Periodic Table

Chemistry Past Exam Questions

Higher Level

2012

Section B - Question 5

5. (*a*) Write the electron configuration (*s*, *p*) of an oxygen atom showing the arrangement of electrons in atomic orbitals. (5)

(*b*) Define *atomic radius* (*covalent radius*).

State and explain the trend in atomic radii (covalent radii) across the second period of the periodic table of the elements. (12)

(*c*) Give **one** reason why electronegativity values exhibit a general increase across the second period of the periodic table. (3)

(*d*) Consider the following hydrides of some of the elements from the second and third periods of the periodic table: $\mathbf{H_2O}$ $\mathbf{NH_3}$ $\mathbf{PH_3}$ $\mathbf{HCl}$

(*i*) State how the bonding in $\mathbf{PH_3}$ differs from the bonding in the other three hydrides.

What is the reason for this difference in bonding?

(*ii*) From these four hydrides, identify the hydride or hydrides in which hydrogen bonding occurs between the molecules.

Give **one** property that is affected by the presence of intermolecular hydrogen bonding in the hydride or hydrides you have identified.

(*iii*) State the shape of the $\mathbf{PH_3}$ molecule and explain using electron-pair repulsion theory how this shape arises. (21)

(*e*) Boron trichloride ($\mathbf{BCl_3}$) is a colourless gas. Would you expect (*i*) the **B–Cl** bonds, (*ii*) the $\mathbf{BCl_3}$ molecules, to be polar or non-polar? Justify your answers. (9)

2011

Section B - Question 5

5. (*a*) Define (*i*) *atomic number*, (*ii*) *relative atomic mass*. (11)

(*b*) Sixty-two elements were known when Mendeleev, pictured on the right, published his periodic table of the elements in 1869.

What was the basis (periodic law) used by Mendeleev in arranging the elements in his periodic table?

Why did Mendeleev leave spaces in his periodic table, e.g. where the element germanium occurs in the modern periodic table?

In a few instances Mendeleev reversed the order of elements required by his periodic law. For example, he placed the element tellurium before the element iodine. Explain why he did this.(12)

(*c*) One of the most useful features of the periodic table of the elements is that it allows trends in the properties of the elements to be compared.

Explain why (*i*) the alkali metals are all reactive, (*ii*) the reactivity of the alkali metals increases down the group. (9)

(*d*) The arrangement of elements in the modern periodic table is now known to be consistent with their electrons filling into atomic orbitals of increasing energy.

(*i*) Define *atomic orbital*.

(*ii*) Write the electron configuration (*s*, *p*, etc.) of the element manganese (**Mn**).

(*iii*) What do the electron configurations of the series of elements from scandium to zinc have in common? (18)

2010

Section B - Question 4 B

(*b*) State **two** differences between Mendeleev's periodic table and the modern periodic table of the elements.

2009

Section B - Question 5

5. (*a*) Define *first ionisation energy* of an element. (8)

(*b*) Use the values on page 45 of the Mathematics Tables to plot a graph on graph paper of first ionisation energy *versus* atomic number for the elements with atomic numbers from 10 to 20 inclusive. (12)

(*c*) Account fully for

(*i*) the general increase in ionisation energy values across the third period of the Periodic Table,

(*ii*) the peaks which occur in your graph at elements 12 and 15,

(*iii*) the sharp decrease in ionisation energy value between elements 18 and 19. (18)

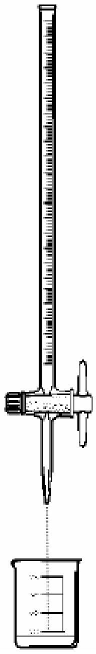
(*d*) Write the *s*, *p* electron configuration for the potassium atom.

Hence state how many (*i*) energy sub-levels, (*ii*) individual orbitals, are occupied by electrons in a potassium atom.

Explain why there are electrons in the fourth main energy level of potassium although the third main energy level is incomplete. (12)

2008

Section B - Question 5



5. (*a*) Define *electronegativity*. (5)

(*b*) State and explain the trend in electronegativity values down the first group in the periodic table of the elements. (9)

(*c*) Use electronegativity values to predict the types of bonding (*i*) in water, (*ii*) in methane, (*iii*) in magnesium chloride. (9)

(*d*) Use dot and cross diagrams to show the formation of bonds in magnesium chloride. (6)

(*e*) Explain the term *intermolecular forces*. (6)

(*f*) Use your knowledge of intermolecular forces to explain why methane has a very low boiling point (b.p. = −164 °C).
The relative molecular mass of methane is only slightly lower than that of water but the boiling point of water is much higher (b.p. = 100 °C). Suggest a reason for this. (6)

(*g*) The diagram shows a thin stream of liquid flowing from a burette. A stream of water is deflected towards a positively charged rod whereas a stream of cyclohexane is undeflected. Account for these observations
Explain what would happen in the case of the stream of water if the positively charged rod were replaced by a negatively charged rod. (9)

2006

Section B - Question 5

(*b*) (*i*) Define *electronegativity*. (6)

(*ii*) Explain why there is a general increase in electronegativity values across the periods in the periodic table of the elements. (6)

(*iii*) Explain, in terms of the structures of the atoms, the trend in reactivity down Group I (the alkali metal group) of the periodic table. (9)

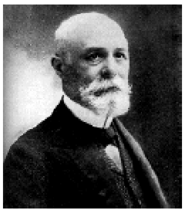
2005

Section B - Question 5

5. (*a*) What are *isotopes*? (5)

Name the scientist pictured on the right who is credited with the discovery in 1896 that uranium salts emit radiation. (3)

Give an example of a radioactive isotope and state **one** common use made of this isotope. (9)



(*b*) Define *atomic radius* (*covalent radius*). (6)

Describe and account for the trend in atomic radii (covalent radii) of the elements

(*i*) across the second period, (*ii*) down any group, of the periodic table. (15)

(*c*) Define *covalent bond*. (6)

Distinguish between a sigma (σ) and a pi (π) covalent bond. (6)