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28 Aug 2024
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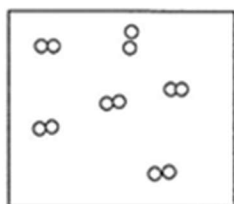
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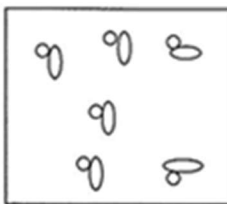
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3 The following diagrams can be used to illustrate

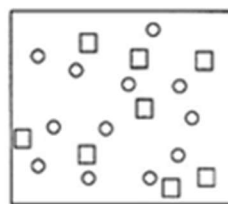
- 1 a mixture of elements and compounds
- 2 a mixture of elements
- 3 molecules of an element
- 4 molecules of a compound



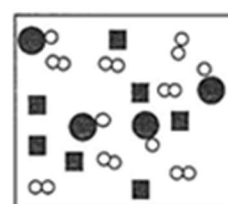
W



X



Y



Z

What is the correct order of the diagrams?

	1	2	3	4
A	X	W	Y	Z
B	X	Z	W	Y
C	Z	Y	W	X
D	Z	Y	X	W

4 A new substance was discovered, and a series of experiments were conducted on it.

Which observation suggests that the substance **cannot** be an element?

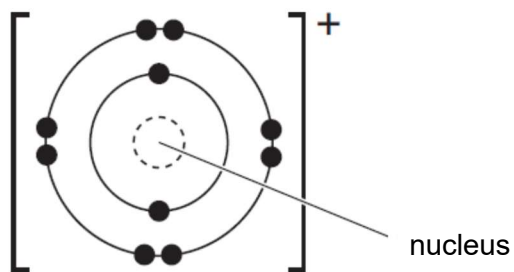
- A** It has a fixed boiling point.
- B** It dissolves in water to form a yellow-green solution.
- C** When heated strongly, a brown solid and a yellow gas are produced.
- D** When heated in air, it can form oxides with two different chemical formulae.

- 5 An atom of element T has x protons and y nucleons.

How many neutrons and electrons are present in a positive ion of another isotope of element T?

	neutrons	electrons
A	y	$x - 1$
B	$y - x$	$x + 1$
C	$y - x + 2$	$x - 1$
D	$y - x + 2$	x

- 6 The diagram of an ion of element Q is shown. In which period and group is element Q found in the Periodic Table?



	Group number	Period number
A	1	2
B	1	3
C	18	2
D	18	3

- 7 The physical properties of four substances are given below.

solid	melting point/°C	boiling point/°C	electrical conductivity	
			in solid	in liquid
1	1130	1950	✗	✓
2	-7.2	58	✗	✗
3	300	340	✗	✗
4	660	2470	✓	✓

Which of the following correctly matches the four substances?

	1	2	3	4
A	aluminium	bromine	astatine	sodium oxide
B	sodium oxide	bromine	astatine	aluminium
C	aluminium	astatine	silicon dioxide	sodium oxide
D	sodium oxide	astatine	silicon dioxide	aluminium

- 8 Chromium is a metal. The structure of chromium is described as a lattice of positive ions in a 'sea of electrons'.

Which statements about chromium are correct?

- 1 Chromium conducts heat because the positive ions are free to move.
- 2 Chromium conducts electricity because the electrons are free to move.
- 3 Chromium ions are held together because of their attraction for each other.
- 4 Chromium has a high melting point due to strong electrostatic forces of attraction.

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

- 9 Which of the following explains why graphite and copper can conduct electricity in the solid state?
- A Both graphite and copper contain mobile electrons.
- B Both graphite and copper contain mobile ions.
- C Graphite contains mobile electrons while copper contains mobile ions.
- D Graphite and copper contain both mobile electrons and mobile ions.
- 10 The chemical formula of antimony oxide is Sb_2O_3 and that of potassium phosphate is K_3PO_4 .

Which chemical formula is likely to be antimony phosphate?

- A SbPO_4
- B Sb_2PO_4
- C $\text{Sb}_2(\text{PO}_4)_3$
- D Sb_3PO_4
- 11 Some properties of four elements, P, Q, R and S, are shown in the table.
- Two of these elements are in Group 1 of the Periodic Table and two are in Group 17.

element	reaction with water	physical state at room temperature
P	reacts vigorously	solid
Q	does not react with water	solid
R	reacts explosively	solid
S	dissolves giving a coloured solution	liquid

Which statement is correct?

