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Class:

**WOODLANDS SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023**

Level: Secondary Four Express

Marks: 40

Subject: Chemistry

Day: Tuesday

Paper: 6092/01

Date: 22 August 2023

Duration: 1 hour

Time: 1135 – 1235

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 Periodic Table is printed on page 20.

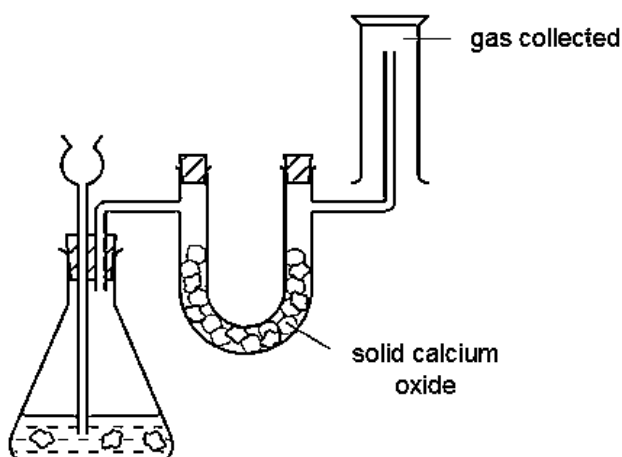
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, submit the OTAS separately from the question paper.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

This document consists of **20** printed pages.

- 1 The diagram below shows the setup for a chemical reaction which produces a gas. The gas is then dried and collected.



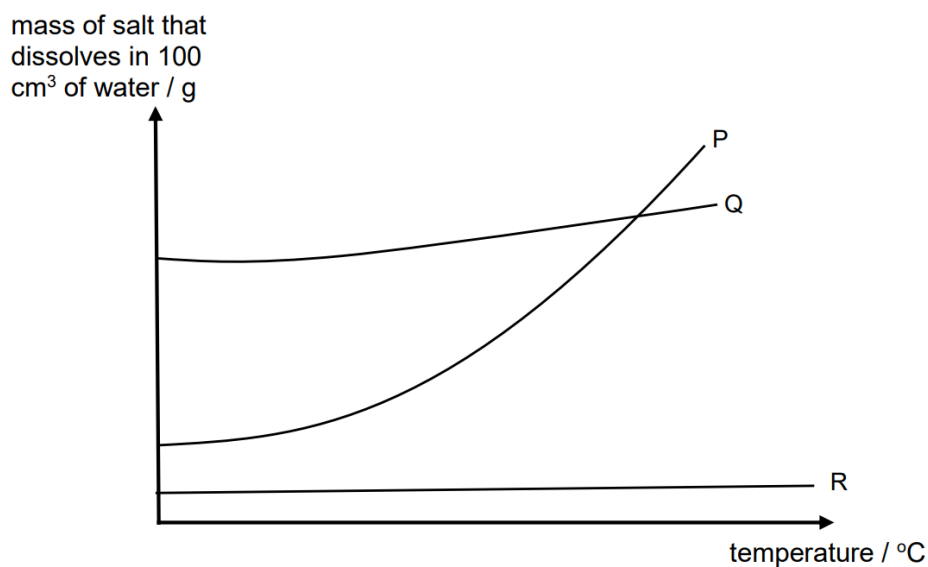
What could the gas be?

- A carbon dioxide
 - B hydrogen
 - C oxygen
 - D sulfur dioxide
- 2 Gore-Tex fabric is a water-resistant and breathable material often used in outdoor sportswear. It can block out rainwater while allowing water vapour from body perspiration to escape. Its structure consists of a few layers of porous membranes, each with pores of different sizes.

Which of the following explains how the fabric can be water-resistant and yet breathable?

- A The pores in the layers are smaller than liquid water droplets and water vapour molecules.
- B The pores in the layers are bigger than liquid water droplets and water vapour molecules.
- C The pores in one layer are smaller than liquid water droplets while the pores in other layers are bigger than water vapour molecules.
- D The pores in one layer are bigger than liquid water droplets while the pores in other layers are smaller than water vapour molecules.

