1.

Which statements about lime are correct?

1 Lime is made by heating calcium carbonate (limestone).

2 Lime is used to desulfurise flue gases.

3 Lime is used to treat alkaline soil.

4 The chemical name for lime is calcium oxide.

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

B

2.

Which statement about calcium carbonate is correct?

A It is made by the thermal decomposition of limestone.

B It is used to neutralise alkaline soils.

C It is a reactant in the test for carbon dioxide.

D It is used to remove impurities in iron extraction.

D

3.

What is an industrial use of calcium carbonate?

A cracking of hydrocarbons

B manufacture of aluminium

C manufacture of cement

D purification of water

C

4.

Which substance is used as a bleach in the manufacture of paper?

A carbon dioxide

B nitrogen dioxide

C silicon dioxide

D sulfur dioxide

D

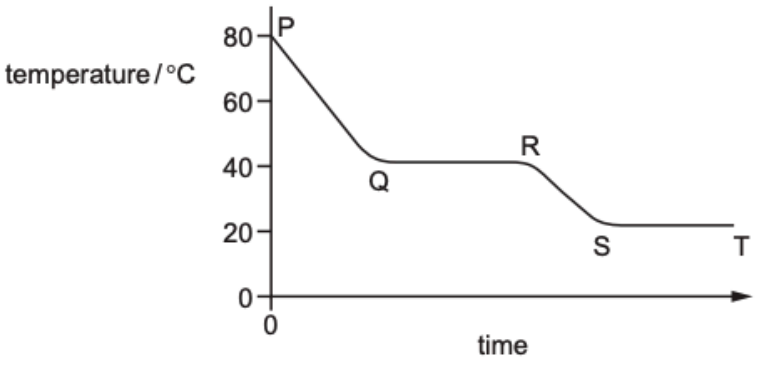
States of matter

1.

Substance M is a solid at 30 °C.

The substance is heated to 80 °C and its temperature measured as it cools down to room temperature.

The cooling curve is shown.



Between which times is substance M freezing?

A P to Q **B** Q to R **C** R to S **D** S to T

B

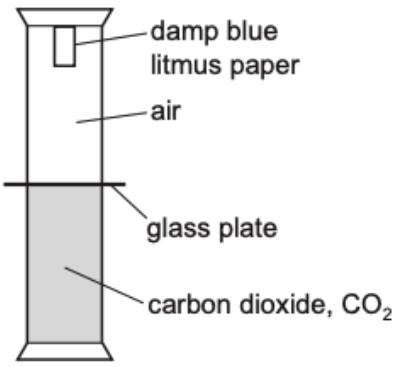
2.

Four experiments, each containing a different acidic gas, are set up as shown.

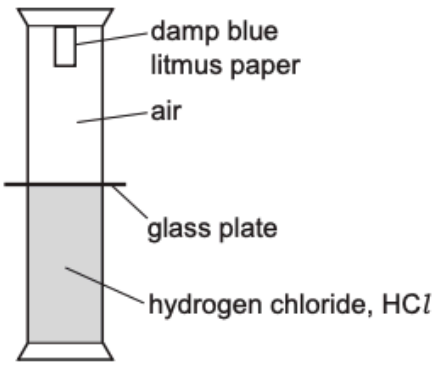
The dividing glass plates are removed at the same time.

In which set of apparatus does the litmus turn red first?

A



B



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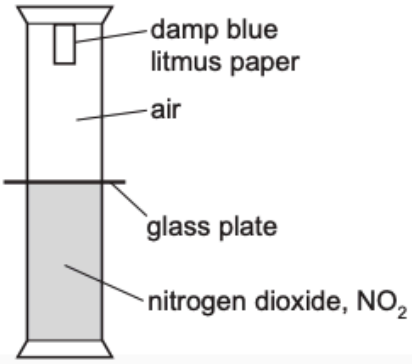
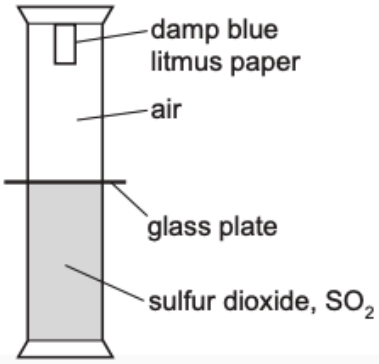


D



Atoms, Elements, Compounds

1.

Sodium ions, Na^+, and oxygen ions, O^{2-}, combine with chromium ions to form a salt.

The salt sodium dichromate has the formula $Na_2Cr_2O_7$.

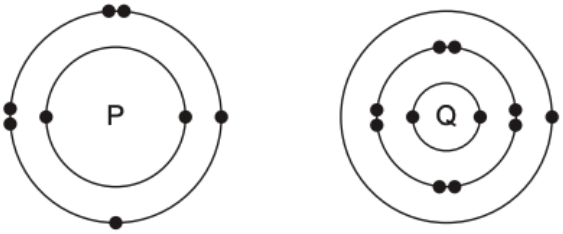
What is the oxidation state of chromium in this salt?

A +2 **B** +3 **C** +6 **D** +12

C

2.

The electronic structures of atoms P and Q are shown.



P and Q form an ionic compound.

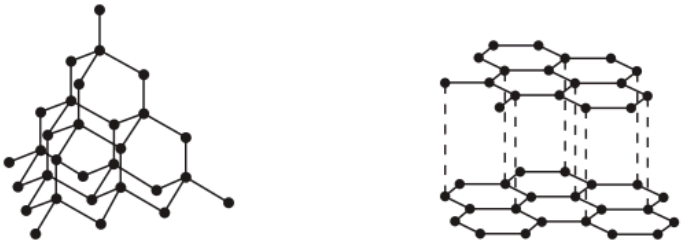
What is the formula of the compound?

A PQ **B** P_2Q **C** P_2Q_3 **D** PQ_2

D

3.

Which pair of statements about diamond and graphite is correct?



diamond graphite

A Diamond and graphite are both pure carbon. They are both macromolecules.

B Diamond and graphite can both be used as electrodes. Graphite is also used as a lubricant.

C Diamond has covalent bonds. Graphite has ionic bonds.

D Diamond is hard with a high melting point. Graphite is soft with a low melting point.

A

4.

X and Y are two different elements.

X and Y have the same number of nucleons.

Which statement about X and Y is correct?

A They have the same physical properties.

B Their atoms have the same number of electrons.

C They are in different groups of the Periodic Table.

D They have different relative masses.

C

5.

What is the total number of shared electrons in a molecule of methanol, CH_3OH?

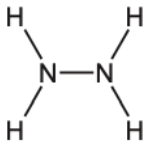
A 4 **B** 5 **C** 8 **D** 10

D

NOTE: Carefully check whether it asks for number of pairs of electrons OR total number of electrons

6.

The molecular structure of hydrazine, N_2H_4, is shown.



Which description of the bonding in hydrazine is **not** correct?

A Each nitrogen atom has a non-bonding pair of electrons.

B Each nitrogen atom has four bonding pairs of electrons.

