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Page 10 of 10

6092/01

28 Aug 2024
1 hour

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 candidate name, class and index number in the spaces at the top of this page and also on the Answer Sheet in the spaces provided.

Do not open this booklet until you are told to do so.

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 19.

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

Parent's Signature: _____

This question paper consists of **19** printed pages and 1 blank page.

- 1 A student measures the time taken for 1.0 g of magnesium to dissolve in 25.0 cm³ of dilute hydrochloric acid. A stopwatch and electronic balance are provided in the set-up.

What additional apparatus is essential to complete the experiment?

- 1 measuring cylinder
- 2 pipette
- 3 gas syringe

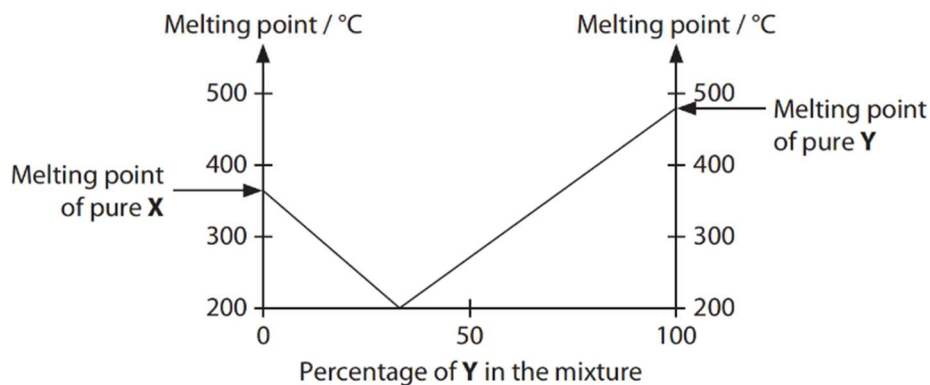
A 1 only **B** 2 only **C** 1 and 2 **D** 1 and 3

- 2 A mixture is made up of two liquids whose boiling points differ by 52.5 °C.

What other information about the liquids is necessary to identify the appropriate method to separate them?

- A** their colours
- B** their densities
- C** their melting points
- D** their miscibility

- 3 The graph shows the melting points of mixtures of substance X and substance Y in different compositions.



Which of the following observations about the mixture is/are correct?

- A** A mixture of X and Y will always have a melting point below that of pure X.
- B** A mixture of X and Y will always have a melting point below that of pure Y.
- C** A mixture of X and Y will always have a melting point between that of both X and Y.
- D** A mixture of X and Y in a 1:1 ratio has the lowest melting point.

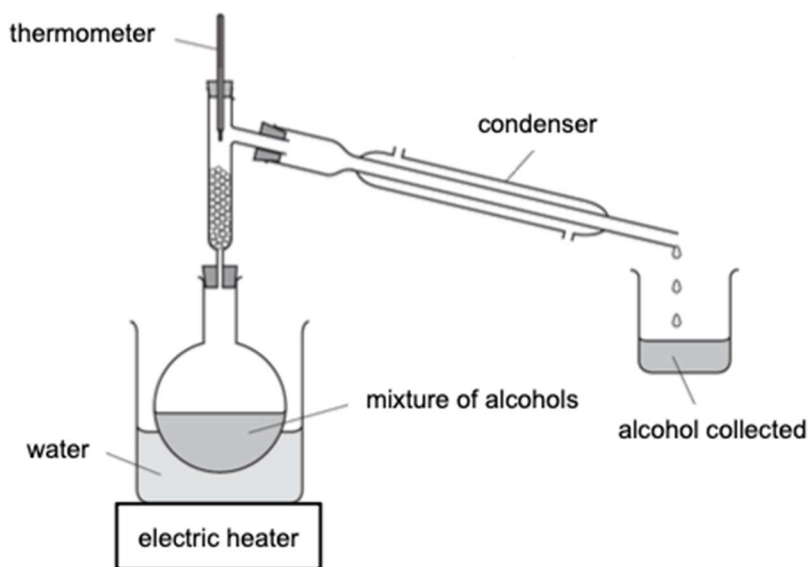
- 4 The table shows some mixtures and their constituents obtained using suitable separation techniques.

	mixture	constituent obtained
1	aqueous sodium chloride	water
2	solid iodine and solid nickel	solid iodine
3	aqueous sodium chloride	solid sodium chloride

Which row gives the correct separation techniques to obtain the constituents from the mixture?

