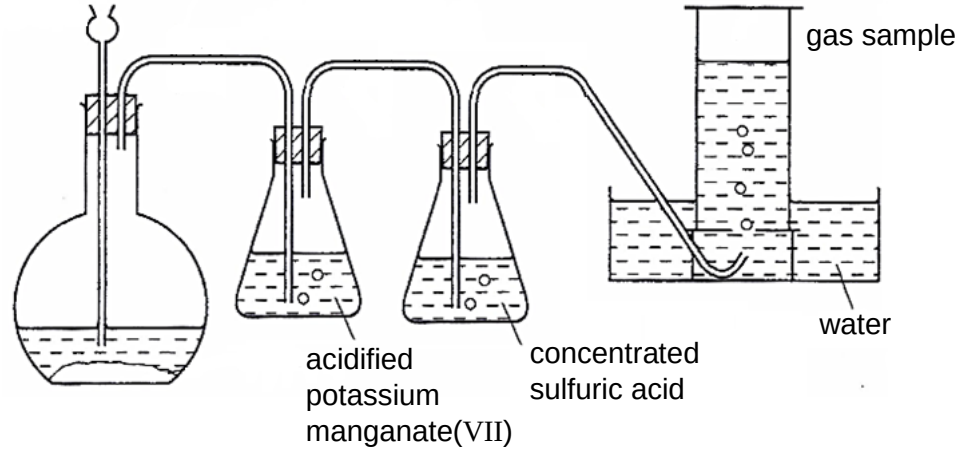
1 The diagram shows the apparatus used to obtain a gas sample from a mixture of ammonia, hydrogen chloride, sulfur dioxide and nitrogen.



Which of the following gas(es) would be present in the gas sample?

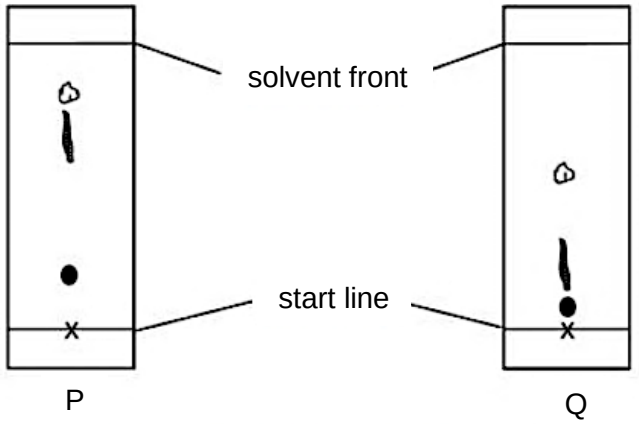
A hydrogen chloride and sulfur dioxide only

B sulfur dioxide and nitrogen only

C ammonia only

D nitrogen only

2 Two students performed paper chromatography to identify the dyes present in a food colouring sample. The two chromatograms, P and Q, are shown.



What is a possible explanation for the difference in the two chromatograms?

A A more concentrated sample was used in chromatogram P.

B Impurities are present in the sample used for chromatogram Q.

C The experiment was performed for a shorter period of time for chromatogram Q.

D The solvents used for chromatogram P and Q are different.

3 The information of two substances, E and F are given.

substance	E	F
arrangement of particles	disorderly and randomly	close and not orderly
movement of particles	moving in all directions at high speed	sliding around randomly

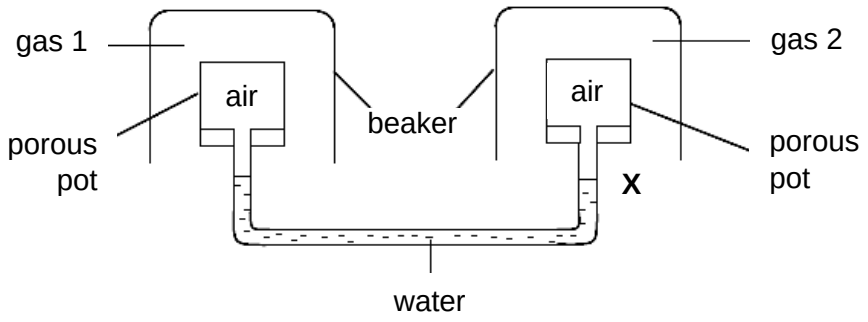
Four substances, which could be E and F, are given below.

substance	description
1	water at 150 ºC
2	magnesium at 200 ºC
3	ethanol at 40 ºC
4	potassium oxide at 10 ºC

Which row shows substances E and F?