C Each nitrogen atom shares one of its electrons with a nitrogen atom.

D Each nitrogen atom shares two of its electrons with hydrogen atoms.

B

7.

Which statement explains why methane has a lower boiling point than water?

A Methane has weaker covalent bonds than water.

B Methane has weaker attractive forces than water.

C Methane molecules are heavier than water molecules.

D Methane molecules have more bonds than water molecules.

B

8.

Magnesium oxide has a high melting point.

Carbon dioxide has a low melting point.

Which row identifies the attractive forces that are broken when these compounds are melted?

	magnesium oxide	carbon dioxide
A	strong attractions between molecules	weak attractions between atoms
B	strong attractions between molecules	weak attractions between molecules
C	strong attractions between ions	weak attractions between atoms
D	strong attractions between ions	weak attractions between molecules

D

9.

A gas is released at point P in the apparatus shown.

damp universal indicator paper

Which gas turns the damp universal indicator paper red most quickly?

A ammonia, NH_3

B chlorine, Cl_2

C hydrogen chloride, HCl

D sulfur dioxide, SO_2

C

10.

Which description of Brownian motion is correct?

A random movement of particles due to bombardment by larger particles

B random movement of particles due to bombardment by smaller particles

C random movement of particles from a high concentration to a low concentration

D random movement of particles from a low concentration to a high concentration

B

11.

Which statements about clean, dry air are correct?

1 It is a mixture of elements only.

2 It is a mixture of elements and compounds.

3 It contains only non-metals.

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

C

Stoichiometry

1.

The equation for the thermal decomposition of sodium hydrogencarbonate is shown.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

The M_r of sodium hydrogencarbonate, $NaHCO_3$, is 84.

The M_r of sodium carbonate, Na_2CO_3, is 106.

In an experiment, 2.1 g of sodium hydrogencarbonate is heated but not all of it decomposes. All of the carbon dioxide is collected and measured at room temperature and pressure. The total volume of carbon dioxide produced is 0.21 dm^3.

The volume of 1 mole of a gas at room temperature and pressure is 24 dm^3.

Which statement is correct?

A The mass of sodium carbonate produced is 0.93 g.

B The mass of sodium carbonate produced is 1.33 g.

C The percentage yield of carbon dioxide is 10%.

D The percentage yield of carbon dioxide is 35%.

A

2.

One mole of alkane Y produces 72 dm^3 of carbon dioxide when burned in excess oxygen, measured at room temperature and pressure.

What is Y?

A butane

B ethane

C methane

D propane

D

3.

When a hydrogen–oxygen fuel cell is in operation, a different reaction happens at each electrode.

at the hydrogen electrode $H_2 \rightarrow 2H^+ + 2e^-$

at the oxygen electrode $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

The electrons that are lost at the hydrogen electrode travel through the external circuit to the oxygen electrode, where they are gained by the oxygen and water.

A hydrogen–oxygen fuel cell is operated for a period of time and four moles of oxygen molecules are consumed.

Which mass of hydrogen is consumed?

A 2.0 g **B** 4.0 g **C** 8.0 g **D** 16.0 g

D

4.

4.55 g of zinc is reacted with 50 cm^3 of 2.25 mol / dm^3 dilute hydrochloric acid.

The equation for the reaction is shown.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Which volume of hydrogen gas, at room temperature and pressure, is produced in the reaction?

A 1.35 dm^3 **B** 1.67 dm^3 **C** 2.70 dm^3 **D** 3.34 dm^3

A

5.

Which sample does **not** contain a number of atoms equal to the Avogadro constant?

A 14 g of nitrogen, N_2

B 6 g of water, H_2O

C 4 g of helium, He

D 28 g of carbon monoxide, CO

D

6.

12.4 g of copper(II) carbonate is heated in a test-tube. Only 50% is decomposed.

[M_r: $CuCO_3$, 124; CuO, 80]

What will be the final mass of the substances in the test-tube?

A 9.4 g **B** 9.8 g **C** 10.2 g **D** 10.6 g

C

7.

The Haber process is a reversible reaction.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The reaction has a 30% yield of ammonia.

Which volume of ammonia gas, NH_3, measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

A 3600 cm^3 **B** 5400 cm^3 **C** 12000 cm^3 **D** 18000 cm^3

A

8.

Chlorine gas will react with iron metal.

Exactly 21.3 g of chlorine reacts with 11.2 g of iron.

How many iron atoms react with 30 molecules of chlorine?

A 10 **B** 15 **C** 20 **D** 30

C

9.

1.0 mol of silver nitrate, $AgNO_3$, contains 1.2×10^{24} ions.

How many ions are there in 0.25 mol of iron(III) oxide, Fe_2O_3?

A 1.5×10^{23} **B** 3.0×10^{23} **C** 7.5×10^{23} **D** 3.0×10^{24}

C

Chemical energetics

1.

When powdered sodium carbonate and aqueous ethanoic acid are mixed, the temperature of the mixture falls.

Which statement about this reaction is correct?

A The reaction is endothermic and ΔH is negative.

B The reaction is endothermic and ΔH is positive.

C The reaction is exothermic and ΔH is negative.

D The reaction is exothermic and ΔH is positive.

B

2.

The equation for the reaction between gaseous hydrogen and gaseous iodine to form gaseous hydrogen iodide is shown.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

The reaction is exothermic.

Which statement explains why the reaction is exothermic?

A Energy is released when H–H and I–I bonds are broken.

B The bond energies of the reactants are larger than the bond energies of the products.

C The products are at a higher energy level than the reactants.

D More energy is released when two HI bonds are formed than is used when the H–H and I–I bonds are broken.

D

3.

The initial and final temperatures of four different reactions are measured.

Which reaction is the **least** exothermic?

	initial temperature /°C	final temperature /°C
A	19	25
B	21	18
C	22	17
D	22	26

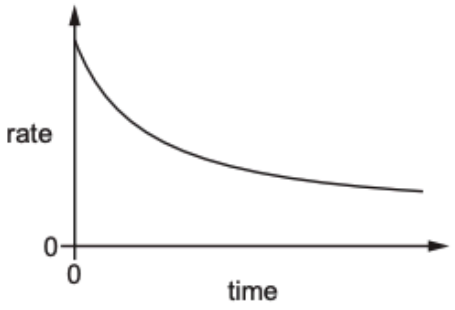
D

Chemical reactions

1.

The reaction between two aqueous compounds, X and Y, is slow and exothermic.

The graph shows how the rate of this reaction changes with time.



A student suggests that the rate of reaction decreases with time because:

1 the activation energy decreases

2 the speed of the molecules of X and Y decreases

3 the concentration of both X and Y decreases with time.

Which suggestions are correct?

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

D

2.

The reversible reaction shown takes place in a closed system at constant temperature.

$$P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g)$$

When the reaction has reached equilibrium, more T is added.

After the addition of T, which other substances increase in concentration?

A P, Q, R and S

B P and Q only

C P, Q and R only

D S only

C

3.

Which substances react to form hydrogen gas?

