



East Spring Secondary School

Towards Excellence and Success

Name: ()

Class:

Preliminary Examination 2023 Secondary 4 Express

CHEMISTRY
Paper 1 Multiple Choice

6092/01

Tuesday
12 September 2023

1 hour
0800 – 0900

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class, index number on the Answer Sheet in the spaces provided.

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.

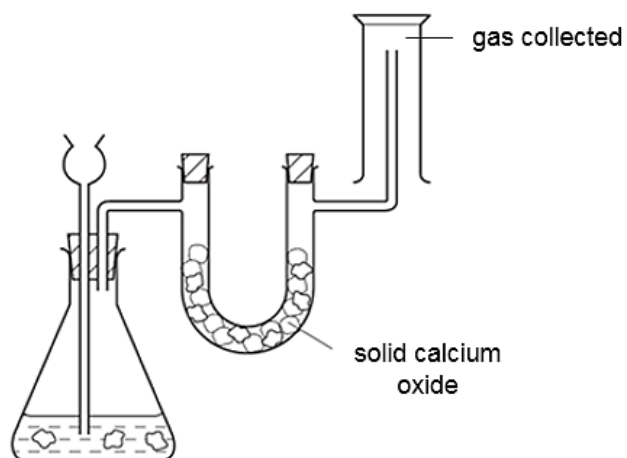
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 17.

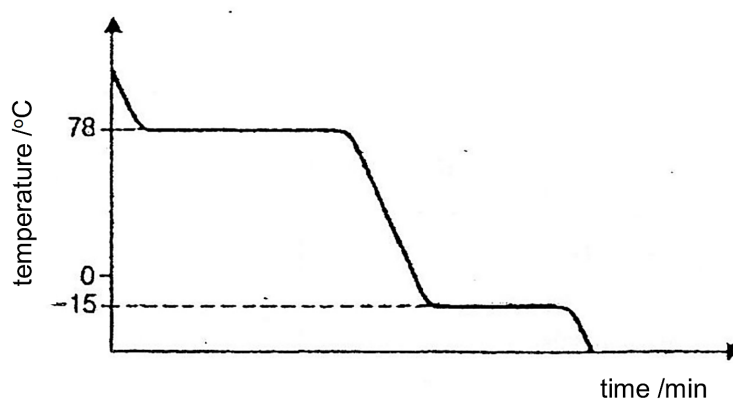
The use of an approved scientific calculation is expected, where appropriate.

- 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?

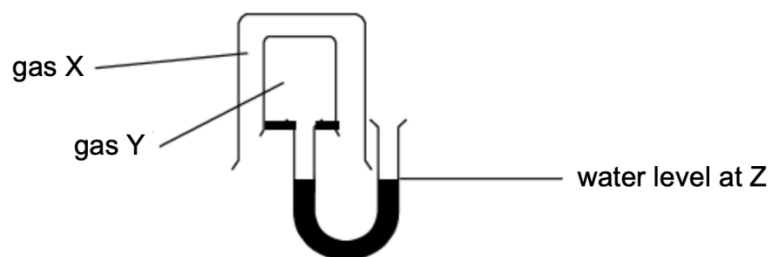
- A** sulfur dioxide **B** carbon dioxide
C oxygen **D** hydrogen
- 2 The cooling curve below shows how the temperature of a gaseous substance changes with time as it is cooled.



What is the state of the substance at 25°C?

- A** gas-liquid mixture
B liquid
C liquid-solid mixture
D solid

- 3 The set-up below shows how the relative rate of diffusion of gas X and Y can be determined.



The water level at Z does not move. Which of the following could be gas X and gas Y?

	X	Y
A	carbon monoxide	carbon dioxide
B	ethene	nitrogen
C	carbon dioxide	sulfur dioxide
D	sulfur dioxide	ammonia

- 4 When aqueous sodium hydroxide is warmed with substance R, a white precipitate that is soluble in excess sodium hydroxide was formed.

Then, when a piece of aluminium foil is added to the mixture, a colourless and pungent gas is evolved. The gas turns moist red litmus paper blue.

Which of the following could substance R be?

