CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2023
Secondary Four

CHEMISTRY 6092/01

Paper 1 Multiple Choice

13 Sep 2023
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, 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 18.
The use of an approved scientific calculator is expected, where appropriate.

1 Diagram 1 shows the paper chromatogram of substance X.

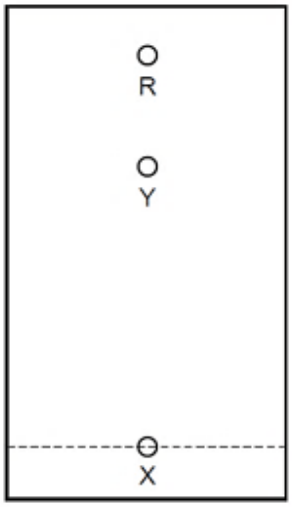


Diagram 1

Diagram 2 shows the cooling curve for substance Y.

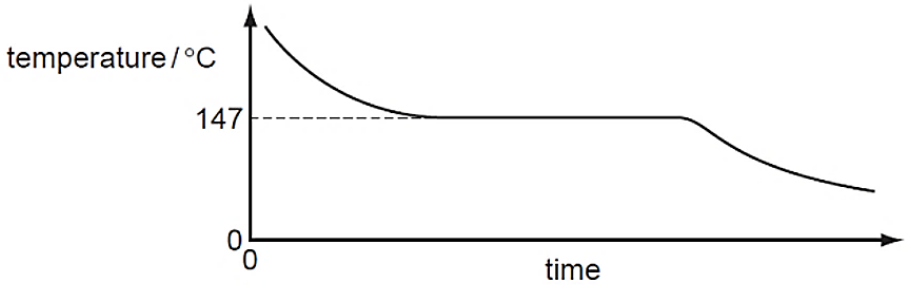


Diagram 2

Which statement about X and Y is correct?

A X is a mixture and Y is a pure substance.

B X is a pure substance and Y is a mixture.

C X and Y are mixtures.

D X and Y are pure substances.

2 A drop of liquid bromine is placed in the bottom of a gas jar. Brown fumes of bromine vapour slowly spread through the covered gas jar.

Why does this happen?

A Bromine vapour is less dense than air.

B Bromine molecules and the molecules in air are always moving around.

C Bromine molecules are smaller than the molecules in air.

D Bromine molecules move faster than the molecules in air.

3 Aqueous silver nitrate is added to aqueous barium iodide until no more precipitate forms. The precipitate is filtered off.

Dilute sulfuric acid is added to the filtrate until no more precipitate is formed. The precipitate is filtered off.

Which statement is correct?

A Both precipitates are soluble in excess aqueous sodium hydroxide.

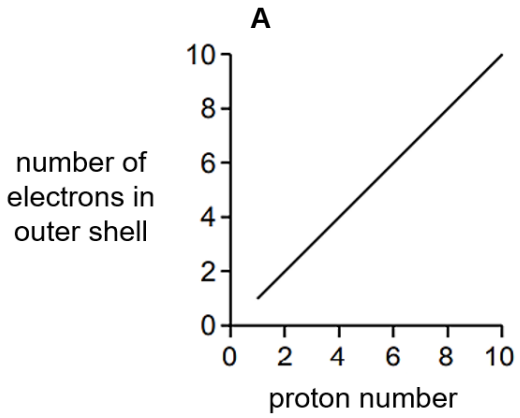
B Both precipitates are white.

C Effervescence is observed in the second experiment.

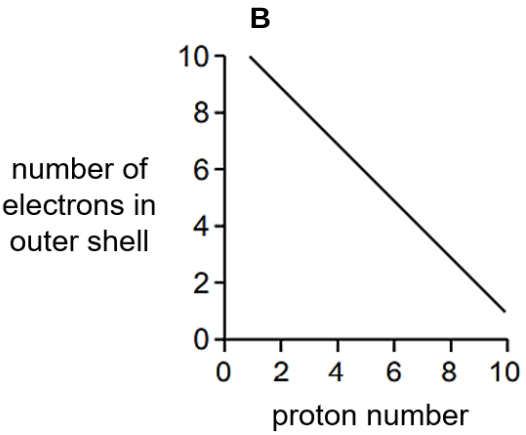
D Nitric acid is present in the filtrate after the second experiment.

