



West Spring Secondary School Preliminary Examination 2022

CHEMISTRY

6092/01

Paper 1

SECONDARY 4 EXPRESS

Name _____ () Date **31 August 2022**

Class _____ Duration **1 hour**

Additional materials: Laminated Periodic Table,
Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name on the Answer Sheet.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the laminated Periodic Table is provided separately.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **16** printed pages including the cover page.

Setter: Mdm Sharena

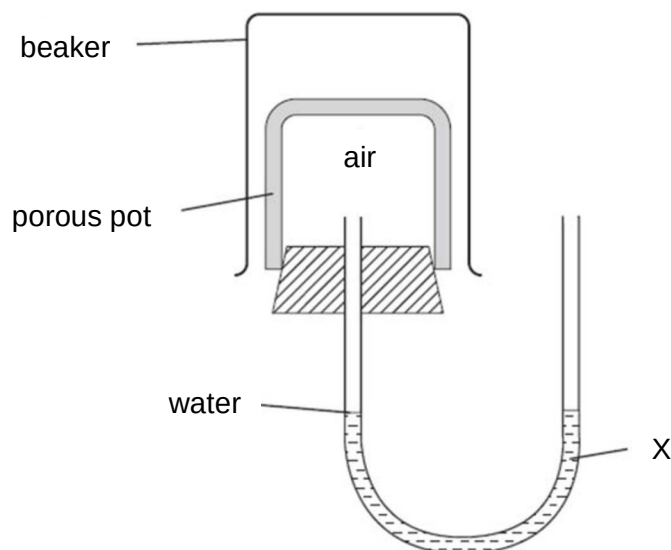
[Turn over

- 1 A student follows the rate of the reaction when 0.19 g of calcium carbonate reacts with excess acid at room temperature and pressure.

What is most suitable for measuring volume of gas produced at different times during this experiment?

- A a 50 cm³ gas syringe
- B an inverted 250 cm³ measuring cylinder filled with water
- C an inverted 50 cm³ burette filled with water
- D place the apparatus on a balance and measure the loss in mass

- 2 The apparatus shown in the diagram was set up.



Which gas, when present inside the beaker, will cause the water level at X to fall?

- | | |
|-----------------------------------|----------------------------|
| A ammonia, NH ₃ | C hydrogen, H ₂ |
| B carbon dioxide, CO ₂ | D nitrogen, N ₂ |

3

3 Some students are asked to describe the difference between the particles in gases and liquids.

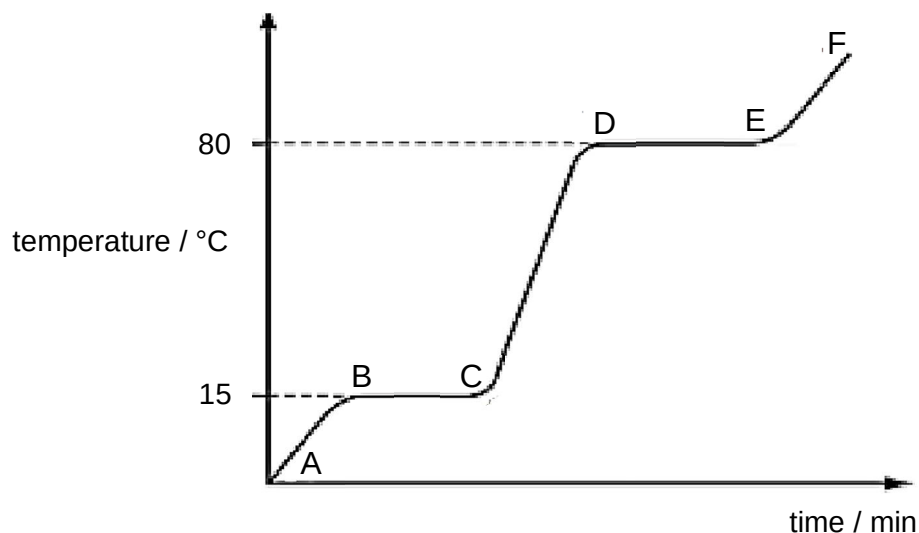
Three of their suggestions are:

- 1 Particles in gases are further apart than particles in liquids.
- 2 Particles in gases are bigger than particles in liquids.
- 3 Particles in gases are smaller than particles in liquids.

