

NORTHBROOKS SECONDARY SCHOOL
Preliminary Examination 2022
Secondary 4 Express



CANDIDATE NAME			
CLASS		INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1

13 September 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in soft pencil.

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

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 Multiple Choice Answer Sheet.

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.

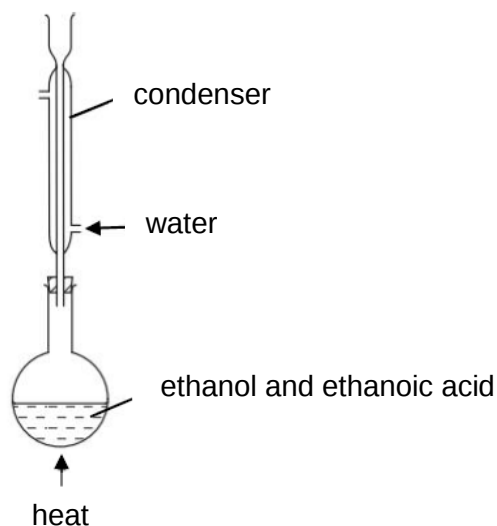
A copy of the Periodic Table is printed on page 18.

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

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

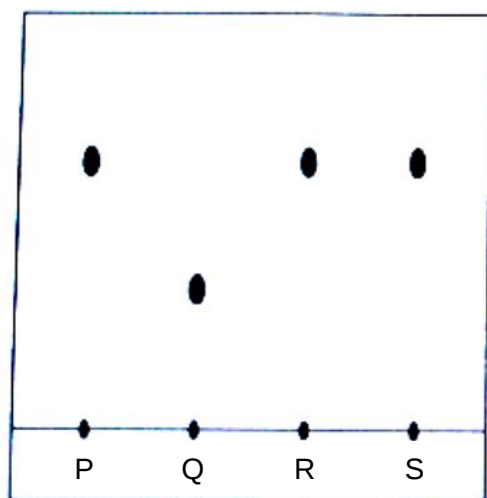
This document consists of 18 printed pages.

- 1 Ethanol and ethanoic acid can react to give ethyl ethanoate using the set-up below.

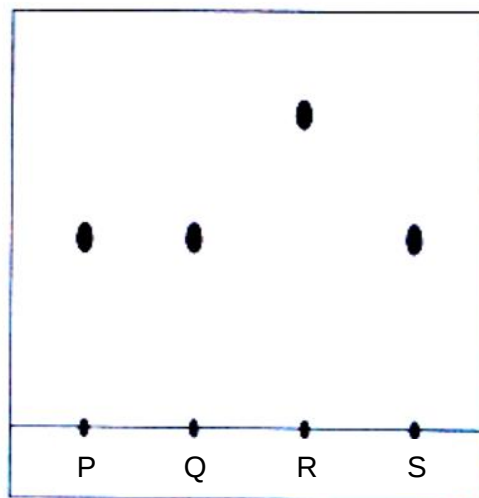


What is the function of the condenser in this set-up?

- A** To separate ethyl ethanoate from the ethanol and ethanoic acid
B To lower the temperature to prevent decomposition of ethyl ethanoate
C To reduce the chances of the ethanol escaping from the reaction mixture
D To allow the ethanol to react with the oxygen in the air
- 2 An unknown sample, P, was tested using paper chromatography, together with three pigments, Q, R and S, using both water and ethanol as solvents.



using water



using ethanol

Which of the three pigments, Q, R or S, is P likely to be?

- A** Q only
B S only
C R and S only
D Q, R and S

3 A solid is thought to be pure hexanoic acid.

Which is the best way to test its purity?

- A** conduct paper chromatography
- B** determine its melting point
- C** measure its pH
- D** weigh it, burn it in oxygen, then weigh the products

4 Which of the following consists of an element, a compound and a mixture in the correct order?

- A** air, diamond, water
- B** helium, argon, sodium chloride
- C** limestone, zinc, lead
- D** sodium, carbon dioxide, salt water

5 Which statement about an atom is correct?

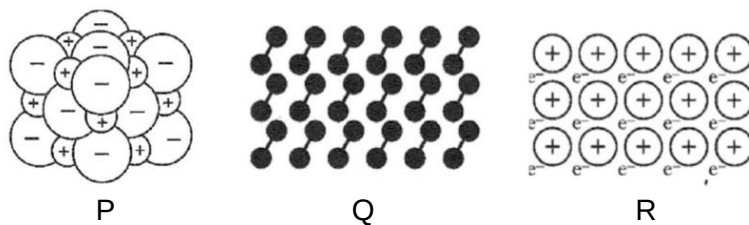
- A** Each element always has the same number of electrons and neutrons.
- B** Each element always has the same number of protons and neutrons.
- C** The nucleon number can be equal to the proton number.
- D** The nucleon number can be lesser than the number of electrons.

