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# CHEMISTRY MULTIPLE CHOICE QUESTIONS

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I. Periodicity

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2002 -2014

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1. Which species represented by the following formulae has the largest radius?

- A  $P^3$       B  $Cl$       C  $Ar$       D  $K^+$

[2002 M/J (12)]

2. Which of the following oxides is **unlikely** to dissolve in aqueous sodium hydroxide?

- A  $Al_2O_3$       B  $MgO$       C  $SO_2$       D  $SiO_2$

[2002 M/J (13)]

3. An element of the third period (Na to S) is heated in chlorine. The product is purified and then added to water. The resulting solution is found to be neutral.

What is the element?

- A sodium  
B aluminium  
C silicon  
D phosphorus

[2002 M/J (14)]

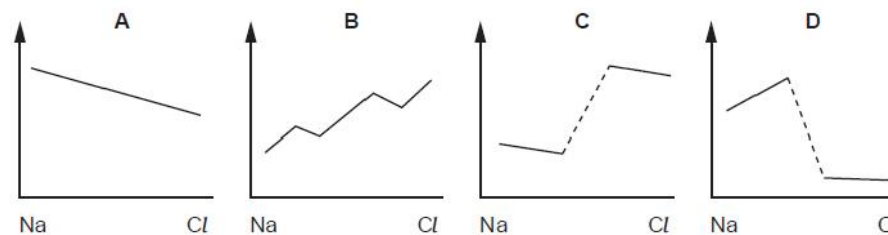
4. The chloride of element Q is hydrolysed by water to form an acidic solution and its oxide reacts with acid to form a salt.

What could be the element Q?

- A magnesium  
B aluminium  
C silicon  
D phosphorus

[2002 O/N (13)]

5. Which diagram represents the change in ionic radius of the elements across the third period (Na to Cl)?



[2002 O/N (14)]

6. Which isotope of an element in the third period of the Periodic Table contains the same number of neutrons as  $^{32}_{16}S$ ?

- A  $^{23}_{11}Na$   
B  $^{24}_{12}Mg$   
C  $^{28}_{14}Si$   
D  $^{31}_{15}P$

[2003 M/J (3)]

7. The successive ionisation energies, in  $\text{kJ mol}^{-1}$ , of an element X are given below.

870    1800    3000    3600    5800    7000    13200

What is X?

- A  $^{33}_{33}As$       B  $^{40}_{40}Zr$       C  $^{52}_{52}Te$       D  $^{53}_{53}I$

[2003 M/J (4)]

8.

A mixture of the oxides of two elements of the third period is dissolved in water. The solution is approximately neutral.

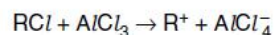
What could be the constituents of the mixture?

- A  $Al_2O_3$  and  $MgO$
- B  $Na_2O$  and  $MgO$
- C  $Na_2O$  and  $P_4O_{10}$
- D  $SO_3$  and  $P_4O_{10}$

[2003 M/J (13)]

9.

Aluminium chloride catalyses certain reactions by forming carbocations (carbonium ions) with chloroalkanes as shown.



Which property makes this reaction possible?

- A  $AlCl_3$  is a covalent molecule.
- B  $AlCl_3$  exists as the dimer  $Al_2Cl_6$  in the vapour.
- C The aluminium atom in  $AlCl_3$  has an incomplete octet of electrons.
- D The chlorine atom in  $RCl$  has a vacant p orbital.

[2003 M/J (14)]

10.

Which of the following statements are correct for the sequence of compounds below considered from left to right?

NaF    MgO    AlN    SiC

- 1 The electronegativity difference between the elements in each compound increases.
- 2 The formula-units of these compounds are isoelectronic (have the same number of electrons).
- 3 The bonding becomes increasingly covalent.

[2003 M/J (34)]

11.

The table gives the successive ionisation energies for an element X.

	1st	2nd	3rd	4th	5th	6th
ionisation energy / $\text{kJ mol}^{-1}$	950	1800	2700	4800	6000	12300

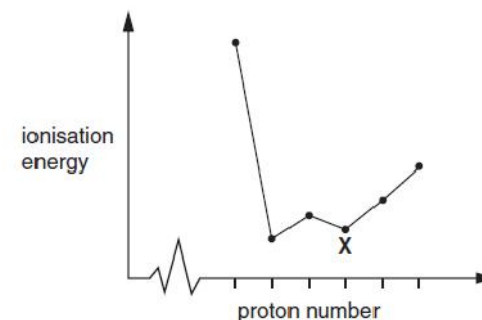
What could be the formula of the chloride of X?

- A  $XCl$
- B  $XCl_2$
- C  $XCl_3$
- D  $XCl_4$

[2003 O/N (5)]

12.

The sketch below shows the variation of first ionisation energy with proton number for six elements of consecutive proton numbers between 1 and 18 (H to Ar).



What is the identity of the element X?

- A Mg
- B Al
- C Si
- D P

[2003 O/N (13)]

13.

Which statements concerning the third period elements (sodium to argon) and their compounds are correct?

- 1 The elements become more electronegative from sodium to chlorine.
- 2 Aluminium oxide is the only oxide which is insoluble in water.
- 3 The maximum oxidation state is shown by silicon.

[2003 O/N (34)]

14.

The species Ar,  $K^+$  and  $Ca^{2+}$  are isoelectronic (have the same number of electrons).

In what order do their radii increase?

	smallest	→	largest
A	Ar		$Ca^{2+}$
B	Ar		$K^+$
C	$Ca^{2+}$		Ar
D	$K^+$		$Ca^{2+}$

[2004 O/N (14)]

15.

The following species contain the same number of electrons.

In which order do their radii increase?

	smallest radius	→	largest radius
A	Ar		$Ca^{2+}$
B	$Ca^{2+}$		Ar
C	$Ca^{2+}$		$K^+$
D	$K^+$		$Ca^{2+}$

[2005 M/J (14)]

16.

Use of the Data Booklet is relevant to this question.

Which element is likely to have an electronegativity similar to that of aluminium?

- A barium
- B beryllium
- C magnesium
- D strontium

[2005 M/J (15)]

17.

In 1999, researchers working in the USA believed that they had made a new element and that it had the following electronic structure.



In which Group of the Periodic Table would you expect to find this element?