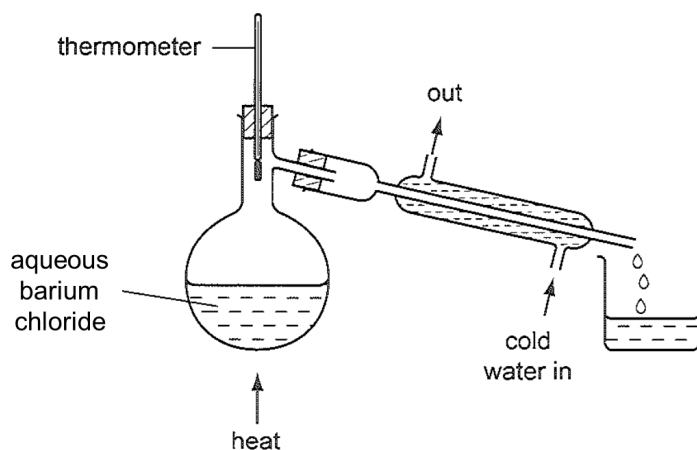
- 3 The diagram below shows the solubility curves of 3 salts, **P**, **Q** and **R** over a range of temperatures. **P**, **Q** and **R** were added to separate beakers of water.



Which of the following shows the best method of obtaining a solid sample from the mixture?

	salt P	salt Q	salt R
A	crystallisation	filtration	evaporate to dryness
B	evaporate to dryness	evaporate to dryness	filtration
C	evaporate to dryness	crystallisation	evaporate to dryness
D	crystallisation	evaporate to dryness	filtration

- 4 An aqueous solution of barium chloride is distilled.



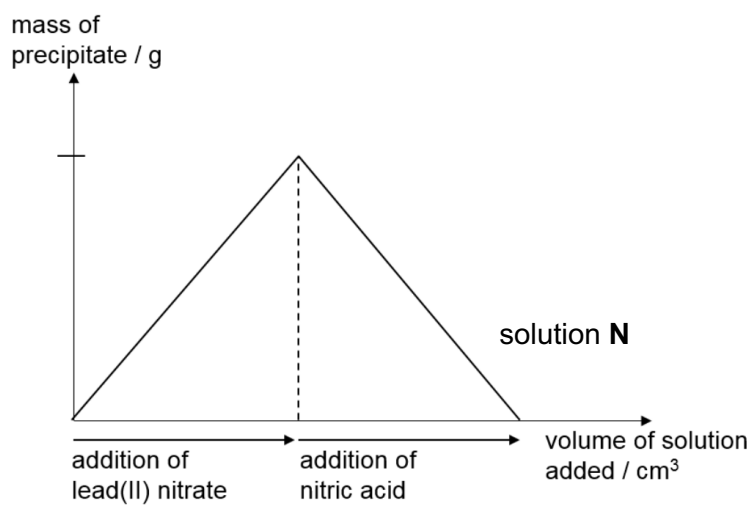
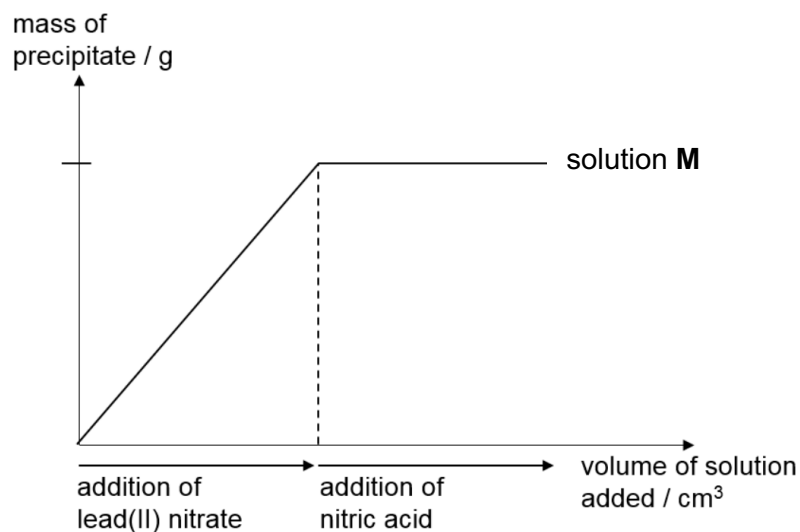
What is the temperature shown by the thermometer and what is observed in the distillation flask?

	thermometer reading/ °C	final contents of distillation flask
A	96	no residue
B	100	white residue
C	104	no residue
D	106	white residue

- 5 Which mixture of gases would change the colour of damp red litmus paper?