1 calcium and water

2 silver and dilute hydrochloric acid

3 magnesium and steam

4 zinc and dilute hydrochloric acid

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

A

4.

Which row describes the effect on the activation energy and the frequency of particle collisions when the temperature of a chemical reaction is increased?

	activation energy	frequency of collisions
A	increases	increases
B	no change	increases
C	increases	no change
D	no change	no change

B

5.

The equation for the reaction of sulfur dioxide with acidified potassium dichromate(VI) is shown.

$$3SO_2 + Cr_2O_7^{2-} + 2H^+ \rightarrow 3SO_4^{2-} + 2Cr^{3+} + H_2O$$

What is oxidised and what is the oxidising agent?

	oxidised	oxidising agent
A	SO_2	$Cr_2O_7^{2-}$
B	SO_2	H^+
C	$Cr_2O_7^{2-}$	H^+
D	$Cr_2O_7^{2-}$	$Cr_2O_7^{2-}$

A

6.

How many species are acting as bases in this reversible reaction?

$$HNO_3 + H_2O \rightleftharpoons H_3O^+ + NO_3^-$$

A 3 **B** 2 **C** 1 **D** 0

B

7.

Three metal compounds, J, K and L, are heated using a Bunsen burner.

The results are shown.

J colourless gas produced, which relights a glowing splint

K colourless gas produced, which turns limewater milky

L no reaction

Which row identifies J, K and L?

	J	K	L
A	magnesium carbonate	potassium carbonate	potassium nitrate
B	magnesium carbonate	potassium nitrate	potassium carbonate
C	potassium nitrate	magnesium carbonate	potassium carbonate
D	potassium nitrate	potassium carbonate	magnesium carbonate

C

8.

What are the products when limestone (calcium carbonate) is heated strongly?

A calcium hydroxide and carbon dioxide

B calcium hydroxide and carbon monoxide

C calcium oxide and carbon dioxide

D calcium oxide and carbon monoxide

C

9.

Dinitrogen tetroxide, N_2O_4, is converted into nitrogen dioxide, NO_2, in a reversible reaction.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The forward reaction is endothermic.

Which conditions give the highest equilibrium yield of nitrogen dioxide?

	pressure / atmospheres	temperature
A	2	high
B	2	low
C	50	high
D	50	low

A

10.

Copper(II) nitrate and zinc carbonate are heated strongly in separate test-tubes.

Which row identifies the gases produced?

	copper(II) nitrate	zinc carbonate
A	oxygen and nitrogen dioxide	carbon dioxide only
B	oxygen and nitrogen dioxide	carbon dioxide and oxygen
C	nitrogen dioxide only	carbon dioxide and oxygen
D	nitrogen dioxide only	carbon dioxide only

A

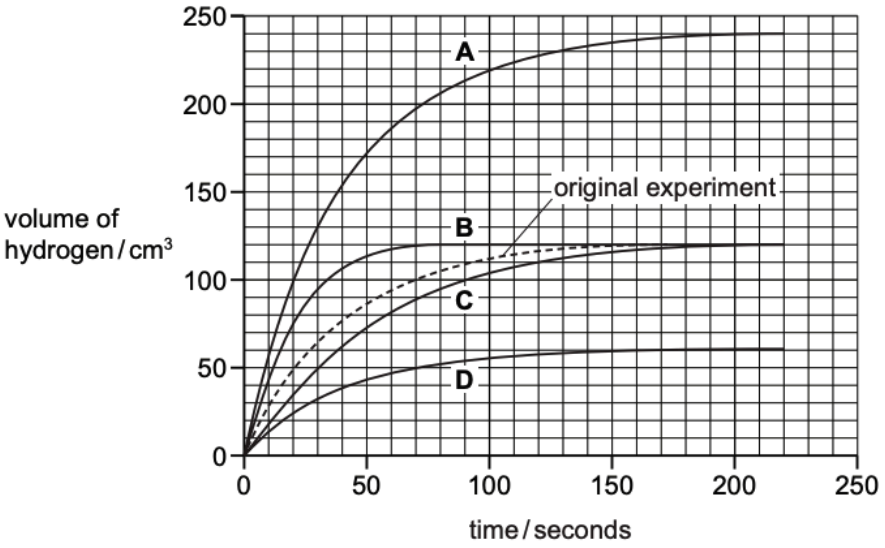
11.

A student adds excess magnesium ribbon to 10 cm^3 of 0.5 mol/dm^3 sulfuric acid.

The hydrogen gas is collected and its volume measured every 10 seconds.

The experiment is repeated using the same mass of magnesium ribbon with 5 cm^3 of 0.5 mol/dm^3 sulfuric acid added to 5 cm^3 of water.

Which graph shows the results of the second experiment?



D

12.

An equilibrium reaction is shown.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The forward reaction is endothermic.

What is the effect of changing the temperature and pressure on the equilibrium position?

	increasing temperature	increasing pressure
A	moves to the left	moves to the left
B	moves to the left	moves to the right
C	moves to the right	moves to the left
D	moves to the right	moves to the right

C

13.

Which row describes the conditions used in the manufacture of sulfuric acid by the Contact process?

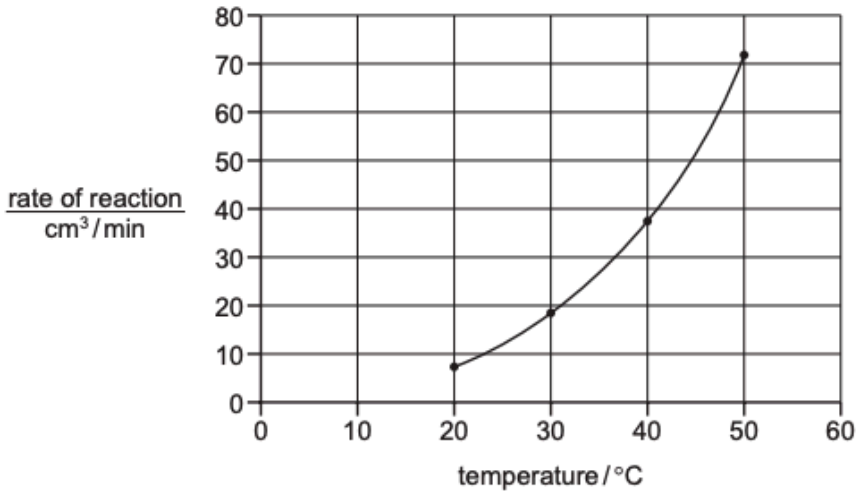
	catalyst	pressure	temperature
A	iron	high	high
B	iron	low	low
C	vanadium(V) oxide	high	low
D	vanadium(V) oxide	low	high

D

14.

The rate of reaction between calcium carbonate chips and hydrochloric acid is studied by collecting the volume of gas released in one minute at different temperatures.

A graph of rate of reaction against temperature is shown.



Which statement fully explains why increasing the temperature has this effect on the rate?

A The kinetic energy of the particles increases so the collisions are harder.

B The number of collisions between particles increases.

C The activation energy needed for the particles to react is reduced.