6 Antimony oxide has the formula Sb_2O_3 while potassium phosphate has the formula K_3PO_4 .

What is the formula of antimony phosphate?

- A** SbPO_4
- B** Sb_2PO_4
- C** $\text{Sb}_2(\text{PO}_4)_3$
- D** Sb_3PO_4

7 The structures of three substances P, Q and R are shown below.



Which statements are correct?

- 1 P and R can conduct electricity in the molten state.
- 2 P and R are compounds while Q is an element.
- 3 P and R have giant structures while Q has a simple structure.

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

8 In the molecules CH_3OH , NH_3 and HF , which atoms use all of their outer shell electrons in bonding?

- A** C and H
B C and F
C N and H
D H and O

9 Which sulfide shows the greatest mass of sulfur in a 6 g sample?

- A** Ag_2S
B FeS_2
C PbS
D SeS_2

10 Part of the Periodic Table is shown below.

The diagram shows a simplified periodic table grid. The elements are positioned as follows:

- W** is in the second period, first group.
- X** is in the third period, fourth group.
- Y** is in the third period, fifth group.
- Z** is in the third period, eighth group.

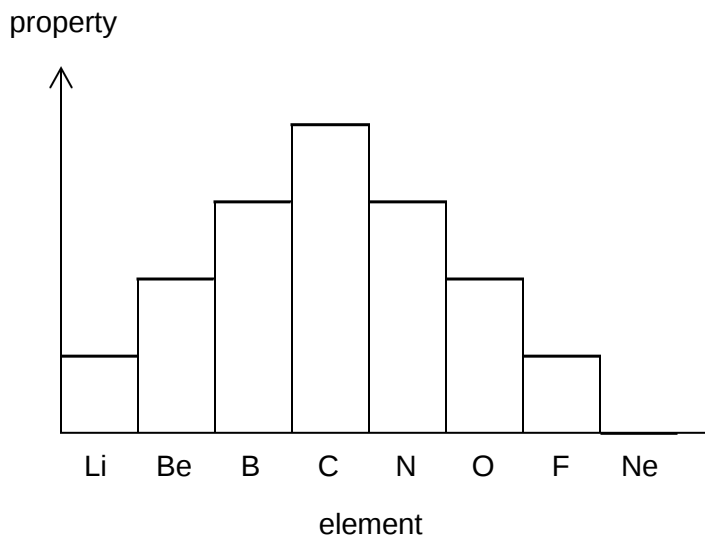
There is an empty space above the space between X and Y, and another empty space above Z.

- 1 Elements W, X and Y have high melting points.
- 2 Y is less reactive than W.
- 3 Z can form both ionic and covalent compounds.
- 4 X and Y form compounds that are coloured.

Which of the following statements are correct?

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

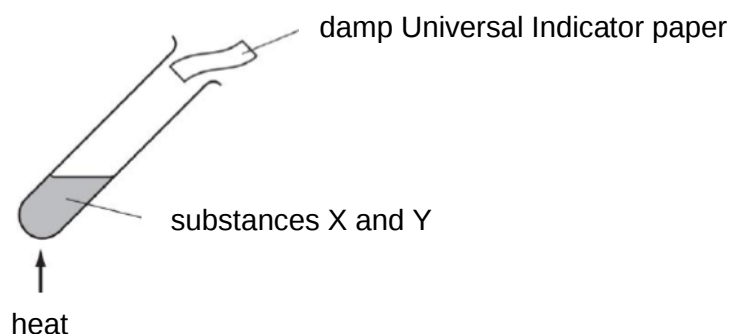
11 The bar chart shows the period of elements from lithium to neon.



What information can be found from this bar chart?