- A** carbon dioxide and sulfur dioxide
- B** chlorine and ammonia
- C** chlorine and nitrogen dioxide
- D** methane and hydrogen chloride

- 6 The graphs below show the mass of precipitate formed when lead(II) nitrate and nitric acid are added successively to solution **M** and solution **N** respectively.



What are the possible identities of the precipitates formed from solution **M** and solution **N**?

	precipitate from solution M	precipitate from solution N
A	PbCl_2	PbCO_3
B	PbCO_3	PbCl_2
C	Pb(OH)_2	PbCO_3
D	PbSO_4	PbCl_2

- 7 Hydrogen can form both hydrogen, H^+ , ions and hydride, H^- , ions.

Which statement about these two ions is correct?

- A H^+ ion has no electrons in its first shell.
- B H^+ ion has more protons than a H^- ion.
- C H^- ion has one more electron than a H^+ ion.
- D H^- ion is formed when a hydrogen atom loses an electron.

- 8 The table shows the information about particles **P**, **Q**, **R** and **T**.

particle	proton number	nucleon number	number of electrons
P	11	23	10
Q	11	23	11
R	17	35	17
T	17	37	17

Which of the following statements are true about **P**, **Q**, **R** and **T**?

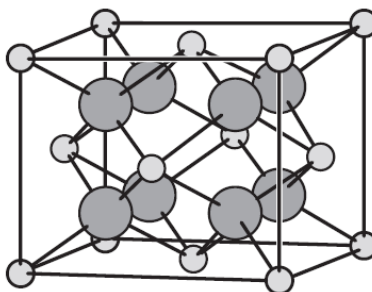
- 1 **P** and **Q** are particles of the same element.
- 2 **P** is a positive ion of atom **Q**.
- 3 **Q** reacts with **R** to form an ionic compound.
- 4 **R** and **T** are isotopes.

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

- 9 Which statement(s) correctly describe(s) the substance given?

statement	mixture of magnesium and sulfur	magnesium sulfide
1	magnesium and sulfur mix without a chemical reaction	magnesium and sulfur combine in a chemical reaction to form magnesium sulfide
2	the mixtures do not have properties of magnesium and sulfur	magnesium sulfide has the properties of magnesium and sulfur
3	the ratio of magnesium to sulfur in mixtures can vary	the ratio of magnesium to sulfur in magnesium sulfide is always the same

- A** 1 only
B 1 and 3
C 2 and 3
D 2 only
- 10 The diagram shows the structure of an ionic compound.



Which of the following is a possible formula for this compound?

- A** CaF_2
B MgO
C SiO_2
D SO_2

- 11 When sucrose is heated, it melts at 192 °C. At this temperature it starts to decompose, and the liquid sucrose turns dark brown.

Based on the information given, which conclusion is correct?

- A the covalent bonds are stronger than the intermolecular forces
 B the intermolecular forces and some covalent bonds are about the same strength
 C the intermolecular forces are stronger than the covalent bonds
 D the structure of the solid is a lattice structure
- 12 Peeling onions often causes tearing of the eyes due to the release of a sulfide compound. Peeling them under running water reduces the problem.

Which of the following statements are true about the sulfide compound?

- 1 It is soluble in water.
 2 It is volatile.
 3 It is an ionic compound with strong ionic bonds.
 4 It is a covalent compound with weak covalent bonds.
- A 1 and 2 only
 B 1 and 4 only
 C 2 and 3 only
 D 2 and 4 only
- 13 Solid copper metal, aqueous copper(II) sulfate, solid graphite and molten magnesium chloride can conduct electricity.

Which pair can conduct electricity because they both contain mobile electrons?

- A aqueous copper(II) sulfate and molten magnesium chloride
 B aqueous copper(II) sulfate and solid copper metal
 C molten magnesium chloride and solid graphite
 D solid copper metal and solid graphite
- 14 An oxide of element X has the formula X_2O_5 . 10.2 g of this oxide contains 5.4 g of X.

