PapaCambridge

Cambridge AS & A Level

CHEMISTRY

Paper 1

Topical Past Paper Questions

+ Answer Scheme

2015 - 2021

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Chapter 10

Group 2

10.1 Similarities and trends in the properties of the Group 2 metals

537. 9701_m22_qp_12 Q: 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

---

538. 9701_m21_qp_12 Q: 14

Which row correctly describes one property of barium and one property of barium oxide?

	observation when barium metal is added to water	pH of solution obtained when a spatula measure of BaO is added to 100 cm^3 of water
A	a few gas bubbles form on the metal surface	8
B	a few gas bubbles form on the metal surface	13
C	rapid effervescence is seen	8
D	rapid effervescence is seen	13

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539. 9701_m21_qp_12 Q: 15

An anhydrous white salt, Z, is heated strongly for 30 minutes. A mixture of gases is given off. The solid remaining in the test-tube is then dissolved in a small volume of dilute hydrochloric acid. The addition of a few drops of dilute sulfuric acid to the test-tube causes a white precipitate to form.

Which substance could be Z?

A barium carbonate

B barium nitrate

C magnesium carbonate

D magnesium nitrate

---

540. 9701_s21_qp_11 Q: 14

Q is a mixture of a Group 2 oxide and a Group 2 sulfate. Q contains equal amounts of the two compounds.

Q is shaken with water and the resulting mixture filtered; a solid residue is obtained. There is no reaction when the solid residue is shaken with HCl(aq). Shaking the filtrate with H_2SO_4(aq) produces a white precipitate.

What could be Q?

A BaO + $BaSO_4$

B BaO + $MgSO_4$

C MgO + $BaSO_4$

D MgO + $MgSO_4$

---

541. 9701_s21_qp_11 Q: 15

Which substance will **not** be a product of the thermal decomposition of hydrated magnesium nitrate?

A dinitrogen monoxide

B magnesium oxide

C oxygen

D steam

---

542. 9701_s21_qp_12 Q: 14

A farmer requires a solid compound to raise the pH of the soil in a field from 5.5 to above 6.0.

Which compound could the farmer use?

A $(NH_4)_2SO_4$ **B** NH_4NO_3 **C** $Ca(OH)_2$ **D** $Ca(NO_3)_2$

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543. 9701_s21_qp_12 Q: 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

---

544. 9701_s21_qp_13 Q: 17

Which statement is correct?

A Doctors can use the very insoluble $MgSO_4$ to investigate the digestive system.

B Farmers can lower the pH of soil by spreading $CaCO_3$ on it.

C Students can test a solution for SO_4^{2-} ions by using $Ba(NO_3)_2(aq)$ followed by $HNO_3(aq)$.

D The insoluble hydroxide, $Ba(OH)_2$, can be safely used to lower the acidity of the stomach.

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545. 9701_s21_qp_13 Q: 18

A solid, X, was placed in an excess of the liquid Y.

A colourless gas was given off and a white precipitate was seen. The precipitate was not X.

What could be the identities of X and Y?

	X	Y
A	$BaCO_3$	H_2O
B	Ca	dilute H_2SO_4
C	Mg	dilute H_2SO_4
D	$SrCO_3$	dilute HCl

---

546. 9701_w21_qp_11 Q: 2

2.0 g of ammonium nitrate, NH_4NO_3, decomposes to give 0.90 g of water and a single gas.

What is the identity of the gas?

A NO **B** NO_2 **C** N_2O **D** N_2

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547. 9701_w21_qp_11 Q: 14

In which list are all three compounds soluble in water?

A barium chloride, calcium carbonate, magnesium hydroxide

B barium hydroxide, calcium hydroxide, strontium carbonate

C barium chloride, barium hydroxide, magnesium sulfate

D barium sulfate, calcium sulfate, magnesium hydroxide

---

548. 9701_w21_qp_12 Q: 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.