	1	2	3
A	distillation	sublimation	evaporation
B	distillation	sublimation	filtration
C	filtration	crystallisation	evaporation
D	sublimation	crystallisation	filtration

- 5 A student carried out an experiment using the set-up shown below to separate a mixture containing four alcohols.



The table gives the boiling points of the four alcohols used.

alcohol	boiling point/ °C
butanol	117
ethanol	79
pentanol	138
propanol	97

Despite repeated attempts, the student only managed to obtain two alcohols from the mixture. Which alcohols did he fail to obtain?

- A** butanol and ethanol
B butanol and pentanol
C ethanol and propanol
D pentanol and propanol
- 6 The rate of diffusion of nitrogen and ammonia gases were compared at 50 °C and 25 °C.
- Which would have the slowest rate of diffusion?
- A** ammonia gas at 25 °C.
B ammonia gas at 50 °C.
C nitrogen gas at 25 °C.
D nitrogen gas at 50 °C.

- 7 Three particles and their nuclide notations are shown.

particle	1	2	3
nuclide notation	${}^{40}_{19}\text{X}^{+}$	${}^{39}_{19}\text{Y}$	${}^{34}_{16}\text{Z}^{2-}$

Which of the following statements is correct about the particles?

- A Particle 1 and 2 have the same number of neutrons.
- B Particle 1 and 3 have the same number of electrons.
- C Particle 1 has more electrons than particle 3.
- D Particle 2 has fewer neutrons than particle 3.

- 8 Solid P conducts electricity and has a high melting point.

When solid P is warmed with excess dilute hydrochloric acid, it partially dissolves leaving behind a residue.

What is P?

- A brass
- B copper(II) oxide
- C graphite
- D iron

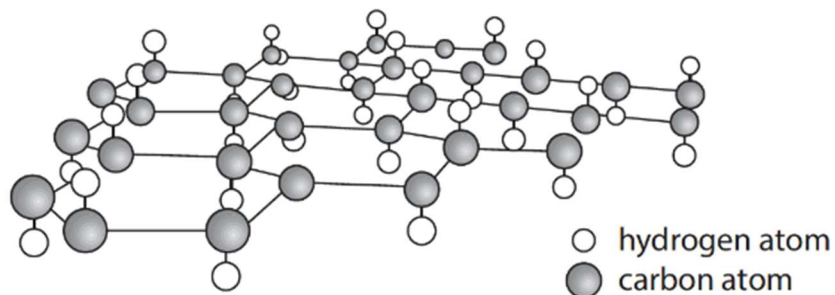
- 9 Compound G contains two elements, metal R and non-metal Q.

G consists of a lattice of positive ions and negative ions. Each positive ion is surrounded by four negative ions and each negative ion is surrounded by eight positive ions.

Which ions are present in, and what is the formula of, compound G?

	ions present	formula
A	$\text{R}^{+} \text{Q}^{2-}$	R_2Q
B	$\text{R}^{2+} \text{Q}^{-}$	RQ_2
C	$\text{Q}^{+} \text{R}^{2-}$	Q_2R
D	$\text{Q}^{2+} \text{R}^{-}$	QR_2

- 10 Graphene has a similar structure to graphite. However, it has one hydrogen attached to each carbon as shown.