	E	F
A	1	2
B	1	3
C	2	1
D	4	3

4 The following apparatus is set up, using different gases in the two inverted beakers.



Which pair of gases would cause an upward movement of the water level at **X**?

	gas 1	gas 2
A	chlorine	fluorine
B	chlorine	hydrogen
C	helium	fluorine
D	helium	hydrogen

5 The nucleon number and number of electrons of elements M and N are shown.

element	nucleon number	number of electrons
M	15	7
N	24	12

Which statement about M and N is correct?

A An atom of M has more neutrons than an atom of N.

B M and N will combine to form a compound with a molecular mass of 102.

C M is a stronger reducing agent than N.

D N is in the same period in the Periodic Table as M.

6 Zircaloy-4 is an alloy comprising 98.0% zirconium, 1.5% tin and 0.5% iron. It is often used to make the parts of nuclear power plants and aircrafts.

Which of the following statements is true about zircaloy-4?

A It is resistant to corrosion as the zirconium and tin atoms form a protective layer over the iron.

B It is strong as the tin and iron atoms form strong bonds with the zirconium atoms.

C It conducts electricity as the metal cations can act as mobile charge carriers when a potential difference is applied.

D It is hard as the atoms have different sizes and cannot slide over each other easily.

7 The table shows the physical properties of substances P, Q, R and S.

substance	melting point / ºC	electrical conductivity	
		in solid state	in molten state
P	2300	poor	poor
Q	800	poor	good
R	80	poor	poor
S	1200	good	good

Using the information in the table, which statement about P, Q, R and S is **incorrect**?

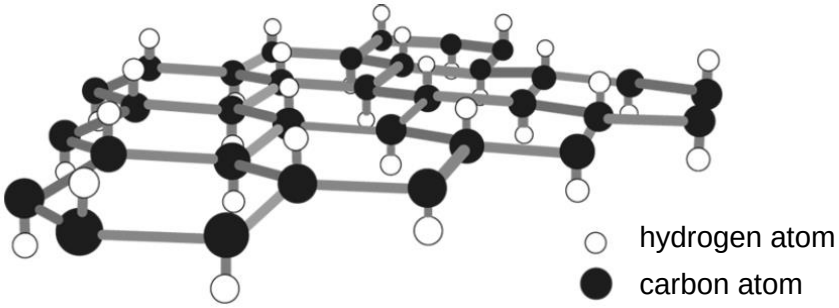
A Substance R consists of weak bonds between the atoms.

B Substance Q consists of strong electrostatic attraction between oppositely charged particles.

C Substance P and S are both insoluble in water.

D Substance S consists of a ‘sea of delocalised electrons’.

8 Graphane has a similar structure to graphite except that it has one hydrogen atom attached to each carbon atom as shown.



The following statements are used to describe graphane.

1 It has a giant molecular structure.

2 It conducts electricity in the solid state.

3 It is soft.

Which statements are correct?

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

9 Oxygen gas can be converted into ozone by passing it through an electric discharge.

$$3O_2\,(g) \rightleftharpoons 2O_3\,(g)$$

In an experiment, 600 cm^3 of oxygen gas was used but only 20% was converted into ozone.

What is the total volume of gases present at the end of the experiment?

A 400 cm^3

B 520 cm^3

C 560 cm^3

D 600 cm^3

10 Cynogen is a compound used as a rocket propellant.
0.845 g of cynogen occupied 390 cm^3 at room temperature and pressure.

What is the molecular formula of cynogen?

A CH_3NO

B C_2H_3N

C C_2N_2

D HCN

11 Reactions 1, 2 and 3 are used in the manufacture of three fertilisers, namely $(NH_4)_2SO_4$, $Ca(H_2PO_4)_2$, and $(NH_4)_3PO_4$.

Reaction 1: $H_2SO_4 + 2NH_3 \rightarrow (NH_4)_2SO_4$

Reaction 2: $2H_2SO_4 + Ca_3(PO_4)_2 \rightarrow Ca(H_2PO_4)_2 + 2CaSO_4$

Reaction 3: $3H_2SO_4 + Ca_3(PO_4)_2 + 6NH_3 \rightarrow 2(NH_4)_3PO_4 + 3CaSO_4$

The relative molecular mass, M_r, of sulfuric acid and of each fertiliser is shown in the table.

substance	H_2SO_4	$(NH_4)_2SO_4$	$(NH_4)_3PO_4$	$Ca(H_2PO_4)_2$
M_r	98	132	149	234

In each reaction, 196 g of sulfuric acid was used.

