LOYANG VIEW SECONDARY SCHOOL
Preliminary Examination 2023
Secondary Four Express

CANDIDATE NAME : .....

CLASS : ..... **INDEX NUMBER** : .....

CHEMISTRY 6092/01

Paper 1 Multiple Choice **11 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.

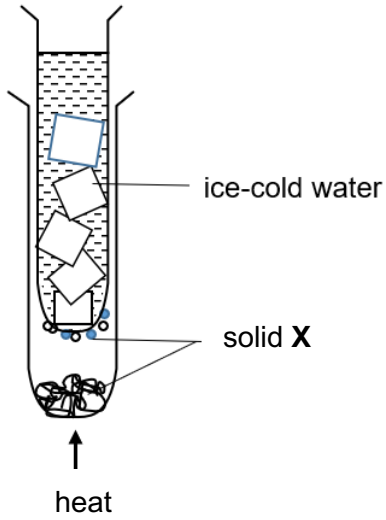
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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 21.
The use of an approved scientific calculator is expected, where appropriate.

Setter: Mrs Rachel Koh

1 The diagram below shows an apparatus for studying the effect of heat on substance **X**.



What is **X**?

A silicon **B** carbon **C** iodine **D** sulfur

2 Four balloons were filled with different types of gases each and left overnight in a room.

balloon	gas in the balloon
P	carbon dioxide
Q	helium
R	hydrogen
S	nitrogen

The balloons were found to have shrunk to different extents overnight.

Which is the correct arrangement of the balloons in increasing order of size?

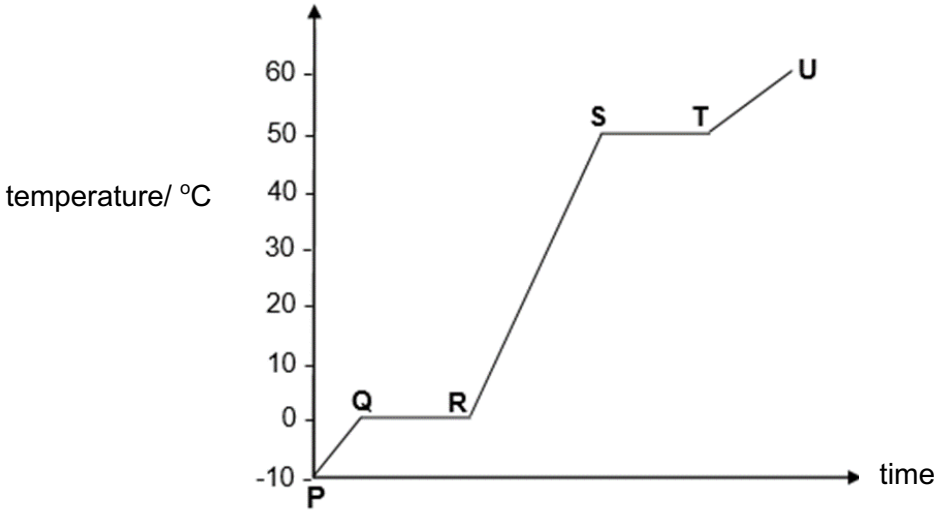
A P, Q, R, S

B Q, R, S, P

C R, Q, P, S

D R, Q, S, P

3 The graph shows the change in the temperature of a substance with time when it is heated from −10°C to 60°C.



Which statement describes the change taking place at the respective stages mentioned?

A Energy is released from points **P** to **Q**.

B Kinetic energy of the particles remains constant from points **P** to **U**.

C Particles gain energy to overcome the forces of attraction from points **S** to **T**.

D There is a large increase in the volume of the substance from points **R** to **S**.

4 The table below shows some information about four substances labelled **P** to **S**.

substance	appearance	change on heating
P	colourless liquid	boils away, leaving a white residue
Q	colourless gas	burns in oxygen to form carbon dioxide and water only
R	yellow solid	splits up by electricity to form a metal and a gas
S	white solid	burns in air to form an oxide as the only product

Which of these substances, **P**,**Q**,**R** and **S** are compounds?