- A II
- B IV
- C VI
- D 0

[2005 O/N (13)]

18.

Consecutive elements X, Y, Z are in Period 3 of the Periodic Table. Element Y has the highest first ionisation energy and the lowest melting point.

What could be the identities of X, Y and Z?

- A sodium, magnesium, aluminium
- B magnesium, aluminium, silicon
- C aluminium, silicon, phosphorus
- D silicon, phosphorus, sulphur

[2005 O/N (14)]

19.

Boron is a non-metallic element which is placed above aluminium in Group III of the Periodic Table. It forms a compound with nitrogen known as boron nitride which has a graphite structure.

Which of the following conclusions can be drawn from this information?

- 1 The empirical formula of boron nitride is BN.
- 2 The boron and nitride atoms are likely to be arranged alternately in a hexagonal pattern.
- 3 Boron nitride has a layer structure with van der Waals' forces between the layers.

[2005 O/N (33)]

20.

In which pair is the radius of the second atom greater than that of the first atom?

- A** Na, Mg      **B** Sr, Ca      **C** P, N      **D** Cl, Br

[2006 M/J (13)]

21.

The oxide and chloride of an element X are separately mixed with water. The two resulting solutions have the same effect on litmus.

What is element X?

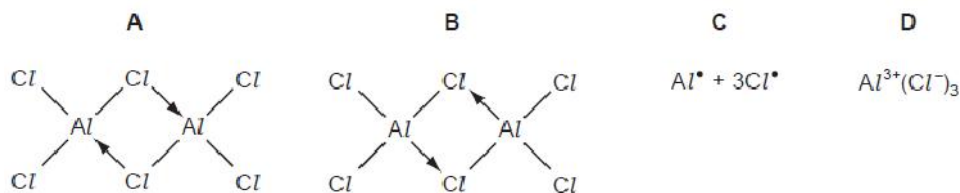
- A** sodium
- B** magnesium
- C** aluminium
- D** phosphorus

[2006 M/J (14)]

22.

Aluminium chloride sublimes at 178°C.

Which structure best represents the species in the vapour at this temperature?



[2006 M/J (15)]

23.

The Group IV elements carbon, silicon and germanium all exist in a diamond structure. The bond lengths in these structures are given below.

element X	C	Si	Ge
bond length X–X/nm	0.154	0.234	0.244

Why does the bond length increase down the group?

- 1 Orbital overlap decreases down the group.
- 2 Atomic radius increases down the group.
- 3 Nuclear charge increases down the group.

[2006 M/J (31)]

24.

Compound X

- does not conduct electricity when in a liquid state,
- when added to water produces a solution that readily conducts electricity.

What could X be?

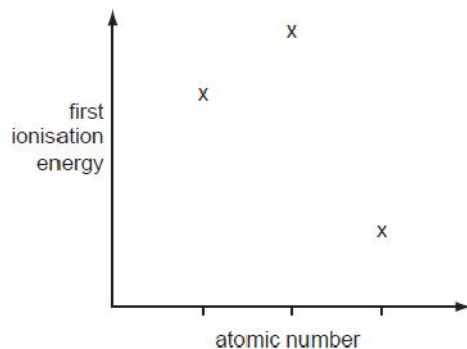
- 1  $MgCl_2$
- 2  $SiCl_4$
- 3  $PCl_3$

[2006 M/J (34)]



25.

Three successive elements in the Periodic Table have first ionisation energies which have the pattern shown in the diagram.



What could be the first element of this sequence?

- A** C                      **B** N                      **C** F                      **D** Na

[2006 O/N (2)]

26.

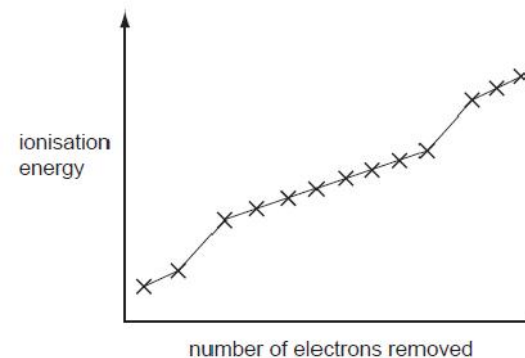
Which statements concerning the third period elements (sodium to argon) and their compounds are correct?

- 1 The elements become more electronegative from sodium to chlorine.
- 2 Aluminium oxide is the only oxide which is insoluble in water.
- 3 The maximum oxidation state is shown by silicon.

[2007 M/J (35)]

27.

The graph shows the first thirteen ionisation energies for element X.



What can be deduced about element X from the graph?

- A** It is in the second period (Li to Ne) of the Periodic Table.  
**B** It is a d-block element.  
**C** It is in Group II of the Periodic Table.  
**D** It is in Group III of the Periodic Table.

[2007 O/N (4)]

28.

When dangerous chemicals are transported by road, vehicles must carry signs that indicate what measures should be taken in the event of a spillage of the chemical carried.

Which material must be used if there were a spillage of metallic sodium?

- A** ethanol  
**B** jets of water  
**C** sand  
**D** water spray

[2007 O/N (12)]

29.

Which species has the largest radius?

- A  $P^3$                       B  $Cl$                       C  $Ar$                       D  $K^+$

[2007 O/N (13)]

30.

Which mixtures, on heating, produce the gas  $ND_3$ ?

[D =  $^2_1H$ , an isotope of hydrogen]

- 1  $CaO(s)$  and  $ND_4Cl(s)$
- 2  $CH_3CN$  and  $NaOD$  in  $D_2O$
- 3  $NDH_3Cl$  and  $NaOD$  in  $D_2O$

[2007 O/N (37)]

31.

In an experiment, 0.1 g samples of  $Na_2O$ ,  $MgO$ ,  $P_4O_{10}$  and  $SO_2$  are added to separate 100  $cm^3$  volumes of water.

For which oxide is the resulting mixture most alkaline?

- A  $Na_2O$                       B  $MgO$                       C  $P_4O_{10}$                       D  $SO_2$

[2008 M/J (13)]

32.

Which element is expected to show the greatest tendency to form some covalent compounds?

- A aluminium  
B calcium  
C magnesium  
D sodium

[2008 M/J (14)]

33.