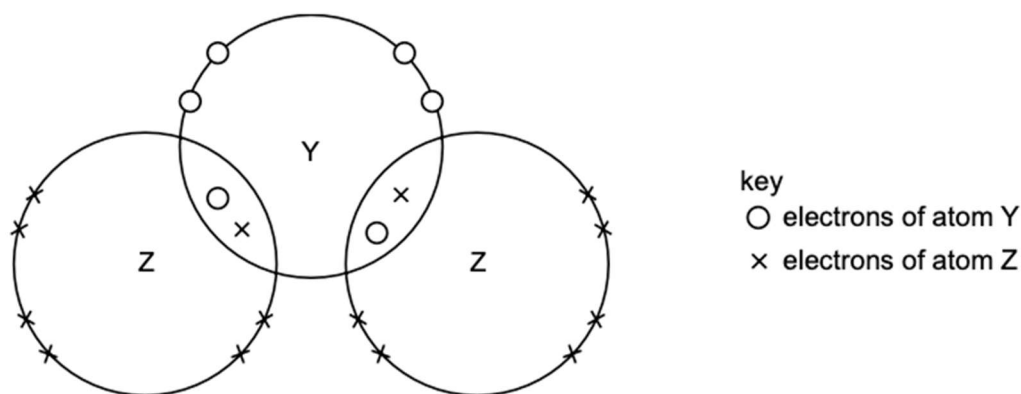


Which set of properties does graphene have?

- 1 it conducts electricity in the solid state
- 2 it has a giant molecular structure
- 3 it is soft

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

- 11 The outer shell electrons in a molecule, YZ_2 , are shown.



Using the Periodic Table, how many protons can be found in atom Y?

A 6 **B** 8 **C** 12 **D** 18

- 12 The complex ion $[\text{Co}(\text{NH}_3)_x]^{3+}$ consists of 36.6 % by mass of cobalt, Co.
[A_r : Co, 59; N, 14; H, 1]

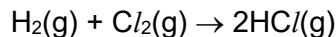
What is the value of x?

A 3 **B** 5 **C** 6 **D** 8

13 What contains the largest number of particles?

- A** 2 g of hydrogen molecules
- B** 4 g of neon atoms
- C** 8 g of oxygen molecules
- D** 22 g of carbon dioxide molecules

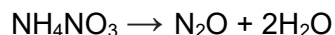
14 Hydrogen gas reacts with chlorine gas to form hydrogen chloride gas.



What is the final volume of the gas mixture when 20 dm³ of hydrogen is reacted with 30 dm³ of chlorine gas at 100 °C?

- A** 40 dm³
- B** 50 dm³
- C** 60 dm³
- D** 70 dm³

15 On heating, ammonium nitrate, NH₄NO₃, decomposes to form dinitrogen oxide and water.



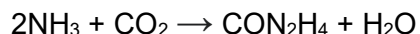
When 80 g of an impure sample of ammonium nitrate is heated, 27 g of water are formed.

What is the mass of ammonium nitrate in the impure sample?

[A_r: H, 1; O, 16; N, 14]

- A** 20.0 g
- B** 49.5 g
- C** 60.0 g
- D** 120 g

16 Ammonia and excess carbon dioxide can react to form urea and water in a reaction.



The percentage yield of this reaction is 80 %.