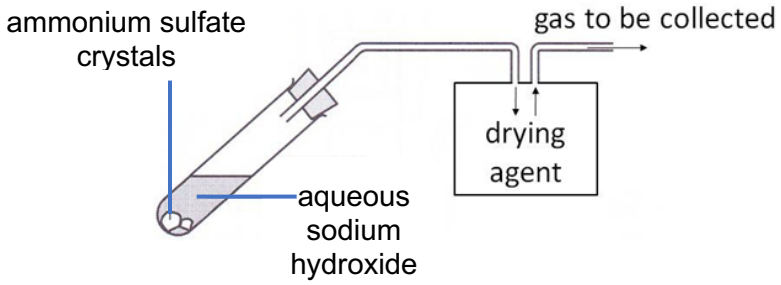
A **P** and **Q** only

B **Q** and **R** only

C **R** and **S** only

D **P**,**Q** and **R** only

5 An excess of aqueous sodium hydroxide was added to a sample of ammonium sulfate crystals. The mixture was then heated gently, and the gas evolved was dried and collected using a suitable method.



What is the most suitable drying agent and gas collection method for the gas evolved?

	drying agent	gas collection method
A	anhydrous calcium chloride	water displacement
B	concentrated sulfuric acid	downward delivery
C	anhydrous calcium chloride	upward delivery
D	concentrated sulfuric acid	upward delivery

6 An element **Z** exists in three isotopic forms as shown below:

isotope	^{150}**Z**	^{155}**Z**	^{157}**Z**
isotopic abundance/ %	**50**	**25**	**25**

What is the relative atomic mass of element **Z**?

A 150

B 152

C 153

D 156

7 The atomic (proton) number of element **P** is 16.

1 **P** reacts with calcium to form an ionic compound, Ca**P**.

2 An oxide of **P** dissolves in water to form a solution that turns blue litmus red.

3 **P** conducts electricity in molten and aqueous state.

4 An ion of **P** has 16 protons and 18 electrons.

Which statements about **P** are correct?

A 1 and 4

B 1, 2 and 3

C 1, 2 and 4

D 2, 3 and 4

8 The atmosphere of a newly discovered planet contains mainly oxygen, argon and nitrogen. The melting and boiling points of these gases are shown in the table below.

gas	melting point / °C	boiling point / °C
oxygen	-219	-183
argon	-189	-186
nitrogen	-210	-196

Out of the three gases, only oxygen exists in the liquid state on the planet.

What is the most likely temperature at the surface of the planet?

A -182 °C

B -184 °C

C -187 °C

D -198 °C

9 A substance, **J**, was synthesised in a water-based medium. The properties of **J** are recorded.

I	**J** is insoluble in water, but dissolves in hexane.
II	**J** melts over a range of 60 to 65 ºC.
III	**J** is a white solid at room temperature.
IV	**J** does not conduct electricity in all states.

The following are statements about **J**.

1 **J** can be isolated from the reaction mixture by dissolving in hexane and then using a separation funnel.

2 **J** can be isolated by filtration and drying the residue with filter paper.

3 **J** is a covalent substance.

4 **J** is an impure substance. If **J** is pure, it would melt at 60 ºC.

Which statement(s) about **J** is/are correct?

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

10 Which statement(s) is/are true for both potassium and potassium chloride?

1 They conduct electricity in the molten state.

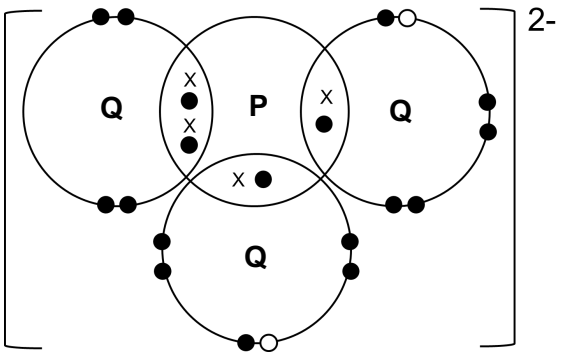
2 They conduct electricity using delocalized electrons.

