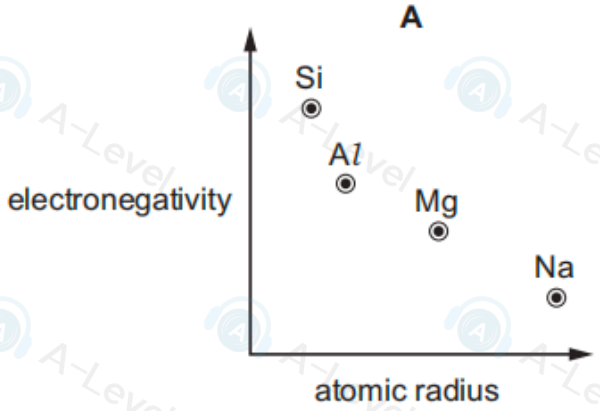
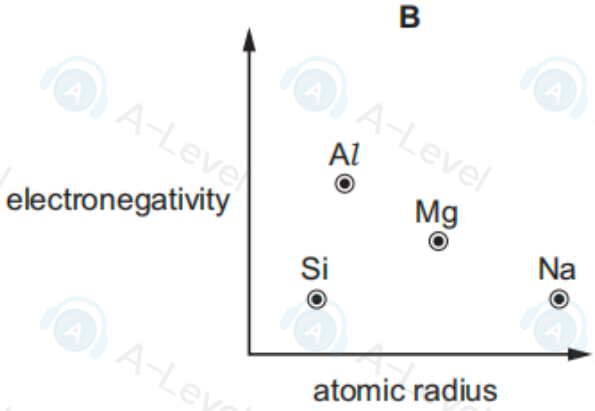
19 Which graph correctly shows relative electronegativity plotted against relative atomic radius for the elements Na, Mg, Al and Si?

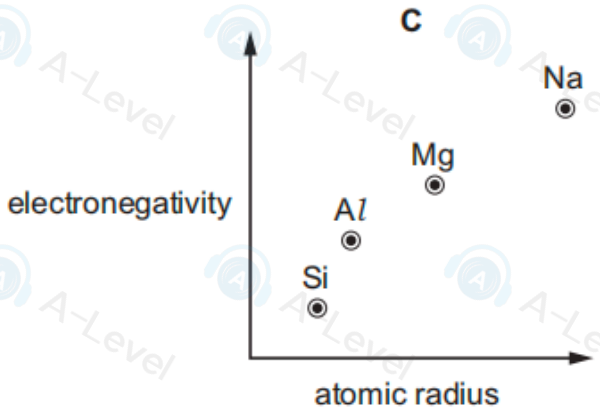
A



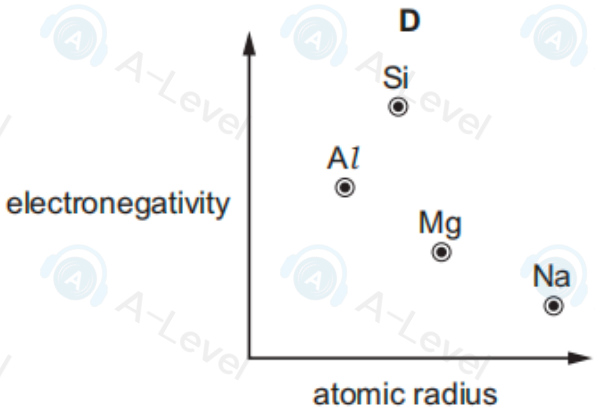
B



C



D



21 Solutions P and Q each contain a different Group 2 ion at the same concentration. One contains Mg^{2+} and the other contains Ba^{2+}. Tests are carried out on separate 5 cm^3 samples of P and Q.

test 1: add 1 cm^3 of 0.1 mol dm^{-3} $Na_2SO_4(aq)$

test 2: add 1 cm^3 of 0.1 mol dm^{-3} $NaOH(aq)$

What are the results of these tests?

	results in test 1	results in test 2
A	more precipitate with Ba^{2+}	more precipitate with Ba^{2+}
B	more precipitate with Ba^{2+}	more precipitate with Mg^{2+}
C	more precipitate with Mg^{2+}	more precipitate with Ba^{2+}
D	more precipitate with Mg^{2+}	more precipitate with Mg^{2+}

22 J dissolves in water to give an aqueous solution K.

K gives a dense white precipitate when aqueous silver nitrate is added.