- A** ammonium chloride
- B** ammonium nitrate
- C** calcium chloride
- D** zinc nitrate

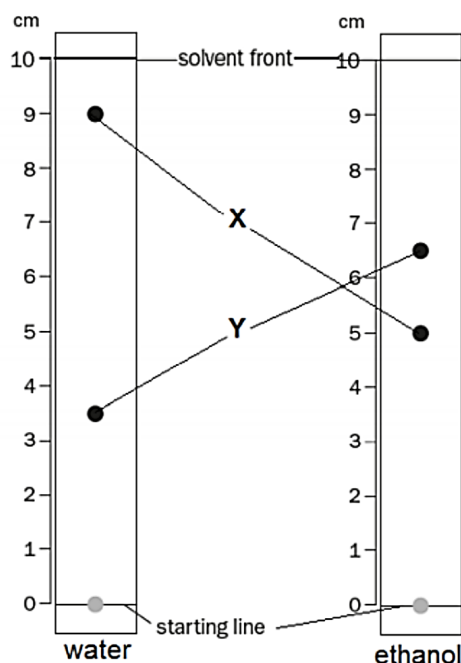
- 5 Which statement about methods of purification and analysis is correct?

- A** A liquid that boils over a range of temperatures may still be 100% pure.
- B** An insoluble substance may be purified using simple distillation.
- C** Chromatography may only be used to separate coloured substances.
- D** Liquid air can undergo fractional distillation, giving oxygen as one of the products.

- 6 A sample was analysed by paper chromatography.

The first experiment was conducted using water as a solvent, and the second experiment was done using ethanol as a solvent.

The results of the two experiments are shown in the diagram below.



What conclusion can be drawn based on these results?

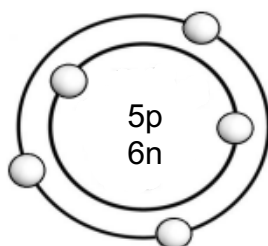
- A Substance Y is more soluble in water than in ethanol.
 - B Substance X is more soluble in ethanol than substance Y.
 - C The R_f value of substance X is greater when water is a solvent instead of ethanol.
 - D The R_f value of substance Y smaller when ethanol is a solvent instead of water.
- 7 The table below shows information about the elements argon, Ar, and calcium, Ca.

element	Ar	Ca
proton number	18	20
nucleon number	40	40

Which of the following statements about the elements is correct?

- A A Ca^{2+} ion has the same number of electrons as an atom of Ar.
- B A Ca^{2+} ion has the same number of protons as an atom of Ar.
- C An atom of Ar has two more electrons than an atom of Ca.
- D An atom of Ca has the same number of neutrons as an atom of Ar.

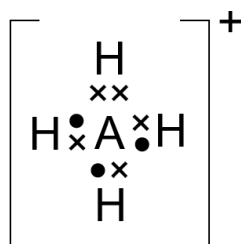
- 8 The diagram represents an isotope of an atom of element X.



Which one of the following correctly describes the particles of the other isotope of the element?

	number of protons	number of neutrons	number of electrons
A	5	6	5
B	5	5	5
C	6	5	5
D	11	12	11

- 9 The ion AH_4^+ can be represented by the 'dot and cross' diagram shown.



Which Group of the Periodic Table does element A belong to?

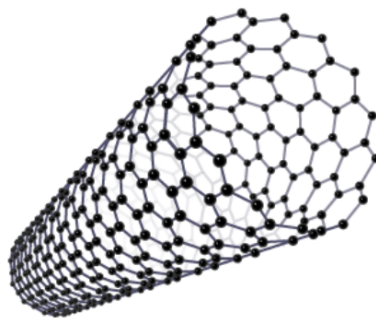
A I

B III

C IV

D V

- 10** Nanotube is an allotrope of carbon. These carbon nanotubes are molecular-scale tubes of carbon arranged similarly to the layers in graphite.



Which row about the physical properties of carbon nanotubes is correct?

	melting point	electrical conductivity
A	high	good
B	high	poor
C	low	good
D	low	poor

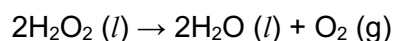
- 11** Iron is a metal. The structure of iron is described as a lattice of positive ions in a 'sea of electrons'.

Which statements about iron are correct?

- 1 Iron conducts electricity because the electrons are free to move.
- 2 Iron conducts heat in solid state because the positive ions are free to move.
- 3 Iron ions are held together because of their attraction for each other.
- 4 Iron has a high melting point due to the strong covalent bonds.

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

- 12** Hydrogen peroxide decomposes to form water and oxygen as shown in the equation below.