Which suggestion or suggestions are correct?

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

4 The graph shows a change of temperature when substance Y is heated.



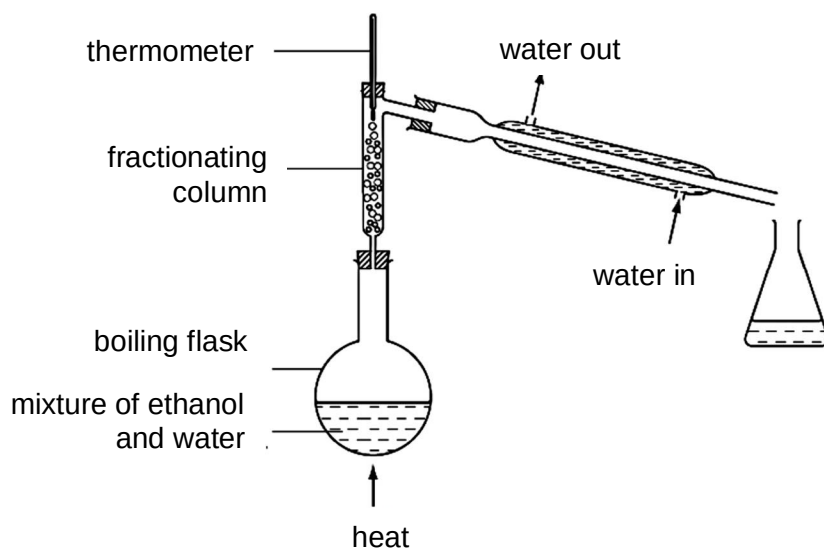
Which stage shows that substance Y is melting?

- A** A to B **B** B to C **C** D to E **D** E to F

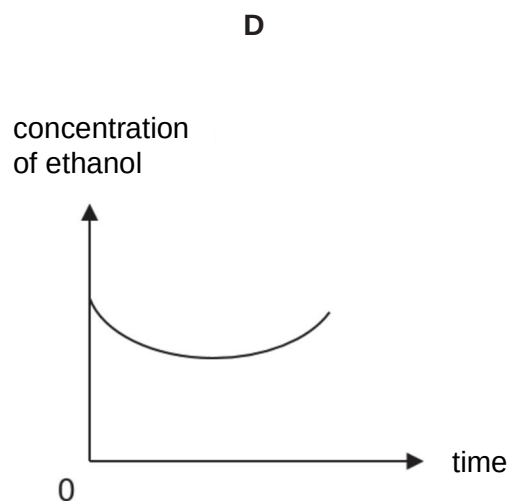
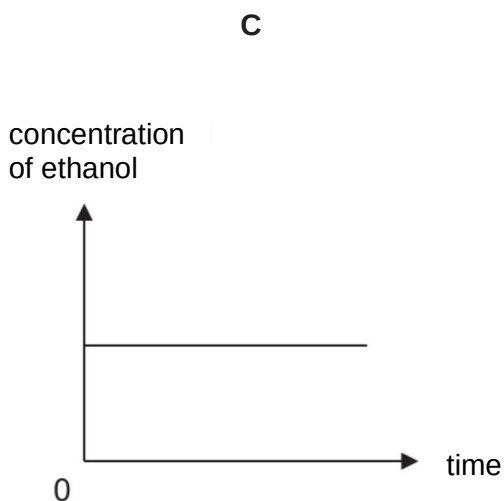
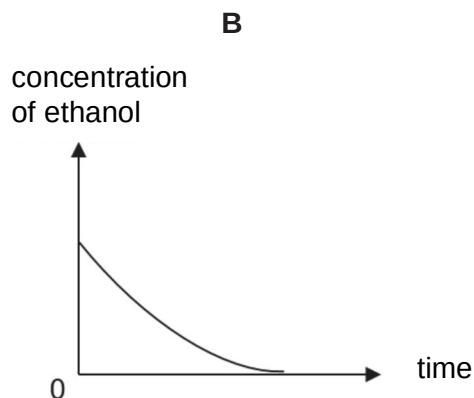
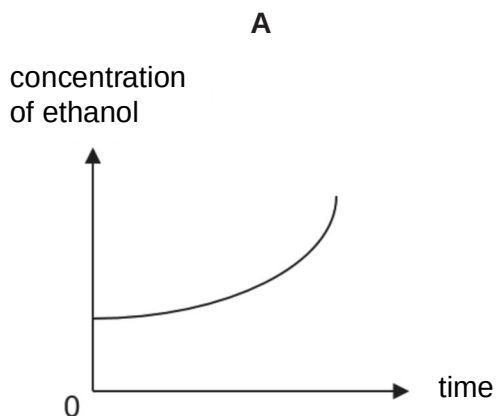
5 At which temperature does a concentrated aqueous solution of sodium chloride begin to boil?