3 They contain positive ions.

4 They have high melting points.

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

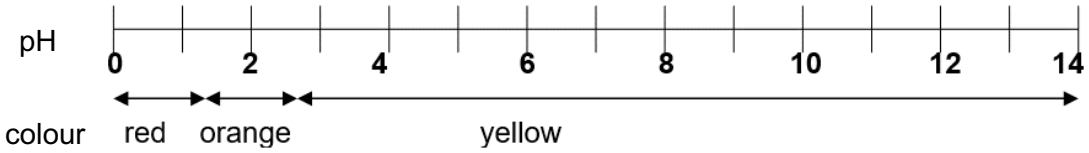
11 The molecular ion, PQ_3^{2-} is represented with the dot-and-cross diagram shown below.



Which is true of Q?

	group number of Q	chloride of Q
A	VI	QCl_2
B	IV	QCl_4
C	IV	QCl_3
D	VI	QCl_4

12 The colour of an indicator **W** in solutions of different pH is shown.



Which two solutions can be distinguished by indicator **W**?

A aqueous solutions of ammonia and sodium hydroxide

B aqueous solutions of hydrogen chloride and carbon dioxide

C aqueous solutions of sodium chloride and sodium hydroxide

D water and an aqueous solution of sodium chloride

13 A disproportionation reaction occurs when an element is simultaneously oxidised and reduced.

Which named element does not undergo disproportionation?

	element	equation of reaction
A	carbon	$H_2C_2O_4 \rightarrow H_2O + CO + CO_2$
B	nitrogen	$H_2O + 2NO_2 \rightarrow HNO_3 + HNO_2$
C	sulfur	$2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$
D	tin	$2Sn^{2+} \rightarrow Sn^{4+} + Sn$

14 The table below shows the properties of some elements W, X, Y and Z in Period 3.

	W	X	Y	Z
appearance at room temperature	grey solid	yellow solid	grey solid	yellowish-green gas
reaction with cold water	violent reaction	no reaction	vigorous reaction	slow reaction
nature of oxide	reacts with acids	reacts with bases	reacts with acids and bases	reacts with bases

Which row shows the correct arrangement of elements in order of increasing proton number in the Periodic Table?

A W, X, Y, Z

B W, Y, X, Z

C Y, W, X, Z

D Z, X, Y, W

15 **M** is an element. It can form a cation $\mathbf{M}^{2+}$ which has an electronic configuration of 2.8.8.

Which of the statements are correct?

1 **M** is a strong reducing agent.

2 **M** is in Period 4 of the Periodic Table.

3 **M** burns in oxygen to form a white solid.

A 1 and 2 only

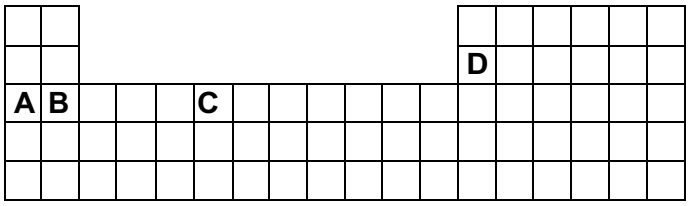
B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3 only

16 The positions of four elements are shown on the outline of part of the Periodic Table. Element **T** has a high melting point and is a good electrical conductor. It forms chlorides **T**Cl_2 and **T**Cl_3.

Which element is **T**?



17 The position of metal **M** in the reactivity series is shown.

K, **M**, A*l*, Zn, Fe, Cu, Ag

Which method will be used to extract **M** from its ore?