4 Which graph shows the number of electrons in the outer shell of an atom, plotted against the proton number for the first ten elements in the Periodic Table?

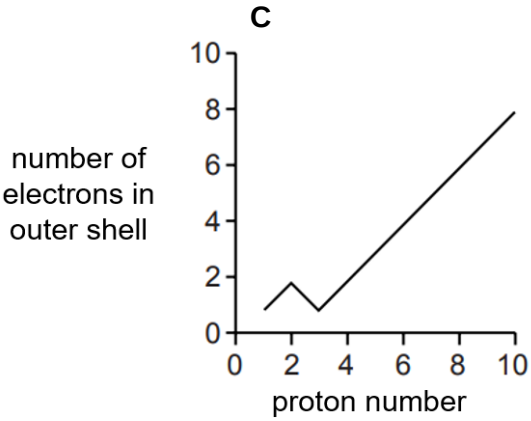
A



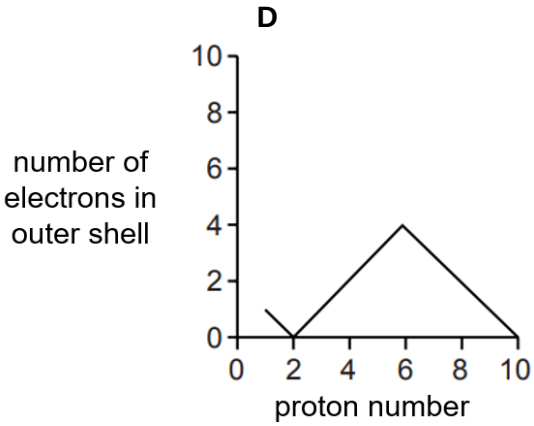
B



C



D



5 Element X reacts with nitrogen to form an ionic compound, X_3N_2.

Which formula for compounds formed by X is correct?

A XO_2

B XS_2

C XF_2

D X_2O

6 Which compound has both ionic and covalent bonds?

A ammonium chloride

B carbon dioxide

C ethyl ethanoate

D sodium sulfide

7 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecule has the most influence on the energy required to boil a covalent liquid?

A The forces of attraction between the molecules

B The reactivity of the molecules

C The shape of the molecules

D The strength of the covalent bonds in the molecules

8 124 g of phosphorus vapour has the same volume of 71 g of chlorine gas at the same temperature and pressure.

What is the formula of a molecule of phosphorus?

A P **B** P_2 **C** P_4 **D** P_8

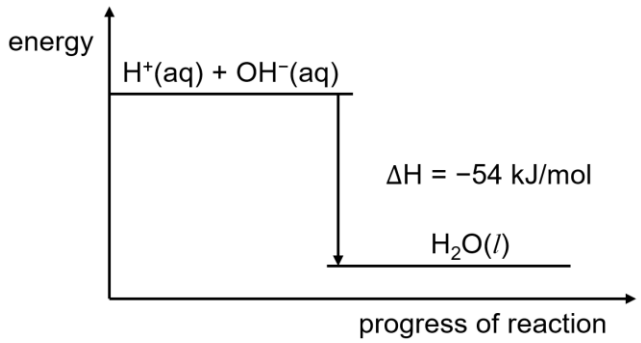
9 The mass of one mole of a chloride formed by a metal Y is 74.5 g.

What is the formula of the chloride?

