an experiment, small amounts of three metals were added to three aqueous metal nitrate solutions. The results are shown in the table.

	aqueous zinc nitrate Zn(NO ₃) ₂	aqueous nickel(II) nitrate, Ni(NO ₃) ₂	aqueous copper(II) nitrate, Cu(NO ₃) ₂
zinc	no reaction	green solution went colourless and zinc coated with a silver solid	blue solution went colourless and zinc coated with a pink solid
nickel		no reaction	
copper	no reaction	no reaction	no reaction

Predict the observations when nickel is added to separate solutions of zinc nitrate and copper(II) nitrate. Write an ionic equation for one of the reactions that takes place. [3]

8. The diagram below shows an experiment in which steam was passed over hot iron filings. The products of the reaction are iron oxide, Fe_3O_4 , and a gas which burns with a blue flame.



- (a) Write an equation, including state symbols, for the reaction and describe what you would see as the iron reacts with the steam. [3]
- (b) Describe how the observations would be different if the experiment was repeated using each of the following two metals in place of the iron filings. [3]
- magnesium
 - copper
- (c) (i) Both copper and aluminium are good conductors of electricity. Explain why overhead cables are usually made from aluminium and not copper. [3]
- (ii) Draw a diagram to show the structure and bonding of aluminium metal. Use your diagram to explain why aluminium conducts electricity so well. [4]

[Total: 10 marks]

9. Brass is an alloy containing zinc and copper.

- (a) Explain why the physical properties of brass are different from those of zinc and copper. [3]
- (b) A sample of powdered brass is added to excess dilute nitric acid.

The mixture is heated gently until all the brass reacts.

The resulting solution, A, contains aqueous copper(II) ions and aqueous zinc ions.

- Suggest the colour of solution A. [1]
- Describe and explain, with the aid of equations, what happens when aqueous sodium hydroxide is slowly added to solution A. [3]

(c) Another sample of powdered brass is added to excess dilute hydrochloric acid.

The mixture is heated and an aqueous solution of a compound B together with a solid C are formed.

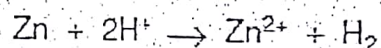
- (i) Name both B and C. [2]
(ii) Write an ionic equation for this reaction. [1]

10. Brass is an alloy of zinc and copper.

- (a) Describe, with the aid of a labelled diagram, the structure of a metal such as copper. [2]
(b) Explain, in terms of their structures, why both zinc and copper are good conductors of electricity. [1]

~~(c) A 1.2 g sample of powdered brass was analysed by reaction with excess dilute sulphuric acid.~~

~~The zinc reacts as shown in the equation to form 0.072 dm³ of hydrogen measured at room temperature and pressure.~~



- ~~(i) Suggest why brass was used in a powdered rather than lump form. [1]
(ii) Calculate the mass of zinc in the sample of brass. [2]
(iii) Calculate the percentage of zinc in the sample of brass. [1]
(d) Describe how aqueous ammonia can be used to show that only the zinc in the sample reacted with the acid. [3]~~

[Total: 10]

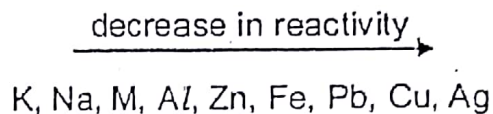
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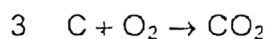
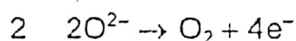
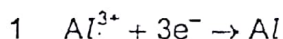
Extraction of Metals- MCQs

1. The position of metal M in the reactivity series is shown.



Which method will be used to extract M from its ore?

- A electrolysis of its aqueous sulfate
 - B electrolysis of its molten oxide
 - C reduction of its oxide by heating with coke
 - D reduction of its oxide by heating with hydrogen
2. In the electrolysis of molten aluminium oxide for the extraction of aluminium, the following three reactions take place.



Which reactions take place at the anode?

- A 1 only B 2 only C 1 and 3 D 2 and 3
3. Which equation in the blast furnace extraction of iron is not a redox reaction?
- A $CaCO_3 \rightarrow CaO + CO_2$
 - B $2C + O_2 \rightarrow 2CO$
 - C $C + CO_2 \rightarrow 2CO$
 - D $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

4. Which statement about the material used for aircraft bodies is correct?

Aircraft bodies are made from

- A an aluminium alloy because pure aluminium is too soft.
- B pure aluminium because of its high melting point.
- C pure aluminium because of its low density.
- D pure aluminium because of its resistance to corrosion.

5. From your knowledge of the manufacture of both aluminium and iron, what is the order of chemical reactivity of aluminium, carbon and iron towards oxygen?

	most reactive	→	least reactive
A	aluminium	carbon	iron
B	aluminium	iron	carbon
C	carbon	aluminium	iron
D	carbon	iron	aluminium

6. In the extraction of iron, carbon monoxide acts as

- A a catalyst.
- B an inert gas.
- C an oxidising agent.
- D a reducing agent.

7. In the manufacture of iron, using a blast furnace, which reaction generates heat?

- A $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
- B $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
- C $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- D $\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$

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	most reactive	→	least reactive
A	aluminium	carbon	iron
B	aluminium	iron	carbon
C	carbon	aluminium	iron
D	carbon	iron	aluminium

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- C $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- D $\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$

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8. Which ionic equation represents the reaction taking place at the anode during the electrolysis of molten aluminium oxide?

- A $Al^{3+} + 3e^{-} \rightarrow Al$
- B $2Al^{3+} + 3O^{2-} \rightarrow Al_2O_3$
- C $O^{2-} - 2e^{-} \rightarrow O_2$
- D $2O^{2-} - 4e^{-} \rightarrow O_2$

9. In the electrolysis of aluminium oxide to extract pure aluminium a compound called cryolite is first added to the oxide.

What is the reason for adding the cryolite?

- A to reduce the corrosion of the carbon electrodes by oxygen
- B to reduce energy costs
- C to enable the aluminium ions and oxygen ions to move to the electrodes
- D to prevent the aluminium formed from being oxidised back to aluminium oxide

10. Iron is extracted from its ore haematite, Fe_2O_3 , by a reduction process in the blast furnace.

Which equation for reactions in the blast furnace shows the formation of the reducing agent?

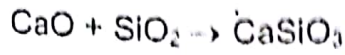
- A $CaCO_3 \rightarrow CaO + CO_2$
- B $CaO + SiO_2 \rightarrow CaSiO_3$
- C $CO_2 + C \rightarrow 2CO$
- D $C + O_2 \rightarrow CO_2$

11. The steel bodies of cars can be protected from rusting by spraying them with zinc.

Why is zinc used?

- A Zinc does not react with acidic exhaust fumes.
- B Zinc forms a stable compound with iron.
- C Zinc has a high melting point.
- D Zinc is higher in the reactivity series than iron.

12. What is the function of silica, SiO_2 , in the equation shown below?



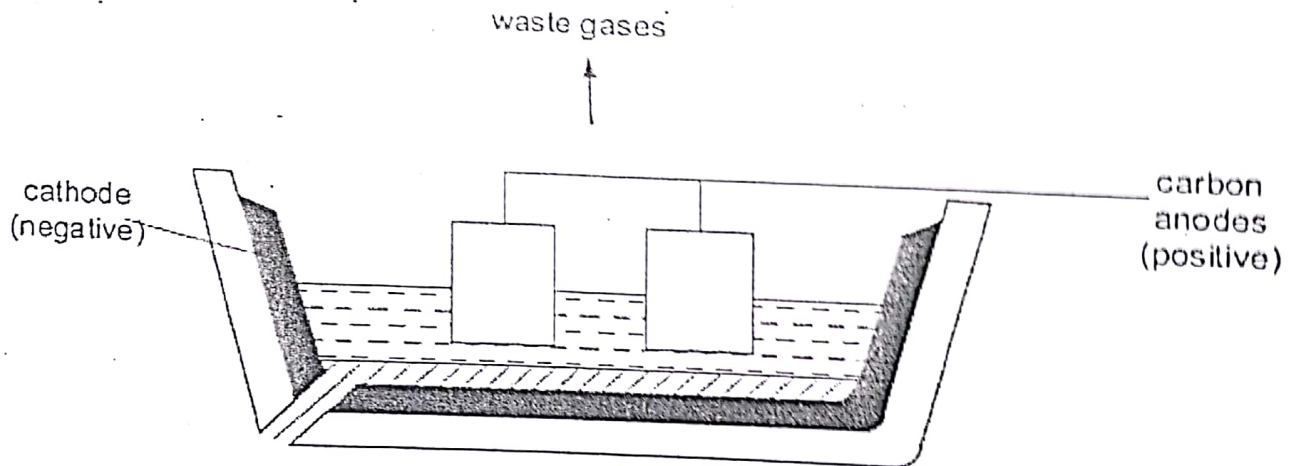
- A a basic oxide
- B a reducing agent
- C an acidic oxide
- D an oxidising agent

13. Alloys are usually harder than the metals from which they are made.

Which difference between the metals explains the greater hardness of alloys?

