ATOMIC THEORY

I am able to:

1 Complete the following sentence:

Atoms contain a ………………… charged nucleus composed of ……………… and ……………

2 Complete the table:

Particle	Relative Mass	Relative Charge
PROTON		
NEUTRON		
ELECTRON		

3 Complete the following sentence:

Electrons have a ………………… charge and are found……………………………………………

4 Virtually all the mass of an atom is due to the ……………………………………………………

5 Explain the terms *mass number* (A), *atomic number* (Z) and *isotope*.

6 Write the symbol for the element which has A = 108 and Z = 47.

7 State the number of protons, neutrons and electrons in each of the following:

^{65}Cu ^{73}Ge $^{15}N^{3-}$ $^{137}Ba^{2+}$

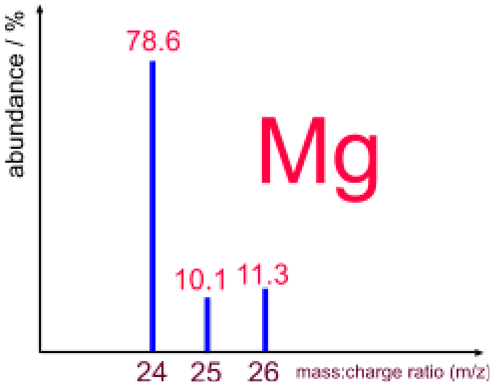
8 Name the instrument which is used to find the isotopic composition of an element so that its relative atomic mass can be determined.

9 Determine the relative atomic mass of copper given the following natural abundances:

^{63}Cu 76.0 % ^{65}Cu 24.0 %

10 Determine the natural abundance of ^{11}B given that boron consists of two isotopes, ^{10}B and ^{11}B, and the relative atomic mass is 10.80.

11 Use the mass spectrum shown to determine the relative atomic mass of magnesium to 1 decimal place.



12 Given that the relative atomic mass of iridium is 192.22 and that it has only 2 isotopes – ^{191}Ir and ^{193}Ir. Explain whether ^{191}Ir or ^{193}Ir is the more common isotope.

13 State the regions of the electromagnetic spectrum.

14 State the relative frequencies, energies and wavelengths of the regions of the electromagnetic spectrum.

15 Arrange ***UV radiation*** ***blue light*** ***infrared radiation*** ***red light*** in order of:

(a) increasing frequency (lowest first) (b) decreasing wavelength (longest first)

(c) increasing energy (lowest first)

16 Distinguish between a continuous spectrum and a line spectrum

17 Describe the emission spectrum of a hydrogen atom – draw a diagram (include at least 4 lines and label the direction in which frequency increases)

18 Explain how a line in the emission spectrum arises.

19 Explain how different series of lines arise.

20 State whether each of the following transitions in the hydrogen emission spectrum would produce a line in the visible, infrared or ultra violet region of the electromagnetic spectrum.

$n = 5 \rightarrow n = 1$ $n = 4 \rightarrow n = 3$ $n = 6 \rightarrow n = 2$ $n = 10 \rightarrow n = 3$

21 Select the highest energy transition in the hydrogen emission spectrum from the following list:

$n = 4 \rightarrow n = 2$ $n = 12 \rightarrow n = 3$ $n = 2 \rightarrow n = 1$ $n = 15 \rightarrow n = 2$

22 Convert each of the following wavelengths to a frequency in Hz.

500 nm 0.450 μm

23 Calculate the energy of the photon emitted for each of the following lines in the hydrogen atom spectrum. Planck's constant = 6.63×10^{-34} Js, speed of light = 3.00×10^{8} ms^{-1}

	Frequency /Hz	Wavelength	Energy / J
1	2.46×10^{15}		
2		6.56×10^{-7} m	
3		486 nm	
4	2.34×10^{14}		

24 State in which region of the electromagnetic spectrum each of the lines in 23 occurs (use the data booklet).

25 Explain what is meant by the *convergence limit* and what important information can be obtained from it.

26 State an equation for the ionisation of hydrogen.

27 Calculate the ionisation energy of hydrogen (in kJ mol^{-1}) given that the frequency of the convergence limit for the series of lines where the electron returns to the ground state (n=1) in the hydrogen atom spectrum is 3.30×10^{15} Hz.

28 Explain the term *orbital*.

29 State the relative energies of s, p, d and f orbitals within any shell (main energy level).

30 State the number of s, p, d, f orbitals within s, p, d, f subshells (sub-levels).

31 State the number of subshells (sub energy levels) and orbitals in the 4th main energy level (shell).

32 Sketch the shape of an s and p_x, p_y and p_z orbitals.

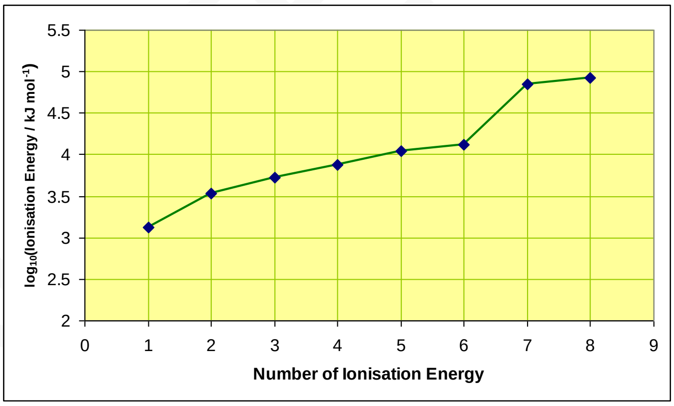
33 State the full electron configurations of: N P Ti Cr Fe Cu Se Kr

34 State the condensed electron configurations of: O Cl Mn As

35 Draw orbital diagrams to represent the electron configuration of: B Si Ni

36 Write equations to represent the first and second ionisation energies of potassium.

37 Determine in which group of the Periodic Table an element is from a graph of successive ionisation energies such as



38 Determine which group an element is in from ionisation energy data such as

	Ionisation energy / kJ mol^{-1}							
Number of IE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
X	786	1580	3230	4360	16000	20000	23600	29100
Y	1060	1900	2920	4960	6280	21200	25900	30500

39 Explain how graphs of successive ionisation energies provide evidence for the existence of shells (main energy levels) and subshells (sub-levels).

40 Explain why the second ionisation energy of an element always higher than the first ionisation energy

41 Explain why the second ionisation energy of potassium is substantially higher than the first ionisation energy?

42 Explain why the first ionisation energy of O is higher than the first ionisation energy of Be.

43 Explain why the first ionisation energy of B is lower than that of Be and the first ionisation energy of O is less than that of N.

44 State the full electron configuration of the following ions: Mg^{2+} S^{2-} Fe^{2+} Cu^{2+} Ga^{3+}