Which reaction will produce the least and greatest mass of fertiliser?

	least mass	greatest mass
A	1	3
B	2	3
C	2	1
D	3	1

12 In an experiment, excess calcium carbonate was reacted with dilute hydrochloric acid. It was observed that the reaction gradually became slower and eventually stopped.

Which statement best explains the observations?

A Calcium carbonate was used up completely.

B There were no more hydrogen ions in the reaction mixture.

C An insoluble layer of calcium chloride is formed around calcium carbonate.

D Carbon dioxide produced reacts with calcium carbonate to give a white precipitate.

13 When dilute sulfuric acid and potassium hydroxide react, a two-step reaction occurs.

Step 1: Potassium hydrogen sulfate, $KHSO_4$ is formed.

$$H_2SO_4\,(aq) + KOH\,(aq) \rightarrow KHSO_4\,(aq) + H_2O\,(l)$$

Step 2: Aqueous potassium hydrogen sulfate reacts with more potassium hydroxide to form potassium sulfate.

$$KHSO_4\,(aq) + KOH\,(aq) \rightarrow K_2SO_4\,(aq) + H_2O\,(l)$$

Which results for these two salts, when tested with blue litmus paper, are correct?

	salt	effect on blue litmus paper
A	$KHSO_4$	turns red
	K_2SO_4	no effect
B	$KHSO_4$	turns red
	K_2SO_4	turns red
C	$KHSO_4$	no effect
	K_2SO_4	turns red
D	$KHSO_4$	no effect
	K_2SO_4	no effect

14 A student is given six reagents as shown to make salts.

dilute nitric acid
dilute hydrochloric acid
dilute sulfuric acid
solid copper(II) carbonate
solid lead(II) oxide
solid silver hydroxide

How many soluble salts can be prepared from these reagents?

A 4
B 5
C 6
D 7

15 An aqueous solution contains the same amount of Ca^{2+} and Cu^{2+} ions.
Aqueous ammonia is added until in excess.
After shaking, the mixture is filtered.

What would be left on the filter paper?

A no solid residue

B blue solid

C blue solid and white solid

D white solid

16 When solid Z was added to dilute sulfuric acid, effervescence was observed and a colourless solution was obtained. When solid Z was added to an aqueous mixture of sodium hydroxide and sodium nitrate and warmed, a gas was evolved which turned moist red litmus paper blue.

What could Z be?

A aluminium

B ammonium nitrate

C copper nitrate

D zinc carbonate

17 Industrial ammonia is obtained by the Haber Process.

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

Which of the following statements about the Haber Process is **incorrect**?

A Hydrogen gas needed for the process is obtained mainly by cracking of large hydrocarbons.

B Energy is released from the Haber Process.

C The catalyst increases the rate of the forward reaction only and favours the production of ammonia.

D The industrial catalyst used is finely-divided iron.

18 In which reaction is substance R acting as an oxidising agent?

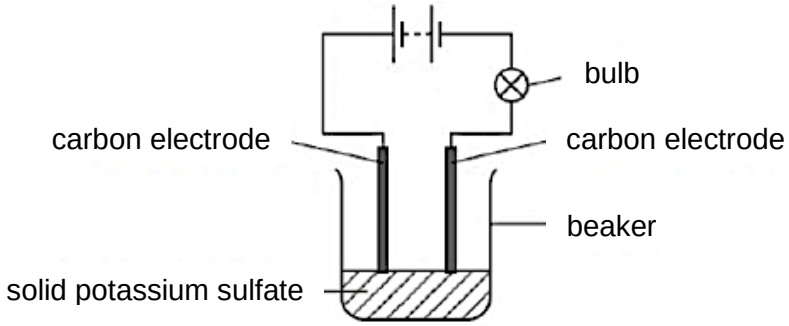
A Purple acidified aqueous potassium manganate(VII) decolourises when a solution of R is added.

B Yellow solution of iron(III) chloride turns green when a solution of R is added.

C Blue solution of copper(II) sulfate turns colourless and a reddish brown solid forms when solid R is added.

D Colourless aqueous potassium iodide turns brown when a solution of R is added.