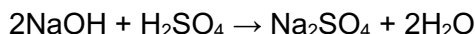


When 24.8 g of impure hydrogen peroxide decomposes, 3.7 dm³ of oxygen gas was collected.

What is the percentage purity of hydrogen peroxide?

- A** 28.2% **B** 42.3% **C** 56.4% **D** 84.6%

- 13 In a volumetric experiment, 25.0 cm³ of 0.100 mol/dm³ sodium hydroxide reacts exactly with 20.0 cm³ of sulfuric acid.



What is the concentration of sulfuric acid used?

- A 0.0625 mol/dm³ B 0.0800 mol/dm³
 C 0.125 mol/dm³ D 0.250 mol/dm³
- 14 Which compound contains the lowest percentage of sulfur by mass?
- A SO₂ B H₂SO₄ C Na₂S D MgS
- 15 Which product is formed at the anode when molten zinc chloride is electrolysed?
- A chloride ions
 B chlorine molecules
 C zinc ions
 D zinc atoms
- 16 A student wants to electroplate an iron spoon with silver only.
 Which of the following set ups should she use to carry out the task successfully?

	anode	cathode	electrolyte
A	iron spoon	silver	copper(II) sulfate solution
B	silver	iron spoon	copper(II) sulfate solution
C	iron spoon	silver	silver nitrate solution
D	silver	iron spoon	silver nitrate solution

- 17 Hydrogen reacts with chlorine according to the equation below.



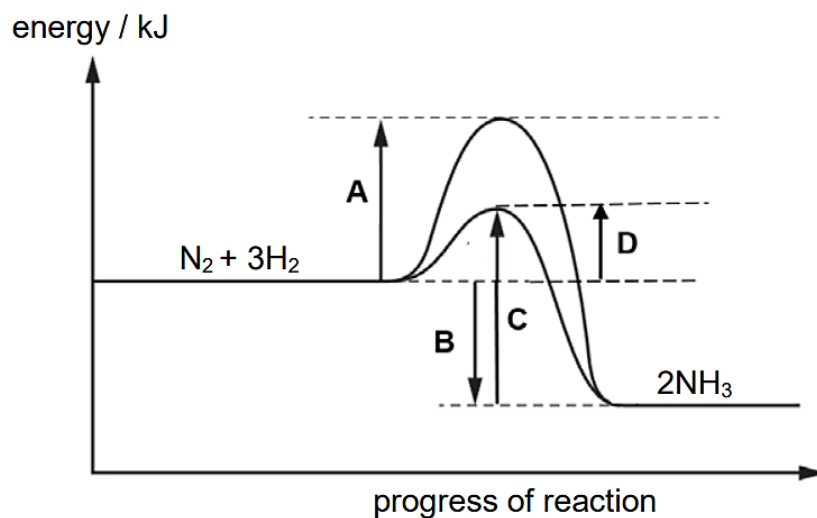
	H–H	Cl–Cl
bond energy in kJ/mol	436	242

What is the H–Cl bond energy in kJ/mol?

- A 339 B 431 C 678 D 862

- 18 The energy profile diagram for both the catalysed and uncatalysed reactions in the production of ammonia is shown below.

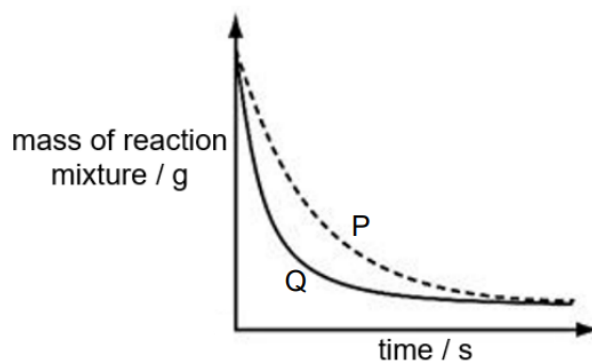
What is the activation energy for the formation of ammonia in the presence of a catalyst?



- 19 A student investigates the rate of reaction between marble chips and excess hydrochloric acid.

The loss in mass of the reaction flask is measured.

The graph shows the results of two experiments, P and Q.



Which change explains the difference between graph P and Q?

- A A catalyst was added in P.
- B A higher temperature was used in P.
- C Bigger marble chips were used in Q.
- D Hydrochloric acid was more concentrated in Q.

