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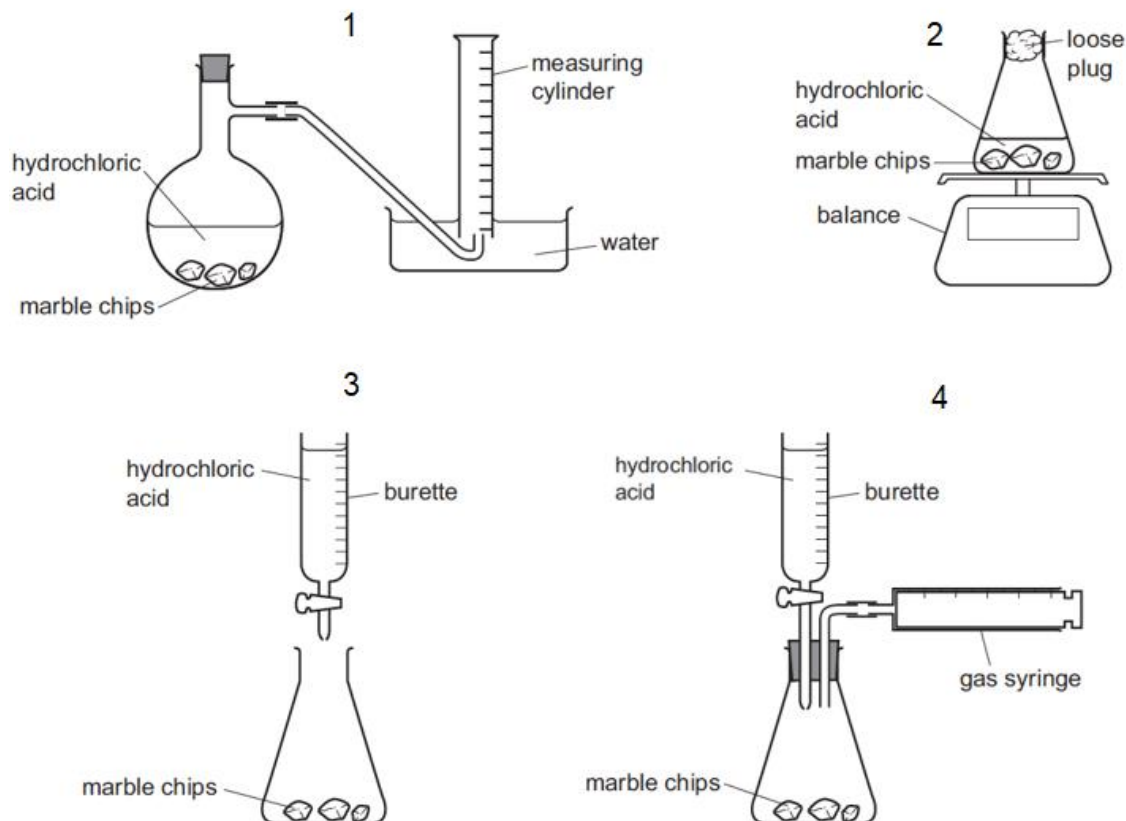


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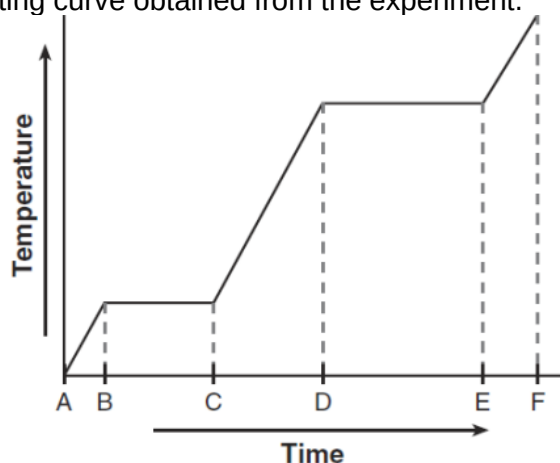
6092/01

This question paper consists of 14 printed pages including this page.