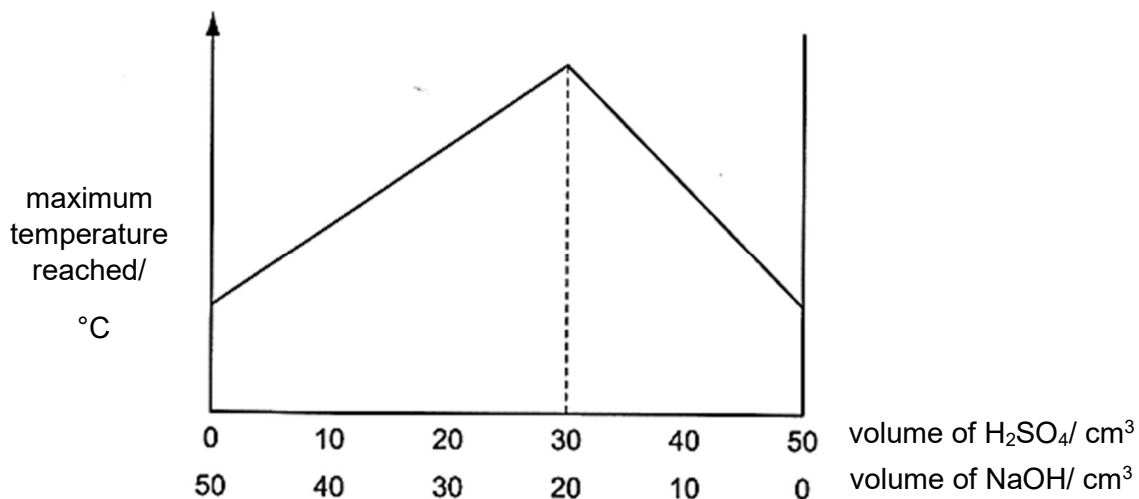
What mass of ammonia required for this reaction to obtain 60.0 g of urea?

[M_r: NH₃, 17; CO₂, 44; CON₂H₄, 60; H₂O, 18]

- A** 10.6 g
- B** 27.2 g
- C** 34.0 g
- D** 42.5 g

- 17** An aqueous solution of sulfuric acid has a concentration of 1.0 mol/dm^3 . Different volumes of this sulfuric acid are added to different volumes of aqueous sodium hydroxide.

The maximum temperature reached in each mixture is measured. The graph shows the results.



What is the concentration of the aqueous sodium hydroxide?

- A** 0.60 mol/dm^3 **B** 0.75 mol/dm^3 **C** 1.50 mol/dm^3 **D** 3.00 mol/dm^3
- 18** A dilute aqueous solution of strong acid, HY , contains molecules of water and the ions H^+ and Y^- .

Which of the following statements is correct?

- A** HY acid partially ionises.
B The solution also contains a high concentration of HY molecules.
C The solution also contains OH^- ions.
D The solution contains more H^+ ions than water molecules.

- 19** A red solution was produced by boiling red cabbage leaves in water. The table shows the colour of the solution when the red solution was added to dilute ethanoic acid, distilled water and aqueous ammonia respectively.

solution	colour of solution
dilute ethanoic acid	red
water	purple
aqueous ammonia	green

Sulfur burns in air to form a gas which dissolves in water to form a colourless solution. What will be observed when the red solution is added to the colourless solution?

- A** Red solution decolourises.
- B** Red solution remains red.
- C** Red solution turns green.
- D** Red solution turns purple.

- 20** Four oxides are added separately to aqueous sodium hydroxide.

- 1 carbon monoxide
- 2 copper (II) oxide
- 3 phosphoric (V) oxide
- 4 zinc oxide

Which oxide(s) react(s) with aqueous sodium hydroxide?

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

- 21** The table shows the results of different experiments conducted on two different acids, K and L, of equal concentrations.

acid	K	L
conductance /mS	400	7.0
temperature change when excess acid reacted with 200 cm ³ of 1.00 mol/dm ³ sodium hydroxide/ °C	6.9	6.7
reaction with magnesium	rapid effervescence	gradual effervescence

Which deduction can be made about the two acids?

- A** Both are strong acids, per mole of K forms lesser hydrogen ions than per mole of L
B Both are strong acids, per mole of L forms lesser hydrogen ions than per mole of K.
C K is a strong acid while L is a weak acid.
D K is a weak acid while L is a strong acid.
- 22** Zinc nitrate is made by reacting an excess of a powdered solid with an aqueous solution.