How many moles are there in 5.4 g of X?

- A $\frac{4.8}{16} \times \frac{2}{5}$
 B $\frac{4.8}{16} \times \frac{5}{2}$
 C $\frac{10.2}{16} \times \frac{2}{5}$
 D $\frac{10.2}{16} \times \frac{5}{2}$

- What is the percentage purity of the sodium carbonate in the sample?

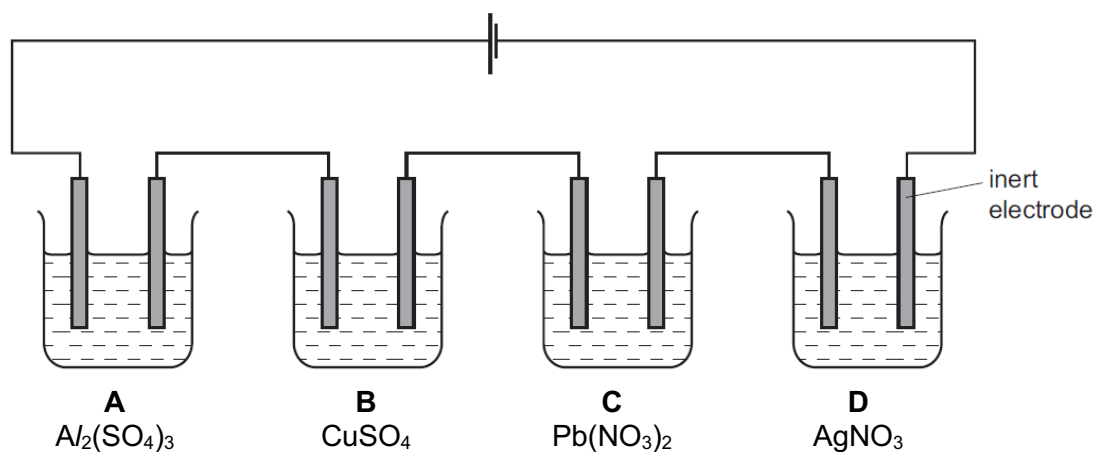
B 45.1%

D 90.2%

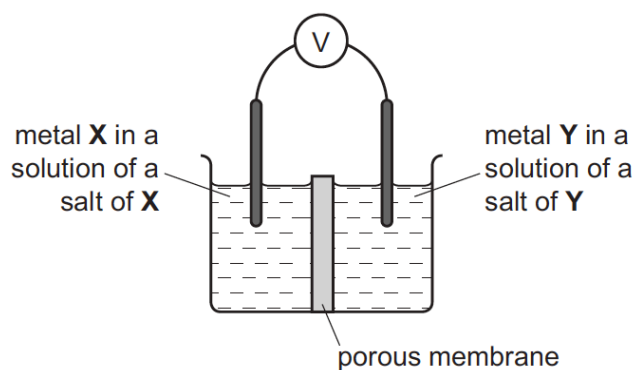
- Which of the following gives the correct pH values of the solutions around the cathode and the anode during the electrolysis?

	pH of solution around the cathode	pH of solution around the anode
A	12	2
B	2	12
C	12	12
D	2	2

- Which solution would produce the greatest increase in mass of the cathode?



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

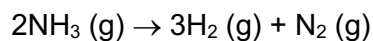


	metal X	metal Y
A	copper	silver
B	magnesium	silver
C	magnesium	iron
D	iron	copper

- 19 Some common bond energies are given in the table below.

bond	bond energy (kJ/mol)
N – H	390
N = N	410
N ≡ N	944
H – H	436

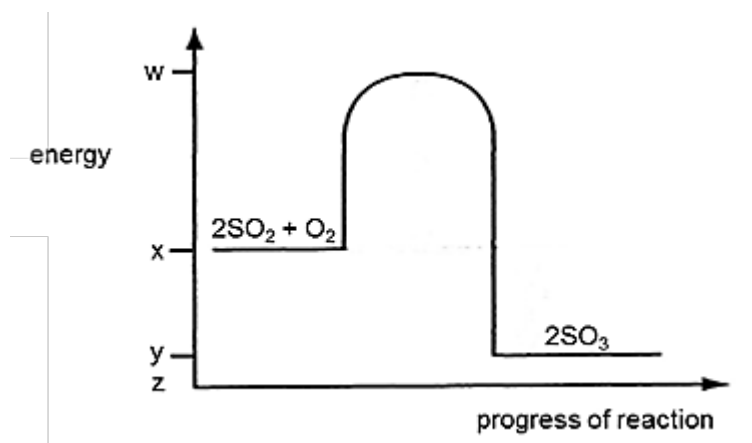
The equation below shows the decomposition of ammonia.