- A atomic radius
- B boiling point
- C density
- D malleability

14. The diagram shows the electrolytic production of aluminium.



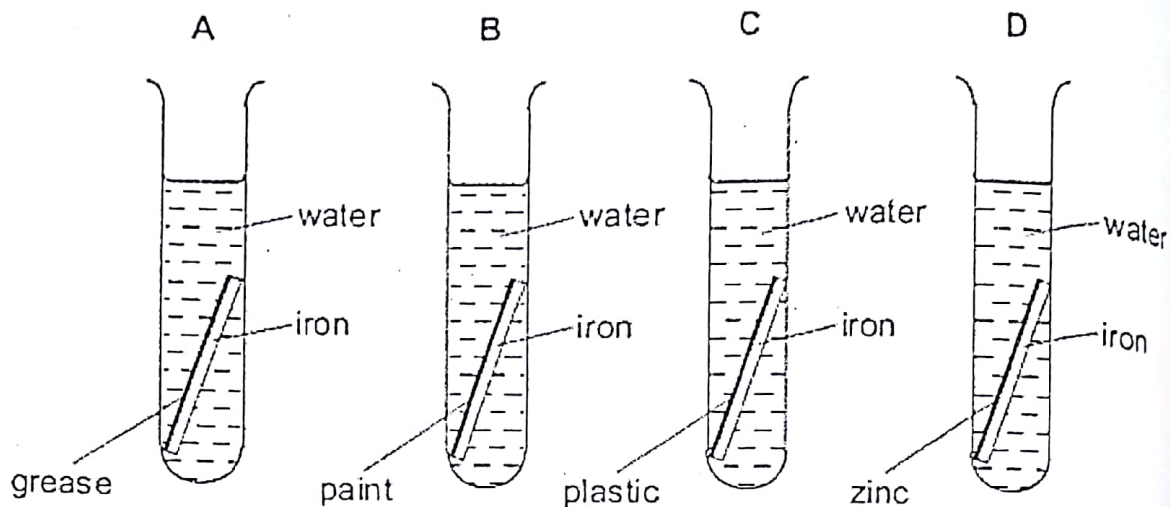
What are the products at the electrodes?

	negative electrode	positive electrode
A	solid aluminium	hydrogen
B	solid aluminium	oxygen
C	liquid aluminium	hydrogen
D	liquid aluminium	oxygen

15. Four test-tubes were set up as shown.

Each piece of iron was protected on one side by a different coating.

In which test-tube is the iron least likely to rust?



16. Three types of steel have different properties.

steel 1 easily shaped

steel 2 brittle

steel 3 resistant to corrosion

What are the names of these three types of steel?

	steel 1	steel 2	steel 3
A	high carbon	mild	stainless
B	high carbon	stainless	mild
C	mild	high carbon	stainless
D	mild	stainless	high carbon

17. Aluminium is used to make saucepans because of its apparent lack of reactivity.

Which property of aluminium explains its unreactivity?

A It has a high electrical conductivity.

B It has a low density.

C It has a surface layer of oxide.

D It is in Group III of the Periodic Table.

18. Which statement about the extraction of aluminium from aluminium oxide is correct?
- A Aluminium is extracted by heating its oxide with carbon.
 - B Aluminium is extracted using electrolysis and is collected at the anode (positive electrode).
 - C Aluminium is extracted using platinum electrodes and direct current.
 - D Molten cryolite is used as a solvent for aluminium oxide.
19. Which metal is used in the sacrificial protection of iron pipes?
- A copper
 - B lead
 - C magnesium
 - D sodium
20. Which gas is not formed during the manufacture of aluminium?
- A carbon dioxide
 - B carbon monoxide
 - C oxygen
 - D sulphur dioxide

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Extraction of Metals MCQs Mark Scheme

Question	Answer	Question	Answer
1	B	11	D
2	D	12	C
3	A	13	A
4	A	14	D
5	A	15	D
6	D	16	C
7	C	17	C
8	D	18	D
9	B	19	C
10	C	20	D

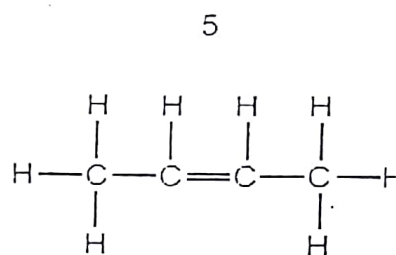
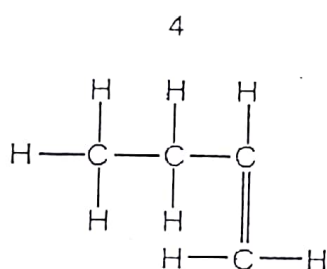
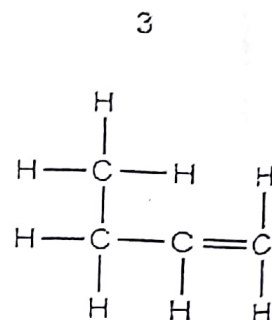
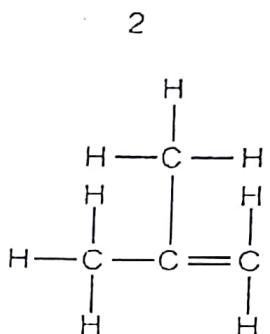
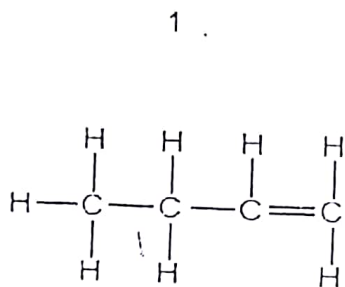
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Alkanes & Alkenes

1. Five structures are shown.

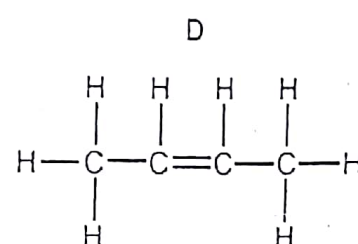
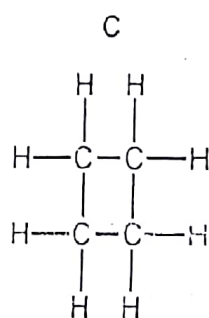
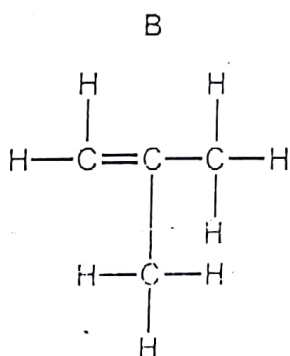
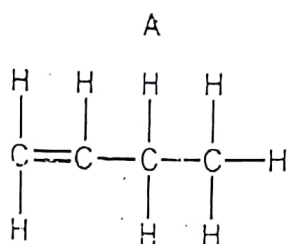


Which structures represent identical molecules?

- A 1 and 3 only
- B 2 and 3 only
- C 1, 3 and 4 only
- D 1, 3 and 5 only

36 Substance X, molecular formula C_4H_8 , does not react with hydrogen.

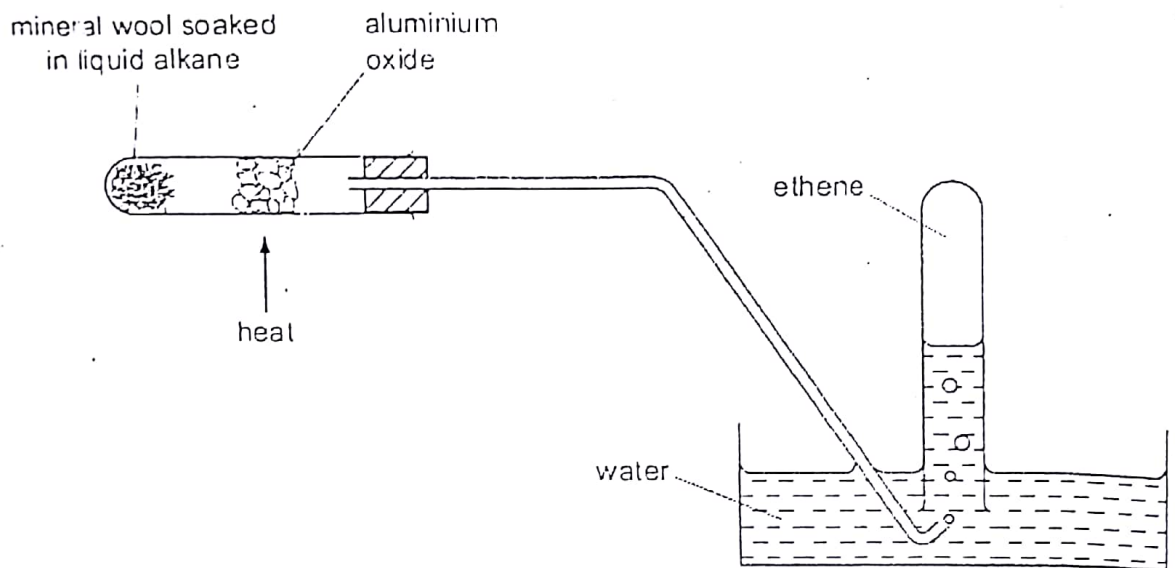
What is the structural formula of X?



3. Which hydrocarbon will burn completely in oxygen to give equal numbers of moles of carbon dioxide and water?

- A C_2H_6 B C_3H_6 C C_4H_{10} D C_5H_{12}

4. The diagram shows the breakdown of an alkane to ethene.

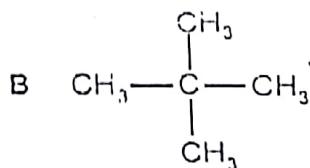
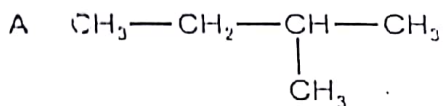
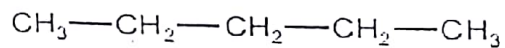


The ethene is then tested with aqueous bromine.