D There are more frequent collisions between particles with enough energy to react.

D

15.

The equation shows the equilibrium between dinitrogen tetroxide, N_2O_4, and nitrogen dioxide, NO_2.

The colours of the reactant and product are also shown.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

colourless brown

The forward reaction is endothermic.

Which statement is **not** correct?

A At equilibrium the concentrations of the reactant and the product are constant.

B At equilibrium the rate of the forward reaction is equal to the rate of the reverse reaction.

C When the pressure is increased a darker brown colour is seen.

D When the temperature is increased a darker brown colour is seen.

C

16.

The equations for two reactions of iodide ions are shown.

reaction 1 $2I^-(aq) + H_2O_2(aq) \rightarrow I_2(aq) + 2OH^-(aq)$

reaction 2 $I^-(aq) + Ag^+(aq) \rightarrow AgI(s)$

Which statement is correct?

A Both reactions are redox reactions.

B Neither reaction is a redox reaction.

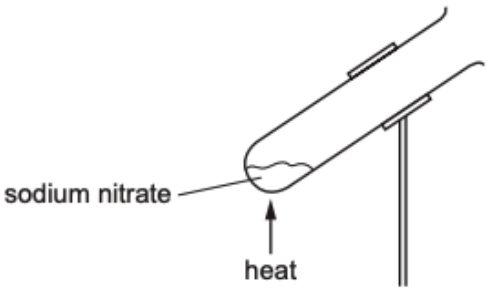
C Only reaction 1 is a redox reaction.

D Only reaction 2 is a redox reaction.

C

17.

Sodium nitrate is a white crystalline solid that decomposes on heating.



Which row describes the decomposition products formed when sodium nitrate is heated strongly?

	solid products	gaseous products
A	sodium nitrite	NO_2 and O_2
B	sodium nitrite	O_2 only
C	sodium oxide	NO_2 and O_2
D	sodium oxide	O_2 only

B

18.

Ammonia is manufactured by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

What are the conditions used in the Haber process?

	temperature / °C	pressure / atm
A	400	100
B	400	300
C	20	300
D	20	100

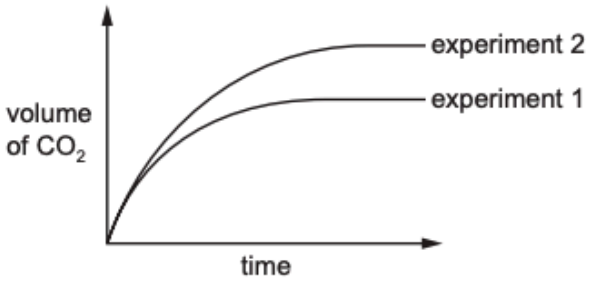
B

19.

An excess of calcium carbonate reacts with dilute hydrochloric acid. The volume of carbon dioxide produced is measured at regular time intervals. The results are shown as experiment 1.

The experiment is repeated with only **one** change to the reaction conditions.

The results are shown as experiment 2.



Which change is made in experiment 2?

A The concentration of the acid is increased.

B The volume of acid is increased.

C The mass of calcium carbonate is increased.

D The calcium carbonate is powdered.

B

20.

When bismuth(III) chloride, $BiCl_3$, reacts with water, a white precipitate of bismuth(III) oxychloride, $BiOCl$, is formed. The equation for the reaction is shown.

$$BiCl_3(aq) + H_2O(l) \rightleftharpoons BiOCl(s) + 2H^+(aq) + 2Cl^-(aq)$$

The reaction is in equilibrium.

Which changes cause the white precipitate to dissolve?

1 adding acid

2 adding water

3 adding sodium chloride solution

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

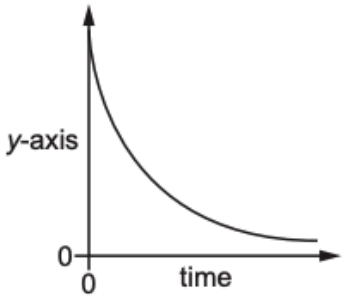
B

21.

An experiment is carried out to find the rate of reaction between hydrochloric acid and zinc.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

The results of the experiment are shown.



What is the label on the *y*-axis?

A amount of $ZnCl_2$ produced

B concentration of HCl

C mass of Zn reacted

D volume of H_2 produced

B

22.

Hydrogen peroxide, H_2O_2, decomposes to form water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Manganese(IV) oxide catalyses the decomposition reaction.

The reaction is investigated in four experiments.

experiment	volume and concentration of hydrogen peroxide	conditions
1	12.5 cm^3 of 1.0 mol/dm^3	25 °C with manganese(IV) oxide powder added
2	12.5 cm^3 of 2.0 mol/dm^3	40 °C with manganese(IV) oxide powder added
3	25 cm^3 of 1.0 mol/dm^3	40 °C without manganese(IV) oxide powder
4	25 cm^3 of 1.0 mol/dm^3	40 °C with manganese(IV) oxide powder added

All reactions go to completion and all measurements of gas volumes are at room temperature and pressure.

Which statement is correct?

A Experiment 1 produces less gas than experiment 4, but at the same rate.

B Experiment 2 produces more gas than experiment 1, but at the same rate.

C Experiment 2 and experiment 4 each produce the same volume of gas, but at different rates.

D Experiment 3 and experiment 4 each produce the same volume of gas and at the same rate.

C

23.

When a mixture of methane and chlorine is exposed to ultraviolet light, a reaction takes place.

Which statements about this reaction are correct?

1 It is an addition reaction.

2 The ultraviolet light provides the activation energy.

3 An equation for the reaction is $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$.

4 CH_3Cl is made in the reaction.

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

D

24.

Nylon and PET are polymers.

Which statements about these polymers are correct?

1 They are both condensation polymers.

2 $HOCH_2CH_2CH_2OH$ could be a monomer for both polymers.

3 The complete combustion of both polymers gives two products only.

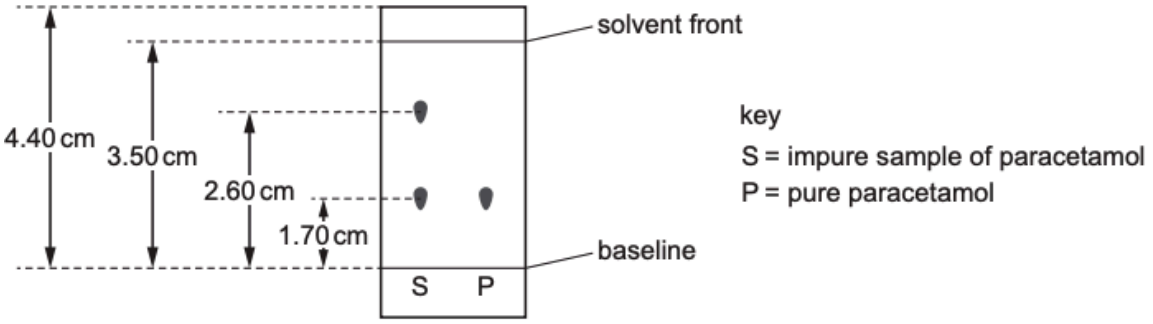
A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

C

25.