- A** 93 °C **B** 99 °C **C** 100 °C **D** 104 °C

- 6 Fractional distillation is used to distil ethanol (boiling point 78°C) from a dilute ethanol solution.



Which graph best shows the change in concentration of ethanol in the boiling flask as distillation proceeds?



- 7 Some properties of four substances P, Q, R and S are given in the table below.

substance	percentage composition by mass	electrical conductivity when solid	effect of heat
P	constant	yes	solid burns in air to form an oxide
Q	varies	no	liquid burns to form carbon dioxide and water
R	constant	no	solid decomposes to form two products
S	varies	yes	solid melts

Which classification of the substances as an element, a mixture or a compound is correct?

	element	compound	mixture
A	P	Q, R	S
B	P	R	Q, S
C	R	Q, P	S
D	S	P	Q, R

- 8 An ion Q^{3-} has 18 electrons.

If its nucleon number is 31, what is the composition of its nucleus?

- A** 15 protons and 15 neutrons
- B** 15 protons and 16 neutrons
- C** 18 protons and 13 neutrons
- D** 21 protons and 10 neutrons

- 9 Which statement about atoms is correct?

- A** The mass of an atom is almost entirely due to its nucleus.
- B** The nucleus and the electrons repel each other.
- C** The protons and neutrons have opposite charges.
- D** The shell nearest to the nucleus always contains the most electrons.



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

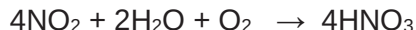
Which statement about carbon disulfide would you predict to be true?

- A** It has a low boiling point and conducts electricity when molten.
- B** It has a low boiling point and is soluble in organic solvents.
- C** It is a crystalline solid at room temperature and conducts electricity when molten.
- D** It is a crystalline solid at room temperature and is soluble in organic solvents.

What is the formula of thallium chlorite?

- A** TlClO_2 **B** Tl_2ClO_2 **C** $\text{Tl}(\text{ClO}_2)_2$ **D** $\text{Tl}_2(\text{ClO}_2)_3$

- 13** Two of the reactions used in the manufacture of nitric acid, HNO_3 , are shown.



What is the maximum number of moles of nitric acid which could be formed from one mole of nitrogen monoxide, NO ?

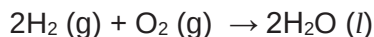
- A** 0.5 mol **B** 1.0 mol **C** 2.0 mol **D** 4.0 mol

- 14** Basic copper carbonate, $\text{Cu}_2\text{CO}_3(\text{OH})_2$, is used as a pigment in paint.

What is the percentage by mass of copper in basic copper carbonate?

- A** 28.8 % **B** 31.2 % **C** 57.7 % **D** 62.4 %

- 15** 20 cm^3 of hydrogen is reacted with 20 cm^3 of oxygen as shown in the equation.



What are the volumes of gases remaining at the end of the reaction?

[All volumes are measured at room temperature and pressure.]

	volume of hydrogen / cm^3	volume of oxygen / cm^3	volume of product / cm^3
A	0	0	20
B	0	0	40
C	0	10	0
D	10	10	0

- 16** Which statement best explains why farmers should not lime the soil and add ammonium nitrate fertiliser at the same time?

- A** It is too costly to add both substances together at the same time.
B The lime makes the soil too alkaline for plant growth.
C The lime will react with ammonium nitrate and result in the loss of nitrogen.
D The lime will react with ammonium nitrate to produce acidic substances that inhibit plant growth.

- 17 The table gives information about three indicators.