- 1 A student follows the rate of the reaction between marble chips, CaCO_3 , and dilute hydrochloric acid. Which of the following set-ups can be used to measure the rate of reaction, together with a stopwatch?



- A 1 and 2 B 1 and 3 C 2 and 4 D 1, 2 and 4
- 2 A sample of a pure solid substance was heated until it turns completely gaseous. The graph below shows the heating curve obtained from the experiment.



Which of the following statements is **not** correct?

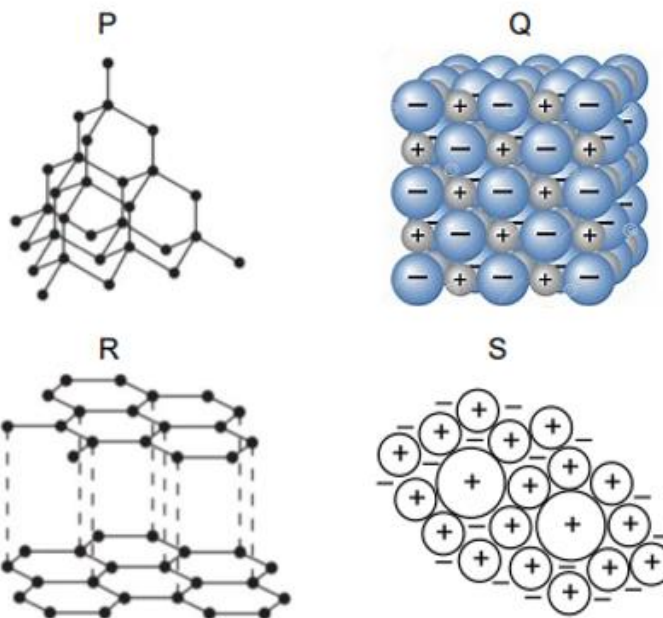
- A At time interval AB, the average kinetic energy of the particles remains the same.
- B At time interval BC, the solid and liquid states are in equilibrium.
- C At time interval CD, heat is absorbed by the particles.
- D At time interval EF, the particles are moving rapidly in any direction.

- 3 The table below shows information about elements flerovium, Fl, and livermorium, Lv.

	Fl	Lv
proton number	114	116
nucleon number	289	292

Which of the following statements about the elements is correct?

- A A Lv^{2+} ion has the same number of electrons as a Fl atom.
 B A Fl^{2+} ion has the same number of protons as an atom of Lv.
 C An atom of Fl has two more electrons as an atom of Lv.
 D An atom of Lv has one fewer neutron than an atom of Fl.
- 4 Bromine crystals are obtained by freezing bromine at -223°C .
 What will the bromine crystals contain?
- A bromine atoms only
 B bromine molecules only
 C bromine ions and molecules
 D bromine atoms and molecules
- 5 The diagrams below show the structures of substances P, Q, R and S.



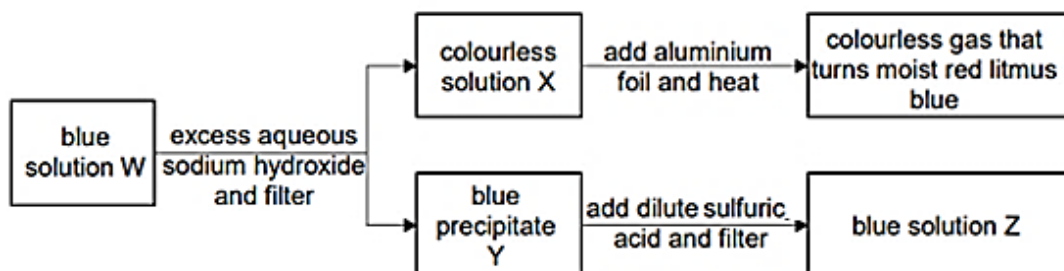
Which of these structures conduct electricity because of mobile electrons?