- A P is above R in Group 1.
- B Q is above R in Group 1.
- C S is below Q in Group 17.
- D R is below S in Group 17.

- 12 Transition elements can have variable oxidation states.
Which pair of compounds show a transition element in two different oxidation states?

- A Co_2O_3 and LiCoO_2
- B Cu_2O and CuSO_4
- C K_2CrO_4 and CrO_3
- D NiO and $\text{Ni}(\text{NO}_3)_2$

- 13 The table shows the pH ranges of an indicator, bromothymol blue.

colour of indicator	yellow		green		blue	
pH	4	5	6	7	8	9

The table shows the pH of four solutions.

solution	W	X	Y	Z
pH	3	5	7	9

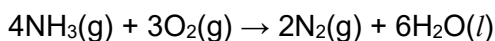
Bromothymol blue was added to a solution in a beaker.

Which description will **not** result in a change in colour of the indicator?

- A Indicator was added to solution Z. Solution W was added to the mixture until in excess.
 - B Indicator was added to solution W. Solution X was added to the mixture until in excess.
 - C Indicator was added to solution X. Solution Y was added to the mixture until in excess.
 - D Indicator was added to solution Y. Solution Z was added to the mixture until in excess.
- 14 Which equation suggests that a metal oxide, RO, behaves as an amphoteric oxide?

- A $\text{RO (s)} + 2\text{H}^+ \text{(aq)} \rightarrow \text{R}^{2+} \text{(aq)} + \text{H}_2\text{O (l)}$
- B $\text{RO (s)} + 2\text{OH}^- \text{(aq)} \rightarrow \text{RO}_2^{2-} \text{(aq)} + \text{H}_2\text{O (l)}$
- C $\text{RO (s)} + \text{H}_2\text{O (l)} \rightarrow \text{R}^{2+} \text{(aq)} + 2\text{OH}^- \text{(aq)}$
- D $\text{RO (s)} + \text{NH}_4^+ \text{(aq)} \rightarrow \text{R}^{2+} \text{(aq)} + \text{H}_2\text{O (l)} + \text{NH}_3 \text{(g)}$

- 15** Which mixture of solids would react with dilute nitric acid to form two different gases?
- A** copper and magnesium carbonate
 - B** copper(II) carbonate and magnesium oxide
 - C** copper(II) carbonate and magnesium
 - D** copper(II) oxide and magnesium carbonate
- 16** In an experiment to determine the concentration of hydrochloric acid, a student titrated 25.0 cm³ of hydrochloric acid with 0.1 mol/dm³ aqueous sodium hydroxide, using methyl orange as an indicator.
Which step would cause her calculated concentration of hydrochloric acid to be higher than its expected value?
- A** The burette was rinsed with distilled water followed by aqueous sodium hydroxide.
 - B** The conical flask was rinsed with distilled water followed by hydrochloric acid.
 - C** The titration reading was taken when methyl orange turns orange.
 - D** Reading the burette at an angle.
- 17** The mineral dolomite is a double carbonate of magnesium and calcium, with the formula CaMg(CO₃)₂. When 2.00 g of an impure sample of dolomite was completely dissolved in excess hydrochloric acid, 0.45 g of carbon dioxide was given off.
What is the percentage purity of the sample?
- A** 23.6%
 - B** 47.1%
 - C** 77.7%
 - D** 94.2%
- 18** 200 cm³ of ammonia burns in 120 cm³ of oxygen according to the following equation:



What volume of nitrogen will be obtained?

- A** 80 cm³
- B** 100 cm³
- C** 240 cm³
- D** 320 cm³

19 What is the concentration of iron(III) ions in 0.01 mol/dm^3 of aqueous iron(III) sulfate?

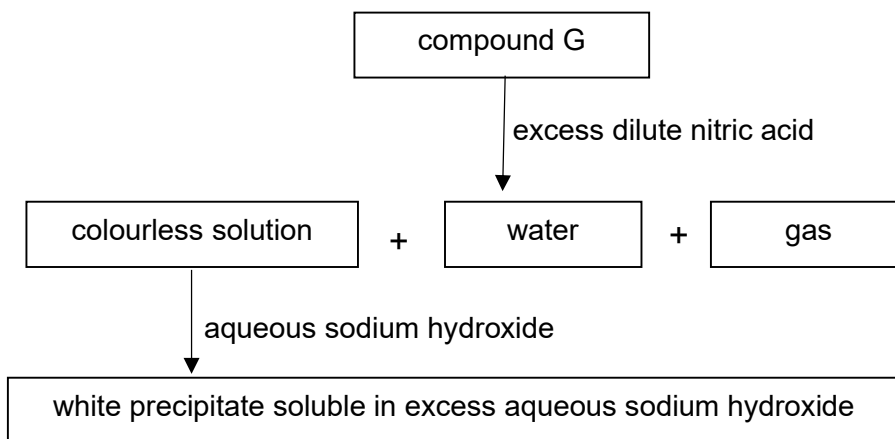
- A** 0.01 g/dm^3 **B** 0.02 g/dm^3
C 1.12 g/dm^3 **D** 1.68 g/dm^3