The painkiller paracetamol is synthesised from 4-aminophenol.

Chromatography is done on an impure sample of paracetamol. The results are shown. The diagram is not drawn to scale.



The sample of paracetamol is contaminated with 4-aminophenol only.

What is the R_f value of 4-aminophenol?

A 0.49 **B** 0.65 **C** 0.74 **D** 1.35

C

26.

Ethanol can be turned into ethanoic acid by passing it over hot copper(II) oxide.

$$CH_3CH_2OH + 2CuO \rightarrow CH_3COOH + H_2O + 2Cu$$

What is this type of reaction?

A precipitation

B redox

C thermal decomposition

D neutralisation

B

Acids, Bases, Salts

1.

An aqueous solution reacts with a solid. The products are an alkaline gas, a salt and water.

What are the aqueous solution and the solid?

	aqueous solution	solid
A	sodium hydroxide	magnesium carbonate
B	hydrochloric acid	magnesium carbonate
C	hydrochloric acid	ammonium chloride
D	sodium hydroxide	ammonium chloride

D

NOTE: acids are aqueous state

2.

Which method produces the salt copper(II) carbonate?

A Add copper(II) oxide to water, then add excess aqueous sodium carbonate. Filter off the precipitate.

B Add copper(II) oxide to dilute sulfuric acid, then add excess aqueous sodium carbonate. Filter off the precipitate.

C Add copper to dilute hydrochloric acid, then add aqueous sodium carbonate. Filter off the precipitate.

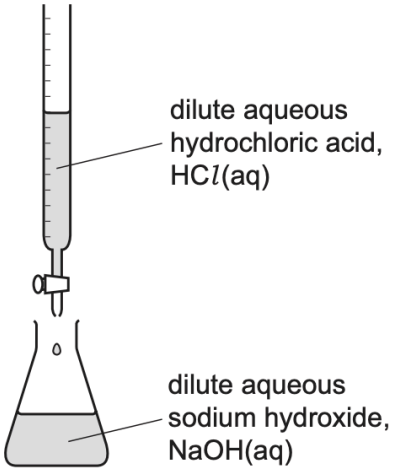
D Add copper(II) oxide to excess aqueous sodium carbonate. Filter off the precipitate.

B

3.

The concentration of a sample of dilute aqueous sodium hydroxide is found by titration.

The apparatus used is shown.



Which information is needed to calculate the concentration of the dilute aqueous sodium hydroxide in mol / dm^3?

	concentration of HCl	volume of HCl used	molar mass of HCl	volume of NaOH used	molar mass of NaOH
A	✓	✓	✓	✓	✓
B	✓	✓	✗	✓	✗
C	✗	✓	✓	✓	✗
D	✓	✗	✗	✗	✓

key

✓ = needed

✗ = not needed

B

4.

Which statement about acids is correct?

A A strong acid has a higher pH than a weak acid of the same concentration.

B A strong acid is a proton acceptor.

C A weak acid is a proton donor.

D A weak acid is fully ionised in aqueous solution.

C

5.

Ethanoic acid reacts with water to produce an acidic solution.

Which row describes the roles of ethanoic acid and water in this reaction?

	ethanoic acid	water
A	accepts a proton	donates a proton
B	accepts an electron	donates an electron
C	donates a proton	accepts a proton
D	donates an electron	accepts an electron

C

6.

Which element has an oxide that is used as a food preservative?

A helium

B hydrogen

C iron

D sulfur

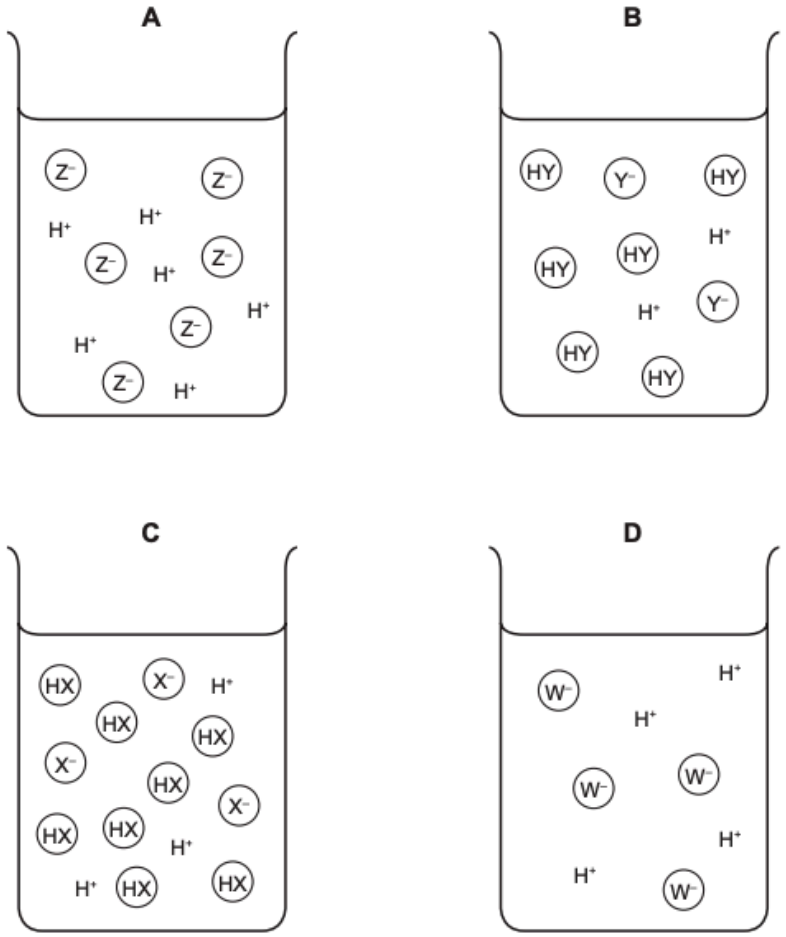
D

NOTE: sulphur dioxide is used as a food preservative

7.

Four different acids are dissolved in water.

Which beaker contains the most concentrated strong acid solution?



A

8.

In which reaction does an acid react with a base?

A Dilute sulfuric acid is added to a piece of magnesium ribbon producing hydrogen.

B Dilute sulfuric acid is added to aqueous barium chloride producing a white precipitate of barium sulfate.

C Aqueous sodium hydroxide is added to aqueous copper(II) sulfate producing a blue precipitate of copper(II) hydroxide.

D Aqueous sodium hydroxide is added to solid ammonium sulfate producing gaseous ammonia.

D

9.

Which statement about aqueous weak acids is correct?

A Weak acids are always dilute aqueous solutions.

B Weak acids dissociate fully in aqueous solution.

C When a weak acid is added to blue litmus paper, it stays blue.

D When a weak acid is added to solid magnesium, effervescence is seen.

D

10.

Zinc oxide is an amphoteric oxide.

Zinc oxide is added to excess dilute hydrochloric acid.