Use of the Data Booklet is relevant to this question.

The combustion of fossil fuels is a major source of increasing atmospheric carbon dioxide, with a consequential rise in global warming. Another significant contribution to carbon dioxide levels comes from the thermal decomposition of limestone, in the manufacture of cement and of lime for agricultural purposes.

Cement works roast 1000 million tonnes of limestone per year and a further 200 million tonnes is roasted in kilns to make lime.

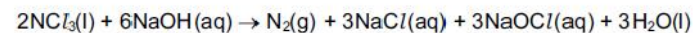
What is the total annual mass output of carbon dioxide (in million tonnes) from these two processes?

- A 440                      B 527                      C 660                      D 880

[2008 M/J (15)]

34.

When the yellow liquid  $NCI_3$  is stirred into aqueous sodium hydroxide, the reaction that occurs can be represented by the following equation.



What will be the result of this reaction?

- 1 The nitrogen is oxidised.
- 2 A bleaching solution remains after the reaction.
- 3 The final solution gives a precipitate with acidified silver nitrate.

[2008 M/J (36)]

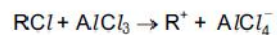
35.

Which oxide, when mixed with water, will produce the most acidic solution?

- A  $CO$                       B  $CO_2$                       C  $SiO_2$                       D  $P_2O_5$

[2008 O/N (13)]

36. Aluminium chloride catalyses certain reactions by forming carbocations (carbonium ions) with chloroalkanes as shown.



Which property makes this reaction possible?

- A  $AlCl_3$  exists as the dimer  $Al_2Cl_6$  in the vapour.
- B  $AlCl_3$  is a covalent molecule.
- C The aluminium atom in  $AlCl_3$  has an incomplete octet of electrons.
- D The chlorine atom in  $RCl$  has a vacant p orbital.

[2008 O/N (15)]

37. The first seven ionisation energies of an element between lithium and neon in the Periodic Table are as follows.

1310    3390    5320    7450    11 000    13 300    71 000     $\text{kJ mol}^{-1}$

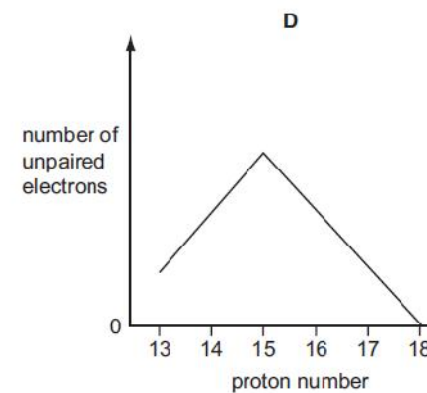
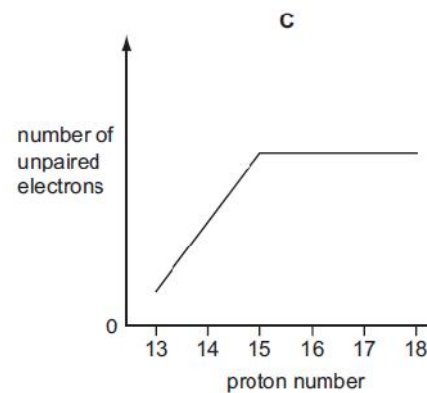
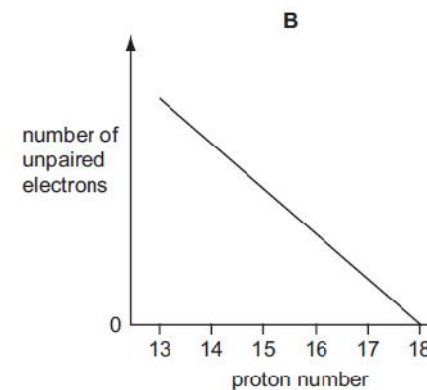
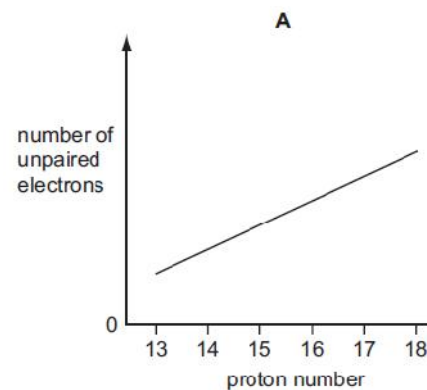
What is the outer electronic configuration of the element?

- A  $2s^2$
- B  $2s^2 2p^1$
- C  $2s^2 2p^4$
- D  $2s^2 2p^6$

[2009 M/J (3)]

38. Use of the Data Booklet is relevant to this question.

Which graph represents the number of unpaired p orbital electrons for atoms with proton numbers 13 to 18?



[2009 M/J (4)]

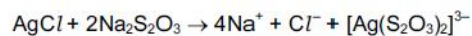


39. Which group of particles is in order of increasing size?

- A N O F
- B  $N^{3-}$   $O^{2-}$   $F^-$
- C  $Na^+$   $Mg^{2+}$   $Al^{3+}$
- D  $Na^+$  Ne  $F^-$

[2009 M/J (12)]

40. In black and white photographic film, light converts silver chloride into metallic silver. After the film has been developed, the unreacted silver chloride is removed by reaction with sodium thiosulfate to produce a 'fixed' negative.

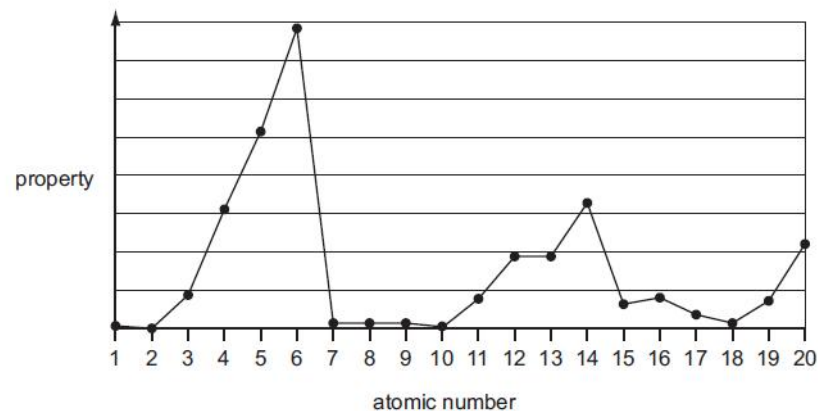


What is the function of the thiosulfate ion?