Determine the enthalpy change of the decomposition of 1 mole of ammonia.

- A** – 105 kJ
B + 44 kJ
C + 88 kJ
D + 311 kJ

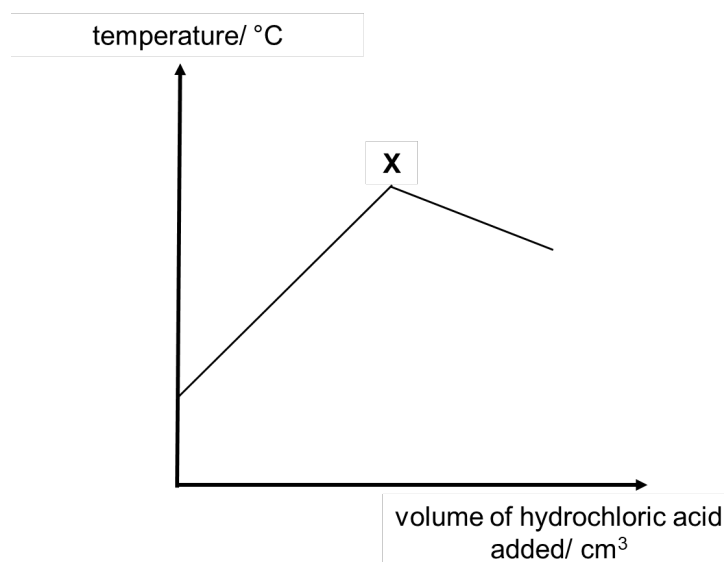
- 20 The energy profile diagram for the reaction between SO_2 and O_2 to produce SO_3 is shown below where w , x , y and z are numerical values of chemical energy.



Which of the following shows the correct value of the activation energy of this reaction?

- | | | | |
|----------|---------|----------|---------|
| A | $w - x$ | B | $w - y$ |
| C | $w - z$ | D | $x - y$ |
- 21 Hydrochloric acid is added to a fixed volume of potassium hydroxide in a conical flask. The mixture is stirred and the temperature is measured.

The graph below shows the results obtained for the experiment.

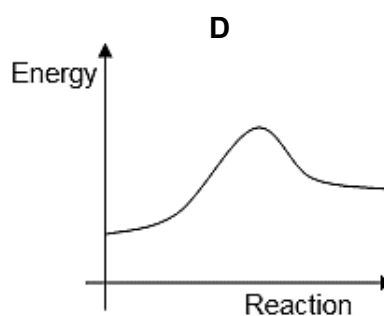
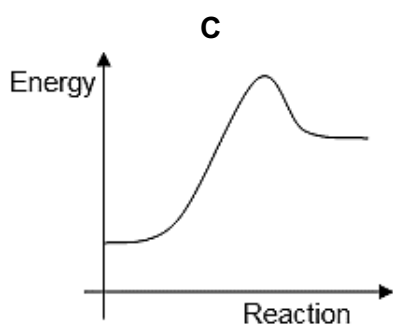
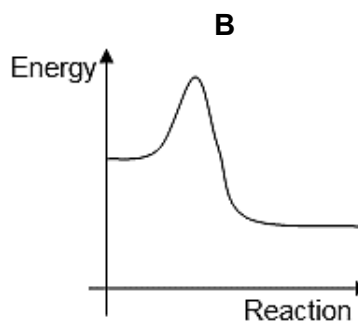
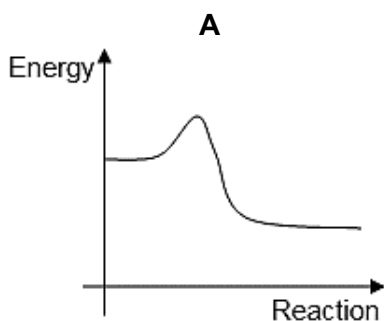


Why does the temperature reading drop beyond point **X** on the graph?