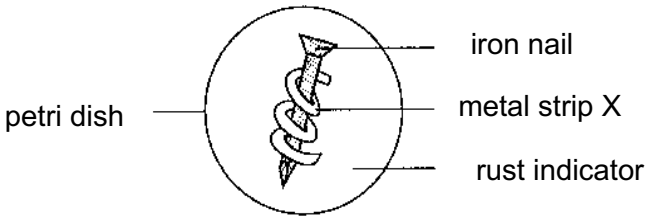
A electrolysis of its molten chloride

B electrolysis of its aqueous sulfate

C reduction of its oxide by heating with coke

D reduction of its oxide by heating with hydrogen

18 The diagram shows an iron nail wrapped in metal strip X placed in a petri dish containing rust indicator.



The rust indicator will turn pink in the presence of rust.

Which statement(s) about the experiment is/are correct?

1 If X is copper, the iron nail will not corrode readily.

2 If X is iron, the iron nail will not corrode readily.

3 If X is silver, a pink colour is observed around the iron nail.

A 1 only

B 1 and 2 only

C 2 and 3 only

D 3 only

19 Approximately 40 % of all iron and steel is produced by the recycling of scrap metal.

1 The recycling of scrap metal costs less money than the blast furnace process.

2 The recycling of scrap metal produces less greenhouse gases and uses less energy than extracting iron from its ore.

3 The recycling of scrap metal reduces water pollution.

4 The percentage of iron in scrap metal is higher than that of iron ores.

Which statements are true about the recycling of scrap metal?

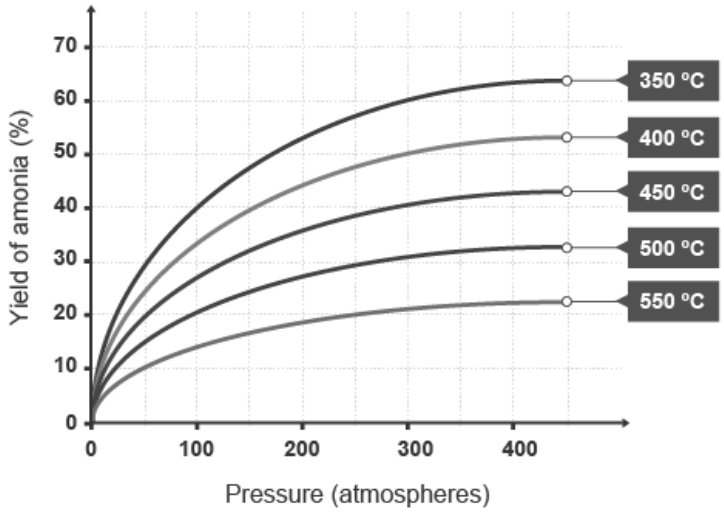
A 1 and 2 only

B 2 and 3 only

C 2, 3 and 4 only

D All of the above

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



Which statement 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.

21 The reaction in the Haber process is represented as

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g) \qquad \Delta H = -92\ kJ$$

Which statement about the Haber process is **not** correct?

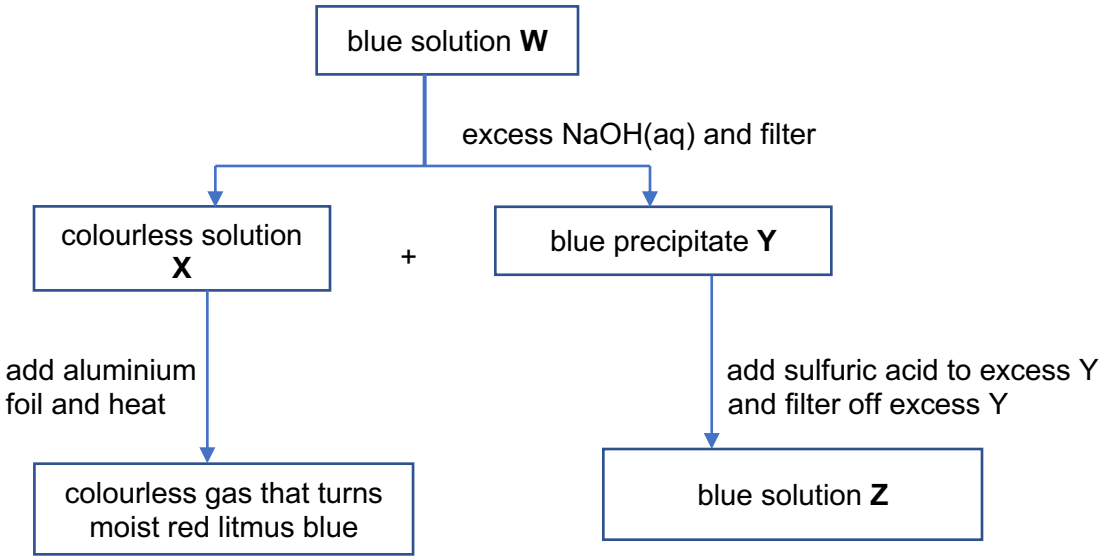
A 92 kJ of heat is given off when 2 mol of ammonia are formed.