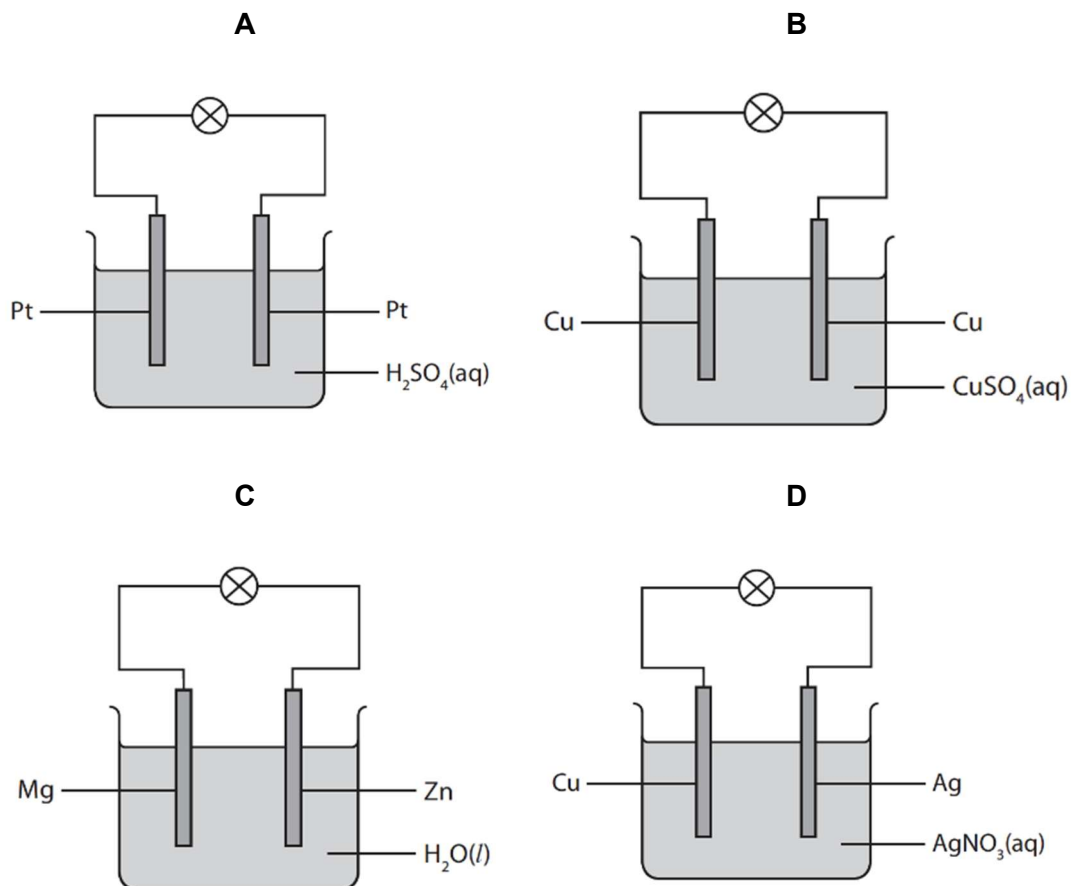
The mixture is filtered and the filtrate is crystallised.

Which row identifies a solid and an aqueous solution that can be used to make a pure sample of zinc nitrate?

	solid in excess	aqueous solution
A	zinc	copper(II) nitrate
B	zinc	magnesium nitrate
C	zinc oxide	sodium nitrate
D	zinc sulfate	dilute nitric acid

- 23** An aqueous solution contains 0.01 mol of zinc ions and 0.01 mol of copper(II) ions. Aqueous ammonia is added until in excess. After shaking, the mixture is filtered. What remains on the filter paper?
- A** 0.01 mol of a blue hydroxide
B 0.01 mol of a white hydroxide
C 0.01 mol of a white hydroxide and 0.01 mol of a blue hydroxide
D no solid residue
- 24** Disproportion is a reaction in which the same element is both oxidised and reduced. Which reaction is an example of disproportion?
- A** $\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2$
B $\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaCl} + \text{NaOCl} + \text{H}_2\text{O}$
C $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$
D $2\text{Pb}(\text{NO}_3)_2 \rightarrow 2\text{PbO} + 4\text{NO}_2 + \text{O}_2$
- 25** In which of the following set-ups, is there no change in the concentration of the solution during electrolysis?
- A** concentrated sodium chloride solution between carbon electrodes
B copper(II) sulfate solution between carbon electrodes
C copper(II) sulfate solution between copper electrodes
D dilute sodium chloride solution between carbon electrodes

26 In which of the following set-ups will the bulb light up?



27 In an electrolysis experiment, the same amount of charge deposited 32.5 g of zinc and 10.4 g of chromium. The charge on the zinc ion was $2+$.