A Y_3Cl **B** Y_2Cl **C** YCl **D** YCl_2

10 The energy level diagram for the reaction between sodium hydroxide and hydrochloric acid is shown.

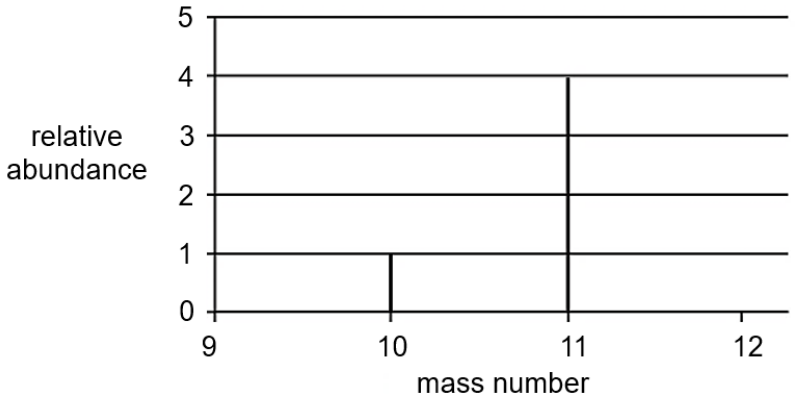
The enthalpy change for one mole of water to be formed in this reaction is −54 kJ/mol.



What is the energy given out when 100 cm^3 of 1.0 mol/dm^3 hydrochloric acid reacts with 100 cm^3 of 1.0 mol/dm^3 sodium hydroxide?

A 0.54 kJ **B** 2.70 kJ **C** 5.40 kJ **D** 10.8 kJ

11 The isotopic composition of an element is indicated below.



What is the relative atomic mass of the element?

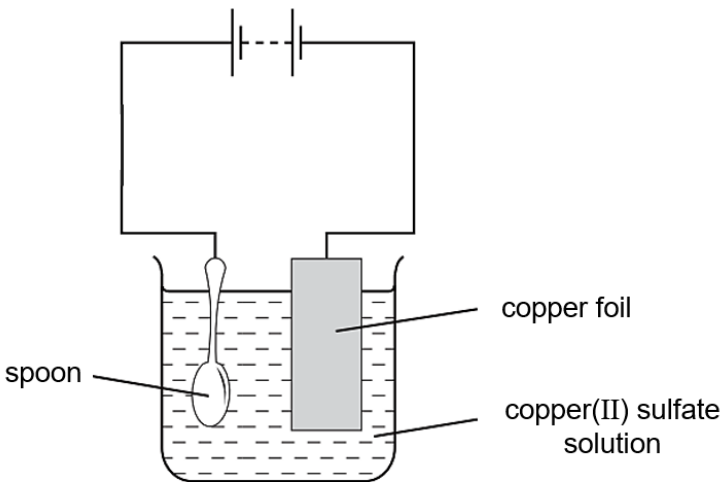
A 10.2 **B** 10.5 **C** 10.8 **D** 11.0

12 A solid nitrate fertiliser reacts with an alkali to produce a gas which turns damp red litmus paper blue.

What is the empirical formula of this fertiliser?

A NO_3 **B** NHO_3 **C** NH_2O **D** $N_2H_4O_3$

13 The apparatus shown below was set up to copper plate the metal spoon.



The experiment did **not** work.

What was the mistake in the apparatus?

A Dilute sulfuric acid should be used as the electrolyte.

B Molten copper(II) sulfate should be used as the electrolyte.

C The battery should be replaced with a voltmeter.

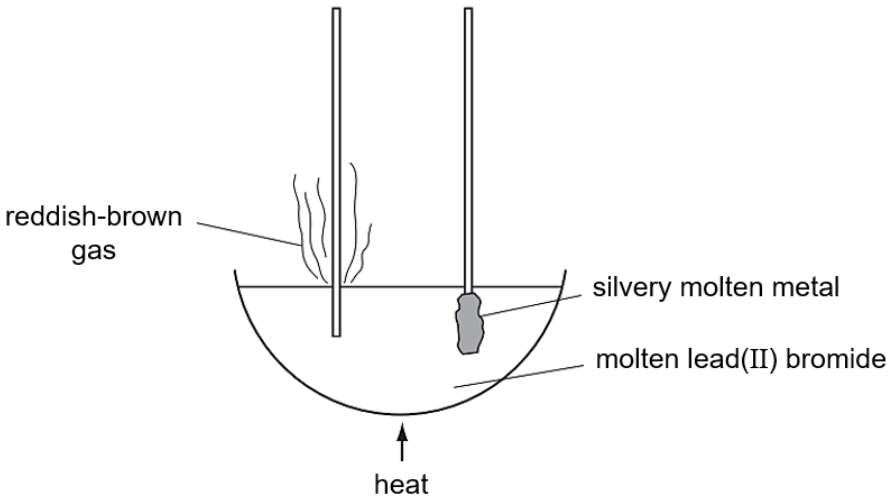
D The spoon should be the negative electrode.