Which information about ethene is correct?

	solubility of ethene gas	action on aqueous bromine
A	insoluble	decolourised
B	insoluble	no reaction
C	soluble	decolourised
D	soluble	no reaction

5. Which structure is not an isomer of the structure shown?



What type of compound is X?

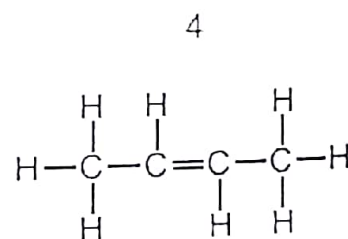
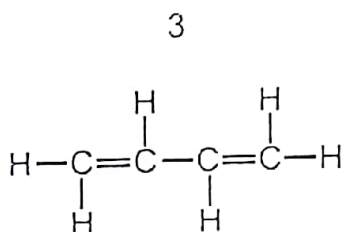
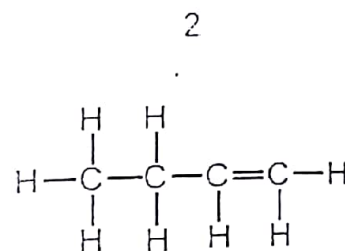
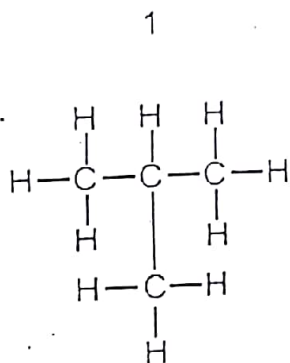
- A an alcohol
- B an alkane
- C an alkene
- D a carboxylic acid

10. A 10 cm³ sample of a gaseous hydrocarbon is completely burnt in oxygen. The total volume of products is 70 cm³.

Which equation represents the combustion of the hydrocarbon?

- A $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
- B $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
- C $\text{C}_3\text{H}_6(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$
- D $2\text{C}_2\text{H}_6(\text{g}) + 7\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$

11. The diagrams show four structures.



Which structures are isomeric butenes?

- A 1 and 2
- B 2 and 3
- C 3 and 4
- D 2 and 4

12. Methane is the first member of the alkane series of hydrocarbons. The second member is ethane which

- 1 has the formula C_2H_4 .
- 2 has a higher boiling point than that of methane.
- 3 has the same empirical formula as methane.
- 4 has chemical properties very similar to those of methane.

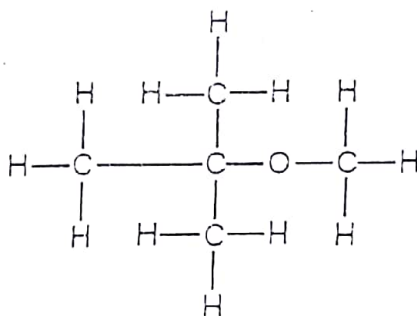
Which statements are correct?

- A 1, 2 and 3 B 1 and 4 C 2 and 4 D 3 only

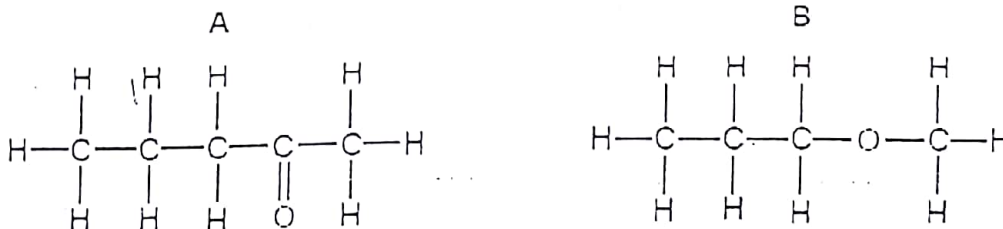
13. Which statement applies to all three of the compounds ethane, ethene and ethanol?

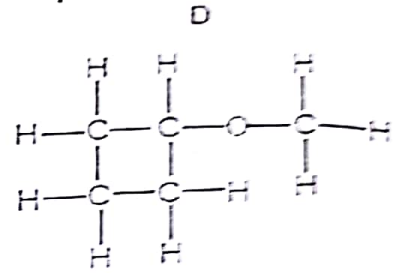
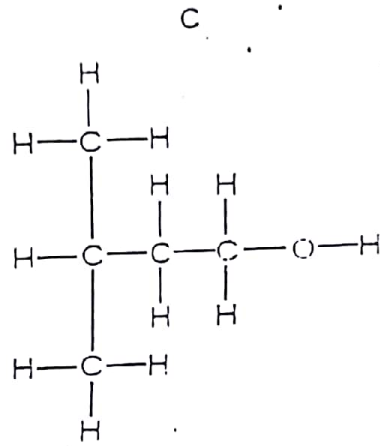
- A One molecule of each compound contains the same number of carbon atoms.
- B One mole of each compound contains the same number of hydrogen atoms.
- C They all occur in crude oil.
- D They are all liquids at room temperature.

14. A compound known in industry as 'MTBE' is used as an additive in 'lead-free' petrol. The structural formula of MTBE is shown.

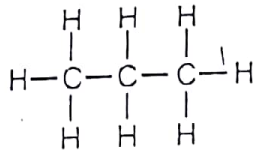


Which compound is an isomer of MTBE?

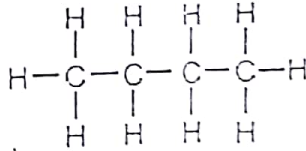




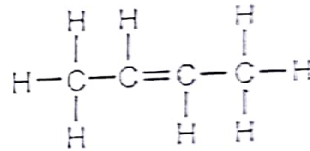
15. The diagrams show four hydrocarbons P, Q, R and S.



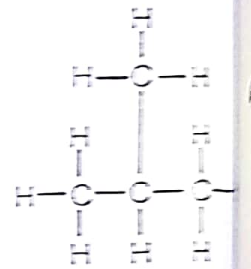
P



Q



R



S

Which two hydrocarbons are isomers of each other?

- A P and Q B P and S C Q and R D Q and S

16. What is the structure of the product of the reaction between butene, $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$ and bromine, Br_2 ?

- A $\text{CH}_2\text{Br}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{Br}$
 B $\text{CH}_2\text{Br}-\text{CH}_2-\text{CHBr}-\text{CH}_3$
 C $\text{CH}_3-\text{CHBr}-\text{CH}_2-\text{CH}_2\text{Br}$
 D $\text{CH}_3-\text{CH}_2-\text{CHBr}-\text{CH}_2\text{Br}$

17. Which property of the alkanes does **not** increase as relative molecular mass increases?

- A boiling point
 B flammability
 C melting point
 D viscosity

18. In which of the following are all the compounds members of the same homologous series?

- A CH_4 C_2H_6 C_3H_8
B CH_4 C_2H_4 C_3H_8
C C_2H_4 C_3H_6 C_4H_{10}
D C_3H_4 C_3H_6 C_3H_8

19. A vegetable oil is polyunsaturated.

Which statement about this vegetable oil is correct?

- A It has double bonds between carbon and hydrogen atoms.
B It reacts with hydrogen to form a solid compound.
C It reacts with steam to form margarine.
D It turns aqueous bromine from colourless to brown.

20. Which compound has an addition reaction with chlorine?

- A C_2H_4 B C_2H_6 C $\text{C}_2\text{H}_5\text{OH}$ D $\text{CH}_3\text{CO}_2\text{H}$

Rasheed Ahmed

A/O Level Chemistry

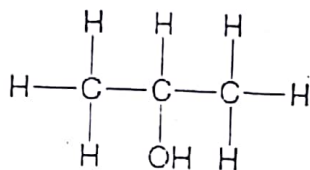
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Alkanes & Alkenes (Theory)

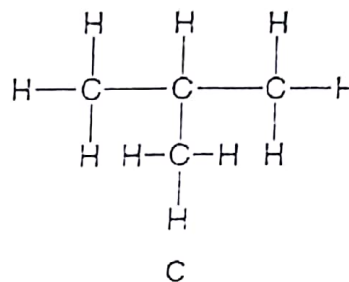
1. The structural formulae of some compounds containing the element carbon are shown.



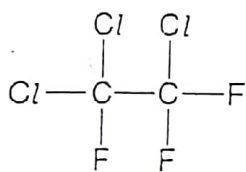
A



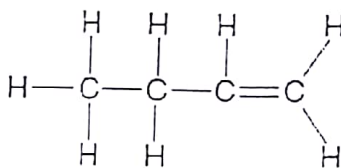
B



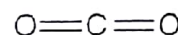
C



D



E



F

(a) Choose from the compounds A, B, C, D, E and F to answer the questions below. Each compound can be used once, more than once or not at all.

Which one of these compounds is

(i) responsible for the depletion of ozone in the upper atmosphere.

..... [1]

(ii) a poisonous gas produced by the incomplete combustion of hydrocarbons,

..... [1]

(iii) an unsaturated hydrocarbon, [1]

(iv) formed when propene reacts with steam, [1]

(v) a product of respiration, [1]

(vi) an isomer of butane? [1]

(b) Name compound B.

..... [1]

2. The table shows the boiling points of the first four members of the alkane homologous series. It also shows the enthalpy changes when these alkanes undergo complete combustion.

alkane	boiling point / $^{\circ}\text{C}$	enthalpy change of combustion /kJ per mole
methane	-161	-890
ethane	-88	-1560
propane	-42	-2219
butane	0	-2877

(a) State two characteristics of a homologous series.