Zinc oxide is added to excess aqueous sodium hydroxide.

Which row describes the observations made in these reactions?

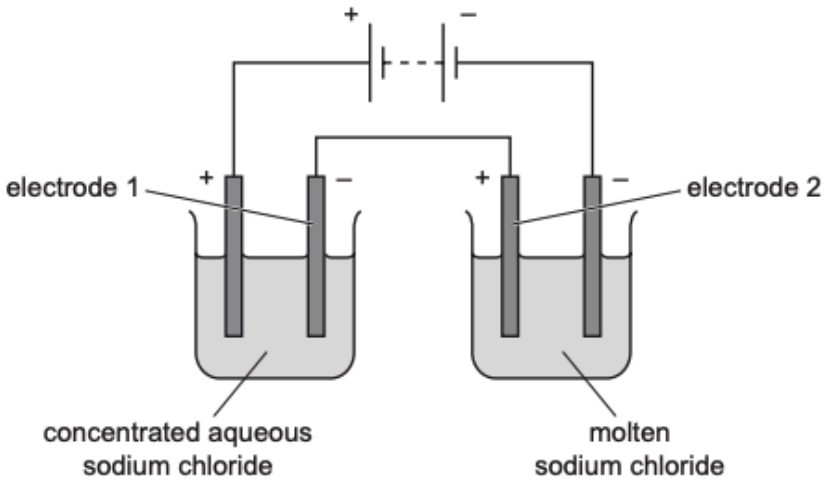
	excess dilute hydrochloric acid	excess aqueous sodium hydroxide
A	colourless solution forms	colourless solution forms
B	colourless solution forms	no visible change
C	fizzing	colourless solution forms
D	fizzing	no visible change

A

Electrochemistry

1.

The electrolysis of concentrated aqueous sodium chloride and molten sodium chloride is shown.



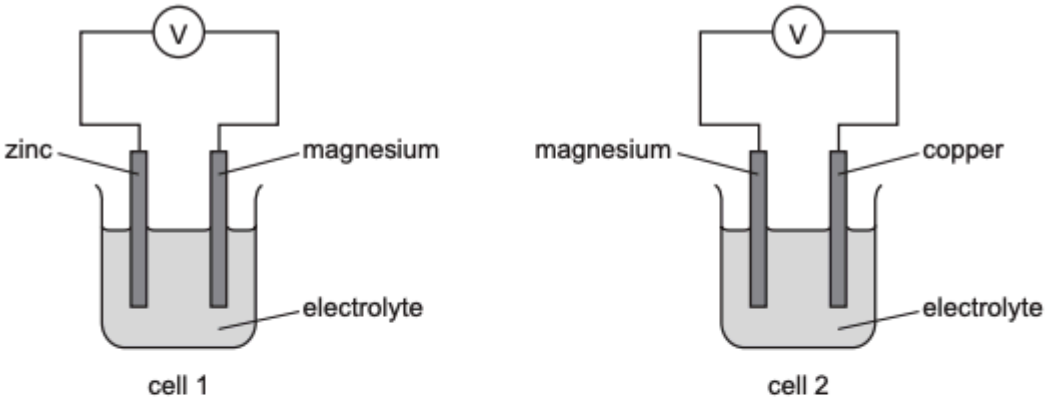
What are the products at electrodes 1 and 2?

	electrode 1	electrode 2
A	chlorine	chlorine
B	hydrogen	chlorine
C	hydrogen	sodium
D	sodium	sodium

B

2.

The electrical energy, or voltage, of two simple cells is measured.



statement 1 The voltage of cell 1 is greater than cell 2.

statement 2 Zinc is more reactive than copper.

statement 3 Magnesium is oxidised in both cells.

statement 4 Magnesium atoms lose electrons to form magnesium ions.

Which option is correct?

A All the statements are correct.

B Only statements 1 and 3 are correct.

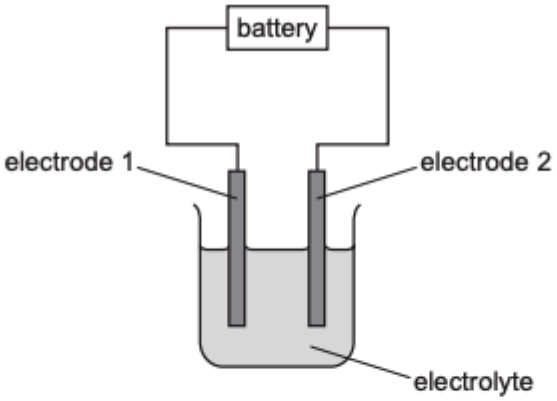
C Statement 2 is correct and explains statement 1.

D Statement 4 is correct and explains statement 3.

D

3.

In the electrolysis diagram, oxidation is occurring at electrode 1 and reduction at electrode 2.



Which row shows the directions of movement of the electrons in the external circuit and of the positive ions in the electrolyte?

	direction of movement of electrons in external circuit	direction of movement of positive ions in electrolyte
A	1 → 2	1 → 2
B	1 → 2	2 → 1
C	2 → 1	1 → 2
D	2 → 1	2 → 1

A

4.

Which statements about hydrogen and oxygen are correct?

	hydrogen and oxygen can react to produce electrical energy	hydrogen and oxygen can be made by the electrolysis of dilute aqueous sodium chloride
A	✗	✗
B	✗	✓
C	✓	✗
D	✓	✓

D

Periodic table

1.

Elements in Group IV of the Periodic Table are shown.

carbon

silicon

germanium

tin

lead

What does **not** occur in Group IV as it is descended?

A The proton number of the elements increases.

B The elements become more metallic.

C The elements have more electrons in their outer shell.

D The elements have more electron shells.

C

2.

Lithium, sodium and potassium are elements in Group I of the Periodic Table.

Chlorine, bromine and iodine are elements in Group VII of the Periodic Table.

Which row identifies the **least** dense of these elements in each group?

	Group I	Group VII
A	lithium	chlorine
B	lithium	iodine
C	potassium	chlorine
D	potassium	iodine

A

3.

The number of protons and the number of neutrons in the atoms of elements X, Y and Z are shown.

	number of protons	number of neutrons
X	6	6
Y	7	6
Z	8	10

Which statement about the elements is correct?

A X and Y are isotopes of the same element.

B Z forms an ion with a +2 charge.

C X and Z react together to form an ionic compound.

D X, Y and Z are non-metals.

D

4.

Some properties of four fuels are shown.

Which fuel is a gas at room temperature and makes two products when it burns in a plentiful supply of air?

	fuel	formula	melting point /°C	boiling point /°C
A	hydrogen	H_2	–259	–253
B	methane	CH_4	–182	–164
C	octane	C_8H_{18}	–57	126
D	wax	$C_{31}H_{64}$	60	400

B

5.

The noble gases are in Group VIII of the Periodic Table.