14 In the commercial electrolysis of concentrated sodium chloride, the products are chlorine, hydrogen and sodium hydroxide.

What is the maximum yield of chlorine and hydrogen when 58.5 kg of concentrated sodium chloride is electrolysed?

	yield of chlorine / kg	yield of hydrogen / kg
A	35.5	1
B	35.5	2
C	71	1
D	71	2

15 The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes connected to an external battery.



Which statement about this process is correct?

A New compounds are formed.

B Reddish-brown gas is formed at the cathode.

C Silvery molten metal is formed at the positive terminal.

D The volume of electrolyte decreases over time.

16 Nitric oxide, NO, and bromine vapour react together in an equilibrium reaction.

$$2NO\,(g) + Br_2\,(g) \rightleftharpoons 2NOBr\,(g) \qquad \Delta H = -23.0\ kJ/mol$$

The forward reaction has an activation energy of 5.4 kJ/mol.

What is the activation energy of the backward reaction?

A −28.4 kJ/mol

B −17.6 kJ/mol

C +23.0 kJ/mol

D +28.4 kJ/mol

17 The combustion of methane is exothermic. The equation is given below.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

What can be deduced from this reaction?

A Fewer bonds are broken than made.

B Less energy is involved in breaking bonds than is involved in making bonds.

C More bonds are broken than are made.

D More energy is involved in breaking bonds than is involved in making bonds.

18 A student measured the temperature change when 4.0 g of potassium chloride granules was dissolved in excess water.

Her calculated energy change from the reaction is +720 J.

Which statement is correct?

A The energy change when one mole of potassium chloride dissolves in water is +13.4 kJ.

B The energy change would be greater when powdered potassium chloride is used.

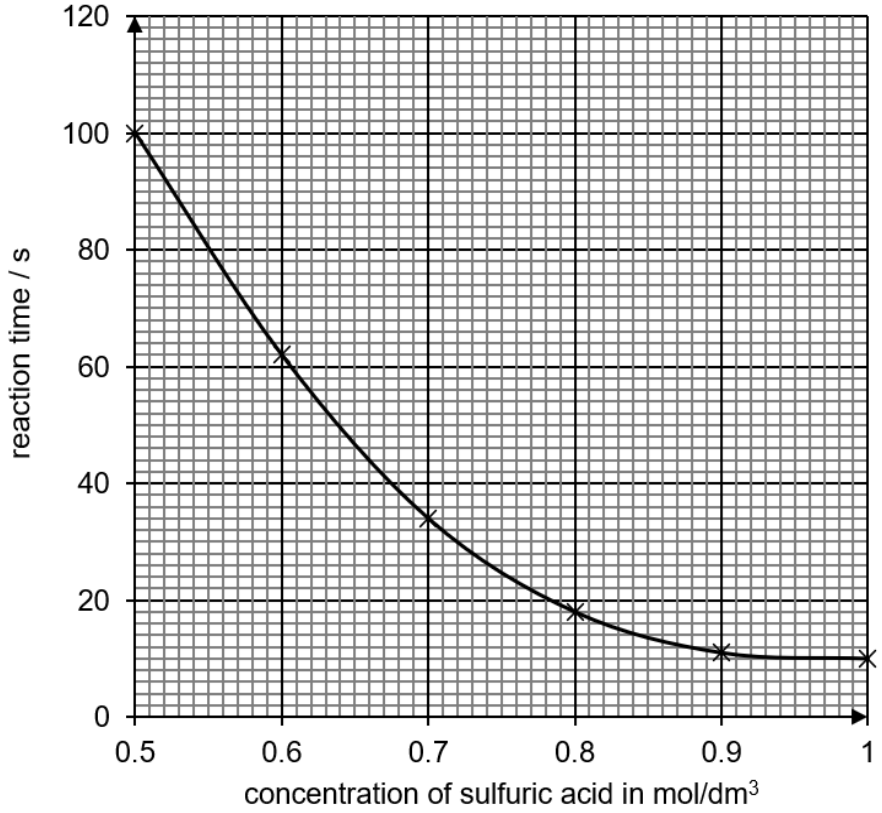
C The energy level of the products is lower than the reactants.