---

549. 9701_w21_qp_13 Q: 14

In which list are all three compounds soluble in water?

A barium chloride, calcium carbonate, magnesium hydroxide

B barium hydroxide, calcium hydroxide, strontium carbonate

C barium chloride, barium hydroxide, magnesium sulfate

D barium sulfate, calcium sulfate, magnesium hydroxide

---

550. 9701_m20_qp_12 Q: 13

Compound Z is insoluble in water but soluble at low pH.

What could be compound Z?

A barium carbonate

B barium chloride

C barium hydroxide

D barium sulfate

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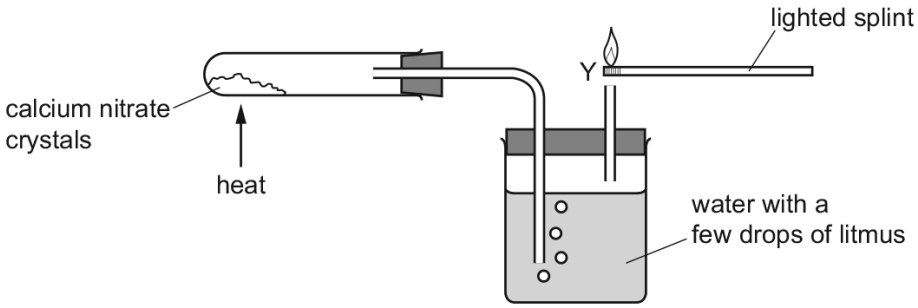
551. 9701_m20_qp_12 Q: 17

A student investigates calcium nitrate crystals by heating them in the apparatus shown.

A colourless gas leaves the apparatus at Y. A flame is held to this gas.



Which observations would the student make?

	litmus solution	flame at Y
A	changes to blue	flame burns more brightly
B	changes to blue	flame goes out
C	changes to red	flame burns more brightly
D	changes to red	flame goes out

---

552. 9701_s20_qp_11 Q: 14

An excess of MgO is shaken with water. The resulting mixture is filtered into test-tube P.

An excess of BaO is shaken with water. The resulting mixture is filtered into test-tube Q.

Which oxide reacts more readily with water and which filtrate has the **lower** pH?

	oxide reacts more readily with water	test-tube with filtrate of **lower** pH
A	BaO	P
B	BaO	Q
C	MgO	P
D	MgO	Q

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553. 9701_s20_qp_12 Q: 17

Which property shows an **increase** from magnesium to barium?

A the first ionisation energy of the elements

B the oxidising power of the metals

C the solubility of the hydroxides

D the solubility of the sulfates

---

554. 9701_s20_qp_13 Q: 14

The statements apply to the elements in Group 2.

Which statement is correct?

A As atomic number increases, ionic radius increases.

B As atomic number increases, reducing ability decreases.

C As atomic number increases, first ionisation energy increases.

D As atomic radius increases, first ionisation energy increases.

---

555. 9701_s20_qp_13 Q: 18

Which property shows an **increase** from calcium to barium going down Group 2?

A the ease of decomposition of the carbonates

B the solubility of the hydroxides

C the solubility of the sulfates

D the volume of hydrogen given off when 1 g of the metal reacts with water

---

556. 9701_w20_qp_11 Q: 13

This question is about two elements in Group 2, Q and R.

Three of the statements shown are correct for metal Q.

The one remaining statement is correct for metal R.

Which statement applies to R?

A A saturated solution of the hydroxide of this metal has the higher pH value.

B This metal has a carbonate that is used in agriculture to reduce the acidity of soil.

C This metal has the greater atomic radius.

D This metal reacts more quickly with cold water.

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557. 9701_w20_qp_11 Q: 15

A student mixes pairs of chemicals together in separate test-tubes.

- excess calcium (s) + water (l)
- barium chloride (aq) + strontium hydroxide (aq)
- calcium carbonate (s) + excess hydrochloric acid (aq)
- magnesium sulfate (aq) + barium nitrate (aq)

How many of the mixtures produce a white, solid product?