.....
 [2]

(b) Pentane is the next member of the alkane homologous series.

(i) Give the molecular formula of pentane.

..... [1]

(ii) Predict the boiling point of pentane.

..... [1]

(c) (i) What information in the table tells you that the combustion of alkanes is exothermic?

..... [1]

(ii) In terms of bond making and bond breaking, explain why the combustion of alkanes is exothermic.

.....

 [2]

- (iii) The difference in the enthalpy change of combustion from one alkane to the next is approximately the same. Suggest why.

.....

.....

..... [2]

- (d) Methane is an atmospheric pollutant. Give one source of this pollutant.

..... [1]

3. Alkynes are a homologous series of organic compounds. Alkynes contain the $C\equiv C$ group. They react in a similar way to alkenes.

[Total: 10]

The table shows some information about the first five alkynes.

alkyne	molecular formula	boiling point / °C
ethyne	C_2H_2	-84
propyne	C_3H_4	-23
	C_4H_6	8
pentyne	C_5H_8	40
hexyne		

- (a) Suggest the name of the alkyne with the molecular formula C_4H_6 .

..... [1]

- (b) Draw the structure of propyne.

- (c) (i) Estimate the boiling point of hexyne.

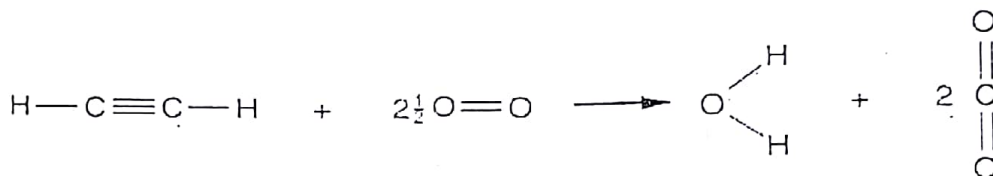
.....°C

[1]

- (ii) Write the molecular formula of hexyne.

..... [1]

- (d) Ethyne reacts with oxygen in an exothermic reaction.



- (i) Explain why the combustion of ethyne is an exothermic reaction. Use ideas about the energy changes that take place during bond breaking and bond forming.

.....

 [2]

- (ii) The complete combustion of one mole of ethyne releases 1410 kJ of energy. Calculate the energy released when 1000 dm³ of ethyne, measured at room temperature and pressure, is completely combusted.

energy released = kJ [2]

- (e) Ethyne is bubbled through aqueous bromine.

- (i) Suggest a possible molecular formula of the product of this reaction.

..... [1]

- (ii) What would you see during the reaction?

..... [1]

4. Ethane, C_2H_6 , and ethene, C_2H_4 , are both gaseous hydrocarbons.

(a) Describe how aqueous bromine can be used to distinguish between a sample of ethane and a sample of ethene.

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

(b) Draw a 'dot-and-cross' diagram for ethane.
You only need to draw the outer electrons of the carbon atoms.

[2]

(c) Ethane reacts with chlorine in the presence of ultra-violet light.
Suggest a structure for a product of this reaction.

[1]

(d) Write both the name and the molecular formula of an alkene molecule containing four carbon atoms.

name

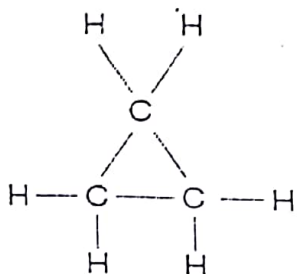
molecular formula [2]

One compound in the wax has the formula $C_{18}H_{38}$.

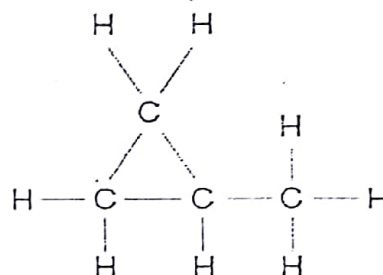
To which class of hydrocarbons does this compound belong? Explain your answer.

.....
 [1]

5. The structures shown below are of the first two members of an homologous series known as the cyclopropanes.



compound D



compound E

Members of an homologous series have a general formula.

(a) (i) State one other characteristic of an homologous series.

..... [1]

(ii) Deduce the general formula for the cyclopropane homologous series.

..... [1]

(b) Cyclopropanes react in a similar way to alkanes such as methane.

(i) Write a chemical equation for the complete combustion of compound D.

..... [2]

(ii) Suggest the type of reaction by which compound D reacts with chlorine.

..... [1]

(c) Name and draw the structure of an alkene that is an isomer of compound D.

name

structure

Alkanols & Alkanoic Acids (Theory)

1. Ethanol can be made both by fermentation and by the addition of steam to ethene.

(a) (i) Name the organic compound required for fermentation.

..... [1]

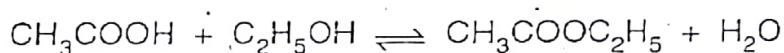
(ii) State the conditions under which fermentation most readily takes place.

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

(b) Write an equation for the reaction between steam and ethene.

[1]

(c) Ethanol, C_2H_5OH , reacts with ethanoic acid, CH_3COOH .



(i) Name the compound $CH_3COOC_2H_5$.

..... [1]

(ii) What name is given to this type of chemical reaction?

..... [1]

(d) (i) Name the third member of the alcohol homologous series.

..... [1]

(ii) Draw the structural formula of this compound, showing all atoms and bonds.

[1]

2. Ethanol, C_2H_5OH , can be manufactured by two different processes.

- process 1 – the catalysed addition of steam to ethene
- process 2 – the fermentation of glucose

(a) Name the type of reaction used to manufacture ethene.

..... [1]

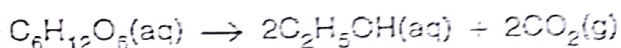
(b) (i) Write the equation for process 1.

[1]

(ii) Suggest the name of the alcohol made when the alkene C_3H_6 reacts with steam in the presence of a catalyst.

..... [1]

(c) The equation for process 2 is shown below.



(i) Describe two essential conditions required for efficient fermentation.

.....

 [2]

(ii) Suggest one advantage of manufacturing ethanol by process 2 rather than by process 1.

.....
 [1]

(d) Process 2 makes an aqueous solution of ethanol. Suggest a method of purification that can be used to remove water from the aqueous ethanol.

..... [1]

(e) Describe a chemical test which could be used to positively identify the carbon dioxide formed during fermentation.

test
 observation [1]

3. An ester is made from a carboxylic acid and an alcohol.

The carboxylic acid has the molecular formula $C_4H_8O_2$. Analysis of the alcohol shows it has the following percentage composition by mass:
52.2% carbon; 13.0% hydrogen; 34.8% oxygen.

(a) (i) Suggest a possible name for the carboxylic acid.

..... [1]

(ii) Draw a possible structure for the carboxylic acid.

[1]

(iii) What is the empirical formula for the carboxylic acid?

..... [1]

(b) Calculate the empirical formula for the alcohol.

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

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

..... [1]

(ii) Suggest one commercial use of this ester.

..... [1]

- (c) Suggest the type of condensation polymer which is made when fumaric acid reacts with ethane-1,2-diol, $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$

.....[1]

- (d) Nylon is a condensation polymer.
State one use of nylon.

.....[1]

- (e) Describe two pollution problems caused by the disposal of non-biodegradable plastics.

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

[Total: 10]

5. Alcohols are an homologous series of organic chemical compounds.

The table shows some information about different alcohols.

alcohol	formula	boiling point / °C
methanol	CH_3OH	65
ethanol	$\text{C}_2\text{H}_5\text{OH}$	78
propanol	$\text{C}_3\text{H}_7\text{OH}$	97
pentanol	$\text{C}_5\text{H}_{11}\text{OH}$	138

- (a) What is meant by the term *homologous series*?

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

- (b) (i) Estimate the boiling point of butanol. [1]
- (ii) A molecule of the alcohol hexanol contains six carbon atoms. Write the formula of hexanol.

..... [1]

- (c) Ethanol can be manufactured from ethene.
Ethene reacts with steam in the presence of an acid catalyst to form ethanol.

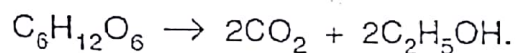
- (i) Write an equation for the reaction between ethene and steam.

..... [1]

- (ii) Name the type of reaction that takes place.

..... [1]

- (d) Ethanol can also be manufactured from glucose, $C_6H_{12}O_6$.

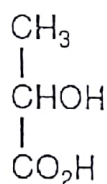


A solution containing 18 kg of glucose makes only 0.92 kg of ethanol.
Calculate the percentage yield of ethanol.

[3]

[Total: 10]

6. The sweat glands in the skin produce small amounts of lactic acid.



lactic acid

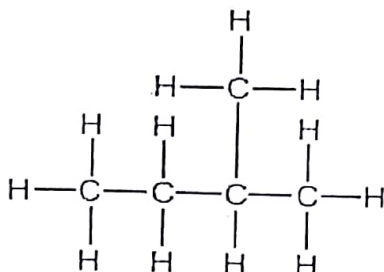
Lactic acid reacts with ethanol to form an ester.