D The sign of the temperature change is positive.

19 When magnesium reacts with dilute sulfuric acid, a gas is released.

In a series of experiments, 0.10 g strips of magnesium are reacted separately with different concentrations of dilute sulfuric acid. In each experiment the acid is in excess.

The reaction time taken for the magnesium to react completely is recorded for each experiment and shown in the graph below.



Which statement is correct?

1 The approximate reaction time when 1.5 mol/dm^3 of sulfuric acid is used is 10 s.

2 The rate of reaction decreases with increasing concentration.

3 The same volume of hydrogen gas is produced in each experiment.

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

20 Bromine is extracted from sea water.

In the final stages of the process, two redox reactions take place.

Step 1: Br_2 (aq) + SO_2 (g) + 2H_2O (*l*) → 2HBr (aq) + H_2SO_4 (aq)
Step 2: 2HBr (aq) + C*l*$_2$ (g) → Br_2 (g) + 2HC*l* (aq)

Which row is correct?

	step 1		step 2	
	oxidising agent	reducing agent	oxidising agent	reducing agent
A	Br_2	SO_2	C*l*$_2$	HBr
B	H_2O	Br_2	C*l*$_2$	HBr
C	SO_2	Br_2	HBr	C*l*$_2$
D	Br_2	H_2O	HBr	C*l*$_2$

21 In volcanic areas, the air pollution due to hydrogen sulfide causes white lead paints to blacken because of the following reaction.

$$PbCO_3 + H_2S \rightarrow PbS + H_2O + CO_2$$

Which statements about the reaction is correct?

1 Carbon is reduced.
2 Hydrogen sulfide acts as an acid.
3 Hydrogen sulfide is oxidised.

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

22 The pH of four different solutions is measured using a pH meter. All solutions measured have the same concentration. The data is recorded below.

	hydrochloric acid	sulfuric acid	ethanoic acid	sodium hydroxide
pH	W	X	Y	Z

Which row shows the correct order of pH measured?

A X < W < Y < Z
B Y < X < W < Z
C Z < Y < W < X
D Z < Y < X < W

23 Salt P can be prepared by reacting together:

- a dilute acid and a metal or
- an acid and an insoluble carbonate.

A pure sample of salt P is then obtained by filtration, followed by crystallisation.

Which is salt P?

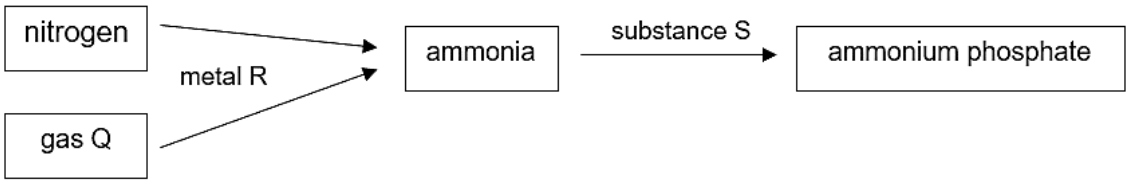
A copper(II) sulfate

B lead(II) sulfate

C magnesium chloride

D sodium chloride

24 The flow diagram below shows how ammonia is produced industrially and subsequently processed to become ammonium phosphate, commonly used as fertiliser.



Which statement is **not** correct?

A Gas Q is a compound that can be obtained by the cracking of crude oil.

B Metal R speeds up the rate of reaction.

C Substance S reacts with ammonia in an acid-base reaction.

D The reaction between nitrogen and gas Q is reversible.

25 Halogens are a group of diatomic elements in Group VII.

Which property shows a decreasing trend down the group?

A ability as oxidising agent

B boiling points

C colour intensity

D density

26 Elements T, U, V, W are four successive elements in the Periodic Table. Element T has atomic number 12.

Which row is correct?

	melting point	electrical conductivity	forms basic oxides
A	V > W	W > U	V, W
B	W > U	U > T	T, U
C	W > T	T > W	V
D	V > W	T > W	T

27 Scrap metal often consists of a mixture of aluminium, iron, chromium and copper.
In the recycling of metals, only the first two steps use physical methods while subsequent steps use chemical methods. The following describes the first two steps used.