- A** the mass number
B the proton number
C the number of electrons used in bonding
D the number of shells which contain electrons

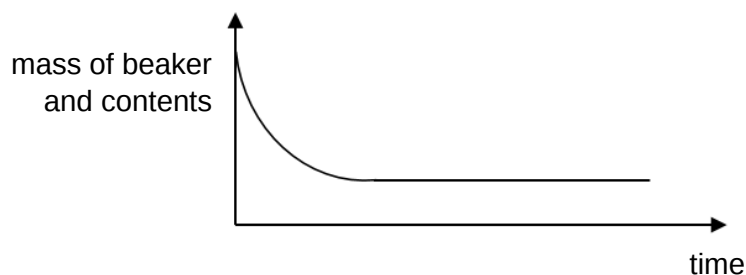
- 12** Two substances, X and Y are mixed and heated.



The damp Universal Indicator paper turns blue during the experiment.

What are substances X and Y?

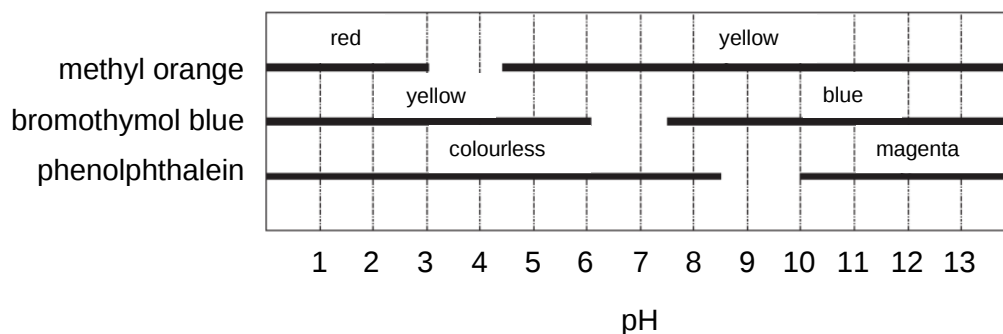
- A** barium hydroxide and ammonium chloride
 - B** barium hydroxide and hydrochloric acid
 - C** hydrochloric acid and ammonium nitrate
 - D** hydrochloric acid and barium nitrate
- 13** Two solutions were mixed in a beaker and the mass of the beaker and contents was then recorded at various times. The graph below shows the results.



What could be the two solutions?

- A** aqueous copper(II) sulfate and aqueous ammonia
- B** aqueous copper(II) sulfate and dilute hydrochloric acid
- C** aqueous sodium hydroxide and zinc sulfate
- D** aqueous sodium carbonate and dilute nitric acid

- 14** The graph below shows the colour ranges of the acid-base indicators, methyl orange, bromothymol blue and phenolphthalein.



A solution, when placed in the three indicators separately, is yellow in methyl orange, blue in bromothymol blue and colourless in phenolphthalein.

What is the pH range of the solution?

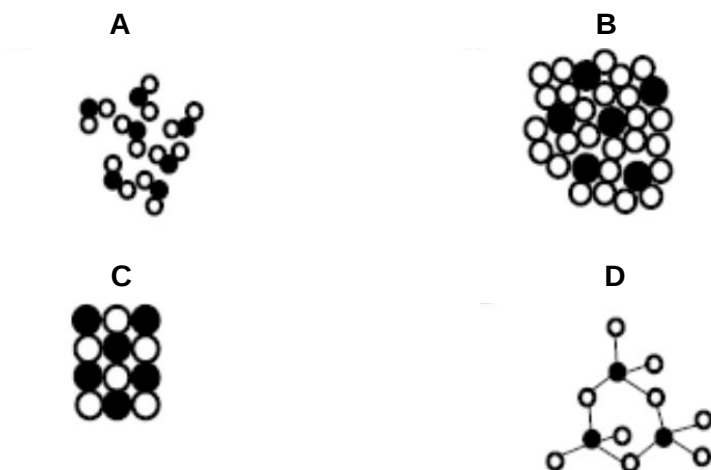
- A** 2.5 to 3.5
 - B** 4.5 to 5.5
 - C** 7.5 to 8.5
 - D** 9.5 to 10.5
- 15** The table shows the solubility of some lead salts in water.

salt	solubility in water
PbCl_2	slightly soluble in cold water, soluble in hot water
PbCO_3 , PbSO_4	insoluble

What will be the best method for making a sample of lead(II) chloride?