20 10.0 cm^3 of 0.10 mol/dm^3 lead(II) nitrate, $\text{Pb}(\text{NO}_3)_2$, is added to 30.0 cm^3 of 0.05 mol/dm^3 sodium chloride, NaCl , in a beaker.

After the reaction, a white precipitate of lead(II) chloride is present.
What else is present?

- A** aqueous lead(II) nitrate only
B aqueous lead(II) nitrate and aqueous sodium nitrate
C aqueous sodium nitrate only
D aqueous sodium chloride and aqueous sodium nitrate

21 The scheme below shows some reactions of compound G.



What is compound G likely to be?

- A** ammonium carbonate
B calcium carbonate
C zinc
D zinc carbonate

22 The presence of nitrates in the soil can be shown by warming the soil with aqueous sodium hydroxide and aluminium foil. Which observation shows that nitrates are present?

- A** Effervescence is observed.
- B** A gas that extinguishes a lighted splint with a 'pop' sound is produced.
- C** A gas that turns moist red litmus paper blue is produced.
- D** A white precipitate is seen.

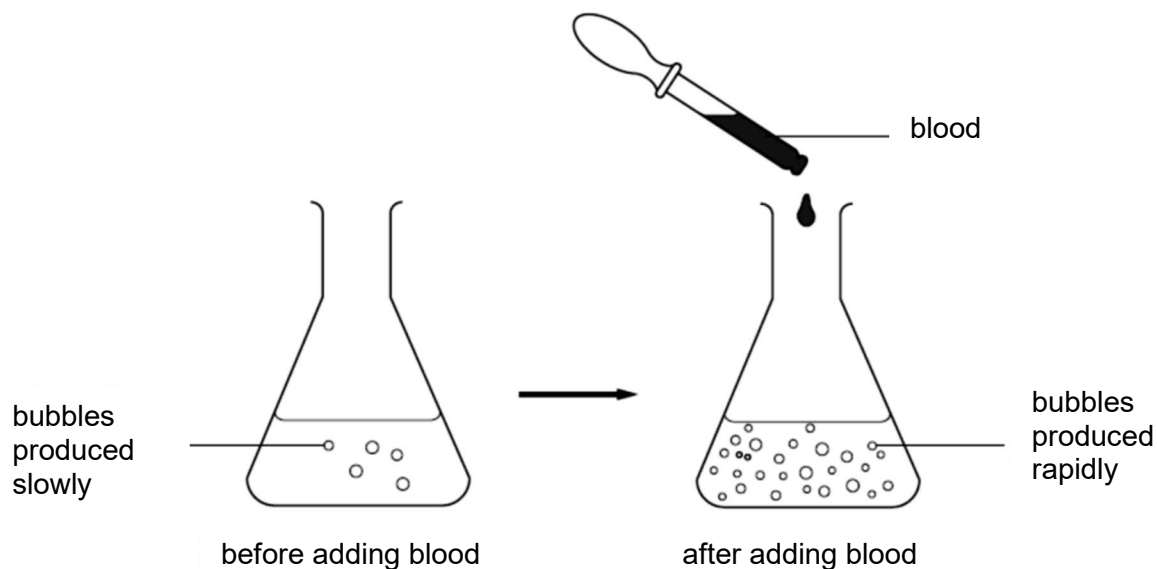
23 Element X displaces element Y from aqueous nitrate of Y. Hot element X does not react with cold water but react with steam to give hydrogen gas. Element Z reacts violently with water. What could element X, Y and Z be?

	X	Y	Z
A	copper	iron	lithium
B	copper	lead	sodium
C	zinc	iron	sodium
D	magnesium	silver	lithium

24 Which statement is correct about metal extraction?

- A** Metals above hydrogen are usually extracted by electrolysis.
- B** Iron can only be extracted by electrolysis.
- C** Calcium can be extracted by heating calcium oxide with carbon.
- D** Copper can only be extracted by passing hydrogen over heated copper(II) oxide.

