Chapter 3: Atomic structure (shared Homework sheet with Chapter 2)

Homework questions

1 The table below shows the first eight ionisation energies of five elements from Period 3 of the Periodic Table. They are not in order.

Element	**Ionisation energies / kJ mol^{-1}**							
	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**
I	740	1500	7700	10 500	13 600	18 000	21 700	25 700
II	1000	2300	3400	4600	7000	8500	27 100	31 700
III	580	1800	2700	11 600	14 800	18400	23 300	27 500
IV	1260	2300	3800	5200	6500	9300	11 000	33 600
V	500	4600	6900	9500	13 400	16 600	20 100	25 500

a Using a Periodic Table, identify each element and explain the reasoning behind your choices. [10]

b Give the complete electron configurations for elements I and II. [2]

c Draw the shape of the following orbitals:

i the orbital from which the first electron of element I is removed [1]

ii the orbital from which the third electron of element I is removed. [1]

d Using the actual symbol of the element, give the equations for the following:

i the 1st ionisation of element II [2]

ii the 7th ionisation of element III. [2]

There are four isotopes of element II, with the following relative isotopic masses and isotopic abundance:

Isotope	**1**	**2**	**3**	**4**
Relative isotopic mass	32	33	34	36
Relative abundance / %	95	0.76	4.22	0.01

e Give the number of electrons, protons and neutrons in a neutral atom of isotope 2. [1]

f Calculate the relative atomic mass of element II. Give your answer to 1 decimal place. [3]

When element II is reacted with fluorine (A_r = 19.0) a compound is formed with the following percentage composition: element II (29.7%), fluorine (70.3%)

g **i** Calculate the empirical formula of the compound using the value you calculated for the A_r of element II. Show your working. [3]

ii The relative molecular mass of the compound is 108.1. What is the molecular formula of the compound? Show your working. [2]

Total = 27

2 Bromine has the atomic number 35 and a relative atomic mass of 79.9.

a The two isotopes of bromine have relative isotopic masses of 79 (relative isotopic abundance 50.5%) and 81 (relative isotopic abundance 49.5%).

i Sketch the mass spectrum for bromine. [4]

ii Explain briefly why the relative atomic mass of bromine is 79.9 and not 80 (the average of the two relative isotopic masses). [2]

b **i** Give the electron configuration of the bromide ion (Br^-). [2]

ii Fluorine is element number 9. Give the electron configuration of a neutral atom of fluorine. [1]

iii Explain why these two elements are in the same group of the Periodic Table. [1]

iv Draw the shape of the outer electron orbital of both elements. [1]

v Sketch a graph of number of electrons removed from an atom of fluorine (horizontal axis) against ionisation energy in kJ mol^{-1} (vertical axis). [3]

c When bromine reacts with excess fluorine the compound BrF_5 is formed.

i Give the balanced symbol equation for the reaction for the formation of the compound from its constituent elements. [2]

ii What volume (at r.t.p.) of fluorine is required to form 0.0500 mol of BrF_5 in this reaction? [3]

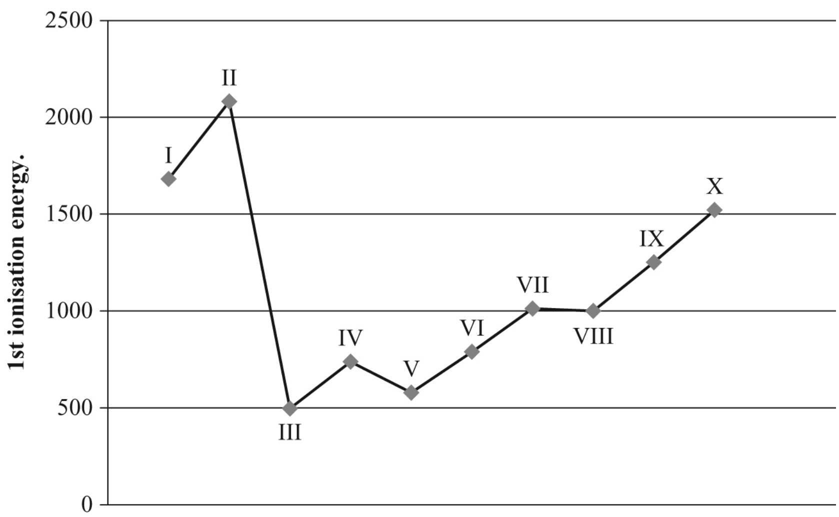
d Another method of preparing BrF_5 involves the reaction between potassium bromide and fluorine. The other product is potassium fluoride.

i Give the balanced symbol equation for this reaction. [2]

ii Calculate the volume of fluorine to form 0.0500 mol of BrF_5 by this method. [3]

Total = 24

3 The graph below shows the 1st ionisation energy for 10 successive elements in Periods 2 and 3 of the Periodic Table. The elements are labelled I, II, etc.



a **i** State the Roman numeral(s) of the element(s) that is (are) a noble gas(es). Explain your choice. [3]

ii List the actual names of the elements and give their electron configurations. [4]

b Why is there:

i a rise in the 1st ionisation energy for elements III to IV? [2]

ii a fall in the 1st ionisation energy from elements IV to V? [2]

iii a steady rise in the 1st ionisation energy from elements V to VII? [2]

c **i** Name element VII. [1]

ii Use an ‘electrons in boxes’ diagram to describe the electron arrangements in the outer electron shell (energy level) of element VII. [3]

iii Explain the slight fall in the 1st ionisation energy from elements VII to VIII. [3]

Total = 20