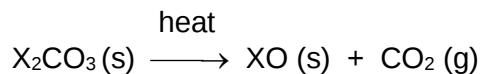
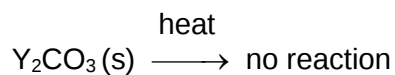
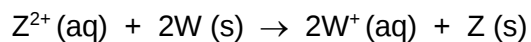
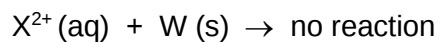
- A** Add dilute hydrochloric acid to aqueous lead(II) nitrate, filter.
- B** Heat lead(II) sulfate with dilute hydrochloric acid, cool, filter.
- C** Heat excess powdered lead with hydrochloric acid, cool, filter.
- D** Shake excess lead(II) carbonate with cold dilute hydrochloric acid, filter.

16 Which of the diagrams shows the structure of an alloy?



17 W, X, Y and Z are four metals which form cations W^+ , X^{2+} , Y^+ and Z^{2+} .

The following are information on some of the reactions that the metals undergo.



What is the order of decreasing reactivity of the metals?

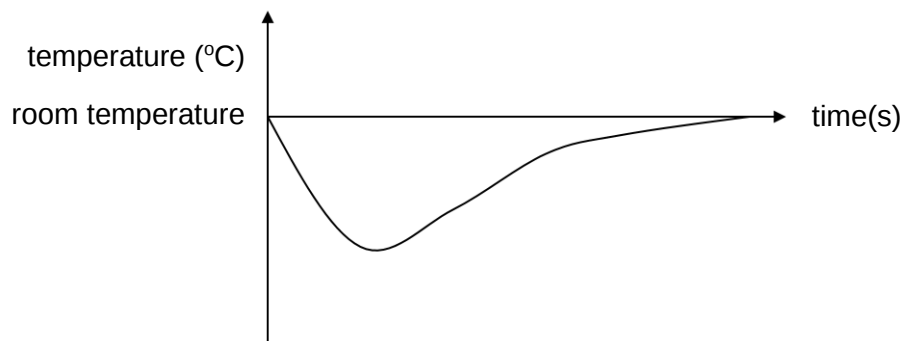
- A** X, W, Z, Y
- B** X, Y, Z, W
- C** Y, X, W, Z
- D** Z, W, X, Y

- 18 The table below shows the reactivity of four metals and their compounds.

metal	addition of dilute sulfuric acid to the metal	heating hydrogen with the metal oxide	adding metal to the aqueous sulfate of metal J
G	effervescence	metal G formed	no reaction
H	no reaction	metal H formed	no reaction
I	effervescence	no reaction	metal J formed
J	effervescence	no reaction	no reaction

What is the order of thermal stability of the metal carbonates from the most to the least thermal stable?

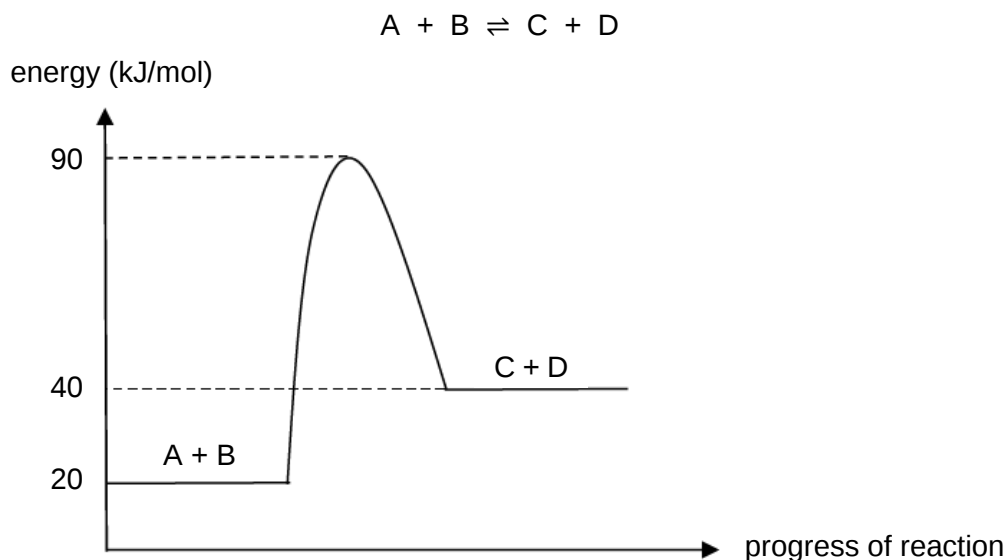
- A H, G, J, I
B H, J, G, I
C I, G, H, J
D I, J, G, H
- 19 Scrap iron is often recycled.
Which reason for recycling is **not** correct?
- A It conserves the amount of iron ore.
B It reduces the amount of pollution due to extraction of iron from its ore.
C It reduces the amount of waste taken to landfill sites.
D It reduces the need to separate and collect the scrap iron from waste.
- 20 The graph below shows the change in temperature recorded during a chemical reaction.