- 20** The table below shows the colour changes when a few drops of aqueous potassium iodide and acidified aqueous potassium manganate(VII) were added separately into four different solutions.

solution	potassium iodide	potassium manganate (VII)
1	colourless to brown	purple to colourless
2	colourless to brown	no change
3	no change	purple to colourless
4	no change	no change

Which solutions contain an oxidising agent?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4
- 21** Which of the following reactions suggest that substance M is an alkali?

- A** Aqueous M reacts with dilute hydrochloric acid to produce a precipitate.
B Aqueous M reacts with zinc oxide to form zinc nitrate solution.
C Aqueous M reacts with ammonium chloride to form ammonia gas when warmed.
D Aqueous M reacts with zinc carbonate to produce a gas.

- 22** The following table shows information on an acid-base indicator.

colour at pH 1	pH range at which colour change occurs	colour at pH 12
yellow	3.0 – 4.6	blue

Which statement about the indicator is correct?

- A** It is blue in colour in a solution of nitric acid.
B It cannot distinguish between a strong acid and a strong alkali.
C It is suitable for an acid-base titration where the end point is pH 9.
D It cannot be used to differentiate between water and sodium hydroxide solution.

23 A student has five reagents.

- ☐ dilute hydrochloric acid
- ☐ dilute sulfuric acid
- ☐ dilute nitric acid
- ☐ solid calcium carbonate
- ☐ solid copper(II) carbonate

How many salts can be prepared using these reagents?

A 3

B 4

C 5

D 6

24 What is the correct sequence of steps that should be carried to obtain a pure sample of barium sulfate from barium nitrate?

- 1 add dilute sulfuric acid
- 2 filter
- 3 crystallise
- 4 wash

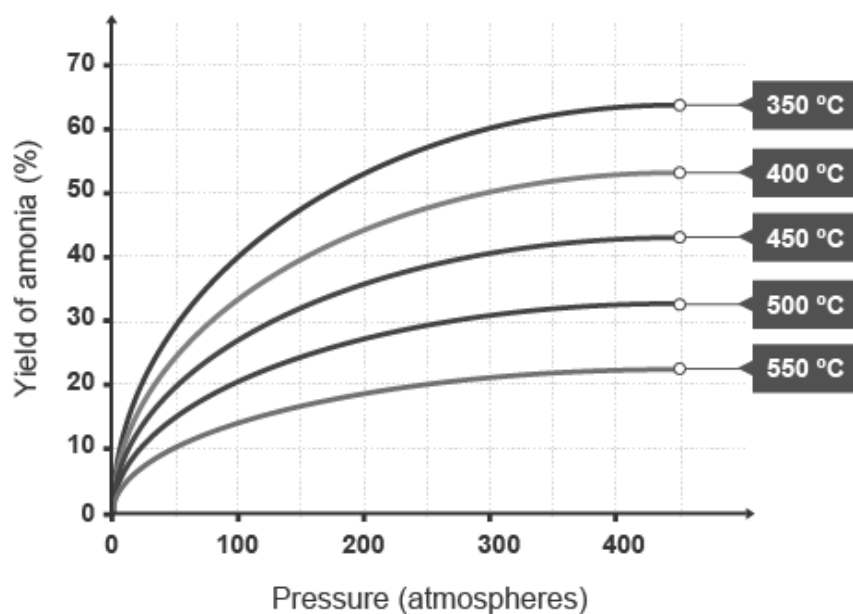
A 1, 2, 3

B 1, 2, 4

C 1, 3, 4

D 2, 3, 4

25 The graph below shows the yield of ammonia from Haber process at different temperatures.



Which of the following statements can be inferred from the graph?

- A A higher percentage yield of ammonia can be obtained at higher pressure.
- B Some of the ammonia formed will decompose to form hydrogen and nitrogen.
- C The speed of reaction is dependent on the presence of iron catalyst.
- D At the right temperature and pressure, all of the hydrogen and nitrogen can be converted into ammonia.

26 Across a period, the character of the elements changes from metallic to non-metallic.

What is the reason for this trend?

- A There is an increase in the nucleon number.
- B There is an increase in the number of neutrons.
- C There is an increase in the number of electron shells.
- D There is an increase in the number of valence electrons.

27 A new element was discovered and has similar properties to the alkali metals.

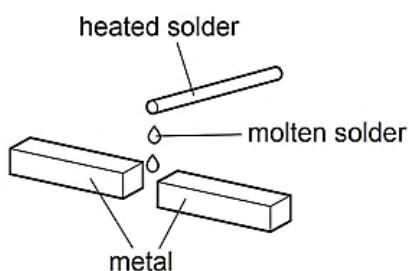
Which of the following is likely to be a property of this new element?