19 In the set-up shown, the bulb does not light up.



Which of the following change would cause the bulb to light up?

A Add more solid potassium sulfate to the beaker

B Add water to potassium sulfate in the beaker

C Change potassium sulfate to copper(II) hydroxide

D Replace the carbon electrodes with zinc and iron electrodes

20 In two separate electrolysis experiments, the same amount of charge deposited 19.5 g of zinc and 8.25 g of manganese. The charge of a zinc ion is +2.
[A_r: Mn, 55; Zn, 65]

What was the charge of the manganese ion?

A +1

B +2

C +3

D +4

21 In the electroplating of silver onto a plastic spoon, which statement is **incorrect**?

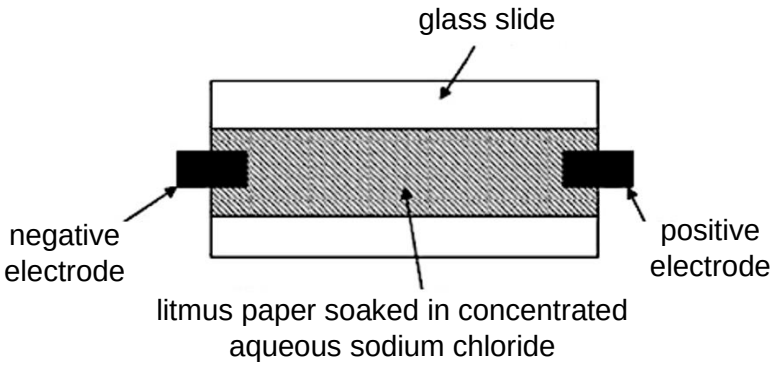
A The plastic spoon should be coated with graphite before electroplating.

B The plastic spoon is placed at the cathode.

C The silver metal at the cathode gets smaller during the process.

D The electrolyte used should be silver nitrate.

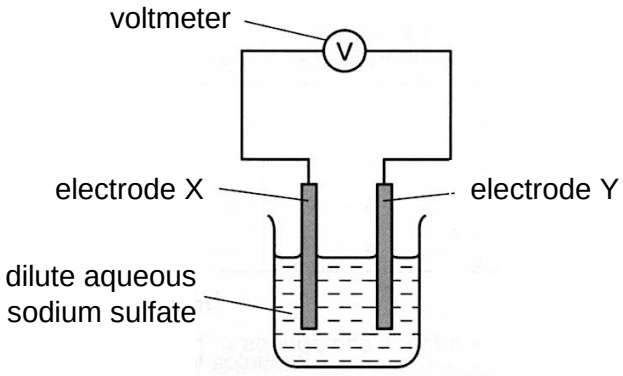
22 A piece of litmus paper was soaked in concentrated aqueous sodium chloride and supported on a glass slide. The paper was connected to an electrical supply as shown.



Which of the following shows the correct observations at the end of the experiment?

	negative electrode	positive electrode
A	blue	bleached
B	blue	no change
C	red	bleached
D	no change	red

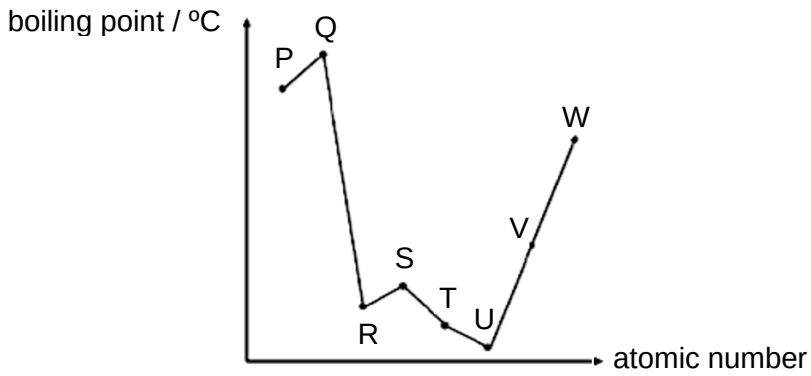
23 A simple cell was set up as shown.



Which pair of electrodes would give the largest reading on the voltmeter, and which electrode will be the negative terminal?

	electrode X	electrode Y	negative terminal
A	copper	zinc	zinc
B	magnesium	copper	copper
C	iron	magnesium	magnesium
D	zinc	iron	iron

24 The graph shows the variation in boiling points for eight consecutive elements with atomic numbers less than or equal to 20, in Period 3 and 4 of the Periodic Table.