- | | |
|----------|--|
| A | The reaction becomes increasingly exothermic. |
| B | The reaction becomes increasingly endothermic. |
| C | The reaction has completed and heat is lost to the surroundings. |
| D | The reaction has completed and heat is absorbed from the surroundings. |

- 22 Four different chemical reactions are represented in the following energy profile diagrams.

Which diagram shows the slowest reaction?



- 23 When dichlorine heptoxide, Cl_2O_7 , is added to water, a reaction takes place which is **not** a redox process.

What could the product(s) of the reaction be?

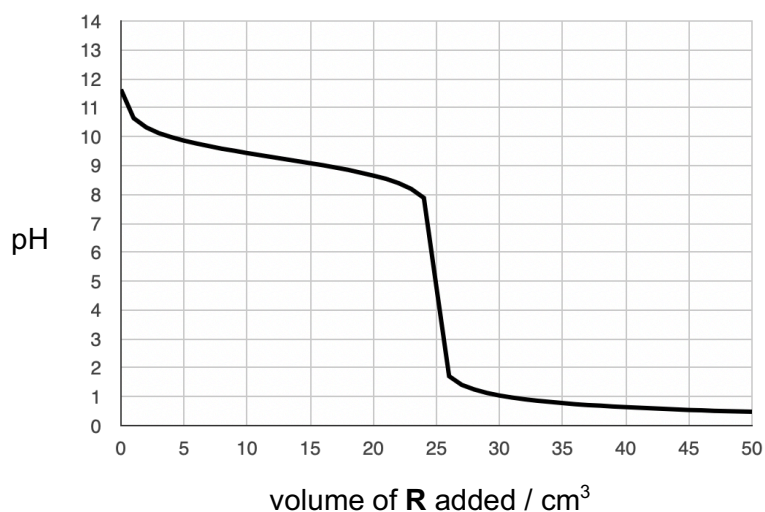
- A** Cl_2 and O_2
- B** HClO_4
- C** HCl and O_2
- D** HOCl

- 24 The table shows the colour changes of some pH indicators.

indicator	pH range for colour change	colour change
congo red	3.0 - 5.0	blue to red
bromothymol blue	6.0 - 7.6	yellow to blue
phenolphthalein	8.2 - 10.0	colourless to pink

What colour would be observed if a few drops of congo red, bromothymol blue and phenolphthalein are added to a solution of pH 7.9?

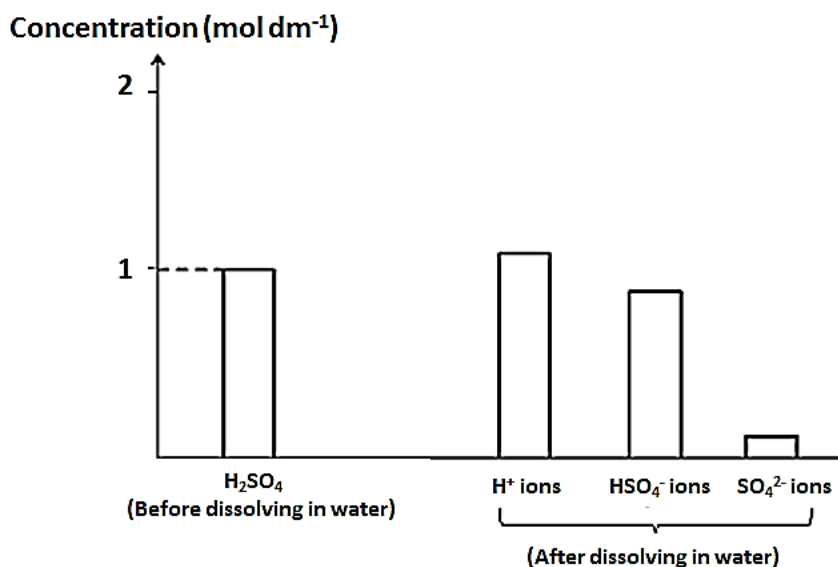
- A blue
 B green (blue + yellow)
 C orange (red + yellow)
 D purple (red + blue)
- 25 Aqueous solution **R** is gradually added to aqueous solution **S**. The changes in pH are shown on the graph.