- A** It has a low melting point.
- B** It does not react with water.
- C** It forms coloured compounds.
- D** It reacts with non-metals to form covalent compounds.

28 Which of the following substances is most likely a transition metal?

	density / g/cm ³	melting point / °C	number of chlorides
A	1.55	842	1
B	3.12	-7	1
C	4.93	113	2
D	8.96	1083	2

29 Solder is an alloy of lead and tin. It is used for joining pieces of metal together.



Which statement about solder is correct?

- A** It can be represented by a chemical formula.
- B** It contains a mixture of lead and tin atoms.
- C** It contains lead and tin atoms chemically bonded.
- D** It has a higher melting point than lead.

- 30** Four unknown metals, Q, R, S and T, are reacted with water, steam, and dilute hydrochloric acid. The results are shown in the table.

	reaction with water	reaction with steam	reaction with dilute hydrochloric acid
Q	slow reaction	fast reaction	fast reaction
R	no reaction	no reaction	no reaction
S	no reaction	very slow reaction	slow reaction
T	fast reaction	explodes	explodes

Which statements are correct?

- 1 R is the least reactive metal.
- 2 T could be potassium.
- 3 S is more reactive than Q.

A 1 only

B 2 only

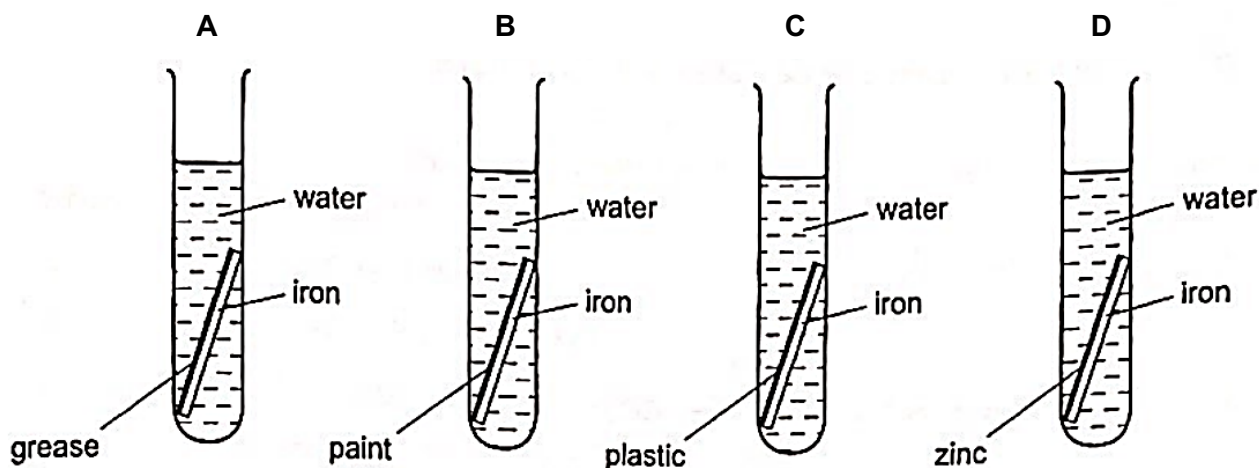
C 1 and 2 only

D 1, 2 and 3

- 31** Four test tubes were set up as shown.

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

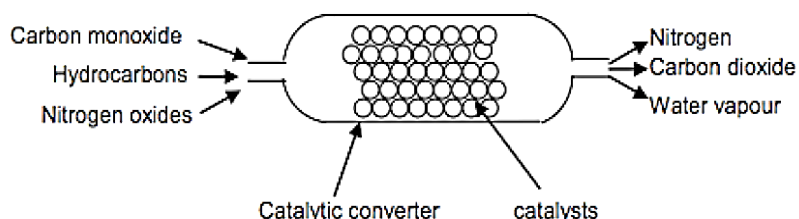
In which test tube is the iron least likely to rust?



32 In the manufacture of iron by the blast furnace, which are the main gases that escape from the top of the blast furnace?

- A nitrogen, oxygen, steam
- B nitrogen, carbon dioxide, carbon monoxide
- C carbon monoxide, carbon dioxide, hydrogen
- D oxygen, carbon dioxide, sulfur dioxide

33 The diagram below shows a section of a catalytic converter in the car's exhaust system.



Which processes take place in the converter?