B The process is carried out at a high pressure of 250 atm.

C The speed of the backward reaction can be equal to the speed of the forward reaction.

D When 2 mol of N_2 and 6 mol of H_2 are used in the process, 4 mol of NH_3 are collected.

22 The scheme shows some reactions that blue solution **W** undergoes.

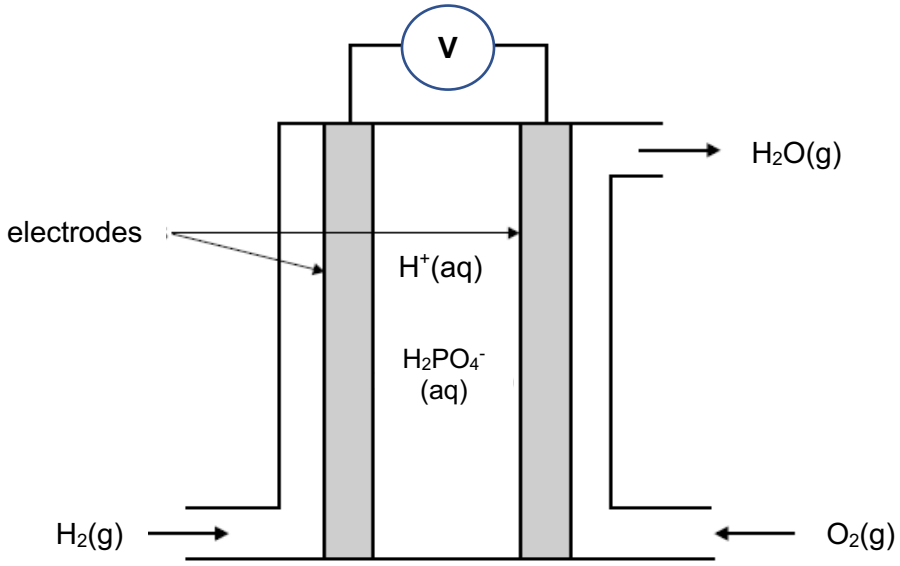


What are the identities of **W**, **X**, **Y** and **Z**?

	W	**X**	**Y**	**Z**
A	$Cu(NO_3)_2$	$NaNO_3$	$Cu(OH)_2$	$CuSO_4$
B	$CuSO_4$	Na_2SO_4	$Cu(OH)_2$	$CuSO_4$
C	$Fe(NO_3)_2$	$NaNO_3$	$Fe(OH)_2$	$FeSO_4$
D	$(NH_4)_2SO_4$	$NH_3(aq)$	$Cu(OH)_2$	$CuSO_4$

23 A fuel cell that can provide power for vehicles is the phosphoric acid fuel cell, PAFC.

A simplified sketch of a phosphoric acid fuel cell is given below.



Which statement about the above fuel cell is **incorrect**?

A The anode and cathode are the positive and negative electrodes respectively.