What could this reaction be?

- A burning magnesium ribbon in the presence of air
B combustion of petrol in the engines of vehicles
C dissolving ammonium chloride in water
D neutralisation of hydrochloric acid with sodium hydroxide

- 21 The energy profile diagram of a reversible reaction is shown below.



Which statement is correct about the energy profile diagram?

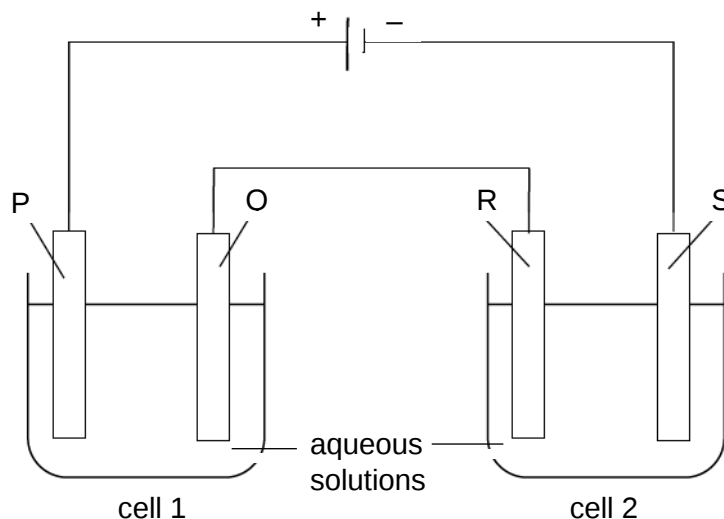
- A Activation energy of the backward reaction is given by -50 kJ/mol.
 - B Activation energy of the forward reaction is given by $+70$ kJ/mol.
 - C Enthalpy change of the backward reaction is given by $+20$ kJ/mol.
 - D Enthalpy change of the forward reaction is given by $+50$ kJ/mol.
- 22 In the reaction between calcium carbonate and ethanoic acid, the following changes could be made to the conditions.
- 1 Increase the concentration of ethanoic acid
 - 2 Increase the particle size of calcium carbonate
 - 3 Increase the temperature of the system
 - 4 Increase the pressure of the system

Which changes would increase the rate of reaction?

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

- 23** In the diagram below, each cell contains an aqueous solution of a single salt and all the four electrodes are platinum.

Electrode Q and S increase in mass during the electrolysis and no gas is given off at Q or S.



Which statement best explains why the increase in mass of Q is greater than the increase in mass of S over the same period of time?

- A** The cation of the solution in cell 1 is different from the cation of the solution in cell 2.
- B** The anion of the solution in cell 1 is different from the anion of the solution in cell 2.
- C** The current flowing in cell 1 is greater than the current flowing in cell 2.
- D** The loss in mass of electrode P is less than the loss in mass of electrode R.

- 24** Which statement is true for both simple and electrolytic cells?