- A P and R B R and S C Q and S D Q, R and S
- 6 Which of the following contains 1 mole of ions when in aqueous state?
- A 0.250 mol of CaO
 B 0.250 mol of $(\text{NH}_4)_3\text{PO}_4$
 C 0.500 mol of H_2SO_4
 D 0.500 mol of CH_3COOH

- 7 Citric acid is widely used as a flavouring and preservative in food.
Which statement best describes the mixture formed when citric acid dissolves in ethanol?

A It turns blue litmus red.
B It contains covalent molecules only.
C It contains both covalent molecules and ions.
D It produces effervescence when added to carbonates.

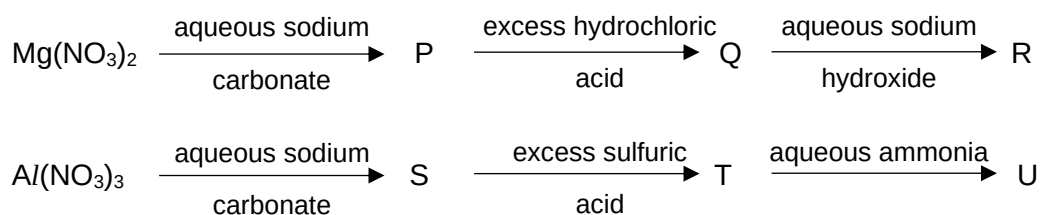
- 8 The flowchart below shows the reaction that solution W undergoes.



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

	W	X	Y	Z
A	$\text{Cu}(\text{NO}_3)_2$	NaNO_3	$\text{Cu}(\text{OH})_2$	CuSO_4
B	CuSO_4	Na_2SO_4	$\text{Cu}(\text{OH})_2$	CuSO_4
C	$\text{Fe}(\text{NO}_3)_2$	NaNO_3	$\text{Fe}(\text{OH})_2$	FeSO_4
D	$(\text{NH}_4)_2\text{SO}_4$	NH_4OH	$\text{Cu}(\text{OH})_2$	CuSO_4

- 9 The flowcharts show the reagents added into separate test tubes containing aqueous magnesium nitrate and aluminium nitrate.



P, Q and R are magnesium compounds.

S, T and U are aluminium compounds.

How many of the compounds formed, P – U, will give a white precipitate in aqueous solutions?

A 2 B 3 C 4 D 5

- 13** Brass, made of copper and zinc, is more suitable to make musical instruments as compared to pure copper.
Which statement best explains why brass is harder than pure copper?

A The zinc atoms have more valence electrons than copper atoms.
B The zinc atoms form strong metallic bonds with copper atoms in brass.
C The zinc atoms prevent the delocalised electrons from moving freely in the lattice
D The zinc atoms prevent layers of copper atoms from sliding over each other easily.

- 14** The table below refers to four metals and some of their compounds.

metal	action of heat on metal carbonate	effect of hydrogen on heated oxide	action of sulfuric acid on metal
P	decomposed	reduced	no reaction
Q	no reaction	no reaction	effervescence observed
R	decomposed	no reaction	effervescence observed
S	decomposed	reduced	effervescence observed

What is the order of reactivity in descending order?

A Q, S, R, P
B Q, R, S, P
C R, S, P, Q
D R, Q, P, S

- 15** Which of the following is **not** a redox reaction?

A $2\text{Ag} + \text{Br}_2 \rightarrow 2\text{AgBr}$
B $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
C $\text{Na}_2\text{CO}_3 + \text{CuCl}_2 \rightarrow 2\text{NaCl} + \text{CuCO}_3$
D $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$

- 16** 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 of the following solutions is/are oxidising agent(s)?

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

- 17 The pollutants released into the air from car exhausts and some power stations include oxides of the type XO and YO₂.

What are X and Y?

	X	Y
A	carbon	nitrogen
B	carbon	nitrogen and sulfur
C	carbon and nitrogen	carbon and nitrogen
D	carbon and nitrogen	carbon, nitrogen and sulfur

- 18 A car burning lead-free fuel has a catalytic converter fitted to its exhaust. On analysis, its exhaust gases are shown to contain small quantities of nitrogen oxides.