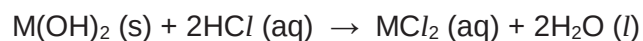
indicator	colour change low pH $\longrightarrow$ high pH	pH at which colour change takes place
methyl orange	red $\longrightarrow$ yellow	4.0
bromothymol blue	yellow $\longrightarrow$ blue	6.5
phenolphthalein	colourless $\longrightarrow$ pink	9.0

If equal volumes of these three indicators were mixed, which colour would be observed at pH 5?

- A blue B green C orange D yellow
- 18 How many different sulfates in total could be prepared by the reaction of dilute sulfuric acid with the following substances?

- copper
- magnesium
- silver
- zinc carbonate

- A 1 B 2 C 3 D 4
- 19 An aqueous solution of a chloride is made by the reaction of hydrochloric acid with the hydroxide of metal M:



Which metal **cannot** be M?

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

- 20 In addition to sodium ions and chloride ions, sea water contains magnesium ions and sulfate ions.

Which method could be used to measure the amount of sulfate ions present in a sample of sea water?

- A Add excess aqueous lead(II) nitrate, dry and weigh the precipitate formed.
- B Add excess aqueous barium nitrate, dry and weigh the precipitate formed.
- C Evaporate off all the water and weigh the remaining solid.
- D Measure the electrical conductivity of the sample.

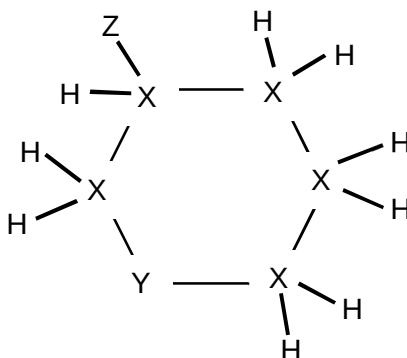
- 21 A pale green solution Z, gives a green precipitate with excess aqueous sodium hydroxide.

An alkaline gas is only given off when the mixture is warmed with powdered aluminium.

Which ions does Z contain?

- A ammonium and copper(II) ions
- B ammonium and iron(II) ions
- C copper(II) and nitrate ions
- D iron(II) and nitrate ions

- 22 The compound below is made up of hydrogen and the elements X, Y and Z.



Which statement is incorrect?

- A Element Z is most likely from Group I.
- B Element X is most likely from Group IV
- C The compound has a simple molecular structure.
- D The compound has the molecular formula X_5YH_9Z .

- 23 Iodine, I, has a lower relative atomic mass than tellurium, Te, but is placed after it in the Periodic Table.

Which statement explains why iodine (I) is placed after tellurium (Te) in the Periodic Table?

- A Iodine has fewer neutrons than tellurium.
 - B Iodine has fewer protons than tellurium.
 - C Iodine has more neutrons than tellurium.
 - D Iodine has more protons than tellurium.
- 24 Lithium reacts with water to form solution P and gas Q.

When solution P reacts with hydrochloric acid, salt R is formed.

What are the formulae of P, Q and R?

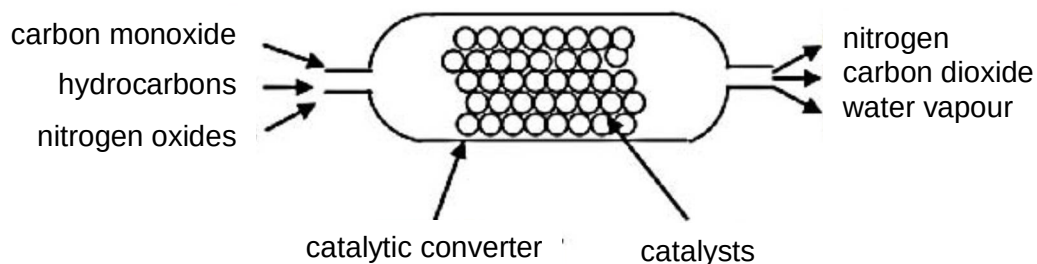
	P	Q	R
A	Li_2O	H_2	LiCl
B	Li_2O	O_2	Li_2Cl
C	LiOH	H_2	LiCl
D	LiOH	O_2	Li_2Cl

- 25 Ammonia is produced by the Haber process.

Which statement is correct?