- A to make the silver ions soluble
- B to oxidise the silver ions
- C to oxidise the silver metal
- D to reduce the silver ions

[2009 M/J (15)]

41. The following graph shows the variation of a property of the first 20 elements in the Periodic Table with the atomic number of the element.



What is the property?

- A atomic radius
- B first ionisation energy
- C ionic radius
- D melting point

[2009 O/N-11 (12)]

42. Which statement correctly describes what happens when silicon tetrachloride is added to water?

- A The  $SiCl_4$  dissolves to give a neutral solution only.
- B The  $SiCl_4$  reacts to give an acidic solution only.
- C The  $SiCl_4$  reacts to give a precipitate and an acidic solution.
- D The  $SiCl_4$  reacts to give a precipitate and a neutral solution.

[2009 O/N-11 (13)]

43. The oxide and chloride of an element **X** are separately mixed with water. The two resulting solutions have the same effect on litmus.

What is element **X**?

- A sodium
- B magnesium
- C aluminium
- D phosphorus

[2009 O/N-11 (14)]

44. Consecutive elements X, Y, Z are in the third period of the Periodic Table. Element Y has the highest first ionisation energy and the lowest melting point.

What could be the identities of X, Y and Z?

- A aluminium, silicon, phosphorus
- B magnesium, aluminium, silicon
- C silicon, phosphorus, sulfur
- D sodium, magnesium, aluminium

[2010 M/J-11 (16)]

45. Which element of the third period requires the least number of moles of oxygen for the complete combustion of 1 mol of the element?

- A aluminium
- B magnesium
- C phosphorus
- D sodium

[2010 M/J-11 (18)]

46. Two properties of non-metallic elements and their atoms are as follows.

- property 1 has an oxide that can form a strong acid in water
- property 2 has **no** paired 3p electrons

Which properties do phosphorus and sulfur have?

	phosphorus	sulfur
<b>A</b>	1 and 2	1 only
<b>B</b>	1 only	1 and 2
<b>C</b>	1 and 2	1 and 2
<b>D</b>	2 only	1 only

[2010 M/J-11 (19)]

47. When gaseous chemicals are transported by road or by rail they are classified as follows.

- flammable
- non-flammable
- poisonous

Which commonly transported gas is non-flammable?

- A butane
- B hydrogen
- C oxygen
- D propene

[2010 M/J-11 (20)]

48. Why is the first ionisation energy of phosphorus greater than the first ionisation energy of silicon?

- A A phosphorus atom has one more proton in its nucleus.
- B The atomic radius of a phosphorus atom is greater.
- C The outer electron in a phosphorus atom is more shielded.
- D The outer electron in a phosphorus atom is paired.

[2010 O/N-11 (13)]

49. Which factor helps to explain why the first ionisation energies of the Group I elements decrease from lithium to sodium to potassium to rubidium?

- A The nuclear charge of the elements increases.
- B The outer electron is in an 's' subshell.
- C The repulsion between spin-paired electrons increases.
- D The shielding effect of the inner shells increases.

[2011 M/J-11 (5)]

50. Which oxides react with water to give a solution of pH 10 or higher?

- 1 CaO
- 2 Na<sub>2</sub>O
- 3 SrO

[2011 M/J-11 (35)]

51. Use of the Data Booklet is relevant to this question.

Which element is likely to have an electronegativity similar to that of aluminium?

- A barium
- B beryllium
- C magnesium
- D strontium

[2011 M/J-12 (12)]

52. In 1999, researchers working in the USA believed that they had made a new element and that it had the following electronic configuration.

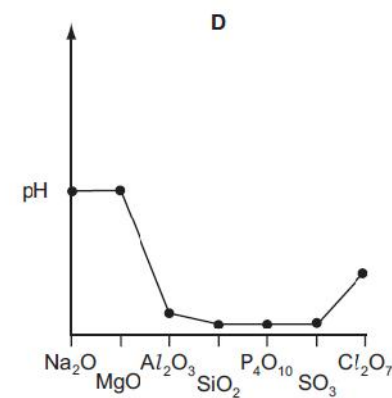
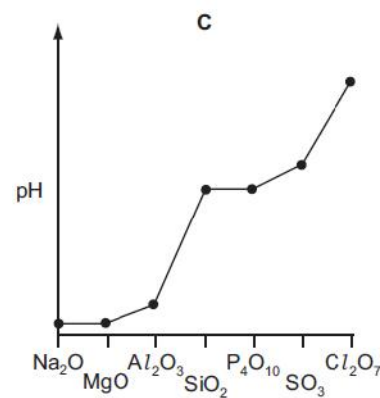
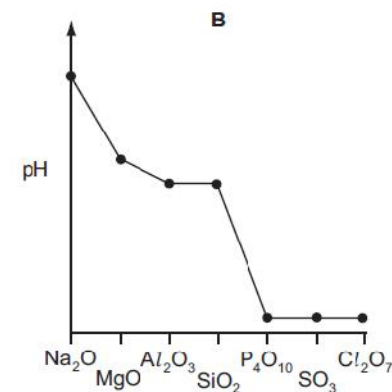
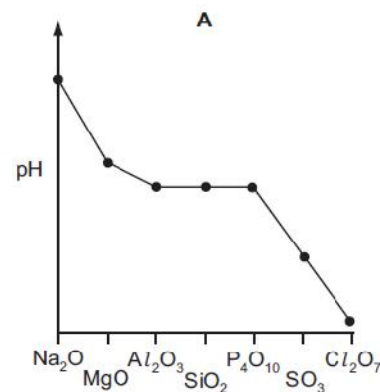


In which Group of the Periodic Table would you expect to find this element?