[A_r : Zn, 65; Cr, 52]

What is the charge on the chromium ion?

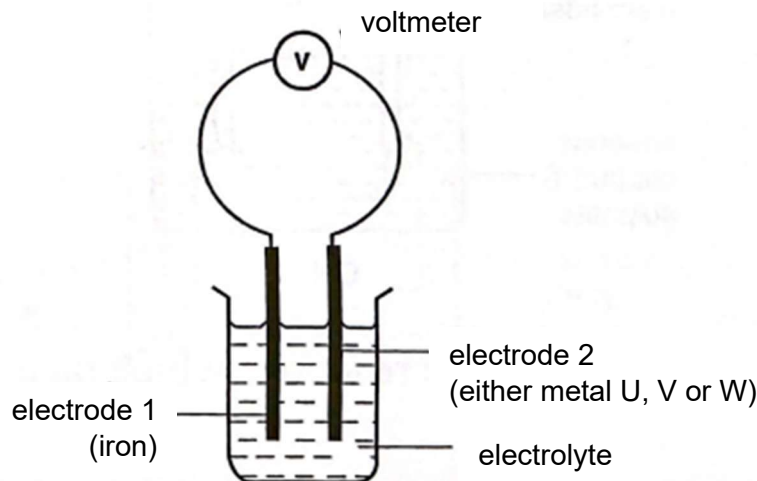
A $2+$

B $3+$

C $5+$

D $6+$

- 28 Three simple cells are set up using iron metal as electrode 1 and three other unknown metals, U, V and W, separately as electrode 2.



The results of the experiments are shown in the table.

metal used as electrode 2	voltmeter reading/ V	positive electrode
U	+1.94	Fe
V	+0.32	Fe
W	+0.78	W

Which row shows the correct metal for U, V and W?

	metal U	metal V	metal W
A	copper	zinc	magnesium
B	magnesium	copper	zinc
C	magnesium	zinc	copper
D	zinc	magnesium	copper

- 29 Metal P reacts rapidly with cold water while metal Q reacts only with steam. Which of the following statements is **incorrect**?

- A** Extraction of metal P requires electricity while metal Q is extracted by chemical reaction.
- B** Metal P displaces Q from a solution containing ions of Q.
- C** The carbonate of P requires a lower temperature to decompose than that of Q.
- D** There is no reaction when oxide of P and metal Q are strongly heated.

30 The following are several properties of an element.

- 1 the number of isotopes it has
- 2 the acidic or basic nature of its oxide
- 3 the charge of its ion

Which property or properties can be predicted based on an element's position in the Periodic Table?

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

31 Excess bromine was shaken with a mixture of potassium chloride and potassium iodide solutions. What will the final solution contain?

- A** potassium bromide, iodine and bromine
B potassium bromide, iodine, bromine and chlorine
C potassium chloride, potassium bromide, bromine and iodine
D potassium iodide, potassium bromide, bromine and chlorine

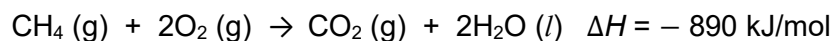
32 A student was investigating an unknown metal D and made the following observations in the laboratory:

1. When D is dipped into a solution of lead, no solid is formed around D.
2. When a strip of lead is dipped into copper(II) nitrate solution, it becomes covered with a pink substance.
3. A clean piece of D is covered with some pink substance when dropped into copper(II) sulfate solution.

Which of the following shows the arrangement of the three metals in order of **increasing** reactivity?