Step 1: Use a large magnet.

Step 2: Separate the least dense metal by using a modified water bath with a suitably adjusted density.

Which metals are likely to be recovered in the first two steps?

A aluminium and copper

B aluminium and iron

C copper and chromium

D copper and iron

28 The list shows the position of metal X in the Reactivity Series of Metals.

Na Al Fe X Cu Ag

Which method could be used to extract metal X?

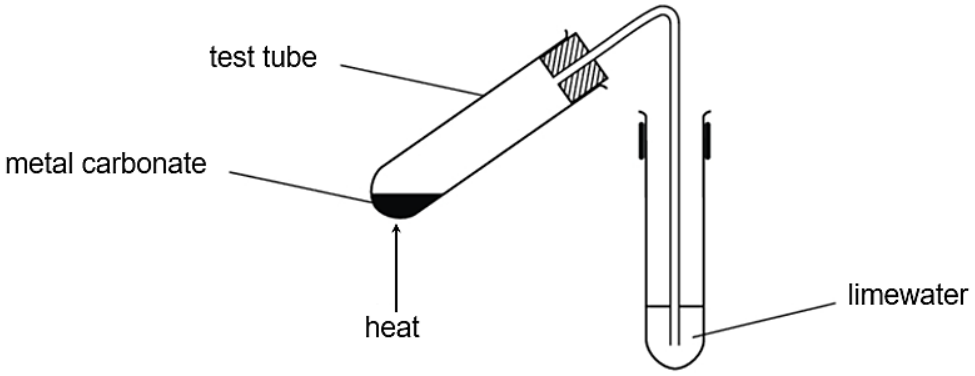
1 electrolysis of the molten metal oxide

2 heating the metal oxide with carbon

3 heating the metal oxide with copper

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

29 The following is an experimental setup to determine the relative thermal stability of metal carbonates.



Which row shows the correct observations?

	relative time taken for the white precipitate to form in limewater	limewater remains colourless
A	$CuCO_3 < MgCO_3$	K_2CO_3
B	$K_2CO_3 < CuCO_3$	$MgCO_3$
C	$K_2CO_3 < MgCO_3$	$CuCO_3$
D	$MgCO_3 < CuCO_3$	K_2CO_3

30 Iron is extracted from haematite in the blast furnace.

Which reaction that takes place in the blast furnace is **not** a redox reaction?

A $C + O_2 \rightarrow CO_2$

B $CO_2 + C \rightarrow 2CO$

C $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

D $SiO_2 + CaO \rightarrow CaSiO_3$

31 Starting in April 2023, a record-breaking heat wave has affected many Asian countries, including India, China, Thailand and Vietnam. Scientists have largely attributed this to worsening global warming due to rising amount of greenhouse gases, mainly carbon dioxide and methane.

Which of the actions correctly impact the amount of greenhouse gases in the air?

	action	amount of carbon dioxide	amount of methane
A	increase population of cattle	↓	↑
B	increase use of electric cars	↑	↓
C	reduce deforestation	↓	negligible
D	reduce ocean size by land reclamation	↓	negligible

32 Recent surveys suggest that up to 4% of the lakes in Sweden and Norway are essentially dead and contain no fish as the pH of the lake water drops to 4 and lower.

Which gases are likely contributors to this environmental consequence?