What can be deduced from the graph?

A Element P has an electronic configuration of 2, 8, 1.

B Element R exists as diatomic molecules.

C Element S has a giant metallic structure.

D Element U is a noble gas.

25 A Group 1 metal with the lowest melting point is reacted with a Group 17 element with the highest colour intensity.

Which compound is formed?

A lithium fluoride

B lithium astatide

C francium fluoride

D francium astatide

26 Element Y has the following properties:

- It forms YBr_2 when reacted with liquid bromine.
- It forms YCl_3 when reacted with dilute hydrochloric acid.

Which of the following best describes element Y?

A Group 2 element

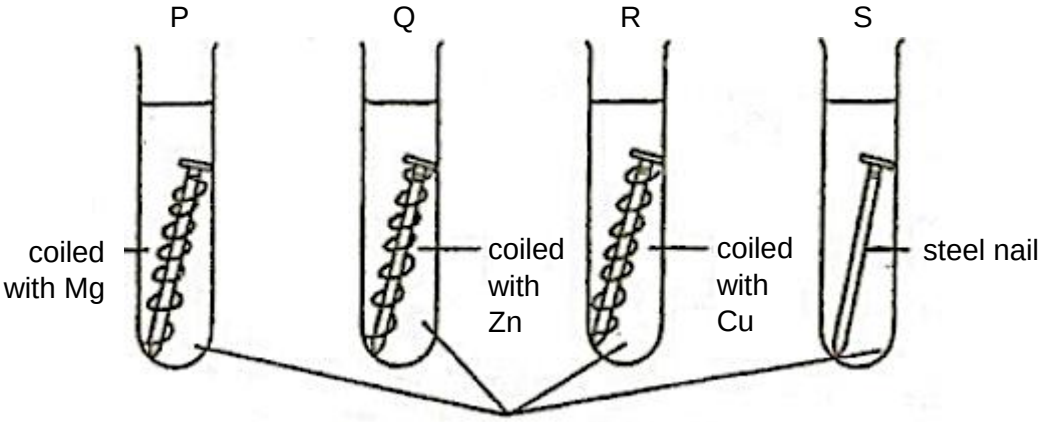
B Group 13 element

C Group 15 element

D Transition element

27 Four clean steel nails were prepared and three of them were coiled with metals as shown. The nails were put into four test tubes, P, Q, R and S. Potassium hexacyanoferrate(III) solution was then poured into the tubes to cover the nails.

Potassium hexacyanoferrate(III) solution forms a dark blue colour with iron ions that are present in the rust. The intensity of blue colour indicates the extent of rusting that has taken place.



Which of the following correctly shows the order, in increasing intensity of the blue colour observed in the four test tubes?

A P, Q, S, R

B P, Q, R, S

C R, S, Q, P

D S, R, Q, P

28 In which equation is the sign of enthalpy, ΔH, correctly shown?

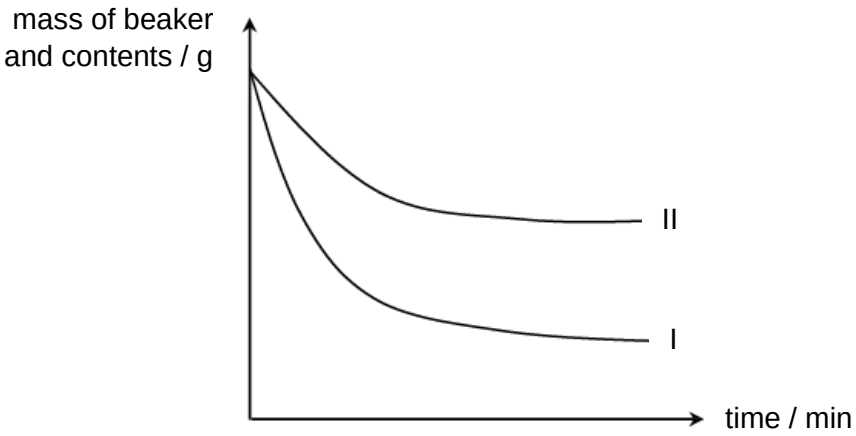
	equation	ΔH
A	$CH_4\ (g) \rightarrow C\ (g) + 4H\ (g)$	negative
B	$H_2O\ (s) \rightarrow H_2O\ (l)$	negative
C	$CuCl_2\ (aq) \rightarrow Cu\ (s) + Cl_2\ (g)$	positive
D	$C_6H_{12}O_6\ (aq) + 6O_2\ (g) \rightarrow 6CO_2\ (g) + 6H_2O\ (l)$	positive