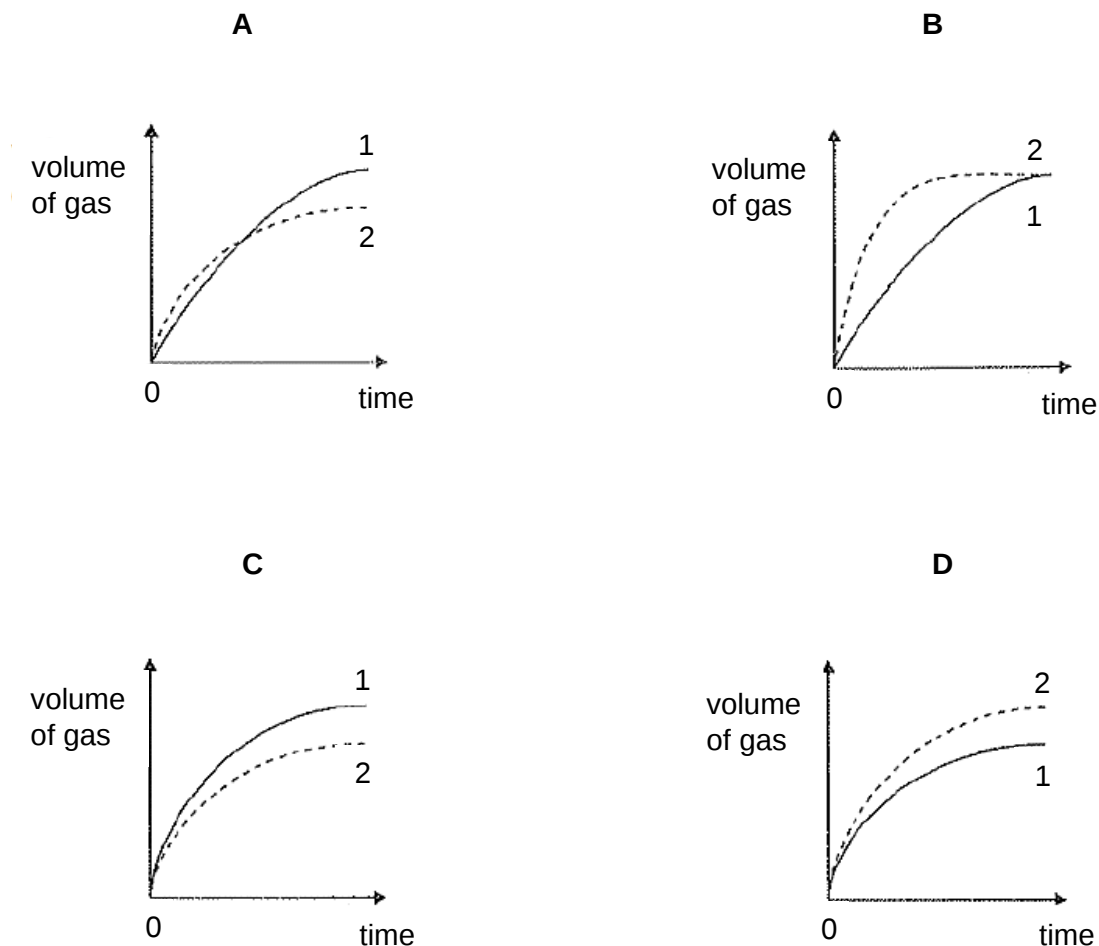
	simple cell	electrolytic cell
A	It converts electrical energy into chemical energy.	It converts chemical energy into electrical energy.
B	Oxidation occurs at the negative electrode.	Oxidation occurs at the positive electrode.
C	Mass of the anode will decrease.	Mass of the anode will increase.
D	Electrons flow from the anode to the cathode.	Electrons flow from the cathode to the anode.

- 25 Two experiments are carried out to measure the volume of carbon dioxide produced when different concentrations of hydrochloric acid are added to excess calcium carbonate.

experiment	acid
1	50 cm ³ of 0.20 mol/dm ³ hydrochloric acid
2	20 cm ³ of 0.50 mol/dm ³ hydrochloric acid

A graph of volume of carbon dioxide against time is plotted for both experiments.

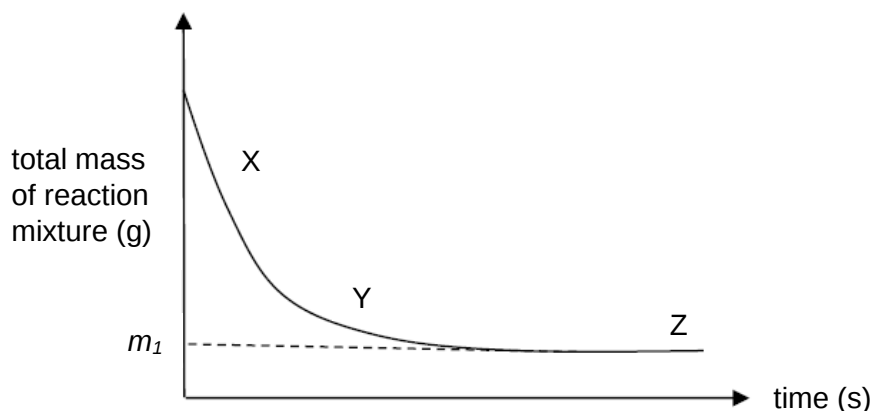
Which graph best shows the results for these experiments?