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

---

558. 9701_w20_qp_11 Q: 18

What are the trends in the stated properties as Group 2 is descended from magnesium to barium?

	decomposition temperature of the carbonate	first ionisation energy
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

---

559. 9701_w20_qp_12 Q: 13

Which row could refer to barium metal and barium hydroxide?

	colour seen when the metal is burnt in O_2	pH of a saturated solution of the hydroxide
A	green flame	8
B	green flame	13
C	white flame	8
D	white flame	13

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560. 9701_w20_qp_12 Q: 16

Due to their similar ionic radii, the reactions of lithium and magnesium and their corresponding compounds are very similar.

Which statement about the reactions of lithium or its compounds can be predicted from this statement?

A Lithium burns very slowly in oxygen.

B Lithium carbonate decomposes on heating in a blue Bunsen burner flame, forming lithium oxide and carbon dioxide.

C Lithium nitrate decomposes on heating, forming lithium nitrite, $LiNO_2$, and oxygen.

D Lithium reacts very violently with cold water, producing hydrogen.

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561. 9701_m19_qp_12 Q: 14

Metal T reacts with water to produce a colourless solution. A white precipitate is produced when this colourless solution is mixed with aqueous sulfuric acid.

What is metal T?

A barium

B magnesium

C potassium

D sodium

---

562. 9701_m19_qp_12 Q: 15

When calcium nitrate thermally decomposes, oxygen is one of the products.

Which volume of oxygen is produced under room conditions when 0.50 mol of calcium nitrate thermally decomposes?

A 6.0 dm^3 **B** 12.0 dm^3 **C** 18.0 dm^3 **D** 30.0 dm^3

---

563. 9701_m19_qp_12 Q: 16

L, M and N are Group 2 metals. L reacts more vigorously with dilute hydrochloric acid than N does. $M(OH)_2$ is more soluble than $N(OH)_2$.

What could be the identities of L, M and N?

	L	M	N
A	Ba	Ca	Sr
B	Ba	Sr	Ca
C	Ca	Ba	Sr
D	Sr	Ca	Ba

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564. 9701_s19_qp_11 Q: 14

Substance X reacts with water. A gas is given off and the pH of the solution increases. The solution is then reacted with sulfuric acid and a white precipitate forms.

What could be substance X?

A barium

B barium oxide

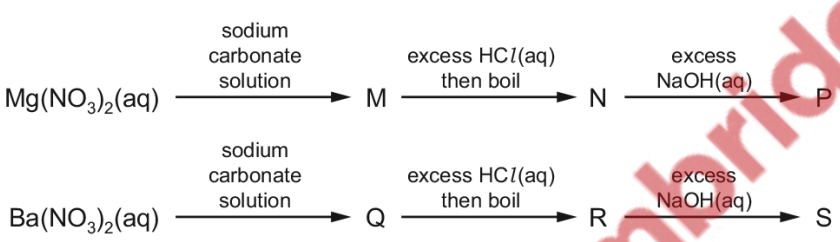
C magnesium

D magnesium oxide

---

565. 9701_s19_qp_11 Q: 15

Solutions of 0.1 mol dm^{-3} $Mg(NO_3)_2$ and 0.1 mol dm^{-3} $Ba(NO_3)_2$ separately undergo a series of reactions using pure reagents.



M, N and P are magnesium compounds.

Q, R and S are barium compounds.

How many of M, N, P, Q, R and S are white precipitates?

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

---

566. 9701_s19_qp_12 Q: 15

How many of the solutions shown, when added to separate portions of magnesium sulfate solution, produce a white precipitate?

$HCl(aq)$ $NH_3(aq)$ $(NH_4)_2CO_3(aq)$ $Ba(NO_3)_2(aq)$

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

---

567. 9701_s19_qp_12 Q: 16

A white solid, Z, is soluble in water. A sample of Z is heated with a Bunsen burner until there is no further change. When the residue is shaken with water a solution is formed with no solid remaining.