- 25** A solution of hydrogen peroxide releases oxygen slowly at room temperature. The diagram shows the effect of adding blood to the solution.



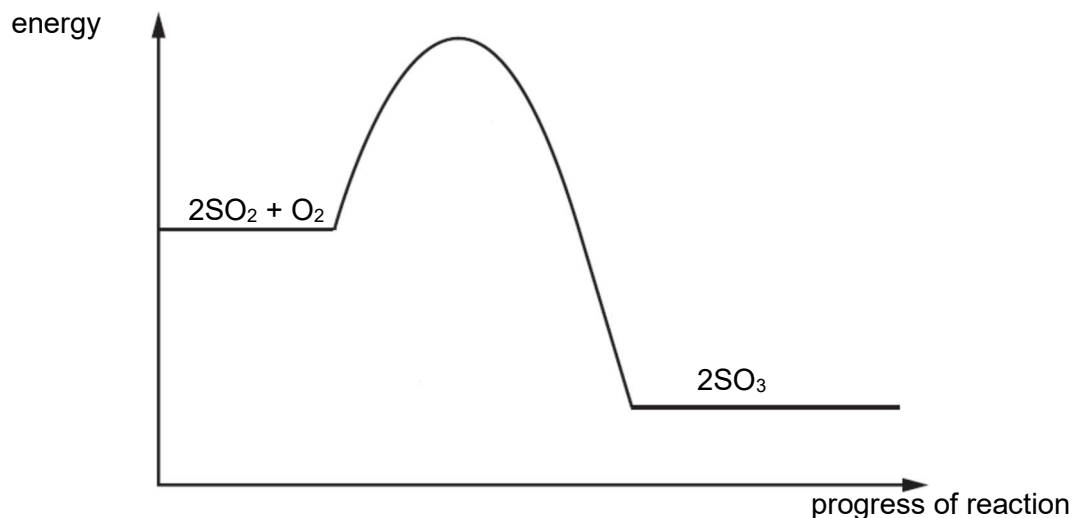
What could be the reason for the observed change?

- A** Blood contains an enzyme.
 - B** Blood contains water.
 - C** Hydrogen peroxide becomes more concentrated.
 - D** Hydrogen peroxide is neutralised by blood.
- 26** Which of the following reaction(s) is/are redox?

- 1 $\text{H}_2\text{SO}_4 + 6 \text{NH}_3 \rightarrow (\text{NH}_4)_2\text{SO}_4$
- 2 $2 \text{H}_2\text{SO}_4 + \text{Ni} \rightarrow \text{NiSO}_4 + 2 \text{H}_2\text{O} + \text{SO}_2$
- 3 $\text{K}_2\text{Cr}_2\text{O}_7 + 2 \text{KOH} \rightarrow 2 \text{K}_2\text{CrO}_4 + \text{H}_2\text{O}$

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

27 The energy profile diagram for the reversible reaction $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ is shown.



Which statements about this reaction are both correct?

	statement 1	statement 2
A	The reverse reaction is endothermic.	The activation energy is different for the forward and reverse reactions.
B	The reverse reaction is endothermic.	The activation energy is the same for the forward and reverse reactions.
C	The reverse reaction is exothermic.	The activation energy is different for the forward and reverse reactions.
D	The reverse reaction is exothermic.	The activation energy is the same for the forward and reverse reactions.

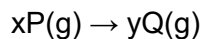
28 The table shows the energy released by the complete combustion of some compounds.

compound	M_r	enthalpy change (kJ/mol)
benzene	78	-3270
heptane	100	-4800
octane	114	-5510
propane	44	-2200

Which compound releases the least energy when **1 g** is completely burned?