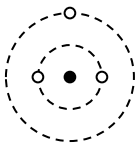
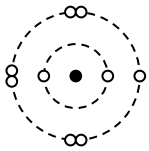
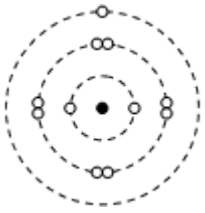
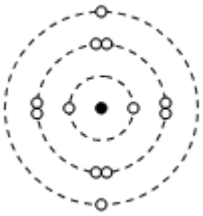
B The only waste product is non-polluting.

C Hydrogen and oxygen undergo redox reactions to generate electricity.

D The fuel cell requires reactants to be continuously supplied to produce electricity.

24 The diagram shows the arrangement of electrons in the atoms of four different elements.

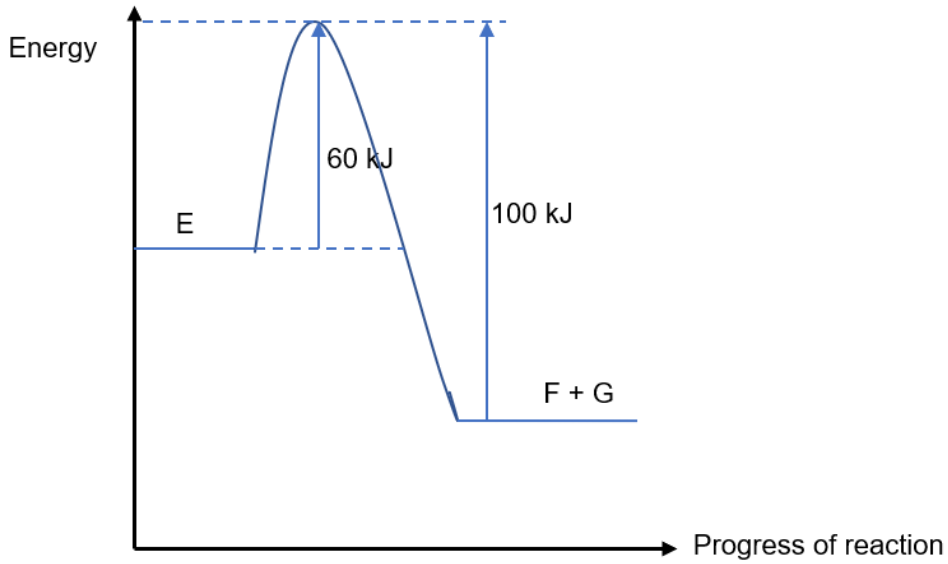
Which element is the most reactive with water?

A	B	C	D
			

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

$$E \rightleftharpoons F + G$$

In the forward reaction, E decomposes to form F and G while in the backward reaction, F and G recombine to form E.



What can be inferred from the energy profile diagram?

	reaction	enthalpy change/ kJ	activation energy/ kJ
A	backward	+ 100	60
B	backward	+ 40	100
C	forward	+ 40	60
D	forward	- 40	100