When heated with aqueous potassium hydroxide, K gives off a gas that turns moist universal indicator paper blue.

What is J?

A ammonium chloride

B ammonium sulfate

C sodium chloride

D sodium hydroxide

23 Ammonium sulfate, $(NH_4)_2SO_4$, and ammonium nitrate, NH_4NO_3, are used as fertilisers.

These salts have different percentages by mass of nitrogen. They have the same effect as each other on the pH of wet neutral soil.

Which row is correct?

	higher percentage of nitrogen by mass	effect on pH of soil
A	ammonium nitrate	decrease
B	ammonium nitrate	increase
C	ammonium sulfate	decrease
D	ammonium sulfate	increase

1 Which species contains a different number of electrons from the other three?

A ClO_4^- **B** H_2SO_4 **C** SO_4^{2-} **D** Te^{2-}

13 The equation for the reaction between aqueous copper ions and aqueous iodide ions is as follows.

$$2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq)$$

What is the change in oxidation state of copper?

A +2 to –1 **B** +2 to 0 **C** +2 to +1 **D** +4 to +2

17 L, M and N are three different elements from Period 3 of the Periodic Table.

L is the element whose atoms have three unpaired electrons in its 3p sub-shell.

M is the element with the highest electrical conductivity in the period.

N is the element with the highest melting point in the period.

Which statement about element L is correct?

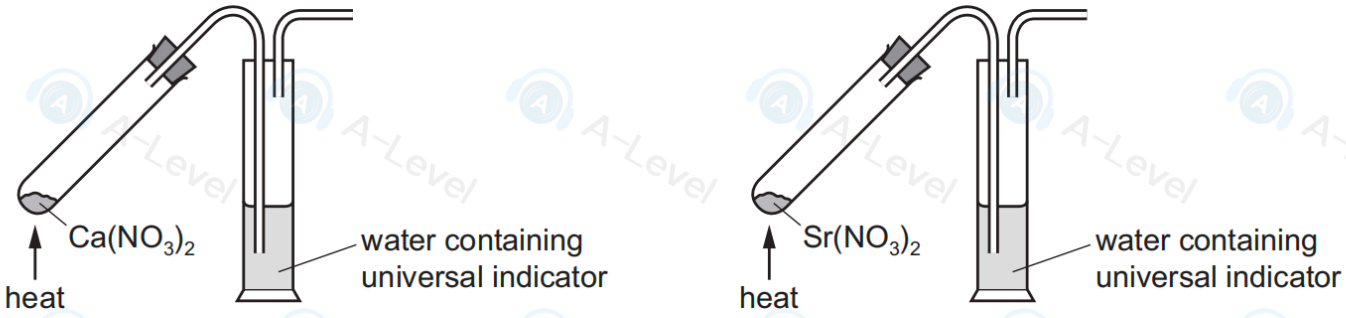
A L has a higher atomic number than M and a lower atomic number than N.

B L has a lower atomic number than M and a higher atomic number than N.

C L has a lower atomic number than both M and N.

D L has a higher atomic number than both M and N.

22 The diagram shows the process of adding calcium nitrate and strontium nitrate to separate boiling tubes and heating them. Identical conditions are used.



As the reactions proceed, the water containing universal indicator changes colour.