What modification(s) would result in lower exhaust concentrations of nitrogen oxides?

- 1 An increase in the surface area of the catalyst in the converter.
- 2 An increase in the percentage of oxygen going into the car.
- 3 A much higher temperature of combustion in the engine.

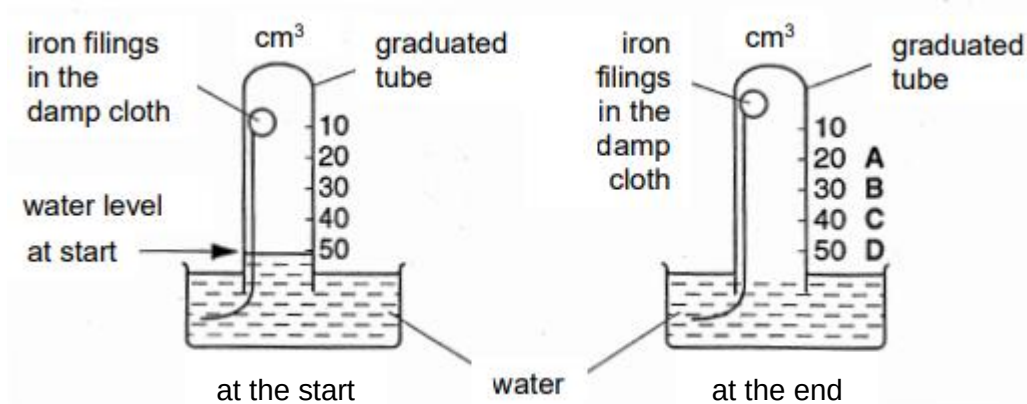
A 1 only

B 2 and 3

C 1 and 2

D 1, 2 and 3

- 19 Iron filings are wrapped in a piece of damp cloth and left to rust in the apparatus as shown.



Which letter indicates the water level when rusting has been completed?

- 20 P, Q and R are elements found in Group VII of the Periodic Table. Three experiments were carried out to determine the reactivity of P, Q and R.

The three reactions are represented by the three equations shown below.

- 1 $R^-(aq) + Q_2(aq) \rightarrow \text{no reaction}$
- 2 $P^-(aq) + R_2(aq) \rightarrow \text{no reaction}$
- 3 $2Q^-(aq) + P_2(aq) \rightarrow Q_2(aq) + 2P^-(aq)$

Which statement about P, Q and R is correct?

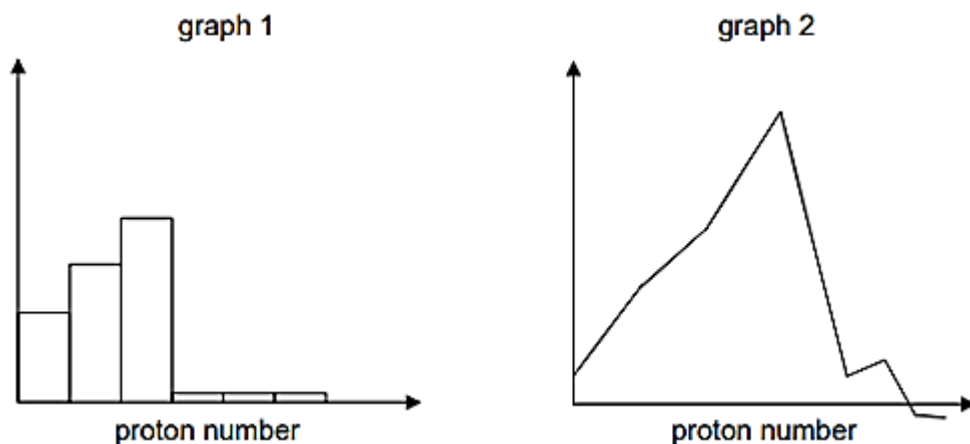
A Q₂ is more reactive than P₂.

B R₂ has a lighter colour than Q₂.