26 In which reaction is the pressure least likely to affect the rate of reaction at room temperature and pressure?

A $C + CO_2 \rightarrow 2CO$

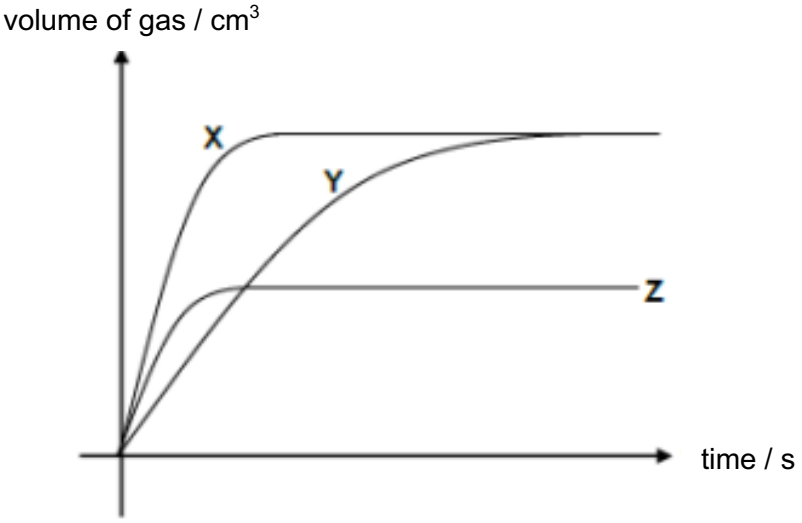
B $2SO_2 + O_2 \rightarrow 2SO_3$

C $N_2 + 3H_2 \rightarrow 2NH_3$

D $NaOH + HCl \rightarrow NaCl + H_2O$

27 A student performed three experiments to produce carbon dioxide gas using excess magnesium carbonate and dilute nitric acid at 30°C.

experiment	magnesium carbonate	dilute nitric acid	
	particle size	volume (cm^3)	concentration (mol/dm^3)
1	powdered	20	1.00
2	lumps	10	1.00
3	lumps	40	0.50



Which graph best represents each of the three experiments?

	experiment 1	experiment 2	experiment 3
A	X	Y	Z
B	X	X	Z
C	X	Z	Y
D	X	X	Y

28 A sample of hydrated $ZnSO_4.\mathbf{n}H_2O$ is formed by combining 0.2 mol $ZnSO_4$ with 36 g of water.

What is the value of **n**?

A 4

B 6

C 8

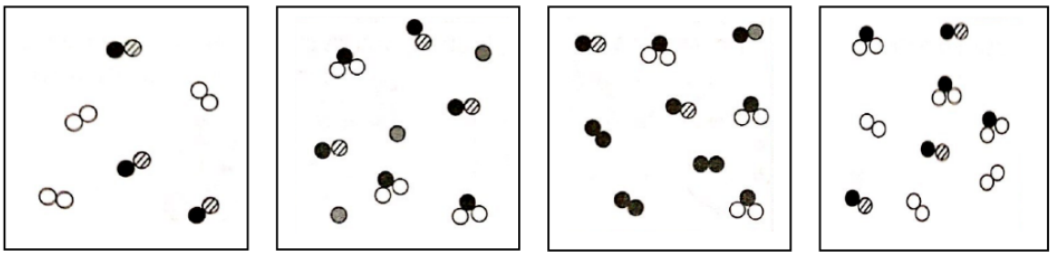
D 10

29 Water gas, consisting of carbon monoxide and hydrogen, is a fuel which can be produced by reacting steam with red-hot coke as follows:

$$H_2O(g) + C(s) \rightarrow H_2(g) + CO(g)$$

Which diagram represents the gaseous reaction mixture when four moles of steam are passed over two moles of red-hot coke?

A **B** **C** **D**



30 Which particles are responsible for the conduction of electricity in dilute hydrochloric acid?

A atoms and molecules

B negative ions and positive ions

C electrons only

D electrons and positive ions

31 In the reaction between 9.2 g of ethanol and excess hydrogen bromide, the mass of bromoethane obtained is 5.4 g.

$$C_2H_5OH + HBr \rightarrow C_2H_5Br + H_2O$$

What is the percentage yield of bromoethane?

[M_r : C_2H_5OH, 46; C_2H_5Br, 109]

A 25% **B** 50% **C** 60% **D** 75%

32 30 cm^3 of 2.0 mol/dm^3 of dilute hydrochloric acid exactly neutralises 20 cm^3 of an aqueous sodium hydroxide of unknown concentration.

What is the concentration of the aqueous sodium hydroxide?

A 0.67 mol/dm^3

B 1.3 mol/dm^3

C 1.5 mol/dm^3

D 3.0 mol/dm^3

33 When heated, two moles of X give one mole of chlorine and two moles of oxygen.

What is the molecular formula of X?