Which row describes the colour change and identifies the nitrate that causes the quickest colour change?

	colour change of universal indicator	nitrate that causes the quickest colour change
A	green to blue	$Ca(NO_3)_2$
B	green to blue	$Sr(NO_3)_2$
C	green to red	$Ca(NO_3)_2$
D	green to red	$Sr(NO_3)_2$

12 The vanadium salt, $VOSO_4$, is soluble in water and reacts readily with powdered manganese in dilute sulfuric acid.

The equation for the reaction is shown.

$$Mn(s) + 2VOSO_4(aq) + 2H_2SO_4(aq) \rightarrow V_2(SO_4)_3(aq) + MnSO_4(aq) + 2H_2O(l)$$

Which statement about this reaction is correct?

A Hydrogen is oxidised in the reaction.

B Manganese is the reducing agent in this reaction.

C Sulfuric acid is the oxidising agent in this reaction.

D The oxidation state of the vanadium changes from +5 to +3.

16 Which row gives mixtures that **both** result in the oxidation of a halide ion?

	mixture 1	mixture 2
A	$AgNO_3(aq)$ and $NaCl(aq)$	concentrated $H_2SO_4(aq)$ and $HI(aq)$
B	$Br_2(aq)$ and $NaCl(aq)$	concentrated $H_2SO_4(aq)$ and $HCl(aq)$
C	$Cl_2(aq)$ and $NaBr(aq)$	$CH_3CHBrCH_3(l)$ + NaOH (ethanolic)
D	$Br_2(aq)$ and $NaI(aq)$	concentrated $H_2SO_4(aq)$ and $NaBr(s)$

17 Chlorine gas is widely used to treat contaminated water.

When chlorine is added to water, which chemical species present is responsible for killing bacteria?

A ClO_2^- **B** Cl^- **C** HCl **D** ClO^-

5 Two moles of VO_2^+ ions react with one mole of zinc atoms in the presence of dilute acid. The products include Zn^{2+} ions and an ion, Y. Ion Y contains vanadium. Only zinc and vanadium change oxidation state in the reaction.

What is ion Y?

A VO_3^- **B** VO^+ **C** VO^{2+} **D** VO_2^{2+}

19 The nitrates of beryllium, calcium, magnesium and strontium all decompose in the same way when heated. When 2.00 g of one of these anhydrous nitrates is decomposed, 1.32 g of gas is produced.

What is the nitrate?

A beryllium nitrate

B calcium nitrate

C magnesium nitrate

D strontium nitrate

8 VO_2Cl reacts with NaI under acidic conditions.

$$2VO_2Cl + 2H_2SO_4 + 2NaI \rightarrow VOCl_2 + VOSO_4 + I_2 + Na_2SO_4 + 2H_2O$$

The oxidation state of Cl is –1 in VO_2Cl and in $VOCl_2$.

Which row about this reaction is correct?

	vanadium	iodine
A	is oxidised	is oxidised
B	is oxidised	is reduced
C	is reduced	is oxidised
D	is reduced	is reduced

25 T is an element in Period 3.

The first ionisation energy of T is lower than that of the element with one less proton.

The oxide of T does not react with water.

What is the identity of T?

A aluminium

B silicon

C sodium

D sulfur

11 NCl_3 reacts with H_2O.

$$NCl_3 + 3H_2O \rightarrow NH_3 + 3HClO$$

The oxidation state of nitrogen does not change in this reaction.

Which statement is correct?

A Chlorine is reduced.

B Chlorine is oxidised.

C Hydrogen is both oxidised and reduced.

D This is not a redox reaction.

6 The boiling points of some hydrogen halides are shown.

hydrogen halide	boiling point / K
H–C*l*	188
H–Br	206
H–I	238

What is the explanation for the trend in boiling point for the hydrogen halides from HC*l* to HI?

A The bond energies of the hydrogen halides increase from HC*l* to HI.

B There is an increase in the strength of the intermolecular forces of attraction from HC*l* to HI.

C The intermolecular hydrogen bonds become stronger from HC*l* to HI.

D There is an increase in the bond polarity from HC*l* to HI.