- (i) State the conditions needed to form an ester. [2]
- (ii) Draw the structure of the ester produced by the reaction of lactic acid with ethanol. [1]

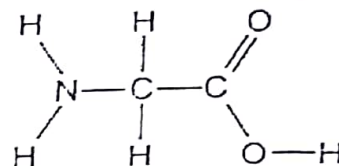
Polymers & Polymerization (MCQs)

1. Which formula represents a compound likely to undergo addition polymerisation?

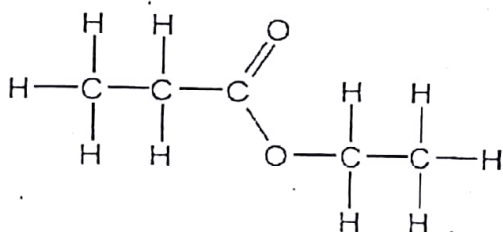
A



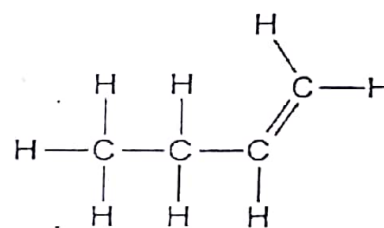
B



C



D



2. In which reaction is water produced?

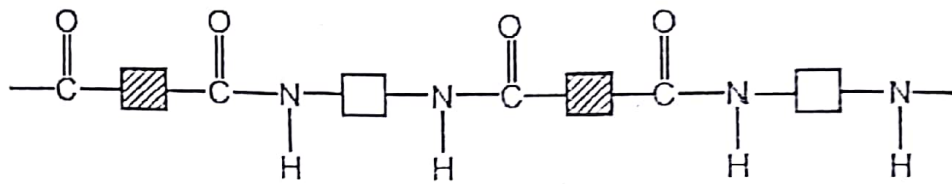
- A manufacture of ethanol from ethene
- B manufacture of margarine from vegetable oils
- C manufacture of poly(ethene) from ethene
- D manufacture of *Terylene* from a carboxylic acid and an alcohol

3. The macromolecules of proteins, fats and carbohydrates can all be broken down into their simple units by a similar process.

What is the process called?

- A esterification
- B hydrolysis
- C oxidation
- D reduction

4. Polymer X has the structure shown.



The list shows four terms that can be applied to polymers.

- 1 addition polymer
- 2 condensation polymer
- 3 polyamide
- 4 polyester

Which two terms can be applied to polymer X?

- A 1 and 3 B 1 and 4 C 2 and 3 D 2 and 4

5. Which statement about *Terylene* is correct?

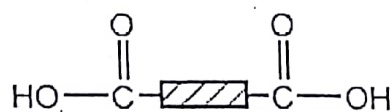
- A It is an addition polymer.
- B It is an alkene.
- C It is a polyamide.
- D It is a polyester.

6. Carbohydrates, proteins, fats and *Terylene* are macromolecules.

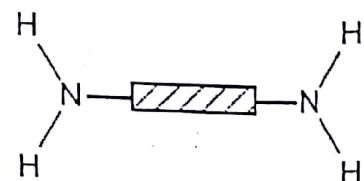
Which element is found in only one of these macromolecules?

- A carbon
- B hydrogen
- C nitrogen
- D oxygen

7. A polymer X is hydrolysed and the two products are



and



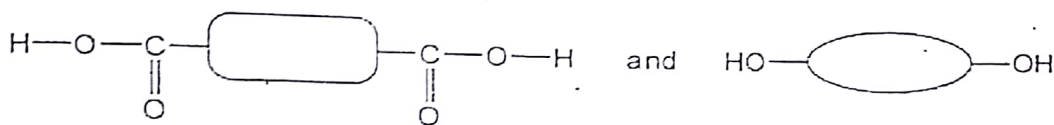
What can be deduced about X?

- A It is a condensation polymer.
- B It is made by addition polymerisation.
- C It is starch.
- D It is Terylene.

8. Information about the gases present in the atmospheres of four planets is given below. Which planet's atmosphere contains the four elements found in all proteins?

	composition of atmosphere		
A	CH ₄	NH ₃	HCl
B	CH ₄	NH ₃	H ₂ O
C	CH ₄	SO ₂	HCl
D	SO ₂	NH ₃	H ₂ O

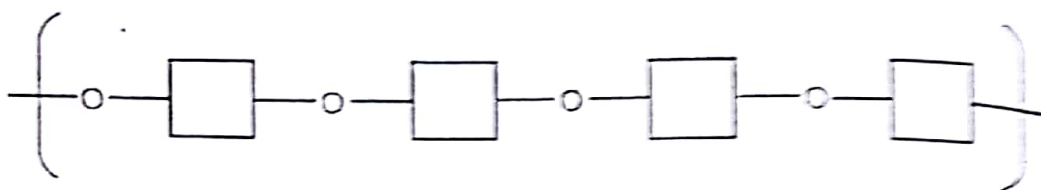
9. Terylene (a polyester) is made by condensation polymerisation of the two monomers shown.



What is the repeat unit of the polymer?

- A $\left[\text{C}(=\text{O})-\text{[Box]}-\text{C}(=\text{O})-\text{[Oval]}-\text{O} \right]_n$
- B $\left[\text{O}-\text{[Box]}-\text{C}(=\text{O})-\text{O}-\text{[Oval]}-\text{O} \right]_n$
- C $\left[\text{C}(=\text{O})-\text{[Box]}-\text{O}-\text{C}(=\text{O})-\text{[Oval]}-\text{O} \right]_n$
- D $\left[\text{C}(=\text{O})-\text{[Box]}-\text{C}(=\text{O})-\text{O}-\text{[Oval]}-\text{O} \right]_n$

10. A section of a polymer is shown.



The structure of its monomer is

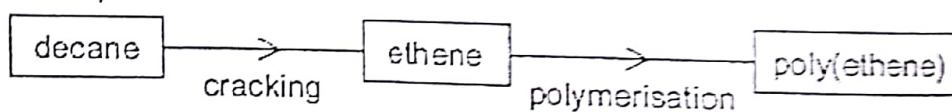


The monomer undergoes condensation polymerisation to form the polymer.

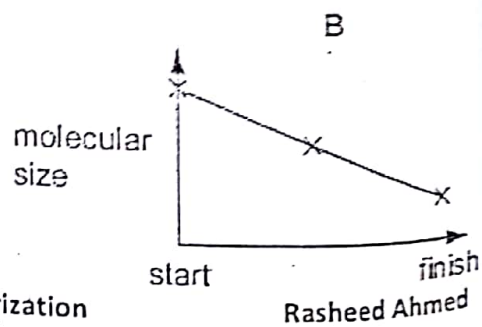
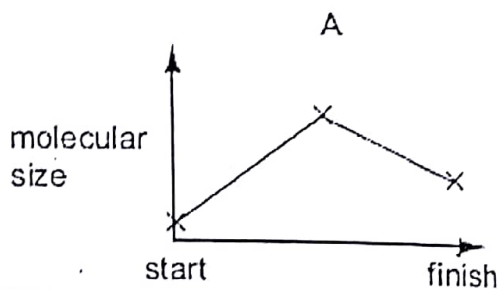
What is made each time a monomer adds to the polymer?

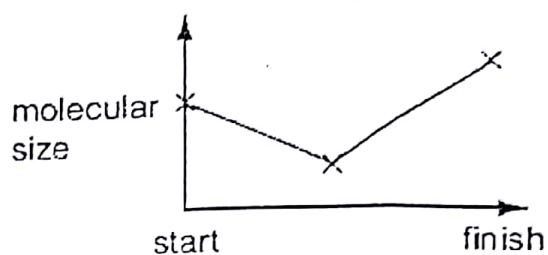
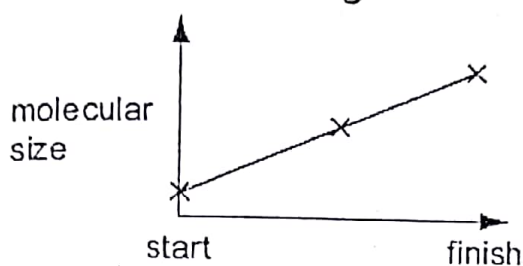
- A hydrogen molecules, H_2
 - B hydroxide ions, OH^-
 - C oxygen atoms, O
 - D water molecules, H_2O
11. What is produced when proteins are hydrolysed?
- A alcohols
 - B amides
 - C amino acids
 - D sugars

12. Poly(ethene) can be manufactured by the process below.

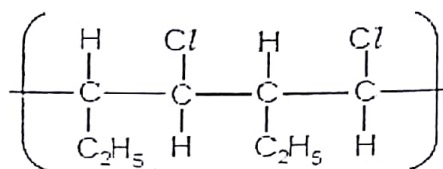


Which diagram shows the change in molecular size during this process?

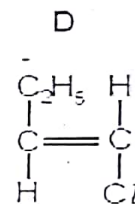
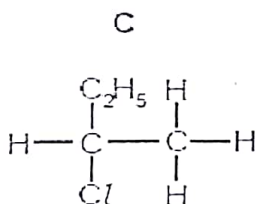
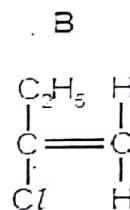
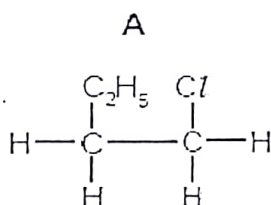




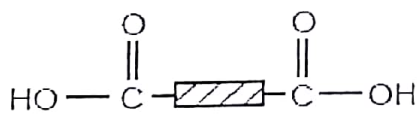
13. The structural formula of a polymer is shown below.