- A II
- B IV
- C VI
- D 0

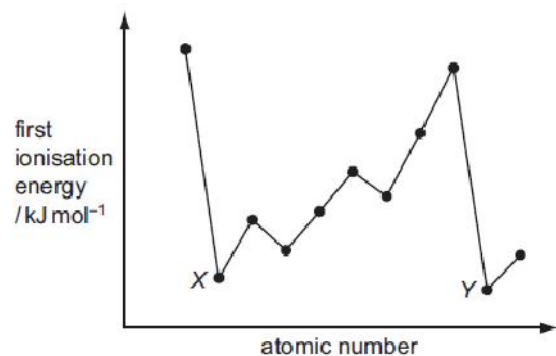
[2011 M/J-12 (13)]

53. The highest oxides of the elements sodium to chlorine are separately added to water. Which diagram best represents the pH of the resulting mixtures?



[2011 M/J-12 (14)]

54. The diagram shows the first ionisation energies of 11 consecutive elements.



Which type of elements are labelled X and Y?

- A Group I metals
- B Group II metals
- C halogens
- D noble gases

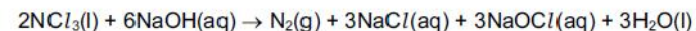
[2011 M/J-12 (15)]

55. Why does aluminium oxide dissolve in sodium hydroxide solution?

- A Aluminium oxide can behave as a base.
- B Aluminium oxide can behave as an acid.
- C Aluminium oxide has a giant structure.
- D The bonding in aluminium oxide is ionic.

[2011 M/J-12 (16)]

56. When the yellow liquid  $\text{NCl}_3$  is stirred into aqueous sodium hydroxide, the reaction that occurs can be represented by the following equation.



What will be the result of this reaction?

- 1 The nitrogen undergoes a redox reaction.
- 2 A bleaching solution remains after the reaction.
- 3 The final solution gives a precipitate with acidified silver nitrate.

[2011 M/J-12 (35)]

57. Which element shows the greatest tendency to form some covalent compounds?

- A aluminium
- B magnesium
- C neon
- D potassium

[2011 O/N-11 (13)]

58.  $\text{Ar}$ ,  $\text{Ca}^{2+}$  and  $\text{K}^+$ , contain the same number of electrons.

In which order do their radii increase?

	smallest radius	→	largest radius
<b>A</b>	Ar	$\text{K}^+$	$\text{Ca}^{2+}$
<b>B</b>	$\text{Ca}^{2+}$	Ar	$\text{K}^+$
<b>C</b>	$\text{Ca}^{2+}$	$\text{K}^+$	Ar
<b>D</b>	$\text{K}^+$	Ar	$\text{Ca}^{2+}$

[2011 O/N-12 (19)]



59.

Nitrogen and phosphorus are both in Group V of the Periodic Table. Phosphorus forms a chloride with the formula  $PCl_5$ .

Why is it **not** possible for nitrogen to form  $NCI_5$ ?

- 1 Nitrogen's outer shell can only contain eight electrons.
- 2 Nitrogen cannot have oxidation state +5.
- 3 Nitrogen is almost inert.

[2012 M/J-11 (33)]

60.

The period 4 elements gallium (Ga), germanium (Ge), arsenic (As) and selenium (Se) are the elements below aluminium, silicon, phosphorus and sulfur in the Periodic Table, a portion of which is shown below.

period 3 elements	Al	Si	P	S
period 4 elements	Ga	Ge	As	Se

The properties of each period 4 element resemble those of the period 3 element directly above it.

Which period 4 elements form oxides that dissolve in water to give an acid solution?

- A As and Se    B Ga and Ge    C Ga and Se    D Se only

[2012 M/J-12 (15)]

61.

Why is the ionic radius of a chloride ion larger than the ionic radius of a sodium ion?

- A A chloride ion has one more occupied electron shell than a sodium ion.
- B Chlorine has a higher proton number than sodium.
- C Ionic radius increases regularly across the third period.
- D Sodium is a metal, chlorine is a non-metal.

[2012 O/N-11 (13)]

62.

Use of the Data Booklet is relevant to this question.

1.15 g of a metallic element reacts with  $300\text{ cm}^3$  of oxygen at 298 K and 1 atm pressure, to form an oxide which contains  $O^{2-}$  ions.

What could be the identity of the metal?

- A calcium
- B magnesium
- C potassium
- D sodium

[2012 O/N-11 (17)]

63.

Elements X and Y are both in period three.

When the chloride of X is added to water, it reacts and a solution of pH 2 is produced.

When the chloride of Y is added to water, it dissolves and a solution of pH 7 is produced.

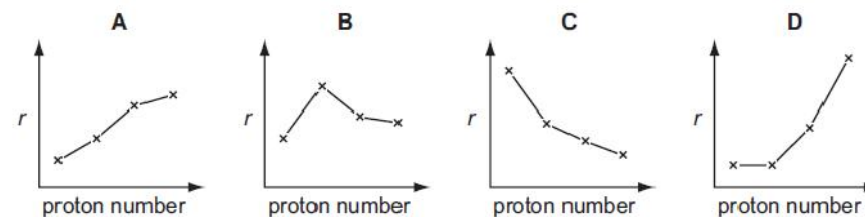
Which statement explains these observations?

- A Both chlorides hydrolyse in water.
- B X is phosphorus and Y is aluminium.
- C X is silicon and Y is sodium.
- D X is sodium and Y is phosphorus.

[2012 O/N-11 (18)]

64.

Which diagram shows the variation of the metallic radius  $r$  of the Group I elements, Li, Na, K and Rb, with increasing proton (atomic) number?



[2012 O/N-11 (19)]



65.

*Use of the Data Booklet is relevant to this question.*

Why is the ionic radius of a sulfide ion larger than the ionic radius of a potassium ion?

- A Ionic radius always decreases with increasing atomic number.
- B Positive ions have smaller radii than negative ions.
- C The potassium ion has more protons in its nucleus than the sulfide ion.
- D The sulfide ion is doubly charged; the potassium ion is singly charged.

[2012 O/N-13 (12)]

66.

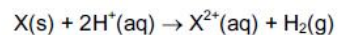
Which oxide, when mixed with water, will produce the solution with the lowest pH?

- A CO<sub>2</sub>
- B Na<sub>2</sub>O
- C P<sub>4</sub>O<sub>10</sub>
- D SiO<sub>2</sub>

[2012 O/N-13 (18)]

67.

An element X and compound YZ react separately with acid as shown.



When 1.0 g of either X or YZ is reacted with an excess of acid, the total volume of gas formed is the same.