- A** Cu, D and Pb
B D, Pb and Cu
C Pb, Cu and D
D Pb, D and Cu

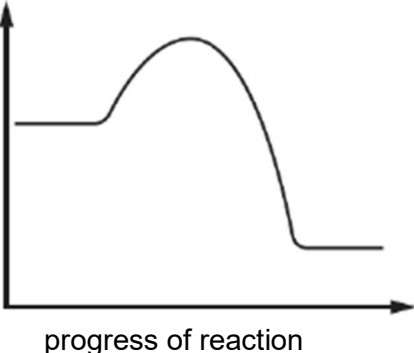
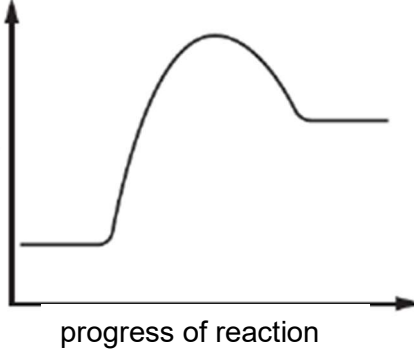
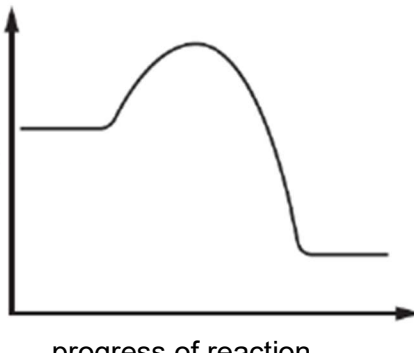
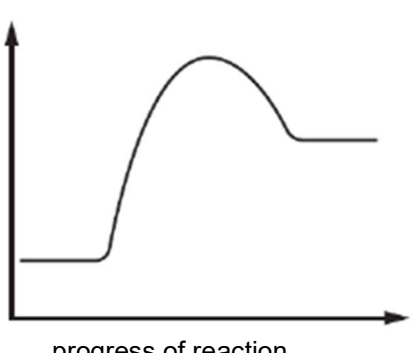
- 33** The equation for the combustion of methane is shown.



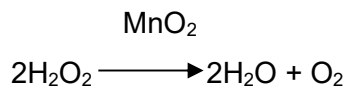
What can be deduced from this information?

- A** The energy released in forming bonds is greater than the energy used in breaking bonds.
 - B** The energy released in forming bonds is less than the energy used in breaking bonds.
 - C** The energy used in forming bonds is greater than the energy used in breaking bonds.
 - D** The energy used in forming bonds is less than the energy used in breaking bonds.
- 34** Which statement about hydrogen-oxygen fuel cell is correct?
- A** Electricity is required to generate hydrogen and oxygen.
 - B** Hydrogen fuel cells produce only water as a by-product.
 - C** Oxygen is oxidised and hydrogen is reduced in the reaction.
 - D** Pure water is used as the electrolyte in the fuel cell.

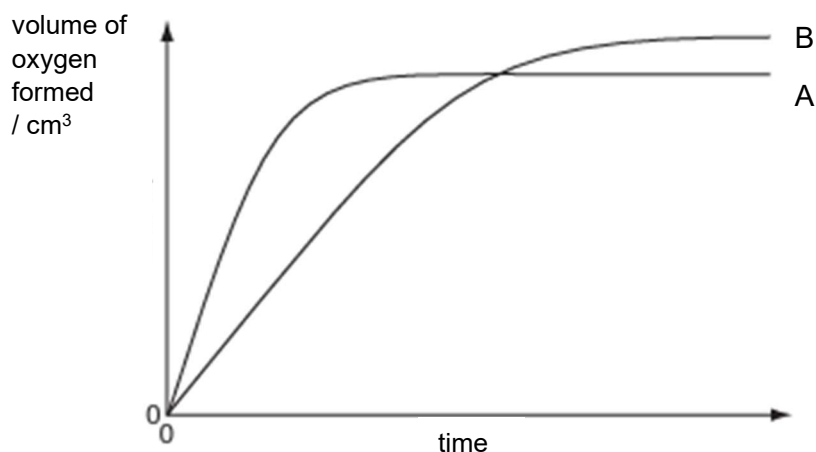
35 Which row describes an endothermic reaction?