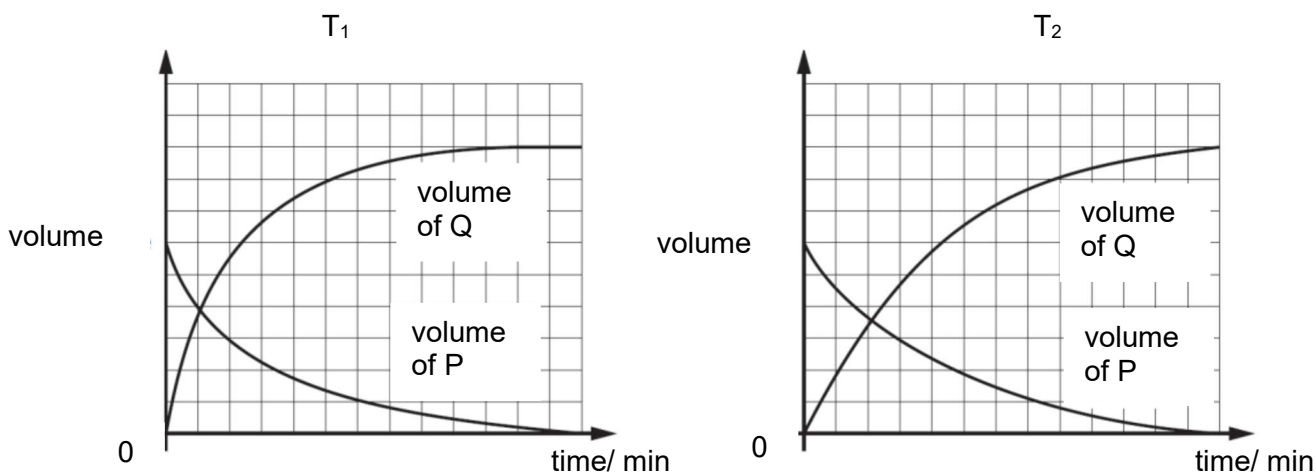
- A** benzene **B** heptane
C octane **D** propane

29 Gas P decomposes to form gas Q.



Two experiments are carried out to investigate the effect of temperature, T_1 and T_2 , on the rate of reaction. All other conditions are kept the same.

The results are plotted on graphs, drawn to the same scale.



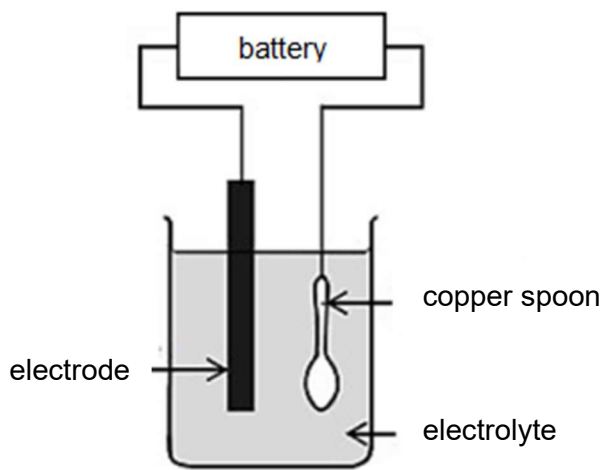
Which row is correct?

	x	y	temperature
A	2	3	T_1 is higher than T_2
B	2	3	T_2 is higher than T_1
C	3	2	T_1 is higher than T_2
D	3	2	T_2 is higher than T_1

30 The presence of iron catalyst in the Haber Process _____.

- A** decreases the activation energy of the reaction
- B** increases the activation energy of the reaction
- C** increase the energy level of the reactants
- D** lowers the enthalpy change of the reaction

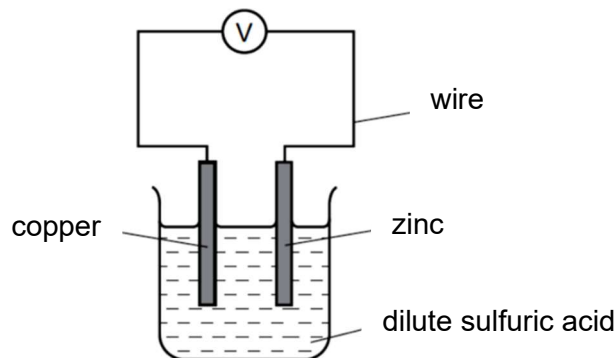
- 31 Which statement about the manufacture of ammonia through the Haber process is correct?
- A The reaction is reversible.
 - B The reaction is endothermic.
 - C Hydrogen is obtained from fractional distillation of air.
 - D Low pressure will result in an increase in yield of ammonia.
- 32 In the electrolysis of molten lead(II) bromide, 3 moles of lead(II) ions were discharged at the cathode. Which of the following would be discharged by the same amount of electricity?
- A 3 moles of iron(III) ions in the electrolysis of aqueous iron(II) chloride
 - B 3 moles of hydrogen ions in the electrolysis of aqueous zinc sulfate
 - C 6 moles of copper(II) ions in the electrolysis of aqueous copper(II) nitrate
 - D 6 moles of silver ions in the electrolysis of aqueous silver nitrate
- 33 The diagram shows the setup for the electroplating of a copper spoon with silver.