- A A high pressure of 500 atm and temperature of 450 °C are used in the process.
- B Hydrogen is obtained from fractional distillation of crude oil.
- C Iron is used as a catalyst to increase the activation energy in the process.
- D Nitrogen obtained from liquid air is used as one of the raw materials.

- 26 The diagram shows the cross section of a catalytic converter in the exhaust system of a car.

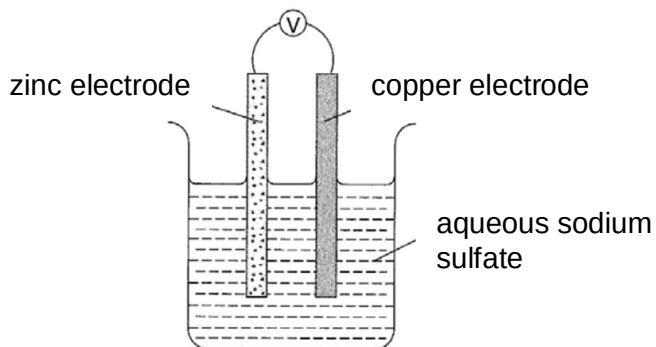


Which process(es) take(s) place in the converter?

- 1 Hydrocarbons oxidise to form carbon dioxide and water vapour.
- 2 Carbon monoxide reacts with nitrogen oxides to form carbon dioxide and nitrogen.
- 3 Nitrogen oxides react with hydrocarbons to form water vapour and nitrogen.

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

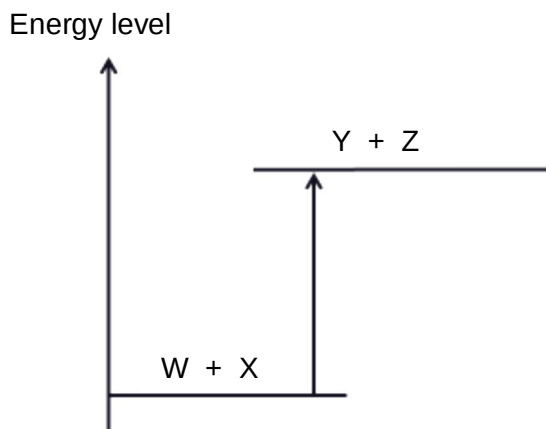
- 27 The diagram shows a simple cell.



Which option describes what happens in the cell?

- A Copper ionizes and becomes smaller.
 B Zinc ionizes and becomes smaller.
 C Effervescence of hydrogen gas is observed at the zinc electrode.
 D Effervescence of oxygen gas is observed at the copper electrode.

- 28 The energy level diagram for a reaction is as shown.



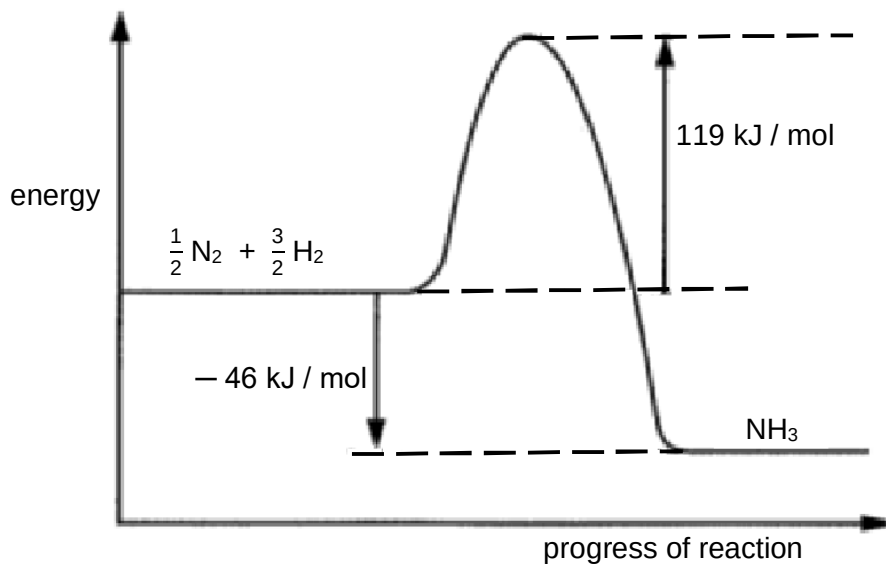
The initial temperature measured was 28.0 °C.