What could Z be?

A $MgCO_3$ **B** $Mg(NO_3)_2$ **C** $BaCO_3$ **D** $Ba(NO_3)_2$

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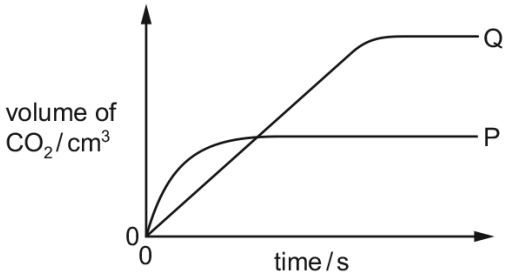
568. 9701_s19_qp_13 Q: 11

The volume of carbon dioxide collected by reacting 0.100 mol of magnesium carbonate with 50.0 cm^3 of 1.00 mol dm^{-3} sulfuric acid is measured against time. The volume produced is plotted against time and the line labelled P on the graph is obtained.



The experiment is repeated using 0.100 mol of the same magnesium carbonate, and a different sample of acid. All other conditions remain the same. Plotting these results gives the line labelled Q.

Which sample of acid could give the line labelled Q?

A 100 cm^3 of 0.500 mol dm^{-3} sulfuric acid

B 100 cm^3 of 1.00 mol dm^{-3} sulfuric acid

C 200 cm^3 of 0.500 mol dm^{-3} hydrochloric acid

D 200 cm^3 of 1.00 mol dm^{-3} hydrochloric acid

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569. 9701_s19_qp_13 Q: 14

Dilute hydrochloric acid is added to solid barium carbonate and solid magnesium carbonate in separate test-tubes.

Dilute sodium hydroxide is added to 0.1 mol dm^{-3} barium chloride and 0.1 mol dm^{-3} magnesium chloride in separate test-tubes.

Which row is correct?

	$BaCO_3$(s) + HCl(aq)	$BaCl_2$(aq) + NaOH(aq)	$MgCO_3$(s) + HCl(aq)	$MgCl_2$(aq) + NaOH(aq)
A	no change	white ppt	no change	no change
B	effervescence	no change	effervescence	no change
C	effervescence	no change	effervescence	white ppt
D	effervescence	white ppt	effervescence	white ppt

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570. 9701_w19_qp_11 Q: 14

A 5.00 g sample of an anhydrous Group 2 metal nitrate loses 3.29 g in mass when heated strongly.

Which metal is present?

A magnesium

B calcium

C strontium

D barium

---

571. 9701_w19_qp_11 Q: 15

Solutions P and Q each contain a different Group 2 ion at the same concentration. One contains Mg^{2+}, 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+}

---

572. 9701_w19_qp_12 Q: 13

Which statement about the compounds of Group 2 elements magnesium to barium is correct?

A Carbonates of Group 2 elements produce bubbles when added to dilute nitric acid.

B Nitrates of Group 2 elements produce nitrogen and oxygen on heating.

C Oxides of Group 2 elements produce bubbles when added to dilute hydrochloric acid.

D The oxides of Group 2 elements are amphoteric.

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573. 9701_w19_qp_12 Q: 14

When equal volumes of saturated solutions of barium hydroxide and calcium hydroxide are mixed, a white precipitate, Y, forms. The mixture is filtered and carbon dioxide is bubbled through the filtrate, producing a second white precipitate, Z.

What are Y and Z?

	Y	Z
A	$Ba(OH)_2$	$Ca(OH)_2$
B	$Ba(OH)_2$	$CaCO_3$
C	$Ca(OH)_2$	$BaCO_3$
D	$Ca(OH)_2$	$Ba(OH)_2$

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574. 9701_m18_qp_12 Q: 20

Which types of stereoisomerism are shown by 2,4-dimethylhex-2-ene?