Some properties of the first four noble gases are shown.

noble gas	boiling point in °C	density in g/dm^3
helium	–267	0.179
neon	–246	0.900
argon	–186	1.782
krypton	–152	3.708

Which row identifies the trends in boiling point and in density as Group VIII is descended?

	boiling point	density
A	decreasing	increasing
B	increasing	increasing
C	decreasing	decreasing
D	increasing	decreasing

B

Metals

1.

Which statement about alkali metals is correct?

A Lithium is more dense than sodium.

B Sodium is more reactive than potassium.

C Sodium has a higher melting point than potassium.

D They are in Group II of the Periodic Table.

C

2.

Why is cryolite used in the extraction of aluminium by electrolysis?

A It dissolves the aluminium oxide.

B It protects the anodes from corrosion.

C It changes bauxite to aluminium oxide.

D It decreases the melting point of the aluminium.

A

3.

Reactions of three metals and their oxides are shown.

metal	add dilute hydrochloric acid to metal	heat metal oxide with carbon
1	✓	✓
2	✓	✗
3	✗	✓

key

✓ = reacts

✗ = does not react

What is the order of reactivity of these metals, from most reactive to least reactive?

A $1 \rightarrow 2 \rightarrow 3$ **B** $1 \rightarrow 3 \rightarrow 2$ **C** $2 \rightarrow 1 \rightarrow 3$ **D** $2 \rightarrow 3 \rightarrow 1$

C

4.

The reactions of metals P, Q, R and S are shown.

metal	reaction with water	reaction with hydrochloric acid	reduction of the metal oxide with carbon
P	no reaction	no reaction	reduced
Q	slow	vigorous	no reaction
R	vigorous	vigorous	no reaction
S	very slow	vigorous	reduced

What is the order of reactivity of the metals?

	least reactive →			most reactive
A	P	S	Q	R
B	P	Q	S	R
C	R	S	Q	P
D	R	Q	S	P

A

NOTE: carefully check whether it is from least reactive to most OR the other way!

5.

Iron from a blast furnace can be converted to steel.

Which statements about steel are correct?

1 Steel contains more carbon than the iron obtained from the blast furnace.

2 Steel is produced by blowing oxygen through the iron.

3 Calcium oxide is added to molten iron to remove basic oxides.

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

D

6.

Elements J and K are in the same period in the Periodic Table.

J reacts with acids to produce a salt and hydrogen.

K reacts with sodium to form an ionic compound.

Which statement about J and K is correct?

A An atom of J has more electrons than an atom of K.

B J and K are both metals.

C J and K are both non-metals.

D J is to the left of K in the Periodic Table.

D

7.

The reactions of four metals, W, X, Y and Z, are listed.

- Metal W displaces metal X from the oxide of metal X.
- Metal Y has a greater tendency to form positive ions than metal W.
- Aqueous ions of metal Z are reduced by metal X.

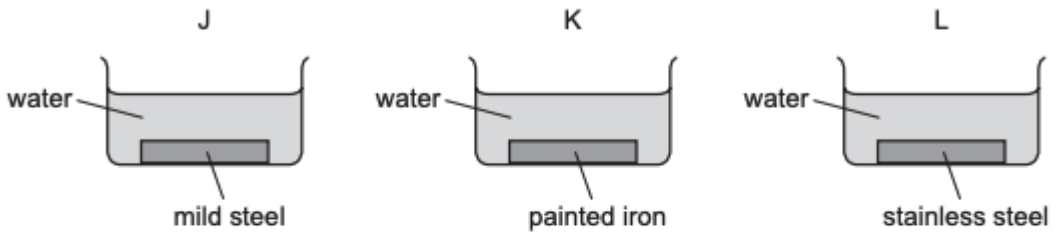
What is the order of reactivity of the metals?

	least reactive		→	most reactive
A	Y	W	X	Z
B	Y	X	W	Z
C	Z	W	X	Y
D	Z	X	W	Y

D

8.

Three experiments, J, K and L, are set up to investigate rusting.



In which experiments does rusting occur?

	J	K	L
A	✗	✓	✓
B	✗	✓	✗
C	✓	✗	✗
D	✓	✗	✓

key
✓ = yes
✗ = no

C

9.

Sodium is a Group I metal.

Which property, that is typical of most metals, is **not** shown by sodium?

A conductor of heat

B high melting point

C malleable

D shiny

B

10.

Some properties of aluminium are listed.

1 It conducts heat.

2 It has a low density.

3 It is strong.

4 It is resistant to corrosion.

Which of these properties make aluminium suitable for making food containers for chilled food products?

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

D

11.

When aqueous iodine is added to a solution of vanadium ions, V^{2+}, the V^{2+} ions each lose one electron.

Which property of transition elements is shown by this reaction?

A Transition elements have variable oxidation states.

B Transition elements form a stable 1+ ion.

C Transition elements are oxidising agents.

D Transition elements can act as catalysts.

A

12.

Some metal nitrates and carbonates decompose when heated strongly.

Metal Q has a nitrate that decomposes to give a salt and a colourless gas only.

The carbonate of metal Q does not decompose when heated with a Bunsen burner.

What is metal Q?

A calcium

B copper

C sodium

D zinc

C

NOTE: carbonates of group I metals don't decompose on heating

13.

When zinc is added to an aqueous solution containing magnesium ions, there is no reaction.

Which species has the greatest tendency to lose electrons?

A Mg **B** Mg^{2+} **C** Zn **D** Zn^{2+}

A

Chemistry of the Environment

1.

Water is treated at a waterworks to make it fit to drink.

What is present in the water when it leaves the waterworks?

A bacteria only

B bacteria and insoluble substances

C chlorine compounds only

D chlorine compounds and soluble substances

D

Organic Chemistry

1.

What is the structural formula of the compound formed in the addition reaction of propene with bromine?

A $CH_3CHBrCH_2Br$

B $CH_2BrCH_2CH_2Br$

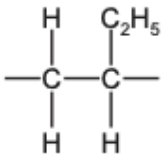
C $CHBr_2CH_2CH_3$

D $CH_3CBr_2CH_3$

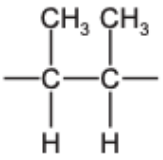
2.

Which structure represents the repeat unit of the addition polymer formed from but-1-ene?

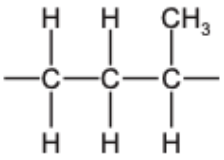
A



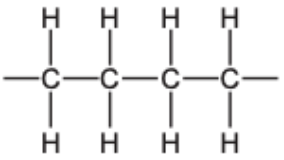
B



C



D



A

3.

What are the products of the addition reactions of ethene with bromine and hydrogen?

	bromine	hydrogen
A	CH_2BrCH_2Br	CH_3CH_3
B	CH_2BrCH_2Br	CH_2CH_2
C	CH_3CH_2Br	CH_3CH_3
D	CH_3CH_2Br	CH_2CH_2

A

4.

Methanoic acid and propan-1-ol react to form an ester.

What is the structural formula of the ester?

A $HCOOCH_2CH_2CH_3$

B $CH_3CH_2COOCH_3$

C $CH_3COOCH_2CH_3$

D $CH_3CH_2CH_2COOH$

A

5.