Which statements are correct?

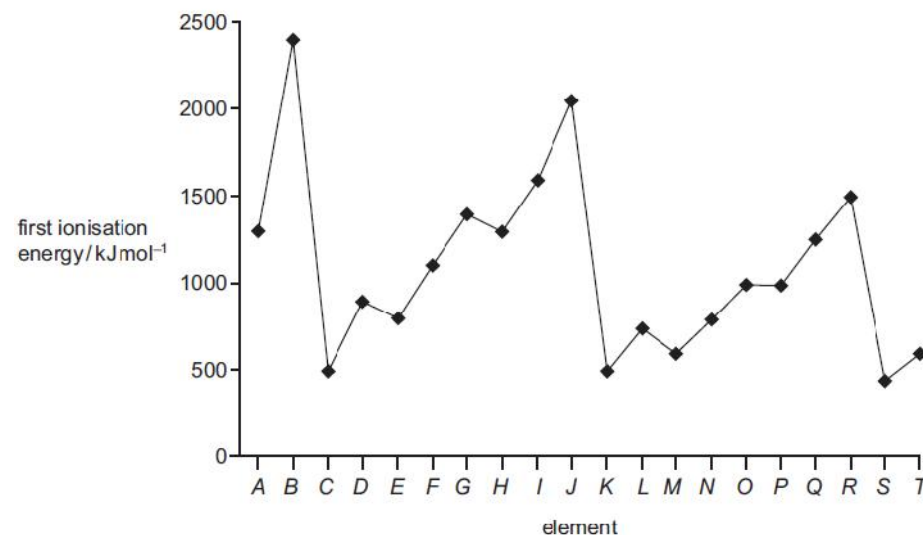
- 1  $A_r(X) = M_r(YZ)$
- 2 X and Y are metals.
- 3 X and Y must both be in the same Group of the Periodic Table.

[2012 O/N-13 (34)]

68.

The first ionisation energies of twenty successive elements in the Periodic Table are represented in the graph.

The letters given are not the normal symbols for these elements.



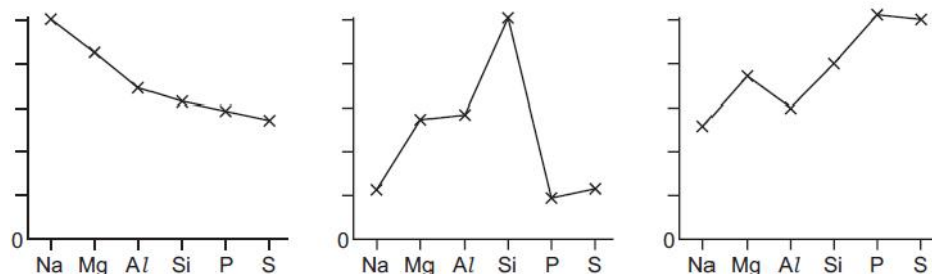
Which statements about this graph are correct?

- 1 Elements B, J and R are in Group 0 of the Periodic Table.
- 2 Atoms of elements D and L contain two electrons in their outer shells.
- 3 Atoms of elements G and O contain a half-filled p subshell.

[2013 M/J-11 (34)]

69.

The trends in three physical properties of the elements Na, Mg, Al, Si, P and S are shown in the graphs.



Which physical property is **not** illustrated?

- A atomic radius
- B electrical conductivity
- C first ionisation energy
- D melting point

[2013 M/J-12 (16)]

70.

Consecutive elements **X**, **Y** and **Z** are in the third period of the Periodic Table. Element **Y** has the highest first ionisation energy and the lowest melting point of these three elements.

What could be the identities of **X**, **Y** and **Z**?

- A sodium, magnesium, aluminium
- B magnesium, aluminium, silicon
- C aluminium, silicon, phosphorus
- D silicon, phosphorus, sulfur

[2013 O/N-11 (19)]

71.

Use of the Data Booklet is relevant to this question.

Carbon and nitrogen are adjacent in the Periodic Table.

Which properties do they both have?

- 1 There is an empty 2p orbital in one atom of the element.
- 2 The principal quantum number of the highest occupied orbital is 2.
- 3 They form compounds in which their atoms form bonds with four other atoms.

[2013 O/N-11 (32)]

72.

Use of the Data Booklet is relevant to this question.

Element X forms  $X^-$  ions that can be oxidised to element X by acidified potassium manganate(VII).

What could be the values of the first four ionisation energies of X?

	1st	2nd	3rd	4th
A	418	3070	4600	5860
B	577	1820	2740	11 600
C	590	1150	4940	6480
D	1010	1840	2040	4030

[2013 O/N-13 (4)]

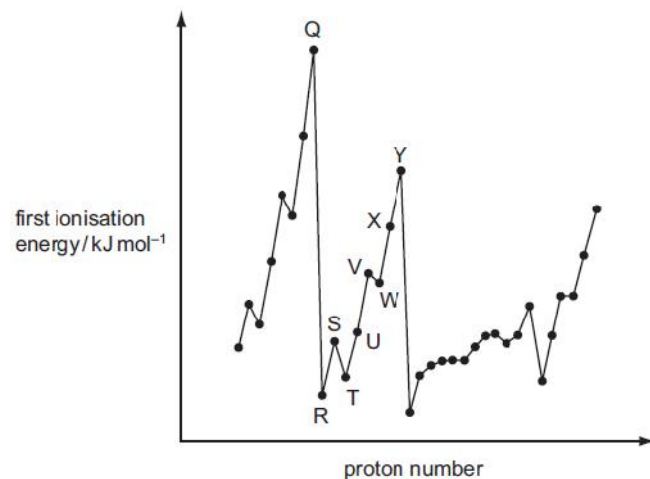
73.

Which oxide is insoluble in aqueous sodium hydroxide?

- A MgO
- B  $Al_2O_3$
- C  $P_4O_{10}$
- D  $SO_2$

[2013 O/N-13 (17)]

74. The graph below shows the variation of the first ionisation energy with the number of protons for some elements.



Which statement is correct?

- A Elements Q and Y are in the same period in the Periodic Table.
- B The general increase from elements R to Y is due to increasing atomic radius.
- C The small decrease between elements S and T is due to decreased shielding.
- D The small decrease between elements V and W is due to repulsion between paired electrons.