A chlorofluorocarbons and ozone

B methane and carbon monoxide

C nitrogen dioxide and sulfur dioxide

D unburnt hydrocarbons and carbon monoxide

33 Which statement about a polyunsaturated vegetable oil is correct?

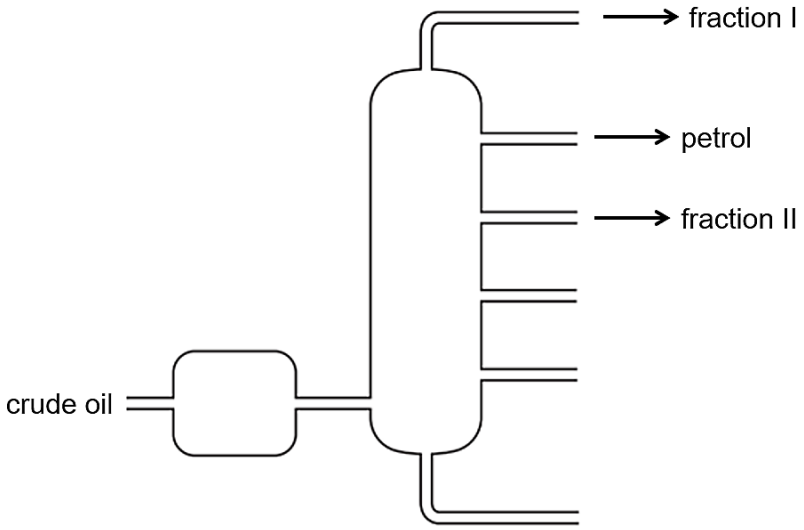
A It has double bonds between carbon and hydrogen atoms.

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.

34 Octane is produced in the petrol fraction during fractional distillation of crude oil.



Which statement describes the fractions just above and below petrol?

A Fraction I contains only methane.

B Fraction II is commonly used as lubricants.

C Fraction I has the lowest boiling point.

D Fraction II is the most flammable.

35 A mixture of 10 cm^3 of propane and 10 cm^3 of propene is burnt in 100 cm^3 of oxygen. The resultant mixture is then cooled to room temperature.

Which statements about the reaction is correct?

1 60 cm^3 of carbon dioxide is produced.

2 The resultant mixture consists of carbon dioxide and water only.

3 10 cm^3 of propene requires 20 cm^3 of hydrogen to be converted to propane.

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

36 Which row correctly describes the type of reaction taking place?

	equation	type of reaction
A	$C_4H_8 + H_2O \rightarrow C_4H_9OH$	substitution
B	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	fermentation
C	$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$	addition
D	$C_{10}H_{22} \rightarrow 2C_5H_{10} + H_2$	condensation

37 Organic compounds P, Q and R have empirical formula C_2H_4O and are isomers of one another. Further chemical tests are carried out and the results are shown below.

	solubility in water	Na_2CO_3 (aq)	acidified $KMnO_4$ (aq)
P	√	√	x
Q	x	x	x
R	√	x	√

Legend

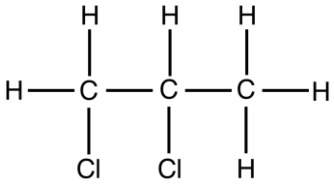
x – no observable change

√ – observable change

Which row correctly describes the homologous series that compounds P, Q and R belong to?

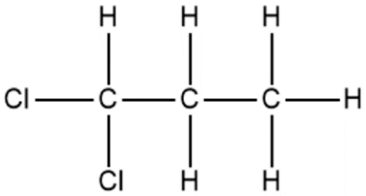
	P	Q	R
A	carboxylic acid	alcohol	ester
B	carboxylic acid	ester	alcohol
C	ester	carboxylic acid	alcohol
D	ester	alcohol	carboxylic acid

38 Dichloroalkanes are often used as industrial solvents to remove paints on furniture. One such compound has the following structure:

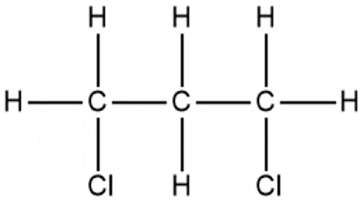


Which structure below is **not** an isomer of the compound shown?