A ClO_2 **B** Cl_2O_4 **C** Cl_2O **D** Cl_4O_2

34 Biodiesel, made by vegetable oil, can be used as a fuel for cars. Even though carbon dioxide is released when biodiesel is combusted, some scientists still claim that biodiesel is a carbon neutral fuel.

What is the basis for this argument?

A Biodiesel is not a carbon compound.

B Plants take up carbon dioxide as they grow.

C Biodiesel produces less carbon dioxide when it burns.

D Plants release carbon dioxide in respiration.

35 Petroleum can be separated into fractions by fractional distillation.

Which statement about this process is correct?

A In a fractionating column, the diesel oil fraction is obtained above the kerosene fraction.

B The fraction obtained at the top of the fractionating column has the highest boiling range.

C The naphtha fraction is a chemical feedstock for petrochemical industries.

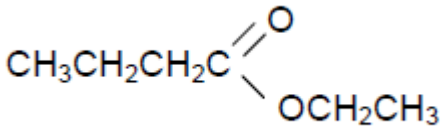
D The relative molecular masses of the compounds obtained near the top of the fractionating column is higher than those of the compounds obtained near the bottom of the column.

36 A molecule of hydrocarbon $C_{15}H_{32}$ undergoes cracking to produce a molecule of octane (C_8H_{18}), a molecule of propene and a number of ethene molecules.

How many ethene molecules are produced?

A 2 **B** 3 **C** 4 **D** 5

37 Rum flavouring is based on the compound with the formula as shown.



What are the starting reagents that can be used to make the above compound?

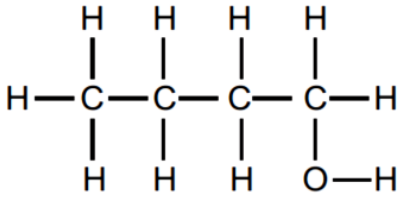
A butanol and ethanoic acid

B butanol and propanoic acid

C ethanol and propanoic acid

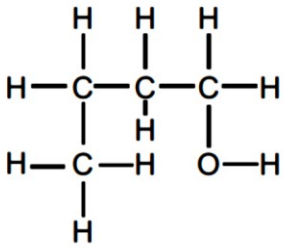
D ethanol and butanoic acid

38 Compound X has the structure shown.

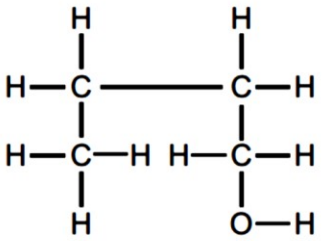


Which structure is an isomer of X?

A



B



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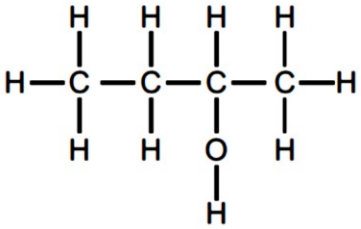
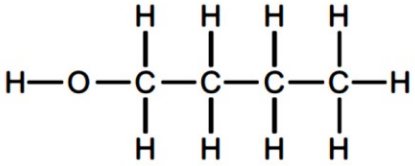
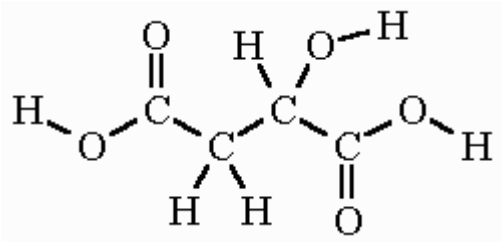


D



39 Malic acid is found in unripe fruit. It was first isolated from an apple in 1785. The structural formula of malic acid is shown below.



How many moles of sodium hydroxide are needed to react completely with 1 mol of malic acid?

A 1 **B** 2 **C** 3 **D** 4

40 Oleic acid is an unsaturated acid found commonly in olive oil which has a molecular formula of $C_{17}H_{31}COOH$.

How many carbon-carbon double bond(s) is/are present in one molecule of oleic acid?

A 1

B 2

C 3

D 4

- End of Paper -

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.).