[2013 O/N-13 (18)]

75. Use of the Data Booklet is relevant to this question.

Elements J and K react together to form compound L. Elements J and K are both in Period 3. Element J has the smallest atomic radius in Period 3. There are only two elements in Period 3 which have a lower melting point than element K.

Which compound could be L?

- A  $MgCl_2$
- B  $MgS$
- C  $Na_2S$
- D  $PCl_3$

[2013 O/N-13 (19)]

76. Which chlorides of Period 3 elements will form a neutral solution when added to water?

- 1  $NaCl$
- 2  $Al_2Cl_6$
- 3  $PCl_5$

[2013 O/N-13 (36)]

77. What is the order of increasing melting point of the four chlorides shown?

$CCl_4$      $HCl$      $MgCl_2$      $PCl_5$

	lowest melting point	→		highest melting point
A	$CCl_4$	$HCl$	$PCl_5$	$MgCl_2$
B	$HCl$	$CCl_4$	$PCl_5$	$MgCl_2$
C	$HCl$	$PCl_5$	$CCl_4$	$MgCl_2$
D	$MgCl_2$	$PCl_5$	$CCl_4$	$HCl$

[2014 M/J-11 (14)]

78. Which description of the bonding and acid/base nature of aluminium oxide is correct?

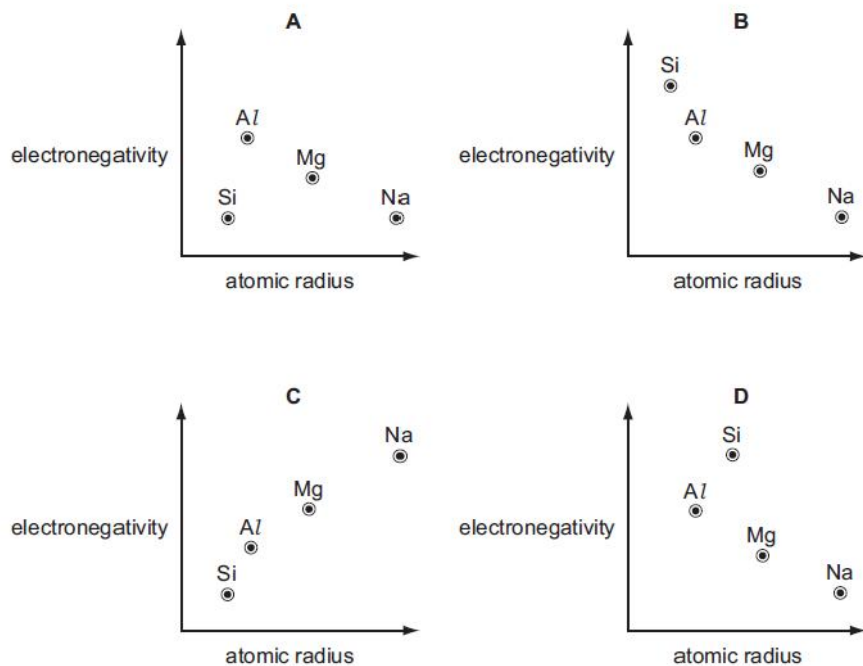
	bonding	acid / base nature
A	covalent	amphoteric
B	covalent	basic
C	ionic	amphoteric
D	ionic	basic

[2014 M/J-11 (16)]

79.

Use of the Data Booklet is relevant to this question.

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



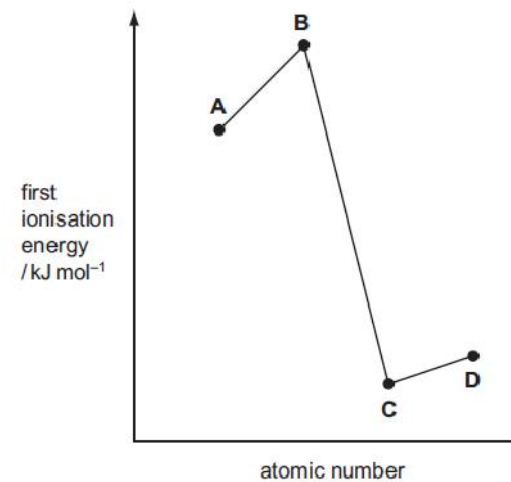
[2014 M/J-11 (19)]

80.

Shown on the graph are the relative values of the first ionisation energies of four elements that have consecutive atomic numbers.

One of the elements reacts with hydrogen to form a covalent compound with formula HX.

Which element could be X?



[2014 M/J-12 (10)]

81.

X and Y are oxides of different Period 3 elements.

If one mole of Y is added to water, the solution formed is neutralised by exactly one mole of X.

What could be the identities of X and Y?

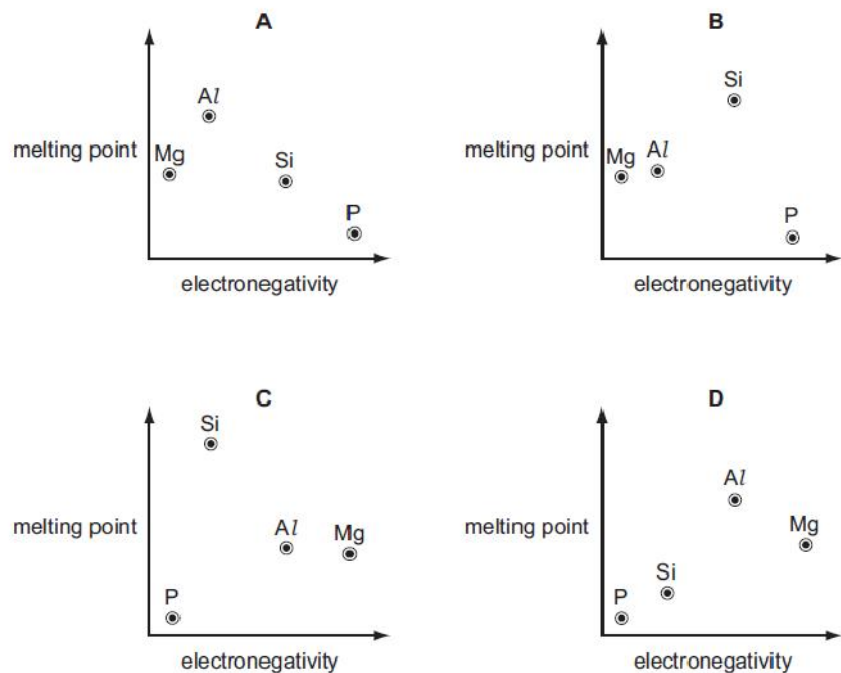
	X	Y
A	Al <sub>2</sub> O <sub>3</sub>	P <sub>4</sub> O <sub>10</sub>
B	Al <sub>2</sub> O <sub>3</sub>	SO <sub>3</sub>
C	Na <sub>2</sub> O	P <sub>4</sub> O <sub>10</sub>
D	Na <sub>2</sub> O	SO <sub>3</sub>

[2014 M/J-12 (13)]



82.