- 26 In which reaction is the pressure **least** likely to affect the rate of reaction?

- A** $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightarrow 2\text{NH}_3 (\text{g})$
- B** $2\text{SO}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2\text{SO}_3 (\text{g})$
- C** $\text{Fe}_2\text{O}_3 (\text{s}) + 3\text{CO} (\text{g}) \rightarrow 2\text{Fe} (\text{l}) + 3\text{CO}_2 (\text{g})$
- D** $\text{Mg} (\text{s}) + \text{H}_2\text{SO}_4 (\text{aq}) \rightarrow \text{MgSO}_4 (\text{aq}) + \text{H}_2 (\text{g})$

- 27 When an excess copper(II) carbonate is added to dilute sulfuric acid, the total mass of the reaction mixture is measured over a period of time as shown in the graph below.



Which statement about the curve is correct?

- A All copper(II) carbonate has reacted at Z.
 - B The change from X to Y is due to the insoluble layer of salt formed.
 - C The concentration of the acid at Y is lower than at X.
 - D The mass of carbon dioxide produced is m_1 g.
- 28 Disproportionation is a reaction in which the same element is both oxidised and reduced.

Which reaction is an example of disproportionation?

- A $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
 - B $\text{Cu} + 4\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{H}_2\text{O} + 2\text{NO}_2$
 - C $\text{H}_2\text{SO}_3 + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$
 - D $\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2$
- 29 The Haber process is a reversible reaction as some of the ammonia formed is unstable and it decomposes readily back into its reactants.

Which method is used to prevent this from happening?

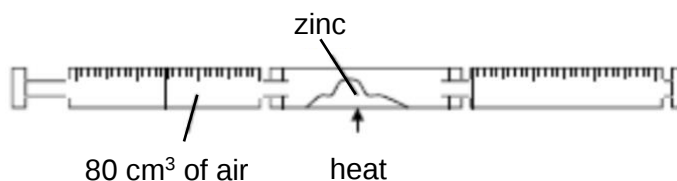
- A adding water to dissolve ammonia
- B cooling the mixture to liquefy ammonia
- C filter the mixture to remove ammonia
- D fractional distil the mixture to separate ammonia gas

- 30** To reduce atmospheric pollution, waste gases from coal-burning power stations are passed through powdered calcium carbonate.

Which of the following gas will **not** be removed by the powdered calcium carbonate?

- A** carbon monoxide
- B** nitrogen dioxide
- C** phosphorous(V) oxide
- D** sulfur dioxide

- 31** An 80 cm^3 sample of air is trapped in a gas syringe. The air is slowly passed over heated zinc in a tube until there is no further change in the volume of air.



What is the approximate final volume of air in the gas syringe?

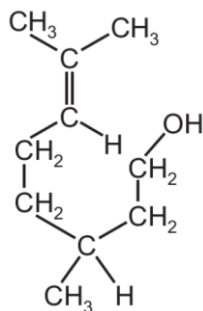
- A** 16 cm^3
 - B** 40 cm^3
 - C** 56 cm^3
 - D** 64 cm^3
- 32** What is the volume of air required for a mixture of 20 cm^3 of methane and 40 cm^3 of carbon monoxide to burn completely?
- A** 60 cm^3
 - B** 80 cm^3
 - C** 300 cm^3
 - D** 400 cm^3
- 33** Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to convert them into less harmful products?
- A** nitrogen dioxide and sulfur dioxide
 - B** nitrogen dioxide and carbon monoxide
 - C** unburnt hydrocarbons and carbon monoxide
 - D** unburnt hydrocarbons and carbon dioxide

- 34 When crude oil is fractionally distilled, which compounds leave from the bottom of the fractionating column?
- A The compounds that are the least flammable.
 B The compounds that are the least viscous.
 C The compounds with the lowest relative molecular mass.
 D The compounds with the lowest boiling points.
- 35 When dodecane, $C_{12}H_{26}$, is cracked, only three hydrocarbons are formed. The hydrocarbons are ethene, propane and propene.

What is the ratio of the hydrocarbons formed?

	ethene	propane	propene
A	1	1	1
B	1	1	3
C	1	3	1
D	3	1	1

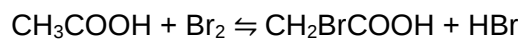
- 36 Citronellol is found in rose oil. The structure of citronellol is shown.



Which statement about citronellol is **not** correct?