A both cis-trans isomerism and optical isomerism

B cis-trans isomerism only

C neither cis-trans isomerism nor optical isomerism

D optical isomerism only

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575. 9701_m18_qp_12 Q: 21

An organic ion containing a carbon atom with a negative charge is called a carbanion.

An organic ion containing a carbon atom with a positive charge is called a carbocation.

The reaction between aqueous sodium hydroxide and 1-bromobutane proceeds by an S_N2 mechanism.

What is the first step in the mechanism?

A attack by a nucleophile on a carbon atom with a partial positive charge

B heterolytic bond fission followed by attack by an electrophile on a carbanion

C heterolytic bond fission followed by attack by a nucleophile on a carbocation

D homolytic bond fission followed by attack by a nucleophile on a carbocation

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576. 9701_s18_qp_11 Q: 18

When 3.00 g of an anhydrous nitrate of a Group 2 metal is decomposed, 1.53 g of gas is produced.

What is the nitrate compound?

A beryllium nitrate

B calcium nitrate

C magnesium nitrate

D strontium nitrate

---

577. 9701_s18_qp_11 Q: 19

Which row correctly describes one property of barium and one property of barium oxide?

	observation when barium metal is added to water	pH of solution obtained when a spatula measure of BaO is added to 100 cm^3 of water
A	a few gas bubbles form on the metal surface	8
B	a few gas bubbles form on the metal surface	13
C	rapid effervescence is seen	8
D	rapid effervescence is seen	13

---

578. 9701_s18_qp_12 Q: 16

In Group 2 of the Periodic Table, the properties of the elements and their compounds show regular change down the group.

Which property shows a **decrease** from magnesium to barium?

A the decomposition temperature of the carbonates

B the decomposition temperature of the nitrates

C the solubility of the hydroxides

D the solubility of the sulfates

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579. 9701_s18_qp_13 Q: 14

An ore contains magnesium carbonate and barium carbonate. A sample of the ore is dissolved in nitric acid.

How could this solution be processed into a magnesium compound and a separate barium compound?

A Add HCl(aq), filter off the solid barium chloride.

B Add HCl(aq), filter off the solid magnesium chloride.

C Add H_2SO_4(aq), filter off the solid barium sulfate.

D Add H_2SO_4(aq), filter off the solid magnesium sulfate.

---

580. 9701_s18_qp_13 Q: 15

When calcium and calcium hydride, CaH_2, react separately with water, they each produce a white solid and a colourless gas. The white solid is the same compound in each reaction.

Which statement is correct?

A Both Ca and CaH_2 produce H_2.

B Both Ca and CaH_2 produce O_2.

C Ca produces H_2 and CaH_2 produces O_2.

D Ca produces O_2 and CaH_2 produces H_2.

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581. 9701_w18_qp_11 Q: 15

A sample of anhydrous calcium nitrate is placed in a test-tube and heated in a roaring Bunsen flame until it decomposes. The description of the gas in the test-tube is then noted. A glowing splint is then put into the test-tube and any changes are noted.

Which observations are correct?

	description of the gas in the test-tube	result of glowing splint test
A	brown	the splint goes out
B	brown	the splint relights
C	colourless	the splint goes out
D	colourless	the splint relights

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582. 9701_w18_qp_11 Q: 18

Which statement explains the observation that magnesium hydroxide dissolves in aqueous ammonium chloride, but not in aqueous sodium chloride?

A The ionic radius of the NH_4^+ ion is similar to that of Mg^{2+} but not that of Na^+.

B NH_4Cl dissociates less fully than $NaCl$.

C The Na^+ and Mg^{2+} ions have the same number of electrons.

D The NH_4^+ ion can donate a proton.

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583. 9701_w18_qp_12 Q: 14

A 4.00 g sample of an anhydrous Group 2 metal nitrate is heated strongly until there is no further change. A solid residue of mass 1.37 g is formed.

Which metal is present?