15 Z is an anhydrous compound of a Group 2 element. When it is heated, Z undergoes thermal decomposition to produce two different gases. Z has relatively low thermal stability compared to other Group 2 compounds containing the same anion as Z.

What is compound Z?

A barium carbonate

B barium nitrate

C magnesium carbonate

D magnesium nitrate

3 Zinc reacts with concentrated nitric acid giving three products only: zinc nitrate, an oxide of nitrogen and water.

3.0 moles of zinc react with 8.0 moles of nitric acid. Zinc nitrate contains Zn^{2+} ions.

What could be the formula of the oxide of nitrogen?

A N_2O **B** NO **C** N_2O_3 **D** NO_2

16 Chlorine gas is reacted with aqueous sodium hydroxide. The oxidation number of chlorine changes from 0 to –1 and also from 0 to +1.

Under which conditions does this reaction occur and what is the colour of the solid silver salt with chlorine in the oxidation state –1?

	reaction conditions	colour of silver salt
A	cold, dilute alkali	white
B	cold, dilute alkali	yellow
C	hot, concentrated alkali	white
D	hot, concentrated alkali	yellow

22 Which statement relating to the elements in Group 17 and their compounds is correct?

A Bromine will reduce KI to form iodine.

B Iodide ions react to form a white precipitate when added to silver nitrate solution.

C Bromide ions react to form a white precipitate when added to silver nitrate solution.

D Chlorine reacts with hydrogen to form a colourless gas.

21 What is the oxidation state of the chlorine-containing species that kills bacteria in drinking water?

A –1 **B** +1 **C** +3 **D** +5

19 X and Y are elements in Period 3 of the Periodic Table.

Y has a greater atomic number than X.

The stable ion formed by Y has a greater radius than the stable ion formed by X.

The stable ion formed by Y has 18 electrons.

Which row is correct?

	number of electrons in the stable ion of X	element with the greater atomic radius
A	10	X
B	10	Y
C	18	X
D	18	Y

9 The equation for a redox reaction is shown.

$$SnCl_2(aq) + 2HgCl_2(aq) \rightarrow SnCl_4(aq) + Hg_2Cl_2(s)$$

Which species is being oxidised in this reaction?

A Sn^{2+} **B** Cl^- **C** Hg^+ **D** Hg^{2+}

20 Equal masses of $CaCO_3$, $Ca(NO_3)_2$, $BaCO_3$ and $Ba(NO_3)_2$ are thermally decomposed. The volume of gas produced in each experiment is measured under the same conditions.

Which compound will produce the greatest volume of gas?

A $CaCO_3$ **B** $Ca(NO_3)_2$ **C** $BaCO_3$ **D** $Ba(NO_3)_2$

12 $KMnO_4$ is an oxidising agent. Its reaction with Fe^{2+} is shown in the following ionic equation.

$$...X...MnO_4^- + ...Fe^{2+} + ...H^+ \rightarrow .....Mn^{2+} + ...Y...Fe^{3+} + ...H_2O$$

What are X and Y when the equation is balanced?

	X	Y
A	1	1
B	1	3
C	1	5
D	5	1

6 The compound potassium bismuthate(V), $KBiO_3$, is a powerful oxidising agent.

What is the significance of the (V) in potassium bismuthate(V)?

A It is the oxidation number of the bismuth atom.

B It is the charge of the bismuthate ion.

C It is the oxidation number of the bismuthate ion.

D It is the sum of the charges of the two ions present.

12 In which row do the oxidation numbers of vanadium increase?

	smallest →		largest
A	VO_4^{3-}	VO_3^-	VO_2^+
B	VO^{2+}	V_2O_3	VO_4^{3-}
C	V_2O_3	VO^{2+}	VO_3^-
D	VO_4^{3-}	VO_2^+	VO^{2+}

21 Which statement comparing magnesium and barium, or their compounds, is correct?

A Magnesium reacts with dilute hydrochloric acid more rapidly than barium does.