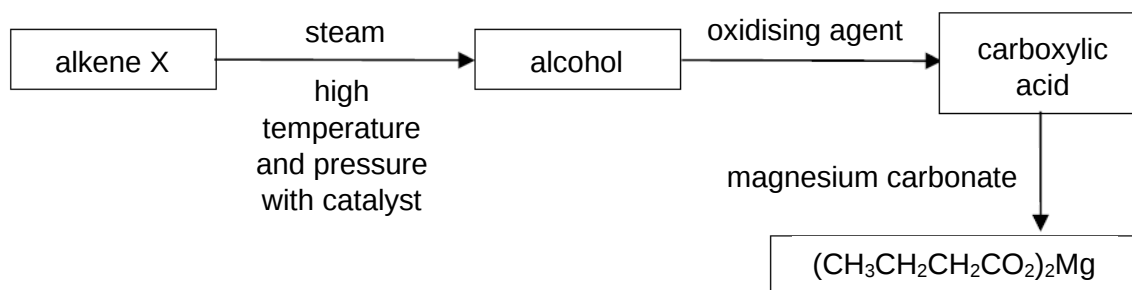
- A Citronellol reacts with sodium hydroxide to produce salt and water.
 B Citronellol turns purple acidified potassium manganate(VII) colourless.
 C Citronellol reacts with hydrogen in the presence of a catalyst.
 D Citronellol forms a polymer with the same empirical formula.

- 37 The chemical equation for a reaction is shown below.



What is this reaction also known as?

- A addition reaction
B condensation reaction
C esterification reaction
D substitution reaction
- 38 A reaction scheme for an alkene X is given. The alkene underwent a series of reactions to obtain the salt, $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2)_2\text{Mg}$.

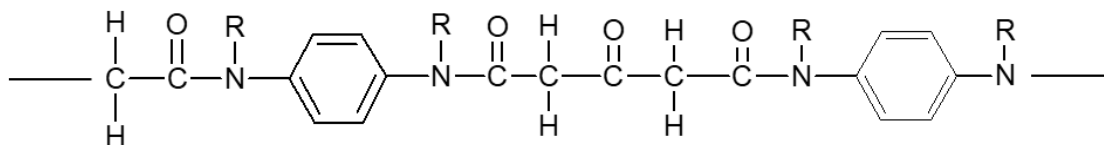


What is alkene X?

- A $\text{CH}_3\text{CH}=\text{CH}_2$
B $\text{CH}_3\text{CH}=\text{CHCH}_3$
C $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
- 39 How does the number of carbon, hydrogen and oxygen atoms in an ester differ from the total number of carbon, hydrogen and oxygen atoms in the alcohol and carboxylic acid from which the ester was derived?

	carbon atoms	hydrogen atoms	oxygen atoms
A	same	same	same
B	less	same	less
C	same	less	less
D	less	less	less

40 A section of a polymer is shown below.



Which of the following shows a monomer involved in the formation of the above polymer?

- A**
- $$\begin{array}{c} \text{O} \quad \text{H} \quad \text{O} \\ \parallel \quad | \quad \parallel \\ \text{HO}-\text{C}-\text{C}-\text{C}-\text{OH} \\ | \\ \text{H} \end{array}$$
- B**
- $$\begin{array}{c} \text{O} \quad \text{R} \quad \quad \quad \text{R} \\ \parallel \quad | \quad \quad \quad | \\ \text{HO}-\text{C}-\text{N}-\text{C}_6\text{H}_4-\text{N}-\text{H} \end{array}$$
- C**
- $$\begin{array}{c} \text{O} \quad \text{H} \quad \text{O} \quad \text{H} \quad \text{O} \\ \parallel \quad | \quad \parallel \quad | \quad \parallel \\ \text{HO}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{OH} \\ | \quad \quad | \\ \text{H} \quad \quad \text{H} \end{array}$$
- D**
- $$\begin{array}{c} \text{R} \quad \text{O} \quad \text{H} \quad \text{O} \\ | \quad \parallel \quad | \quad \parallel \\ \text{H}-\text{N}-\text{C}-\text{C}-\text{C}-\text{OH} \\ | \\ \text{H} \end{array}$$

End of Paper

The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
		Key																
		proton (atomic) number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9												5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24												13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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	114 Fl flerovium	116 Lv livermorium	–	–	–	–	

lanthanoids

actinoids

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