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

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

34 Petroleum can be separated into fractions by fractional distillation.

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

- A The lubricating oil fraction is a source of polishes and waxes.
- B In a fractionating column, bitumen is obtained below lubricating oil.
- 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 One mole of polyunsaturated oil is converted completely to margarine. When the reaction is completed, the mass of the margarine is 6.0 g more than the mass of the vegetable oil.

How many carbon-carbon double bonds does the polyunsaturated vegetable oil contain?

- A 1 B 2 C 3 D 6

- 36 What is the structure of the product of the reaction between butene, $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3$, 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 $\text{CH}_3-\text{CHBr}-\text{CH}_2\text{Br}-\text{CH}_3$
D $\text{CH}_2\text{Br}-\text{CHBr}-\text{CH}_2-\text{CH}_3$

- 37 X is an organic compound that fizzes when added to solid calcium carbonate.

What could be correct about X?

- A It could be formed by reducing an alcohol.
B It could form an ester with a carboxylic acid.
C It could have the empirical formula $\text{C}_2\text{H}_4\text{O}$.
D It could have the molecular formula $\text{C}_2\text{H}_4\text{O}$.

- 38 In which of the following reactions below is hydrogen either a reactant or a product?

- 1 addition of magnesium to propanoic acid
- 2 conversion of butene to butane
- 3 conversion of vegetable oil to margarine
- 4 fermentation of glucose

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

39 If one mole of each alcohol is burnt in excess oxygen, which alcohol will produce CO_2 and H_2O in a mole ratio of 3:4?

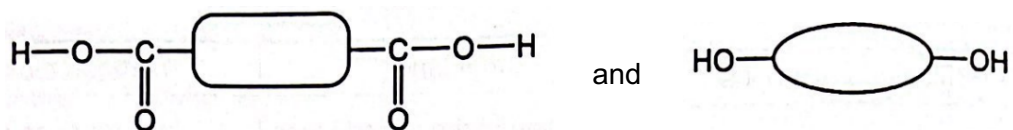
A CH_3OH

B $\text{C}_2\text{H}_5\text{OH}$

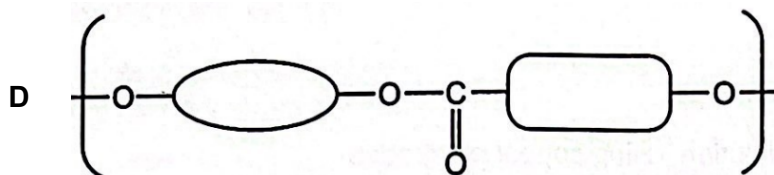
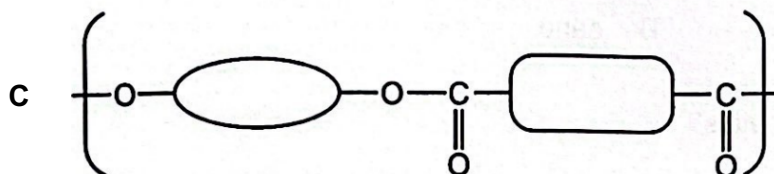
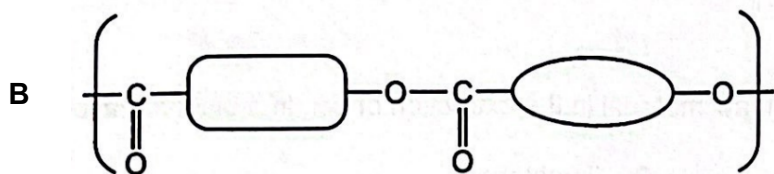
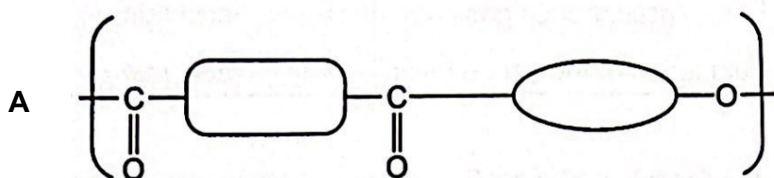
C $\text{C}_3\text{H}_7\text{OH}$

D $\text{C}_4\text{H}_9\text{OH}$

40 Terylene is a polyester made by condensation polymerisation of the two monomers shown.



What is the repeat unit of the polymer?



End of Paper 1

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