As the reaction progressed, the reaction temperature changed by 5.5 °C.

What would be the final temperature recorded?

- A** 22.5 °C **B** 28.0 °C **C** 33.5 °C **D** 39.0 °C

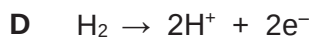
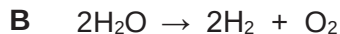
- 29 The energy profile diagram shows the formation of ammonia.



What is the activation energy for the decomposition of ammonia into its elements?

- A** 46 kJ / mol **B** 73 kJ / mol **C** 119 kJ / mol **D** 165 kJ / mol

30 Which is the overall equation for the reactions that take place in a hydrogen fuel cell?

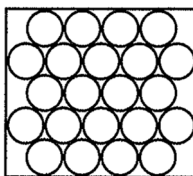


31 Iron rusts easily, hence steel structures should be treated to slow down the rusting process.

Which option describes incorrectly how each method protects iron from rusting and its main disadvantage?

	method	how it protects	disadvantage
A	alloying steel with chromium to make stainless steel	chromium reacts with oxygen in the air to form a barrier of chromium oxide which prevents iron from rusting	production of stainless steel is costly
B	coating steel plates with zinc	zinc is less reactive than iron, and provides a barrier between iron and the atmosphere	when the coating of zinc is scratched, iron will corrode in place of zinc, making it rust more quickly
C	painting steel	provides a barrier between the iron and the atmosphere	paint scrapes off easily to expose iron to the atmosphere
D	storing steel objects in a dry place	absence of water prevents iron from rusting quickly	difficult to keep storage place dry at all times

- 32 The arrangement of atoms in pure iron is shown.

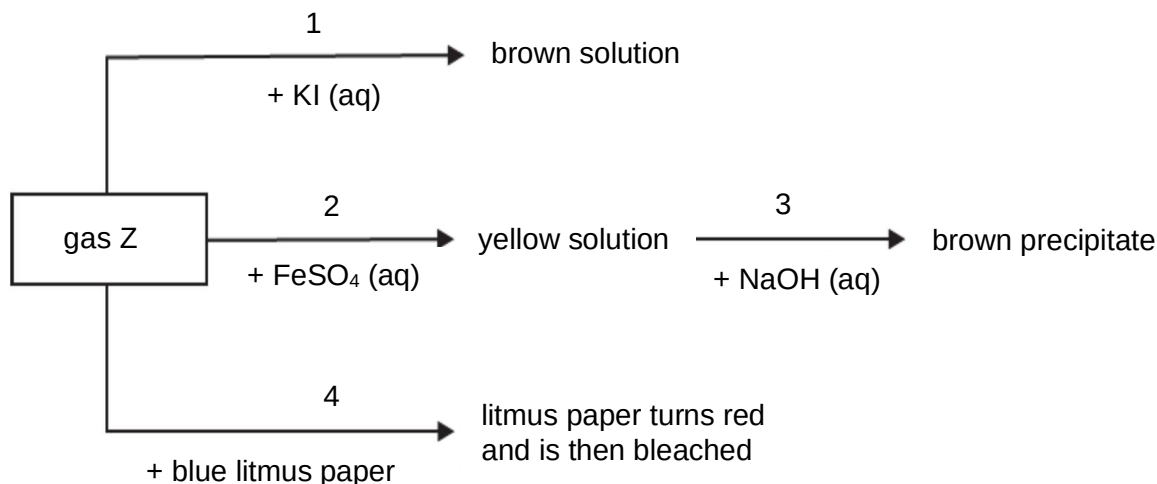


Steel can be made by adding carbon to pure iron.

Which description of the arrangement of atoms in steel is correct?

- A A regular pattern of carbon atoms with iron atoms fitting into the gaps between them.
- B A regular pattern of iron atoms with carbon atoms fitting into the gaps between them.
- C An irregular pattern of iron atoms with carbon atoms randomly spread throughout the structure.
- D Rows of iron atoms alternating with rows of carbon atoms.

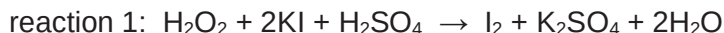
- 33 The scheme below shows reactions of a gas Z.



Which statement is incorrect?