A barium

B calcium

C magnesium

D strontium

---

584. 9701_w18_qp_12 Q: 15

In which row are all statements comparing magnesium and barium correct?

	fourth ionisation energy		reaction with water	
	magnesium	barium	magnesium	barium
A	higher	lower	faster	slower
B	higher	lower	slower	faster
C	lower	higher	faster	slower
D	lower	higher	slower	faster

---

585. 9701_m17_qp_12 Q: 14

Why does barium react more rapidly with cold water than magnesium does?

A Barium atoms are larger and form ions more easily than magnesium atoms.

B Barium floats on the surface of the water but magnesium sinks in the water.

C Barium hydroxide is less soluble than magnesium hydroxide.

D The sum of the 1st and 2nd ionisation energies of barium is more than that for magnesium.

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586. 9701_s17_qp_11 Q: 14

An excess of MgO is shaken with water. The resulting mixture is filtered into test-tube X.

An excess of BaO is shaken with water. The resulting mixture is filtered into test-tube Y.

Which oxide reacts more readily with water and which filtrate has the **lower** pH?

	oxide reacts more readily with water	test-tube with filtrate of **lower** pH
A	barium oxide	X
B	barium oxide	Y
C	magnesium oxide	X
D	magnesium oxide	Y

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587. 9701_s17_qp_11 Q: 15

Samples of magnesium carbonate, $MgCO_3$, are placed in crucibles R and S. The sample in crucible R is heated until there is no further loss in mass, and then allowed to cool. The sample in crucible S is left unheated.

Dilute hydrochloric acid is then added to both crucibles.

On adding the dilute hydrochloric acid, which observations are correct?

	R	S
A	gas produced	gas produced
B	gas produced	no gas produced
C	no gas produced	gas produced
D	no gas produced	no gas produced

---

588. 9701_s17_qp_12 Q: 3

In some fireworks there is a reaction between powdered aluminium and powdered barium nitrate. Heat is evolved, an unreactive gas is produced, and all nitrogen atoms are reduced.

What is the equation for this reaction?

A $2Al + Ba(NO_3)_2 \rightarrow Al_2O_3 + BaO + 2NO$

B $4Al + 4Ba(NO_3)_2 \rightarrow 2Al_2O_3 + 4Ba(NO_2)_2 + O_2$

C $10Al + 3Ba(NO_3)_2 \rightarrow 5Al_2O_3 + 3BaO + 3N_2$

D $10Al + 18Ba(NO_3)_2 \rightarrow 10Al(NO_3)_3 + 18BaO + 3N_2$

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589. 9701_s17_qp_12 Q: 14

Trends are seen in the physical and chemical properties of the elements of Group 2 and their compounds.

Which property shows a **decrease** from magnesium to barium?

A the rate of the reaction between the element and dilute hydrochloric acid

B the solubility of the hydroxides

C the solubility of the sulfates

D the temperature of decomposition of the carbonates

---

590. 9701_s17_qp_12 Q: 15

Calcium oxide is added to water and the resulting mixture is filtered.

This filtrate is X.

When carbon dioxide is bubbled through filtrate X, a white precipitate is formed.

Which equation for this reaction of filtrate X with carbon dioxide is correct?

A $CaO + CO_2 \rightarrow CaCO_3$

B $Ca(OH)_2 + CO_2 \rightarrow CaO + H_2CO_3$

C $2CaO + H_2O + CO_2 \rightarrow CaCO_3 + Ca(OH)_2$

D $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

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591. 9701_s17_qp_13 Q: 15

Which row correctly describes the reactions of calcium and strontium with water?

	substance reduced	substance oxidised	more vigorous reaction
A	calcium or strontium	water	calcium + water
B	calcium or strontium	water	strontium + water
C	water	calcium or strontium	calcium + water
D	water	calcium or strontium	strontium + water

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592. 9701_w17_qp_11 Q: 15

The mineral dolomite is a mixture of magnesium carbonate and calcium carbonate.