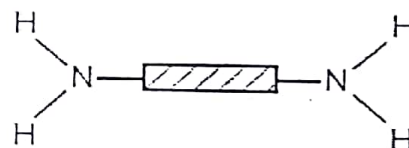
Which one of the following will form this polymer?



14. A polymer X was hydrolysed and the two products were



and



What can be deduced about X?

- A It was a condensation polymer.
- B It was starch.
- C It was made by addition polymerisation.
- D It was *Terylene*.

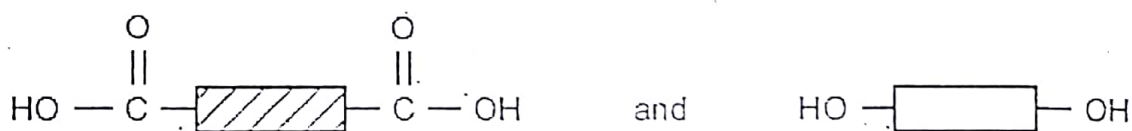
15. Which natural resource is being depleted by the manufacture of plastics?

- A air
- B fossil fuels
- C metal ores
- D water

16. Which element is least likely to be found in a macromolecule?

- A carbon
- B hydrogen
- C oxygen
- D sodium

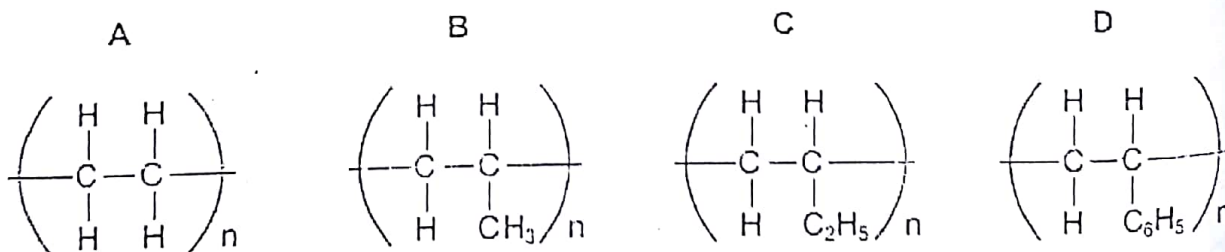
17. A macromolecule is made from the two monomer molecules shown below.



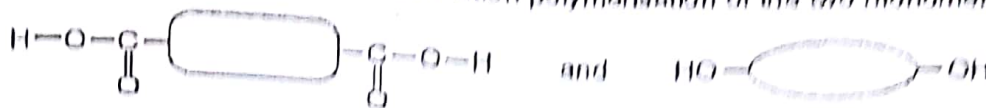
What is the macromolecule?

- A a carbohydrate
- B a polyamide
- C a polyester
- D a protein

18. Which polymer has the empirical formula CH?



19. Terylene (a polyester) is made by condensation polymerisation of the two monomers shown.



What is the repeat unit of the polymer?

- A $\left[\text{C}(=\text{O})-\text{[rectangle]}-\text{C}(=\text{O})-\text{O}-\text{[oval]}-\text{O} \right]_n$
- B $\left[\text{O}-\text{[rectangle]}-\text{C}(=\text{O})-\text{O}-\text{[oval]}-\text{O} \right]_n$
- C $\left[\text{C}(=\text{O})-\text{[rectangle]}-\text{O}-\text{C}(=\text{O})-\text{[oval]}-\text{O} \right]_n$
- D $\left[\text{C}(=\text{O})-\text{[rectangle]}-\text{C}(=\text{O})-\text{[oval]}-\text{O} \right]_n$

20. The macromolecules of proteins, fats and carbohydrates can all be broken down into their simple units by a similar process.

What is the process called?

- A esterification
- B hydrolysis
- C oxidation
- D reduction

Rasheed Ahmed

A/O Level Chemistry

0333-4277385

Polymers & Polymerization (Theory)

1. Proteins are naturally occurring macromolecules.

(a) (i) What do you understand by the term *macromolecule*?

.....[1]

(ii) Name another naturally occurring macromolecule.

.....[1]

(b) Proteins can be hydrolysed to amino acids.

State a suitable reagent and condition for this hydrolysis.

reagent.....

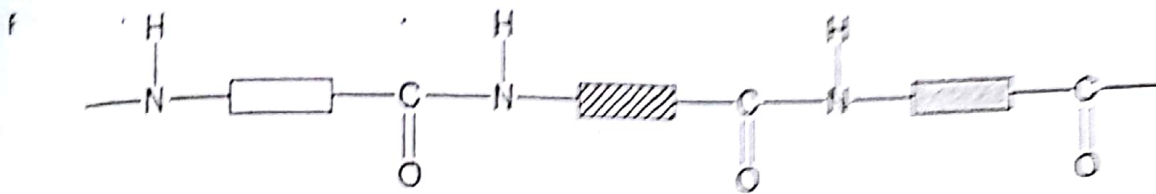
condition[2]

(c) The amino acids can be identified by paper chromatography.

Describe, with the aid of a labelled diagram, how paper chromatography can be used to identify particular amino acids.

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

(d) The structure of a section of a protein can be represented as,



(i) Describe one similarity in the structure of a protein and the structure of nylon.

..... [1]

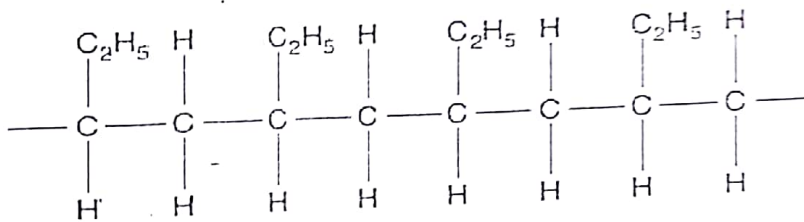
(ii) Describe one way in which the structure of a protein differs from the structure of nylon.

..... [1]

[Total: 10]

2. Plastics are made of macromolecules called polymers. In the middle of the Pacific Ocean there is a huge area of water that is contaminated with small bits of plastics. The waste plastics have been washed away from coastlines.

(a) Part of the structure of one of the polymers found in the ocean is shown below.



(i) Name this type of polymer.

..... [1]

(ii) Draw the structure of the monomer used in the manufacture of this polymer.

..... [1]

(iii) Explain why this polymer is described as a saturated hydrocarbon.

..... [1]

(b) Suggest why this polymer is not destroyed in water.

..... [1]

.....

[Total: 4]

3. *Terylene* is a polyester used to make clothing materials.

(i) Draw the partial structure of *Terylene*. Include all the atoms and all the bonds in the ester linkage.

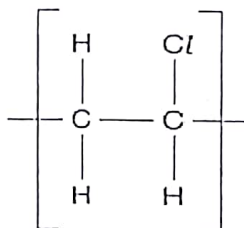
[2]

(ii) Which type of natural macromolecule contains the ester linkage?

..... [1]

4. Poly(chloroethene) is an addition polymer. It is often found in solid household waste.

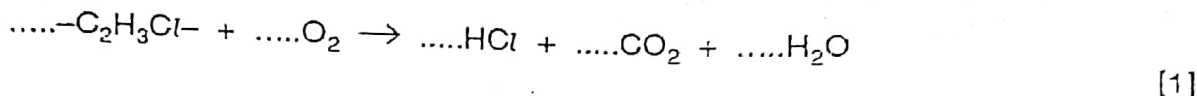
The diagram shows the repeat unit of poly(chloroethene).



(a) Draw the structure of the monomer used to make poly(chloroethene).

(b) One way to dispose of solid household waste is to burn it at a high temperature. The burning of poly(chloroethene) gives the waste gases hydrogen chloride, carbon dioxide and water.

(i) Balance the following equation to show the burning of poly(chloroethene).



(ii) Hydrogen chloride gas is removed from the waste gases by reacting with moist powdered calcium carbonate. Name the solid product formed.

.....[1]

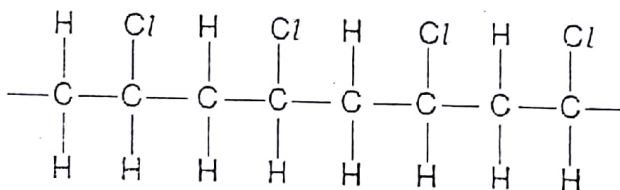
(c) Name and state the use of a man-made condensation polymer.

name of condensation polymer

use of condensation polymer [2]

[Total: 5]

5. The macromolecule below is an addition polymer.



polymer X

(a) Draw the structure of the monomer from which polymer X is formed. [1]

(b) The atoms in polymer X are covalently bonded.

(i) Explain what is meant by a covalent bond. [1]

(ii) Polymer X is used as an insulating cover for electrical wires. Explain why polymer X does not conduct electricity. [1]

(c) Polymer X is non-biodegradable.