What are **R** and **S**?

	R	S
A	aqueous ammonia	ethanoic acid
B	ethanoic acid	sodium hydroxide
C	hydrochloric acid	aqueous ammonia
D	sodium hydroxide	hydrochloric acid

- 26 The following bar chart shows the concentration of the various ions formed when 1 mol of sulfuric acid, H_2SO_4 , is dissolved in water and made up to 1 dm^3 .



A student inferred the following from the bar chart.

- 1 H_2SO_4 is a strong acid.
- 2 HSO_4^- is a weak acid.
- 3 H_2SO_4 is a weak acid.
- 4 HSO_4^- is a strong acid.

Which of the statement(s) is/are correct?

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

- 27 50.0 cm³ of 0.10 mol/dm³ silver nitrate is added to 150.0 cm³ of 0.05 mol/dm³ sodium chloride in a beaker. What is the resulting solution in the beaker after removing the silver chloride precipitate?

- A aqueous silver nitrate and aqueous sodium nitrate
- B aqueous sodium chloride and aqueous sodium nitrate
- C aqueous sodium chloride only
- D aqueous sodium nitrate only

- 28 Ammonia gas is produced industrially by the Haber process.

Which of the following statements is **not** true regarding the Haber process?

- A Nitrogen is obtained from the air.
- B A catalyst is added to increase the rate of reaction.
- C High pressure is applied to increase the yield of ammonia.
- D High temperature is applied to increase the yield of ammonia.

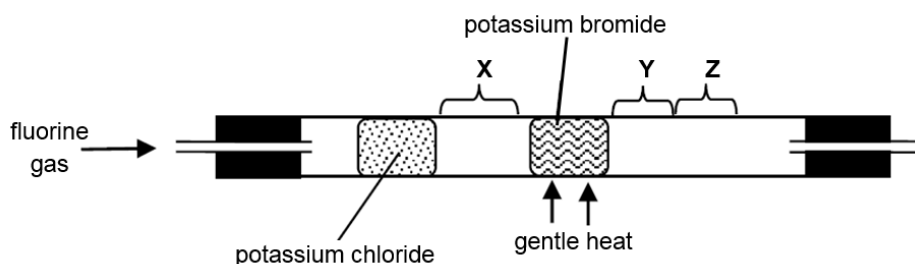
- 29 Four elements identified only as **W**, **X**, **Y** and **Z** are all found in the third period of the Periodic Table. **W**, **X**, **Y** and **Z** are not the actual chemical symbols of the elements.

- 1 **W** does not lose, gain or share electrons with other elements.
- 2 **X** forms an alkaline solution when reacted with cold water.
- 3 **Y** is diatomic.
- 4 **X**, **Y** and **Z** form ions which are smaller than their parent atoms.

Using the information provided, what is the most likely order of arrangement of these elements from left to right in the third period?

- A X, Z, Y, W
- B X, Y, Z, W
- C Z, Y, W, X
- D W, Y, Z, X

- 30 Using the apparatus shown, fluorine gas was passed through the tube. After a short time, coloured substances were seen at **X**, **Y** and **Z**.



What was seen at **X**, **Y** and **Z**?

	X	Y	Z
A	greenish-yellow gas	orange-brown vapour	reddish-brown liquid
B	greenish-yellow gas	reddish-brown liquid	orange-brown vapour
C	pale-yellow gas	green-yellow gas	reddish-brown liquid
D	pale-yellow gas	orange-brown vapour	reddish-brown liquid

- 31 The solid carbonates of three metals, **W**, **X** and **Y** are heated.

	result
carbonate of W	carbon dioxide given off solid changes colour from green to black
carbonate of X	carbon dioxide given off solid does not change colour
carbonate of Y	carbon dioxide not given off solid does not change colour

Which statements are correct?