C R₂ is a stronger oxidising agent than P₂.

D P₂ is a solid at room temperature and pressure.

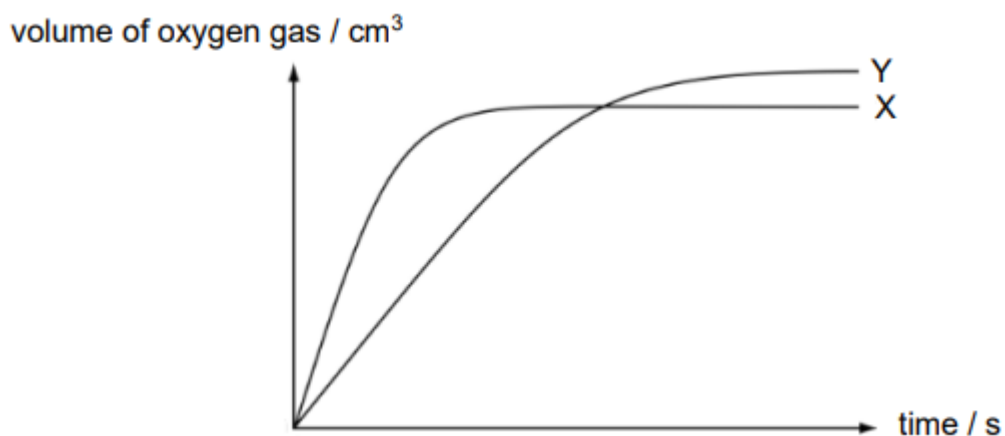
- 21 The graphs below show the trend in physical properties of the elements across Period 3.



Which physical property is represented by the y-axis of the graphs?

	graph 1	graph 2
A	electrical conductivity	melting point
B	charge on ion	atomic radius
C	number of valence electrons	melting point
D	metallic character	charge on ion

- 22 The diagram below shows curve X which was obtained by the decomposition of 100 cm³ of 1.00 mol/dm³ hydrogen peroxide using manganese (IV) oxide as catalyst.



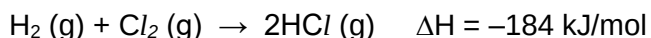
Which of the following changes made to the original experiment would produce curve Y?

- A Adding 10.0 cm³ of water.
- B Adding 10.0 cm³ of 0.500 mol/dm³ of hydrogen peroxide.
- C Lowering the temperature of the solution by 10.0 °C.
- D Reducing the mass of manganese (IV) oxide added.

- 23** Which of the following acids and the quantity stated will produce the fastest initial rate of reaction when 4.00 g of magnesium ribbon is added to it at room temperature and pressure?

- A** 15.0 cm³ of 2.00 mol/dm³ nitric acid
B 20.0 cm³ of 1.00 mol/dm³ hydrochloric acid
C 20.0 cm³ of 1.50 mol/dm³ sulfuric acid
D 30.0 cm³ of 2.00 mol/dm³ ethanoic acid

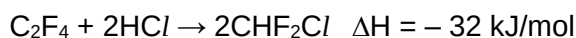
- 24** Hydrogen and chlorine react together to form hydrogen chloride.



- 1 Increasing the pressure has no effect on the total volume of hydrogen chloride obtained.
- 2 48 dm³ of hydrogen gas is mixed with 24 dm³ of chlorine gas to produce 48 dm³ of hydrogen chloride gas.
- 3 An increase in pressure will lead to higher frequency of collisions between H₂ and Cl₂ molecules.
- 4 A decrease in temperature of the mixture will lead to an increase in rate of reaction.

Which of the statements are correct?

- A** 1 and 3 **B** 2 and 3 **C** 1, 2 and 3 **D** 2, 3 and 4
- 25** Chlorodifluoromethane could be obtained from the following reaction:



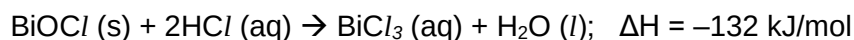
The bond energies of some of the bonds are given in the following table.

bond	bond energy kJ/mol
C–F	495
C–H	413
C–C	347
C=C	610
C–Cl	339

What is the bond energy of the H–Cl bond?