Which graph correctly shows the relative melting points of the elements Mg, Al, Si and P plotted against their relative electronegativities?



[2014 M/J-12 (16)]

83.

A student investigated the chloride of a Period 3 element. This is what he wrote down as his record of what he did and what he saw.

The compound was a white crystalline solid. It dissolved easily in water to give a solution of pH 12. When placed in a test-tube and heated in a roaring Bunsen flame, the compound melted after several minutes heating.

What can be deduced from this record?

- A At least one of the recorded observations is incorrect.
- B The compound was magnesium chloride,  $MgCl_2$ .
- C The compound was phosphorus pentachloride,  $PCl_5$ .
- D The compound was sodium chloride,  $NaCl$ .

[2014 M/J-13 (12)]

84.

The species Ne,  $Na^+$  and  $Mg^{2+}$  are isoelectronic. This means that they have the same number of electrons.

In which order do their radii increase?

	smallest	→	largest
A	Ne		$Mg^{2+}$
B	Ne		$Na^+$
C	$Mg^{2+}$		$Na^+$
D	$Mg^{2+}$		Ne

[2014 M/J-13 (16)]

85.

Which properties do compounds of aluminium and silicon have in common?

- A Aqueous solutions of their chlorides contain aluminium or silicon cations.
- B Their chlorides have co-ordinate bonding.
- C Their oxides are amphoteric.
- D Their oxides are insoluble in water.

[2014 M/J-13 (18)]



86. Element X, in Period 3, has the following properties.

- Its oxide has a giant structure.
- It forms covalent bonds with chlorine.
- Its oxide will neutralise  $\text{HCl(aq)}$ .

What is element X?

- A Mg                      B Al                      C Si                      D P

[2014 O/N-11 (12)]

87. Which property is **not** associated with the element sodium?

- A It can react with cold water to form hydrogen.  
 B It forms a basic oxide.  
 C It forms a neutral chloride.  
 D It is an oxidising agent.

[2014 O/N-11 (13)]

88. *Use of the Data Booklet is relevant to this question.*

A sample of potassium oxide,  $\text{K}_2\text{O}$ , is dissolved in  $250\text{cm}^3$  of distilled water.  $25.0\text{cm}^3$  of this solution is titrated against sulfuric acid of concentration  $2.00\text{mol dm}^{-3}$ .  $15.0\text{cm}^3$  of this sulfuric acid is needed for complete neutralisation.

Which mass of potassium oxide was originally dissolved in  $250\text{cm}^3$  of distilled water?

- A 2.83g                      B 28.3g                      C 47.1g                      D 56.6g

[2014 O/N-11 (15)]

89. Which oxide does **not** react with cold dilute sodium hydroxide to produce a salt?

- A  $\text{Al}_2\text{O}_3$                       B  $\text{P}_4\text{O}_{10}$                       C  $\text{SO}_2$                       D  $\text{SiO}_2$

[2014 O/N-11 (19)]

90. *Use of the Data Booklet is relevant to this question.*

In some types of spectroscopy, it is important to know if ions are isoelectronic. This means that they contain equal numbers of electrons.

Which ion is **not** isoelectronic with  $\text{K}^+$ ?

- A  $\text{Ca}^{2+}$                       B  $\text{Cl}^-$                       C  $\text{S}^{2-}$                       D  $\text{Ti}^{3+}$

[2014 O/N-13 (2)]

91. X, Y and Z are compounds of three elements in Period 3. Their electrical conductivities are shown in the table.

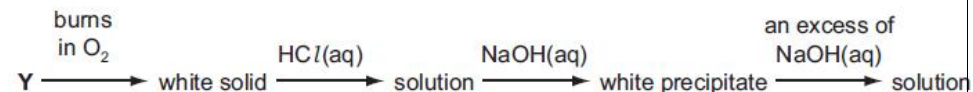
	X	Y	Z
conductivity of the compound in the molten state	good	does not conduct	does not conduct
conductivity of the mixture obtained by adding the compound to water	good	good	does not conduct

What could be compounds X, Y and Z?

	X	Y	Z
A	$\text{Al}_2\text{O}_3$	$\text{SiCl}_4$	NaF
B	NaF	$\text{Al}_2\text{O}_3$	$\text{SiCl}_4$
C	NaF	$\text{SiCl}_4$	$\text{SiO}_2$
D	$\text{SiCl}_4$	$\text{Al}_2\text{O}_3$	$\text{SiO}_2$

[2014 O/N-13 (14)]

92. An element Y reacts according to the following sequence.



What could be element Y?

- A Al                      B Ca                      C Mg                      D P

[2014 O/N-13 (17)]

93.

One molecule of the oxide of element **Z** reacts with six molecules of water to produce an acidic compound.

What is element **Z**?

- A aluminium
- B phosphorus
- C sodium
- D sulfur

[2014 O/N-13 (18)]

94.

A student examines two semi-precious stones; one is agate,  $\text{SiO}_2$ , and the other is calcite,  $\text{CaCO}_3$ .

How could they be distinguished?

- A Add a fixed amount of cold aqueous sodium hydroxide to each separately and measure any temperature change.
- B Heat each separately over a gentle Bunsen flame and note which one melts first.
- C Shake each separately with dilute hydrochloric acid and test any gas formed.
- D Shake each separately with distilled water and add a few drops of Universal Indicator.

[2014 O/N-13 (19)]