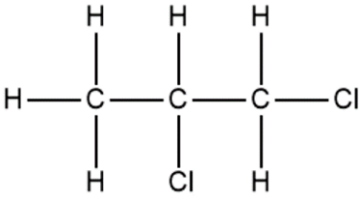
A



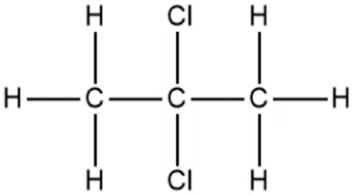
B



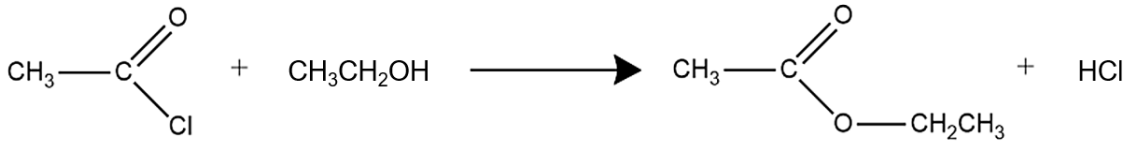
C



D



39 Ethanoyl chloride reacts readily with ethanol to form ethyl ethanoate as shown in the reaction below.



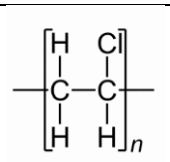
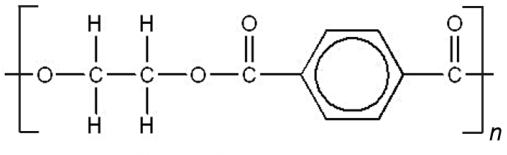
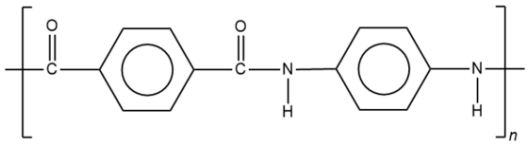
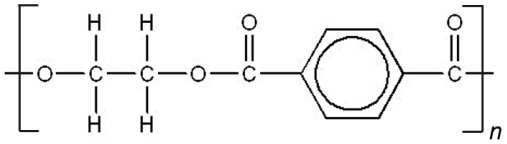
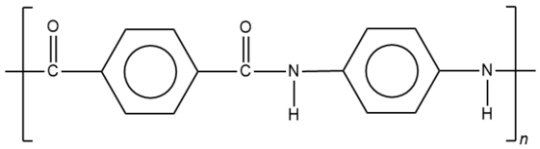
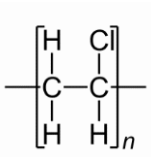
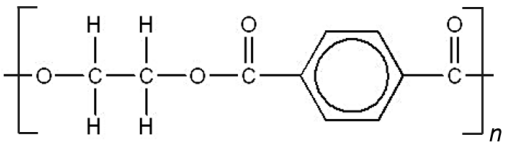
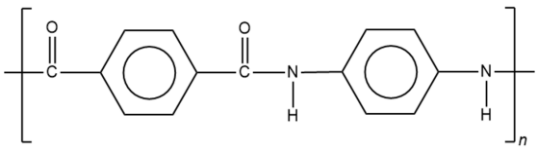
ethanoyl chloride ethanol ethyl ethanoate

What is the molecular formula of the compound formed when propanoyl chloride reacts with methanol?

A C_2H_4O **B** $C_3H_6O_2$ **C** C_4H_8O **D** $C_4H_8O_2$

40 X and Y are two commonly used biodegradable polymers.
X has a similar structure to nylon-6 and Y has a similar structure to terylene.

Which row shows the polymers X and Y?

	X	Y
A		
B		
C		
D		

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** hydrogen 1										2 **He** helium 4
3 **Li** lithium 7	4 **Be** beryllium 9		Key: proton (atomic) number, atomic symbol, name, relative atomic mass									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	57 **La** lanthanum 139	58 **Ce** cerium 140	59 **Pr** praseodymium 141	60 **Nd** neodymium 144	61 **Pm** promethium –	62 **Sm** samarium 150	63 **Eu** europium 152	64 **Gd** gadolinium 157	65 **Tb** terbium 159	66 **Dy** dysprosium 163	67 **Ho** holmium 165	68 **Er** erbium 167	69 **Tm** thulium 169	70 **Yb** ytterbium 173	71 **Lu** lutetium 175
actinoids	89 **Ac** actinium –	90 **Th** thorium 232	91 **Pa** protactinium 231	92 **U** uranium 238	93 **Np** neptunium –	94 **Pu** plutonium –	95 **Am** americium –	96 **Cm** curium –	97 **Bk** berkelium –	98 **Cf** californium –	99 **Es** einsteinium –	100 **Fm** fermium –	101 **Md** mendelevium –	102 **No** nobelium –	103 **Lr** lawrencium –

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