(i) Describe one pollution problem that this causes. [1]

(ii) Polymer X can be disposed of by burning at high temperature. This produces waste gases, some of which are toxic such as hydrogen chloride. The hydrogen chloride can be removed by reacting the waste gases with moist calcium carbonate powder. Name the three products of this reaction. [3]

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(d) Sea fishing nets used to be made from natural fibres. Many nets are now made from nylon. Suggest one advantage, other than strength, and one disadvantage of using nylon rather than natural fibres to make sea fishing nets.

advantage

disadvantage [2]

[Total: 7 marks]

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WSO – Polymers and Polymerization

Rasheed Ahmed

Air, Water & Pollution (MCQs)

1. A catalytic converter in a car exhaust system speeds up the change of pollutants into less harmful products.

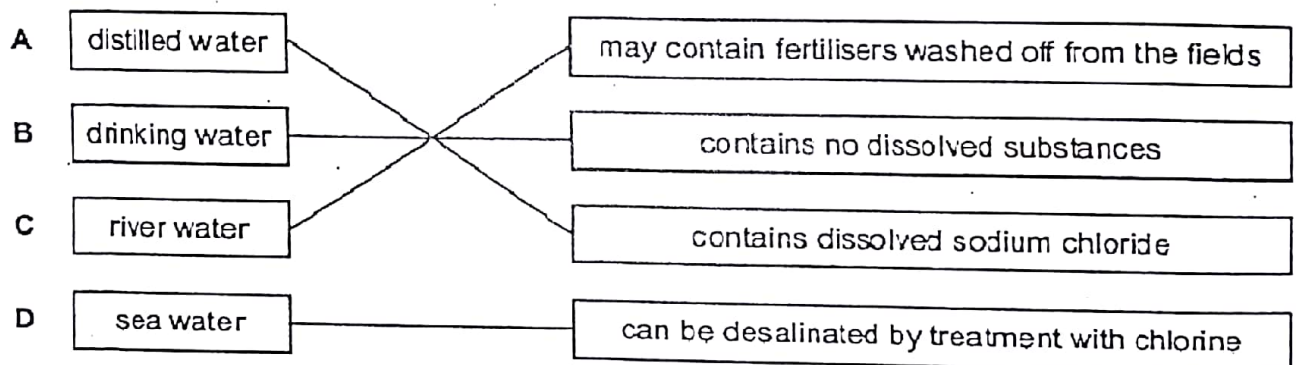
Which change does not occur in a catalytic converter?

- A carbon dioxide \rightarrow carbon
- B carbon monoxide \rightarrow carbon dioxide
- C nitrogen oxides \rightarrow nitrogen
- D unburned hydrocarbons \rightarrow carbon dioxide and water

2. Which natural process can cause nitrogen oxides to be formed in the atmosphere?

- A bacterial decay of plants
- B lightning activity
- C photosynthesis
- D respiration

3. Which type of water in the left hand column is linked correctly to a statement in the right hand column?



4. Which gas burns in air to form only one product?

- A ammonia
- B carbon monoxide
- C hydrogen chloride
- D methane

5. Why is carbon used in the purification of drinking water?

- A It desalinates the water.
- B It disinfects the water.
- C It filters out solids.
- D It removes tastes and odours from the water.

6. Which substances will burn in air and give carbon dioxide amongst the combustion products?

- 1 calcium carbonate
- 2 ethane
- 3 ethanol
- 4 methanol

A 1 and 2 only B 2 and 3 only C 1, 2 and 3 only D 2, 3 and 4 only

7. Four current problems in our atmosphere are listed.

- 1 acid rain
- 2 depletion of the ozone layer
- 3 presence of greenhouse gases
- 4 incomplete combustion of carbon compounds

Which atmospheric pollutant is responsible for each problem?

- W chlorofluorocarbons
- X sulfur dioxide
- Y carbon monoxide
- Z carbon dioxide

	1	2	3	4
A	W	X	Z	Y
B	X	W	Z	Y
C	X	Z	W	Y
D	Z	Y	X	W

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B	X	W	Z	Y
C	X	Z	W	Y
D	Z	Y	X	W

8. Which process takes place during photosynthesis?

- A Carbohydrate is decomposed and oxygen is formed.
- B Carbon dioxide is taken in and oxygen is formed.
- C Oxygen is taken in and carbohydrate is formed.
- D Oxygen is taken in and carbon dioxide is formed.

9. Which gas, present in pond water, decreases in concentration during eutrophication?

- A carbon dioxide
- B methane
- C nitrogen
- D oxygen

10. Methane is a greenhouse gas.

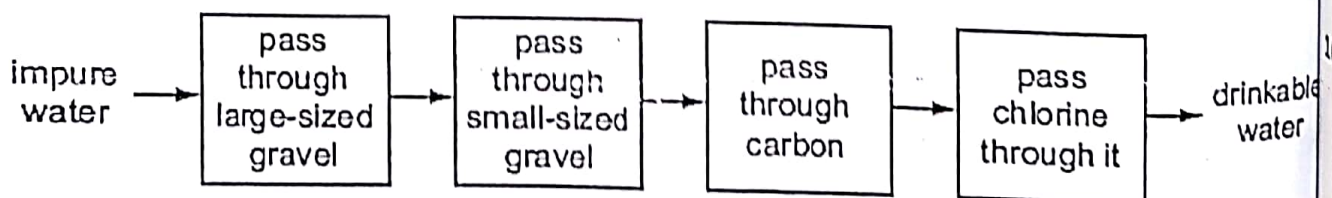
Which process releases methane into the air?

- A combustion of petrol
- B decay of vegetable matter
- C photosynthesis
- D volcanic activity

11. Carbon dioxide and carbon monoxide are both

- A absorbed by sodium hydroxide.
- B colourless.
- C inflammable in air.
- D lighter than air.

12. The flow chart shows how impure water can be treated to produce drinkable water.



What is not removed from the water by this process?

- A clay particles
- B microbes
- C nitrates
- D odours

13. A solid substance Z burns in air to form a product that is gaseous at 20°C.

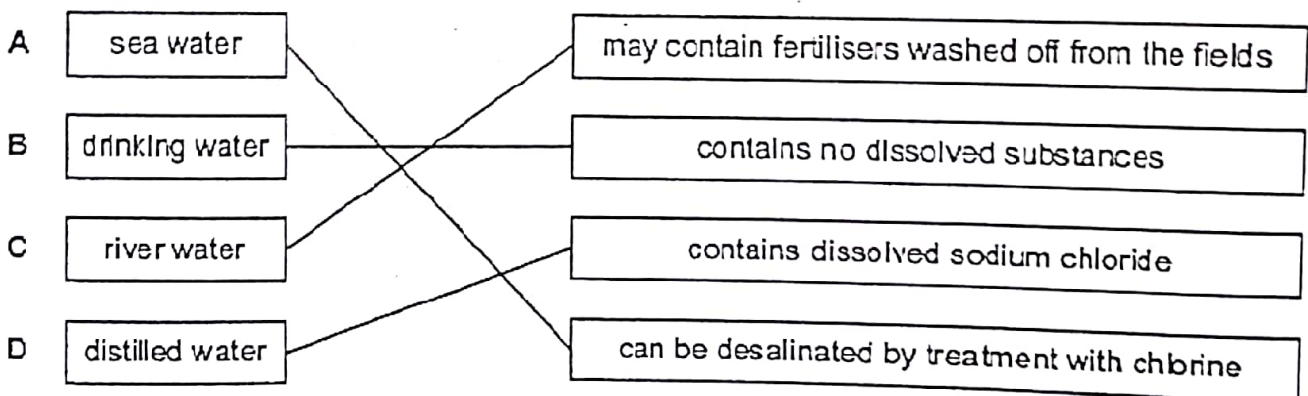
What is Z?

- A hydrogen
- B carbon monoxide
- C carbon
- D magnesium

14. Why are catalytic converters fitted to car exhausts?

- A to decrease the amount of carbon dioxide emitted
- B to decrease the amount of nitrogen oxides emitted
- C to improve energy conservation
- D to reduce global warming

15. Which type of water in the left hand column is linked correctly to a statement in the right hand column?



16. The table shows pollutants which cause eutrophication, sources of these pollutants and a problem that eutrophication causes.

Which entry in the table is correct?

	pollutant	source	problem
A	nitrates	detergents	oxygen depletion
B	nitrates	fertilisers	excess oxygen
C	phosphates	detergents	oxygen depletion
D	phosphates	fertilisers	excess oxygen

17. Which gas burns in air to form a single product?

- A ammonia
- B carbon monoxide
- C hydrogen chloride
- D methane

18. Vegetable matter is biodegradable.

Which gas is released into the atmosphere when vegetable matter biodegrades?

- A carbon monoxide
- B methane
- C nitrogen dioxide
- D sulphur dioxide

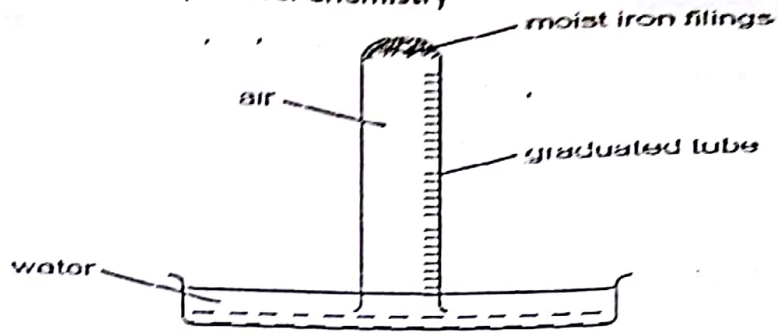
19. To reduce atmospheric pollution, the waste gases from a coal-burning power station are passed through powdered calcium carbonate.

Which waste gas will not be removed by the powdered calcium carbonate?