Methane reacts with chlorine in substitution reactions.

How many different products, containing a single carbon atom, can be made during the reactions?

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

C

6.

Which substances are structural isomers?

A but-2-ene and propene

B ethyl ethanoate and butanoic acid

C methyl methanoate and ethanol

D propan-1-ol and butan-1-ol

B

7.

Some properties of colourless liquid L are listed.

- It boils at 65 °C.
- When added to water, two layers form which do not mix.
- It does not react with sodium carbonate.
- It has no effect on bromine water.

What is L?

A ethanol

B hexane

C hexene

D ethanoic acid

B

8.

The reaction of ethanol with acidified potassium manganate(VII) is shown.

$$CH_3CH_2OH \xrightarrow[H^+]{KMnO_4} CH_3COOH$$

Which type of reaction is taking place?

A addition

B condensation

C hydrolysis

D oxidation

D

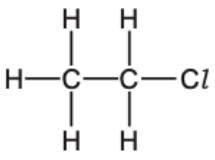
9.

Ethane reacts with chlorine in the presence of ultraviolet light.

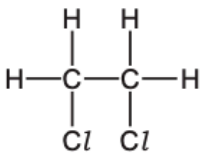
Which substances are produced in the reaction?

1

2



3



4

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

C

10.

Which compound has the most $-CH_2-$ groups in one molecule?

A butane

B butanoic acid

C butan-1-ol

D but-1-ene

C

11.

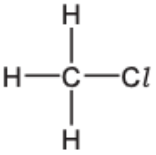
Methane reacts with chlorine in the presence of ultraviolet light.

Which substance is **not** produced in this reaction?

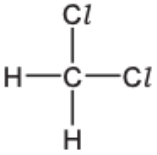
A

B

C



D

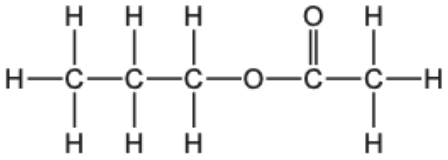


A

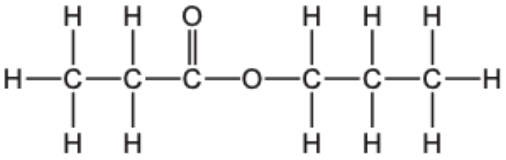
12.

Which structure represents the ester made from ethanoic acid and propanol?

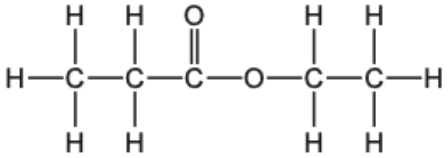
A



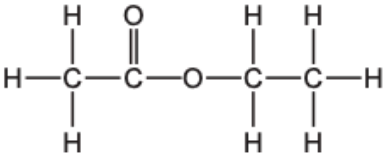
B



C



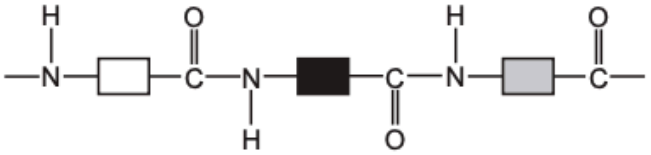
D



A

13.

The structure of a polymer is shown.



Which statements about the polymer are correct?

1 The polymer is nylon.

2 The polymer is formed by condensation polymerisation.

3 There are ester linkages between the monomers.

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

C

NOTE: Terylene is a polyester

14.

Which pair of compounds are structural isomers of each other?

A $CH_3CH_2CH_3$ and $CH_3CH_2CH_2CH_3$

B $CH_2{=}CHCH_3$ and $CH_3CH{=}CH_2$

C $CH_2(OH)CH_2CH_3$ and $CH_3CH_2CH_2OH$

D $CH_3CH_2CH_2COOH$ and $CH_3COOCH_2CH_3$

D

Experimental techniques

1.

Rock salt is a mixture of salt and sand.

The method used to separate the sand from the salt is listed.

step 1 Crush the rock salt, add to warm water and stir.

step 2 Pour the mixture through a filter paper held in a funnel.

step 3 Evaporate the water to crystallise the salt.

Which statement about the method is correct?

A The filtrate in step 2 is pure water.

B The residue in step 2 is pure crystals of salt.

C The solute is salt.

D The solvent is a mixture of salt and water.

C

2.

When acid is added to salt X, a gas is produced which turns limewater milky.

When sodium hydroxide is added to salt X, a gas is produced which turns litmus paper blue.

What is X?

A $CaCO_3$ **B** $(NH_4)_2CO_3$ **C** NH_4NO_3 **D** $ZnCO_3$

B

3.

Which substance should be pure for the intended use?

A a drug for curing disease

B limestone for iron extraction

C petroleum for fractional distillation

D water for washing a car

A

4.

Acidified aqueous silver nitrate is added to a test-tube containing aqueous chloride ions.

The test-tube is then left in direct sunlight.

Which row describes the observations and explains what happens to the reaction mixture?

	observation on adding aqueous silver nitrate	observation after leaving in sunlight	explanation
A	yellow precipitate	precipitate dissolves	silver chloride forms
B	yellow precipitate	precipitate turns grey	silver ions are reduced
C	white precipitate	precipitate dissolves	silver chloride forms
D	white precipitate	precipitate turns grey	silver ions are reduced

D

5.

Water is added to anhydrous copper(II) sulfate.

What happens during the reaction?

A The copper(II) sulfate turns blue and the solution formed gets colder.

B The copper(II) sulfate turns blue and the solution formed gets hotter.

C The copper(II) sulfate turns white and the solution formed gets colder.

D The copper(II) sulfate turns white and the solution formed gets hotter.

B

6.

Aqueous ammonium sulfate is made by reacting aqueous ammonia with dilute sulfuric acid.

How is solid ammonium sulfate obtained from the resulting solution?

A crystallisation

B distillation

C filtration

D solvent extraction

A

7.

Tests are done on an aqueous solution.

test	a few drops of aqueous sodium hydroxide are added	aqueous sodium hydroxide is added in excess
observation	white precipitate	precipitate dissolves to give a colourless solution

Which cations produce these observations?

1 aluminium, Al^{3+}

2 calcium, Ca^{2+}

3 zinc, Zn^{2+}

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

B

8.

Which test is used to show that a sample of water is pure?

A Evaporate the water to see if any solids remain.

B Heat the water to check its boiling point.

C Test with anhydrous cobalt(II) chloride.

D Use universal indicator paper to check its pH.

B

9.

The following substances can be reacted together to prepare salts.

1 copper(II) oxide and excess hydrochloric acid

2 hydrochloric acid and excess sodium hydroxide

3 hydrochloric acid and excess zinc carbonate

In which reactions can the excess reactant be separated from the solution by filtration?

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

D

10.

Which piece of apparatus should be used to measure exactly 21.4 cm^3 of water?

A 25 cm^3 beaker

B 25 cm^3 pipette

C 50 cm^3 burette

D 50 cm^3 measuring cylinder

C