- 1 Metal **Y** is a stronger reducing agent than metal **X**.
 - 2 Metal **W** could be used as a catalyst.
 - 3 Only the carbonates of **W** and **X** give off carbon dioxide when added to dilute nitric acid.
- A** 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

- 32 Which of the following combinations below correctly states how the increase in the percentage of carbon in steel affects its physical properties?

	strength	malleability	melting point	brittleness
A	↑	↑	↓	↓
B	↑	↓	↓	↑
C	↑	↓	↑	↓
D	↓	↑	↑	↓

key:

↑ = increase

↓ = decrease

- 33 When an iron extraction manufacturing plant is built near a city, the limestone buildings in the city begin to crumble.

Which gas is most likely to cause this damage?

- A** carbon dioxide
- B** carbon monoxide
- C** oxygen
- D** sulfur dioxide

- 34 Petroleum can be separated into fractions by fractional distillation.

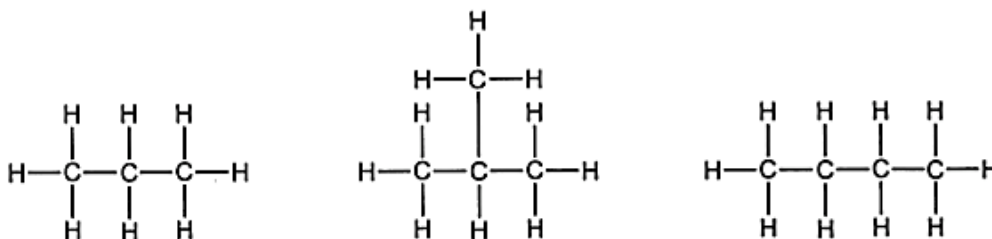
Which statement about this process is **not** correct?

- A** The lubricating oil fraction is used to make polishes and waxes.
- B** In a fractionating column, the bitumen is obtained below the kerosene fraction.
- C** The fraction obtained at the top of the fractionating column has the highest boiling point.
- D** The relative molecular masses of the compounds obtained near the bottom of the fractionating column are higher than those of the compounds obtained near the top of the column.

- 35 What is a suitable starting material in the manufacture of poly(ethene)?

- A** bitumen
- B** methanol
- C** naphtha
- D** petroleum gas

- 36 The diagrams show the structures of three hydrocarbons.



Which statement is correct for **all** three compounds?

- A They are isomers of each other.
 B They have the same general formula.
 C They have the same physical properties.
 D They react with aqueous chlorine.
- 37 Test tubes X and Y contain an alkane and alkene respectively. Aqueous bromine was added to each test tube and ultraviolet light was shone on the reaction mixtures.

Which of the following describes the appearance of the reaction mixtures after some time?

	test tube X	test tube Y
A	brown	colourless
B	brown	brown
C	colourless	colourless
D	colourless	brown

- 38 The following statements describe an organic compound, **L**.

1	It does not react with aqueous sodium hydroxide.
2	It does not decolorise bromine solution.
3	It does not decolourise acidified potassium manganate(VII).

What could be the molecular formula of compound **L**?

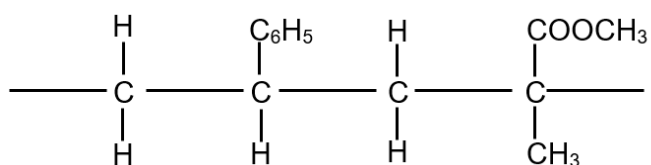
- A $\text{CH}=\text{CHCOOH}$
 B $\text{CH}_2=\text{CHCOOCH}_3$
 C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

- 39 Compound **P** reacts with compound **Q** to form product **R**.

Which of the following correctly identifies **P**, **Q** and **R**?

	P	Q	R
A	CH ₃ OH	HCO ₂ H	CH ₃ CO ₂ CH ₃
B	CH ₃ CO ₂ H	Na	CH ₃ CO ₂ Na
C	C ₃ H ₇ OH	KMnO ₄	C ₃ H ₇ CO ₂ H
D	CH ₃ CO ₂ H	C ₂ H ₅ OH	C ₂ H ₅ CO ₂ CH ₃

- 40 Part of a polymer is shown.



What type of reaction forms this polymer?

- A** addition polymerisation
- B** condensation polymerisation
- C** repeated polymerisation
- D** substitution polymerisation

End of Paper

The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
Key atomic number atomic symbol name relative atomic mass																	
3 Li lithium 7	4 Be beryllium 9																
11	12																
Na sodium 23	Mg magnesium 24																
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)