29 The table shows the energy released by the complete combustion of some compounds used as fuels.

Which fuel produces the most energy when 1 gram of the compound is completely burnt in oxygen?

	compound	molecular mass	ΔH in kJ/mol
A	methane	16	–880
B	ethanol	46	–1380
C	propane	44	–2200
D	heptane	100	–4800

30 Excess magnesium was added to a beaker of dilute nitric acid on an electronic balance.
A graph of the mass of the beaker and its contents was plotted against time, and labelled as curve I.



What change(s) in the experiment will yield results in curve II?

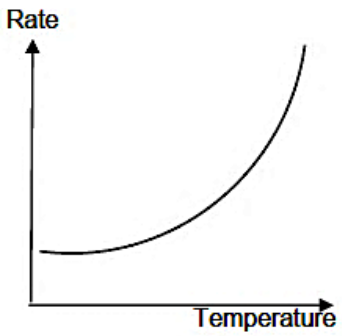
1 A higher temperature
2 The same volume of a less concentrated solution of nitric acid
3 The same mass of magnesium but in larger pieces

Which statement(s) is/are correct?

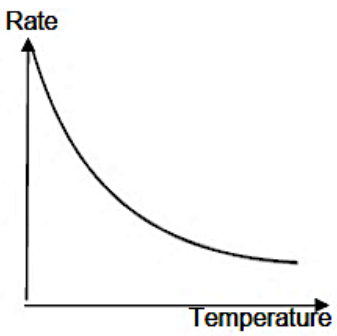
A 1 only
B 2 only
C 1 and 2 only
D 2 and 3 only

31 Which of the following graphs shows how the rate of reaction varies with temperature for the fermentation of glucose?

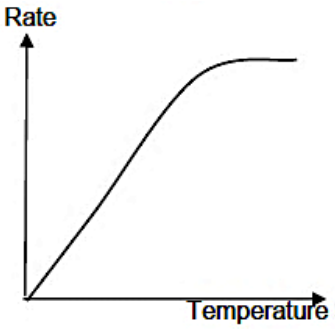
A



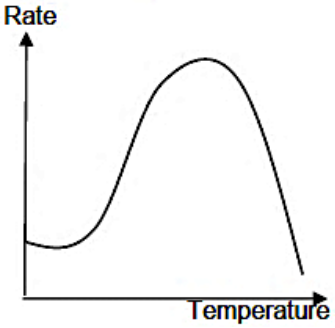
B



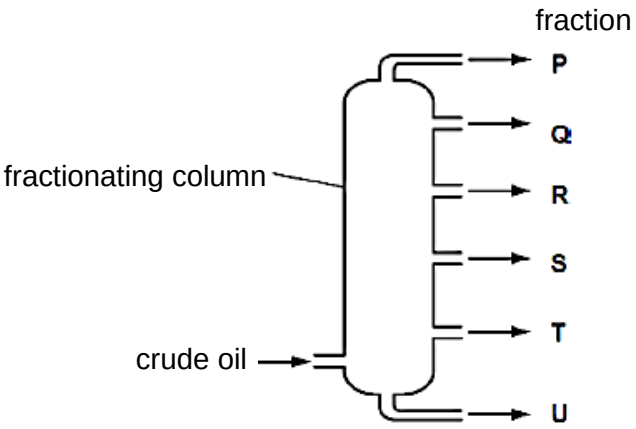
C



D



32 The diagram shows the fractional distillation of crude oil.



Which of the following explains why fraction Q is collected above fraction S?

	boiling point of Q	average molecular mass of Q
A	higher than S	smaller than S
B	higher than S	greater than S
C	lower than S	smaller than S
D	lower than S	greater than S

33 A molecule of $C_{19}H_{40}$ undergoes catalytic cracking. The products of the reaction are one butene molecule, one propane molecule and some ethene molecules.

How many ethene molecules are produced during the reaction?

A 5

B 6

C 7

D 8

34 A margarine, which is made from vegetable oil, is described as “polyunsaturated”.

What does this type of margarine contain?