An aqueous reagent, X, was added to a small sample of dolomite. Effervescence was seen and a white solid, Y, was formed.

What could be the correct identity of reagent X and solid Y?

	reagent X	solid Y
A	hydrochloric acid	calcium chloride
B	hydrochloric acid	magnesium chloride
C	sulfuric acid	calcium sulfate
D	sulfuric acid	magnesium sulfate

---

593. 9701_w17_qp_12 Q: 14

Radium is an element below barium in Group 2 of the Periodic Table.

Which equation shows what happens when solid radium nitrate, $Ra(NO_3)_2$, is heated strongly?

A $Ra(NO_3)_2(s) \rightarrow RaO(s) + N_2O(g) + 2O_2(g)$

B $2Ra(NO_3)_2(s) \rightarrow 2RaO(s) + 2N_2(g) + 5O_2(g)$

C $2Ra(NO_3)_2(s) \rightarrow 2RaO(s) + 4NO_2(g) + O_2(g)$

D $4Ra(NO_3)_2(s) \rightarrow 2Ra_2O(s) + 8NO_2(g) + 3O_2(g)$

---

594. 9701_w17_qp_12 Q: 19

X is a mixture of two compounds of Group 2 elements.

X undergoes thermal decomposition to produce a white solid and only two gaseous products. One of the gaseous products relights a glowing splint.

What could be the components of mixture **X**?

A $MgCl_2$ and $CaCO_3$

B $MgCO_3$ and $Ca(NO_3)_2$

C $Mg(NO_3)_2$ and $Ca(NO_3)_2$

D MgO and CaO

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595. 9701_s16_qp_11 Q: 14

X and Y are both Group 2 metals.

X and Y both form hydroxide compounds, but $X(OH)_2$ is more soluble in water than $Y(OH)_2$.

If a piece of metal Y is put into cold water a very slow reaction occurs, and only a very few, small hydrogen bubbles can be seen.

What could be the identities of X and Y?

	X	Y
A	barium	magnesium
B	barium	strontium
C	calcium	strontium
D	magnesium	calcium

---

596. 9701_s16_qp_12 Q: 16

A solid, **T**, was placed in an excess of the liquid **U**.

A colourless gas was given off and a white precipitate was seen. The precipitate was not **T**.

What could be the identities of **T** and **U**?

	T	**U**
A	$BaCO_3$	H_2O
B	Ca	dilute H_2SO_4
C	Mg	dilute H_2SO_4
D	$SrCO_3$	dilute HC*l*

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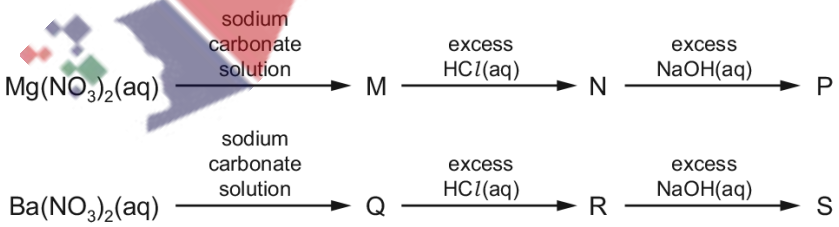
597. 9701_s16_qp_13 Q: 14

Solutions of $Mg(NO_3)_2$ and $Ba(NO_3)_2$ separately undergo a series of reactions.



M, N and P are magnesium compounds.

Q, R and S are barium compounds.

How many of M, N, P, Q, R and S are white precipitates?

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

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598. 9701_s16_qp_13 Q: 16

Steam is passed over heated magnesium to give compound J and hydrogen.

What is **not** a property of compound J?

A It has an M_r of 40.3.

B It is basic.

C It is a white solid.

D It is very soluble in water.