	energy level diagram	energy transfer
A		energy is transferred from the reaction to the surroundings
B		energy is transferred from the reaction to the surroundings
C		energy is transferred from the surroundings to the reaction
D		energy is transferred from the surroundings to the reaction

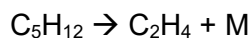
- 36 Curve A was generated by monitoring the breakdown of 100 cm³ of 1.0 mol/dm³ hydrogen peroxide according to the equation shown. Manganese(IV) oxide, MnO₂ is acting as the catalyst.



What change in the initial experimental setup would produce curve B?



- A adding more deionised water
 B adding more manganese(IV) oxide
 C adding some 0.1 mol/dm³ hydrogen peroxide
 D increasing the temperature at which the experiment was conducted
- 37 The equation shows the cracking of one mole of pentane, C₅H₁₂, into two organic compounds at high temperature, in the presence of a solid catalyst.



M is further reacted with 1 mole of fluorine to form Q.

Which of the following is likely to be the structure of Q?

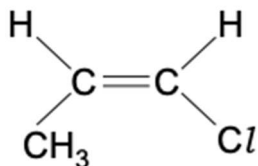
- A CH₃CH₂CH₃
 B CH₂FCH₂CH₂F
 C CH₃CH₂CH₂F
 D CH₂FCHFCH₃

- 38** The number of C=C bonds in a vegetable oil can be found by reacting the oil with iodine. 0.02 moles of vegetable oil was found to increase its mass by 20.32 g when shaken with an excess solution of iodine.

How many C=C bonds are there in one molecule of the vegetable oil?

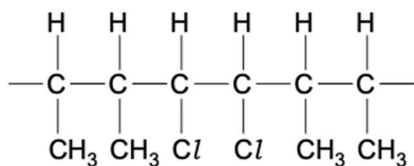
- A** 2 **B** 4 **C** 6 **D** 8

- 39** The structure shows a monomer.

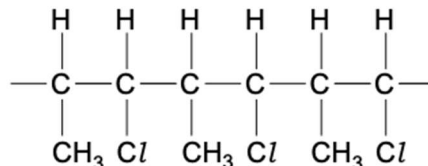


Which structure shows part of the polymer chain formed from three molecules of the monomer?

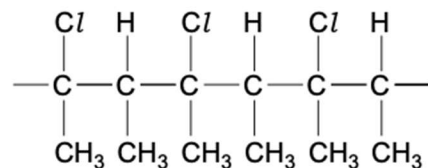
A



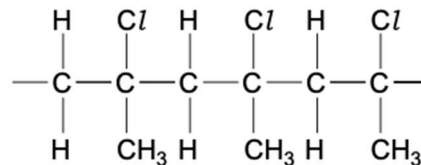
B



C



D



- 40** A sweet-smelling ester is created for use in a new lollipop taste. The ester has the formula $\text{C}_3\text{H}_7\text{CO}_2\text{C}_2\text{H}_5$. Which pair of reactants would produce this ester?

- A** $\text{C}_2\text{H}_5\text{Cl}$ and $\text{C}_3\text{H}_7\text{CO}_2\text{H}$
B $\text{C}_2\text{H}_5\text{OH}$ and $\text{C}_3\text{H}_7\text{CO}_2\text{H}$
C $\text{C}_2\text{H}_5\text{OH}$ and $\text{C}_2\text{H}_5\text{COC}$
D $\text{C}_3\text{H}_7\text{OH}$ and $\text{C}_2\text{H}_5\text{CO}_2\text{H}$

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
Key proton (atomic) number atomic symbol name relative atomic mass																	1 H hydrogen 1
																	2 He helium 4
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	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 oganeson –

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 dm³ at room temperature and pressure (r.t.p.).

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

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