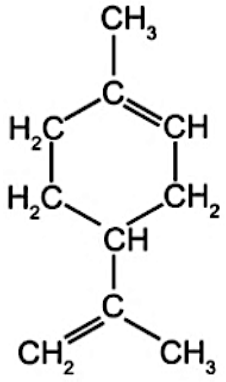
A unsaturated molecules joined by addition polymerisation

B long chain alkane molecules

C polymer molecules with multiple carbon-carbon double bonds

D polymer molecules with amide linkages

35 The diagram shows the structural formula of limonene, which is commonly found in citrus fruits.



Which statements about limonene are correct?

1 It decolourises aqueous bromine.

2 It undergoes addition polymerisation.

3 It undergoes substitution reaction with chlorine gas under UV light.

4 It reacts with hydrogen gas under suitable conditions to form a product with chemical formula $C_{10}H_{18}$.

A 1 and 2 only

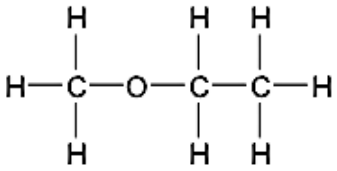
B 1 and 4 only

C 2 and 4 only

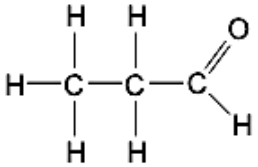
D 1, 2 and 3 only

36 Which compound is an isomer of propanol?

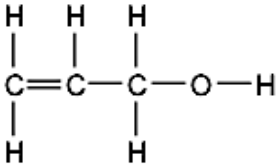
A



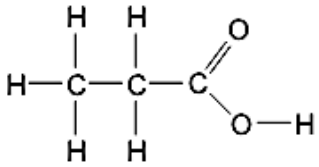
B



C



D



37 A carboxylic acid has the molecular formula $C_{17}H_{29}CO_2H$.

How many carbon-carbon double bonds are present in one molecule of the acid?

A 1

B 3

C 5

D 6

38 Which of the following properties does not change in the polymerisation of ethene?

A chemical reactivity

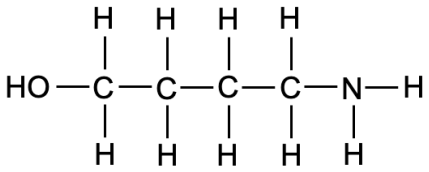
B density

C boiling point

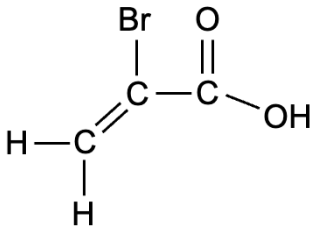
D empirical formula

39 Which monomers would undergo polymerization on their own?

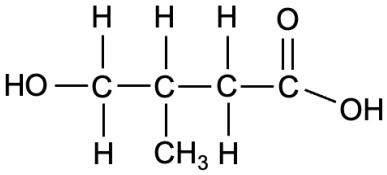
1



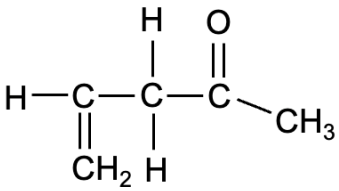
2



3



4



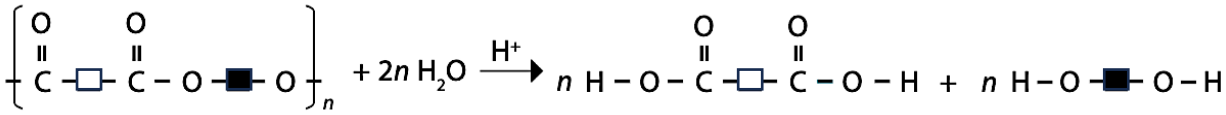
A 1 and 3 only

B 2 and 3 only

C 1 and 4 only

D 2, 3 and 4 only

40 The equation for one method of recycling a polymer is shown.



Which statements are correct?

1 If □ is CH_2, the carboxylic acid product has a M_r of 104.

2 The polymer was formed from addition polymerisation.

3 The reaction is acid-catalysed hydrolysis.

4 The polymer could be Terylene.

A 1 and 3 only

B 2 and 4 only

C 1, 3 and 4 only

D 1, 2 and 4 only

End of Paper

Setter: Ms Jasmine Liew

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							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	3	4	5	6	7	8	9	10	11	12	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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).

The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}