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599. 9701_w16_qp_11 Q: 18

Which row of the table gives correct comparisons between the solubilities of calcium and barium hydroxide and the thermal stabilities of calcium 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

---

600. 9701_w16_qp_12 Q: 17

When heated, magnesium nitrate decomposes.

Which equation for the thermal decomposition of magnesium nitrate is correct?

A $Mg(NO_3)_2 \rightarrow MgO + NO_2 + NO + O_2$

B $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO + 3O_2$

C $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$

D $3Mg(NO_3)_2 \rightarrow Mg_2N_3 + MgO + 3NO + 7O_2$

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601. 9701_s15_qp_11 Q: 13

The three minerals below are obtained from mines around the world. Each one behaves as a mixture of two carbonate compounds. They can be used as fire retardants because they decompose in the heat, producing CO_2. This gas smothers the fire.

barytocite	$BaCa(CO_3)_2$
dolomite	$CaMg(CO_3)_2$
huntite	$Mg_3Ca(CO_3)_4$

What is the order of effectiveness as fire retardant, from best to worst?

	best → worst		
A	dolomite	barytocite	huntite
B	dolomite	huntite	barytocite
C	huntite	barytocite	dolomite
D	huntite	dolomite	barytocite

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602. 9701_s15_qp_11 Q: 19

Use of the Data Booklet is relevant to this question.

Which mass of solid residue will be obtained from the thermal decomposition of 4.10 g of anhydrous calcium nitrate?

A 0.70 g **B** 1.00 g **C** 1.40 g **D** 2.25 g

---

603. 9701_s15_qp_12 Q: 12

Use of the Data Booklet is relevant to this question.

When 3.00 g of an anhydrous nitrate of a Group II metal is decomposed, 1.53 g of gas is produced.

What is the nitrate compound?

A beryllium nitrate

B calcium nitrate

C magnesium nitrate

D strontium nitrate

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604. 9701_s15_qp_12 Q: 13

What happens when a piece of magnesium ribbon is placed in cold water?

A A vigorous effervescence occurs.

B Bubbles of gas form slowly on the magnesium.

C The magnesium floats on the surface of the water and reacts quickly.

D The magnesium glows and a white solid is produced.

---

605. 9701_s15_qp_12 Q: 14

Compound **X** releases carbon dioxide gas and forms a white solid, **Y**, when it is heated. Neither **X** nor **Y** are soluble in water. Compound **Y** is used as a refractory kiln lining.

What is compound **X**?

A $CaCO_3$ **B** CaO **C** $MgCO_3$ **D** MgO

---

606. 9701_s15_qp_13 Q: 18

Due to their similar ionic radii, the reactions of lithium and magnesium and their corresponding compounds are very similar.

Which statement about the reactions of lithium or its compounds can be predicted from this statement?

A Lithium burns very slowly in oxygen.

B Lithium carbonate decomposes on heating in a blue Bunsen burner flame, forming lithium oxide and carbon dioxide.

C Lithium nitrate decomposes on heating, forming lithium nitrite, $LiNO_2$, and oxygen.

D Lithium reacts very violently with cold water, liberating hydrogen.

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607. 9701_w15_qp_11 Q: 12

X is a Group II metal. The carbonate of **X** decomposes when heated in a Bunsen flame to give carbon dioxide and a white solid residue as the only products. This white solid residue is sparingly soluble in water. Even when large amounts of the solid residue are added to water the pH of the saturated solution is less than that of limewater.

What could be the identity of **X**?

A magnesium

B calcium

C strontium

D barium

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608. 9701_w15_qp_11 Q: 13

Rat poison needs to be insoluble in rain water but soluble at the low pH of stomach contents.

What is a suitable barium compound to use for rat poison?

A barium carbonate

B barium chloride

C barium hydroxide

D barium sulfate

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609. 9701_w15_qp_12 Q: 12

Which property decreases on descending Group II?

A radius of the cation, M^{2+}

B reactivity of the element with water

C shielding of outermost electrons

D the ease of thermal decomposition of the carbonates, MCO_3

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