- A** 389 kJ/mol **B** 431 kJ/mol **C** 778 kJ/mol **D** 862 kJ/mol

- 26** Bismuth(III) oxychloride dissolves in concentrated hydrochloric acid to give a colourless solution of bismuth(III) chloride.



The activation energy for the forward reaction is 45 kJ/mol. Addition of water re-forms bismuth(III) oxychloride as a white precipitate.

What is the activation energy for the reverse reaction?

- A** - 45 kJ/mol **B** - 87 kJ/mol **C** 87 kJ/mol **D** 177 kJ/mol
- 27** Three electrolytic cells are set up using inert electrodes. The electrolytes used are listed below.
- cell 1: concentrated aqueous potassium chloride
cell 2: dilute sulfuric acid
cell 3: dilute copper (II) chloride

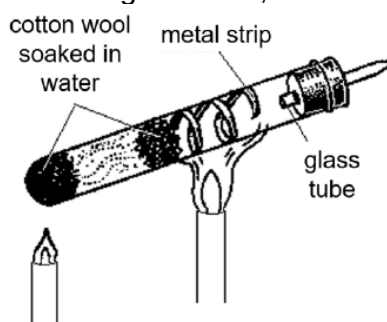
In which of these cell(s) is/are gases formed at both electrodes?

- A** 2 only **B** 3 only **C** 1 and 2 **D** 2 and 3
- 28** Three simple cells are set up using zinc metal and three other unknown metals, U, V and W, as electrodes.

cell	metals used	voltage / V	positive electrode
1	Zn, U	-0.45	Zn
2	Zn, V	+2.71	V
3	Zn, W	+1.11	W

What of the following lists the metals in order of decreasing reactivity?

- A** U, Zn, V, W
B U, Zn, W, V
C V, W, Zn, U
D V, Zn, W, U
- 29** In the experiment shown below, a strip of metal was heated in a glass tube. When a spark was created at the outlet of the glass tube, no flame was observed.



Which of the following could be the metal strip?

- A** calcium **B** lead **C** magnesium **D** zinc

30 Which of the following statements about the Haber Process is correct?

- A The final yield is increased by operating at high temperature.
- B The final yield is increased by operating at low pressure.
- C The rate of reaction is increased by operating at low temperature.
- D The rate of reaction is increased by operating at high pressure.

31 Which statement about a petroleum fraction is correct?

- A It boils at a fixed temperature.
- B Its molecules are all hydrocarbons.
- C None of its molecules is found in other fractions,
- D All its molecules contain the same number of carbon atoms.

32 Two compounds are thought to be isomers.

Possible similarities and differences are listed below. Which combination would confirm isomerism?

	similarity	difference
A	molecular mass	molecular structure
B	molecular structure	molecular mass
C	chemical properties	physical properties
D	physical properties	chemical properties

33 5 g of vegetable oil ($M_r = 800$) reacted completely with 900 cm^3 of hydrogen gas (measured at room temperature and pressure) to form margarine which is a saturated fat. How many carbon-carbon double covalent bonds are there in one molecule of the oil?

- A 3 B 4 C 5 D 6

34 Which of the following molecules is **not** a substitution product formed when butane reacts with chlorine in the presence of sunlight?

- A $\text{C}_4\text{H}_5\text{Cl}_4$
- B C_4HCl_9
- C $\text{C}_4\text{H}_2\text{Cl}_8$
- D $\text{C}_4\text{H}_3\text{Cl}_7$