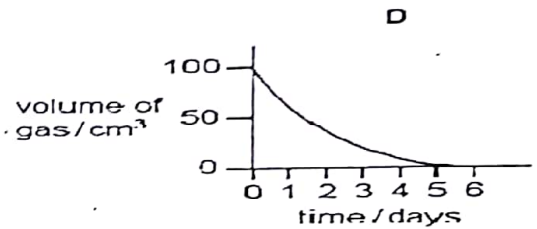
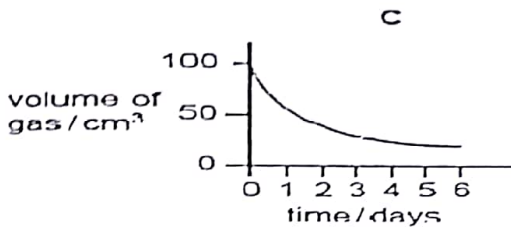
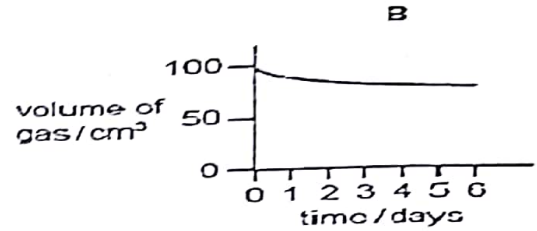
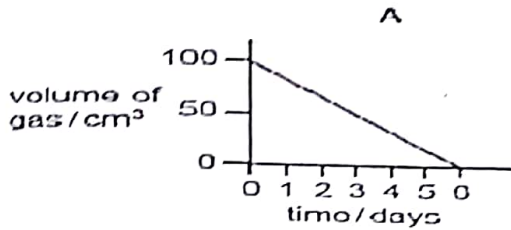
- A carbon monoxide, CO
- B nitrogen dioxide, NO₂
- C phosphorus(V) oxide, P₂O₅
- D sulphur dioxide, SO₂

20. The apparatus shown was set up with 100 cm³ volume of air in the tube.

The volume of gas in the tube was measured at intervals for six days.



Which graph best represents how the volume of gas changes with time?



21. The gases coming from a car's exhaust contain oxides of nitrogen.

How are these oxides formed?

- A Nitrogen reacts with carbon dioxide.
- B Nitrogen reacts with carbon monoxide.
- C Nitrogen reacts with oxygen.
- D Nitrogen reacts with petrol.

22. The table shows pollutants and their possible effects.

Which line is **not** correct?

	pollutant	effect
A	CFCs	cause destruction of the ozone layer
B	CH ₄	forms photochemical smog
C	CO	is poisonous to humans
D	NO ₂	forms acid rain

23. Which pollutant increases the growth of algae in rivers and streams?

- A chlorine
- B heavy metal ions
- C nitrate ions
- D sulphur dioxide

24. Which gas is not produced when hydrocarbons are burnt in the internal combustion engine?

- A carbon dioxide
- B carbon monoxide
- C hydrogen
- D nitrogen oxides

25. Which gas cannot be removed from the exhaust gases of a petrol powered car by its catalytic converter?

- A carbon dioxide
- B carbon monoxide
- C hydrocarbons
- D nitrogen dioxide

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Organic Chemistry

(O - Level Class Test 1)

Name:

Marks: (/45) Time: 45 min

1. This question refers to the three organic compounds labelled A, B and C below.

Compound A
 $\text{CH}_3\text{CH}=\text{CHCOOH}$

Compound B
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

Compound C
 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{OH}$

(a) Name the functional group(s) present in compound A.

(1)

(b) (i) Compounds B and C could react together to form an ester. Give the two conditions used for this reaction.

(2)

(ii) Suggest the structural formula of the ester formed. Clearly label ester bond and ester group.

(2)

(c) Aqueous sodium carbonate was added to each compound.

(i) State which of the compounds A, B and C would react with sodium carbonate to give carbon dioxide.

(1)

(ii) Give balanced chemical equation of the reaction.

(1)

(iii) Describe a test for carbon dioxide.

(1)

(d) Each compound was shaken with bromine water.

(i) State which of the compounds A, B and C would decolourise the bromine water.

(1)

(ii) Identify the structural feature that is responsible for the decolourisation of bromine water

(1)

(iii) State the type of reaction occurring when bromine water is decolourised.

(1)

(iv) Write an equation for the reaction between bromine and one of the compounds.

(1)

(iv) Give the structural formula of another isomer, of the compound, which has reacted with bromine water.

(1)

(V) Separate samples of compound A, B and C are heated with acidified KMnO_4 . Which compound would react with the acidified KMnO_4 ?

(1)

(Vi) What do you observe?

(1)

(Vii) What type of reaction is this?

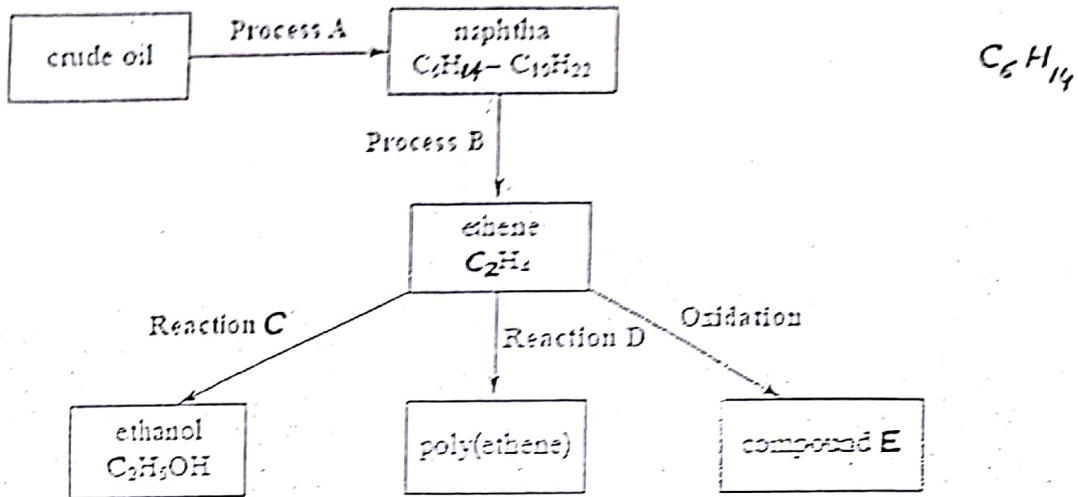
(1)

(Viii) Give the structural formula of the organic product of the reaction.

(1)

(Total 17 marks)

2. Crude oil is a source of many compounds that are of great importance in the chemical industry. Study the scheme below and answer the questions that follow.



(a) Give the name of Process A. Describe how the process of separating crude oil into fractions, including naphtha, is carried out.

.....

.....

..... (2)

(b) (i) Give the name of Process B, in which the naphtha fraction is converted into many different compounds, including ethene.

..... (1)

(ii) State the essential conditions required for the process.

.....

..... (1)

(iii) Write an equation using C_6H_{14} to show the formation of ethene and one other compound.

..... (1)

(c) Describe with terms and conditions how ethene is converted into ethanol in Reaction C. Write an equation for the reaction, using displayed formulae.

.....

(3)

d) Give one advantage and one disadvantage that this method of producing ethanol has over the fermentation method.

(2)

(d) Name the type of polymerisation taking place in Reaction D. Draw the repeating unit of the polymer.

(1)

(e) Compound E has the following percentage composition by mass: C = 38.7% H = 9.7% O = 51.6%

(i) Use these figures to calculate the empirical formula of E.

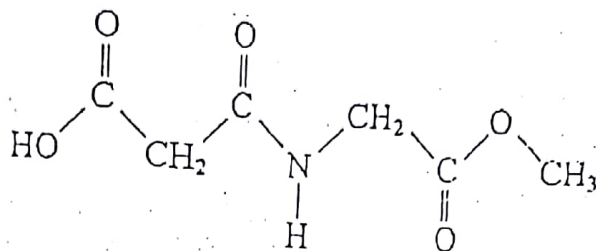
(2)

(ii) Given that 0.05 mol of E has a mass of 3.1 g, calculate the relative molecular mass of E and hence determine its molecular formula.

(2)

(Total 15 marks)

3. The following diagram shows the structure of an artificial sweetener called Sweetex.



(a) On the diagram draw circles around and label

(i) a carboxylic acid group

(ii) an ester group.

(iii) a peptide bond

(3)

(b) (i) Write down the molecular formula of Sweetex.

.....
(1)

(ii) The relative molecular mass of Sweetex is 175. Calculate the percentage by mass of carbon in Sweetex.

.....
.....
(1)

(c) (i) Suggest what you would observe if Sweetex was added to sodium carbonate solution.

.....
.....

(ii) Write an ionic equation to represent this reaction using H^+ for the acidic species.

.....
(2)

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(d) A small pill of Sweetex is placed in the bottom of a cup of coffee. After standing for a few minutes without stirring, all of the coffee tastes sweet. Explain what happens to the Sweetex molecules.

.....
.....
.....
.....

(1)

(Total 8-marks)

4. Nylon is a condensation polymer, which is used in the fishing nets due to its strength and durability.

(a) (i) Suggest the names and structures of the monomers of nylon.

(1)

(ii) Draw two repeat units of the nylon polymer.

(1)

(iii) Name a natural condensation polymer which has the same linkage.

(1)

(iv) Suggest an advantage and a disadvantage of using nylon polymer.

(1)

(1)

(Total 5 marks)

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CT1 - O - Level - Organic Chem

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