- A Gas Z is chlorine.
- B In stage 1, potassium iodide is reduced to form iodine.
- C In stage 2, iron(II) sulfate is oxidized to form iron(III) sulfate.
- D The brown precipitate formed in stage 3 is iron(III) hydroxide.

- 34 Hydrogen peroxide (H_2O_2) acts as an oxidising agent in some reactions, but in others, as a reducing agent.



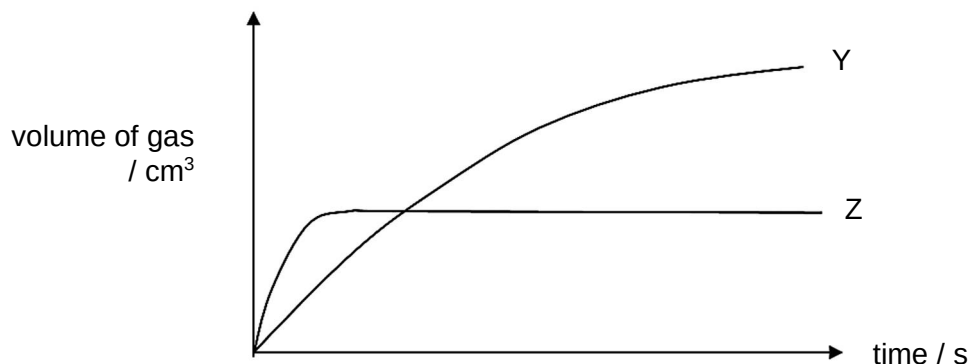
Which row identifies correctly the role of hydrogen peroxide in each reaction?

	reaction 1	reaction 2	reaction 3
A	oxidising agent	reducing agent	reducing agent
B	oxidising agent	reducing agent	oxidising agent
C	reducing agent	oxidising agent	oxidising agent
D	reducing agent	oxidising agent	reducing agent

- 35 Manganese(IV) oxide catalyses the decomposition of aqueous hydrogen peroxide to water and oxygen.

In order to follow the rates of this reaction for two different solutions of hydrogen peroxide the total volumes of oxygen evolved were recorded at regular time intervals and the results were plotted.

In each experiment, the same mass of catalyst was used and the temperature was the same.



If graph Y corresponds to 20 cm^3 of 4.0 mol / dm^3 hydrogen peroxide solution, what is the volume and concentration of graph Z?

- A** 5 cm^3 of a 8.0 mol / dm^3 solution
- B** 10 cm^3 of a 2.0 mol / dm^3 solution
- C** 20 cm^3 of a 4.0 mol / dm^3 solution
- D** 20 cm^3 of a 8.0 mol / dm^3 solution

- 36 When crude oil is fractionally distilled, which compounds leave from the top of the fractionating column?
- A The compounds that are the least flammable.
 B The compounds that are the most viscous.
 C The compounds with the highest relative molecular mass.
 D The compounds with the lowest boiling points.

- 37 What is the structure of the product of the reaction between butene, $\text{CH}_3\text{—CH}_2\text{—CH=CH}_2$, and bromine, Br_2 ?
- A $\text{CH}_3\text{—CH}_2\text{—CHBr—CH}_2\text{Br}$
 B $\text{CH}_3\text{—CHBr—CH}_2\text{—CH}_2\text{Br}$
 C $\text{CH}_2\text{Br—CH}_2\text{—CH}_2\text{—CH}_2\text{Br}$
 D $\text{CH}_2\text{Br—CH}_2\text{—CHBr—CH}_3$

- 38 X reacts with steam to form Y.

Y is oxidized to Z.



If X is propene, what is the formula of Z?

- A C_3H_6 B $\text{C}_3\text{H}_7\text{OH}$ C $\text{C}_2\text{H}_5\text{COOH}$ D $\text{C}_3\text{H}_7\text{COOH}$
- 39 Which carboxylic acid would combine with ethanol to give the ester $\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$?
- A butanoic acid C methanoic acid
 B ethanoic acid D propanoic acid
- 40 The table refers to the polymers nylon and poly(ethene).

Which row is correct?

	polymer	type	use
A	nylon	addition	cling film
B	nylon	condensation	parachutes
C	poly(ethene)	addition	parachutes
D	poly(ethene)	condensation	cling film