B One mole of magnesium carbonate gives off a greater amount of gas when it reacts with an excess of dilute hydrochloric acid than one mole of barium carbonate does.

C The solubility of magnesium sulfate in water is greater than the solubility of barium sulfate in water.

D Magnesium carbonate undergoes thermal decomposition **less** readily than barium carbonate does.

10 In a catalytic converter in the exhaust system of a car, carbon monoxide is oxidised to carbon dioxide, and nitrogen monoxide is reduced to nitrogen.

What are the changes in oxidation number of carbon and nitrogen in these two processes?

	carbon	nitrogen
A	–2	+2
B	–1	+1
C	+1	–1
D	+2	–2

13 Which statement about the compounds of the Group 2 metals is correct?

A Barium carbonate is less thermally stable than strontium carbonate.

B Barium sulfate is less soluble than magnesium sulfate.

C Calcium hydroxide is less soluble than magnesium hydroxide.

D Calcium nitrate is more thermally stable than strontium nitrate.

14 A 0.005 mol sample of anhydrous calcium carbonate is completely thermally decomposed to give 100 cm^3 of gas.

In a separate experiment carried out under the same conditions, a 0.005 mol sample of anhydrous calcium nitrate is completely thermally decomposed. The volume of gaseous products is measured.

What total volume of gaseous products is produced from the calcium nitrate?

A 50 cm^3 **B** 100 cm^3 **C** 200 cm^3 **D** 250 cm^3

21 Which row gives correct comparisons between the solubilities of calcium hydroxide and barium hydroxide and the thermal stabilities of calcium carbonate and barium carbonate?

	solubility		thermal stability	
	calcium hydroxide	barium hydroxide	calcium carbonate	barium carbonate
A	higher	lower	higher	lower
B	higher	lower	lower	higher
C	lower	higher	higher	lower
D	lower	higher	lower	higher

17 When concentrated sulfuric acid reacts with sodium iodide the products include sulfur, iodine, hydrogen sulfide and sulfur dioxide.

Which statement is correct?

A Hydrogen sulfide is the product of a reduction reaction.

B Iodide ions are stronger oxidising agents than sulfate ions.

C Sulfur atoms from the sulfuric acid are both oxidised and reduced.

D Sulfur atoms from the sulfuric acid are oxidised to make sulfur dioxide.

18 NO, NO_2, CO and unburnt hydrocarbons are present in the exhaust gases of internal combustion engines. When catalytic converters are used to remove these compounds from the exhaust gases, redox reactions occur.

What happens to each compound in the catalytic converter?

	NO	NO_2	CO	unburnt hydrocarbons
A	oxidised	oxidised	reduced	oxidised
B	oxidised	oxidised	oxidised	oxidised
C	reduced	reduced	oxidised	oxidised
D	reduced	reduced	reduced	reduced

11 One of the reactions in the rechargeable lead / acid battery is shown.

$$Pb(s) + PbO_2(s) + 4H^+(aq) + 2SO_4^{2-}(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$$

Which statement about this reaction is correct?

A Lead is both oxidised and reduced.

B Lead is neither oxidised nor reduced.

C Lead is oxidised only.

D Lead is reduced only.

23 Chlorine reacts with aqueous sodium hydroxide forming two chlorine-containing products.

Which row shows the oxidation states of chlorine in the products under the conditions stated?

	conditions	oxidation state of C*l* in products
A	cold NaOH(aq)	–1 and +3
B	cold NaOH(aq)	–1 and +5
C	hot NaOH(aq)	–1 and +3
D	hot NaOH(aq)	–1 and +5

24 A catalytic converter reduces the amount of pollutants in the fumes from a car exhaust.

Which row identifies a pollutant and shows how it is removed by the action of the catalyst?

	pollutant	chemical removal
A	carbon dioxide	reduced to carbon
B	carbon monoxide	oxidised to carbon dioxide
C	oxides of nitrogen	oxidised to nitric acid
D	unburnt hydrocarbons	oxidised to carbon dioxide and hydrogen