35 An alcohol, X, was fully oxidised to form a carboxylic acid.

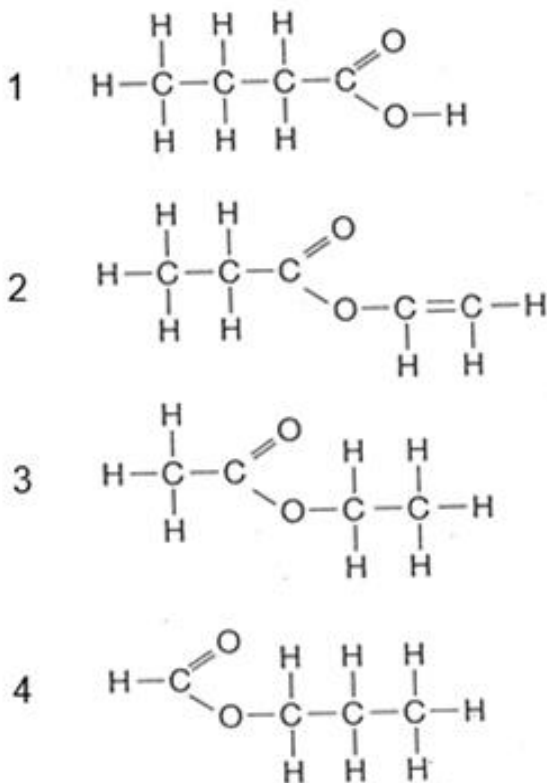
Neutralisation of the acid with aluminium oxide gives a salt with the formula $(\text{CH}_3\text{CO}_2)_3\text{Al}$.

What was alcohol X?

- A CH_3OH
- B $\text{CH}_3\text{CH}_2\text{OH}$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

- 36** The table shows the results of tests carried out on compound P which has the molecular formula $C_4H_8O_2$.

test	observation
add bromine water	bromine water remains orange
add aqueous sodium carbonate	effervescence observed



What could compound P be?

- A** 1 only **B** 3 only **C** 1 and 3 **D** 1 and 4
- 37** The structures of two isomers of butane are given below.



How many statements about the two isomers are correct?

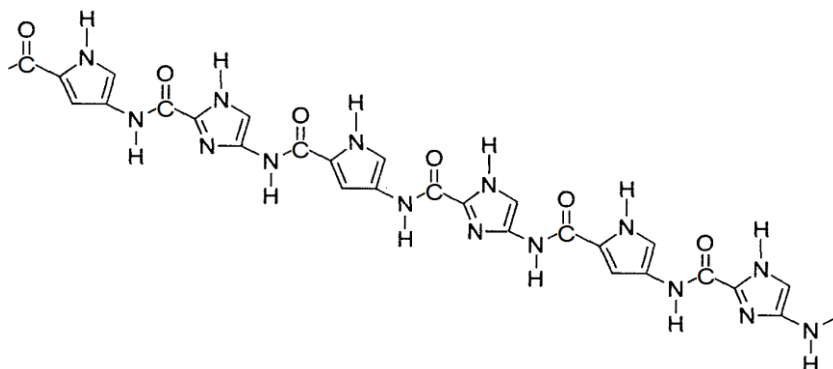
- Combustion of 10 g of each isomer will give the same volume of gases.
- Both will react with steam to give the same molecule.
- Both will react with hydrogen to give the same molecule.
- 1 mol of each isomer will react with 1 mol of bromine to give the same mass of products.

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

- 38 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 The fraction obtained at the top of the fractionating column has the highest boiling point.
 C In a fractionating column, the bitumen fraction is obtained below the kerosene fraction.
 D The molecules reaching the top of the column have the smallest relative molecular mass.

- 39 The structure below shows part of a polymer.



- 1 It is a nylon.
- 2 It is formed in an addition polymerisation reaction.
- 3 It is formed from two different types of monomers.
- 4 Each monomer has at least two different functional groups.

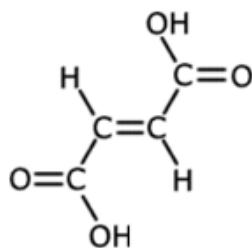
Which statements are correct?

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

- 40 The following diagrams show four monomers.



How many of these monomers would react with the molecule below to form a polymer?



A 1 B 2 C 3 D 4

The Periodic Table of Elements

Group																	
I	II	1 Hhydrogen1										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	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			
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 -			
actinoids																	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).