Which statement is **not** correct?

- A The electrode would be made of pure silver metal.
- B The electrolyte would be a soluble silver salt.
- C The spoon would be connected to the positive terminal of the battery.
- D The mass of the electrode decreases with time.

34 The diagram shows a simple cell.



Which statement about the simple cell is correct?

- A Electrons flow from copper along the wire to zinc.
- B Copper electrode decreases in size.
- C The pH value of the electrolyte increases.
- D Reddish-brown solid formed on the zinc electrode.

35 The general formula of the alkanes is C_nH_{2n+2} .
Which physical property decreases as n increases?

- A boiling point
- B flammability
- C melting point
- D viscosity

36 The list shows reactions in which ethanol is either a reactant or a product.

1. combustion of ethanol
2. conversion of ethene to ethanol
3. fermentation of glucose
4. oxidation of ethanol to ethanoic acid

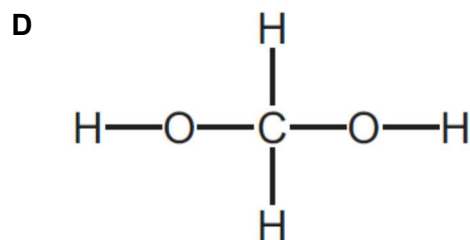
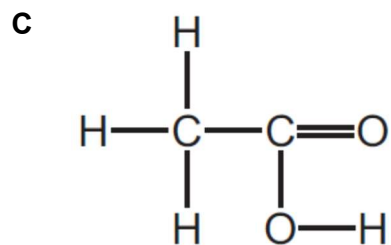
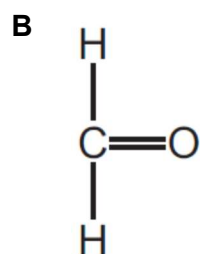
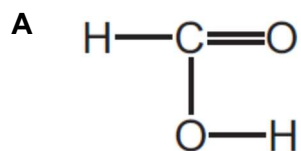
In which reactions is water also either a reactant or a product?

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

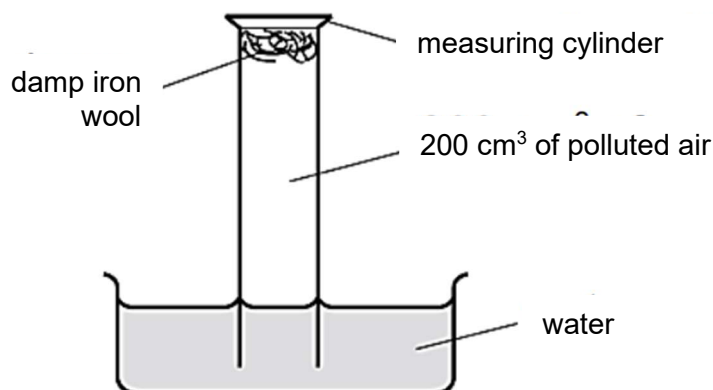
37 Which molecule is **not** produced by an addition reaction of ethene?

- A CH_3CH_3
- B $\text{CH}_2\text{BrCH}_2\text{Br}$
- C $\text{CH}_3\text{CH}_2\text{OH}$
- D $\text{CH}_3\text{CH}_2\text{CH}_3$

38 Which structure shows a carboxylic acid with the lowest relative molecular mass?



- 39** An experiment to find the percentage of oxygen in 200 cm^3 of polluted air is shown.



The apparatus is left for one week. After this time, the volume of gas in the measuring cylinder is 164 cm^3 .

What is the percentage of oxygen, to the nearest whole number, in the polluted air?

- A** 18%
 - B** 21%
 - C** 41%
 - D** 82%
- 40** In the catalytic converter in the exhaust system of a car, harmful gases are converted into carbon dioxide, nitrogen and water.

- 1 Carbon monoxide reacts with hydrocarbons.
- 2 Carbon monoxide reacts with nitrogen monoxide.
- 3 Platinum and rhodium catalyse the redox reactions

Which processes take place in the catalytic converter?

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

Group																	
1	2	Key						17	18								
		proton (atomic) number atomic symbol relative atomic mass															
		1 H hydrogen 1															
3 Li lithium 7	4 Be beryllium 9	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 fleorevium	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, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.