ATOMIC THEORY

1 Complete the following sentence:

Atoms contain a *positively* charged nucleus composed of *protons* and *neutrons*

2 Complete the table:

Particle	Relative Mass	Relative Charge
PROTON	1	+1
NEUTRON	1	0
ELECTRON	$5x10^{-4}$	-1

3 Complete the following sentence:

Electrons have a *negative* charge and are found *outside the nucleus in orbitals*

4 Virtually all the mass of an atom is due to the *protons and neutrons/nucleus*

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

mass number (A), total number of protons+neutrons in the nucleus of an atom

atomic number (Z) number of protons in an atom

isotope atoms of the same element (same number of protons) that have different mass numbers (different number of neutrons)

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

$^{108}_{47}Ag$

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

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

	protons	**neutrons**	**electrons**
^{65}Cu	29	36	29
^{73}Ge	32	41	32
$^{15}N^{3-}$	7	8	10
$^{137}Ba^{2+}$	56	81	54

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

Mass spectrometer

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

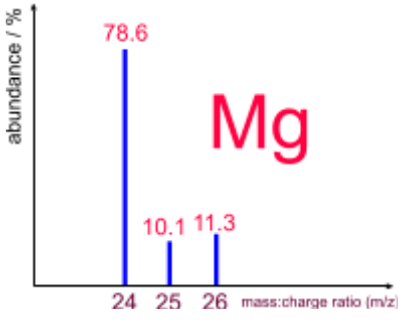
^{63}Cu 76.0 % ^{65}Cu 24.0 %

63.48

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.

80%

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



24.3

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.

^{193}Ir is more common as the relative atomic mass is closer to 193 than 191
61% ^{193}Ir and 39% ^{191}Ir

13 State the regions of the electromagnetic spectrum.

radio waves	microwaves	Infrared	Visible light	Ultraviolet	X-rays	γ-rays

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

increasing frequency →						
increasing energy →						
radio waves	microwaves	Infrared	Visible light	Ultraviolet	X-rays	γ-rays
decreasing wavelength →						

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)

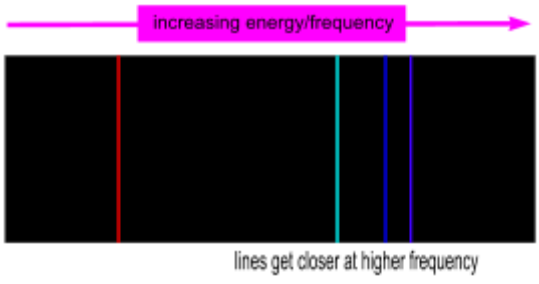
(a)	***infrared radiation***	***red light***	***blue light***	***UV radiation***
(b)	***infrared radiation***	***red light***	***blue light***	***UV radiation***
(c)	***infrared radiation***	***red light***	***blue light***	***UV radiation***

16 Distinguish between a continuous spectrum and a line spectrum

Continuous - all frequencies/wavelengths/colours present

Line – only certain discrete frequencies/wavelengths/colours present

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)



Series of lines of lines on a dark background
Lines get closer at higher frequency

18 Explain how a line in the emission spectrum arises.

Electron promoted to a higher energy level is unstable
Falls down to lower energy level
Energy given out as a photon of light
Energy of photon = energy difference between higher and lower levels

19 Explain how different series of lines arise.

Electrons fall down to different lower energy levels, e.g. to n=1, n=2 etc.

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.

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

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

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 Explain the term *orbital*.

Atomic orbital: region of space in an atom where there is a high probability of finding an electron

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

$s < p < d < f$

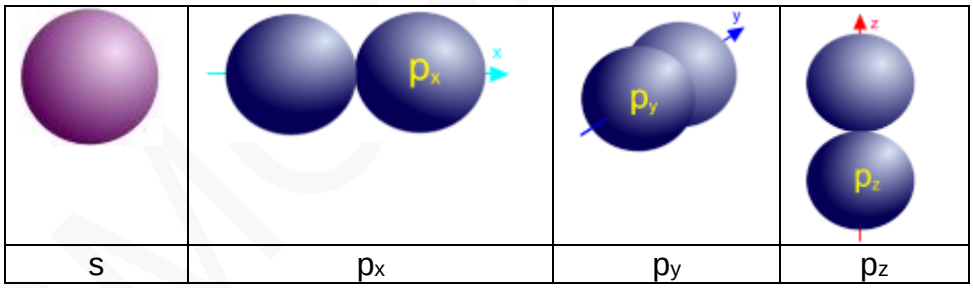
24 State the number of s, p, d, f orbitals within s, p, d, f subshells (sub-levels).

s	p	d	f
1	3	5	7

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

Subshells: 4 (s,p,d,f) Orbitals: 16 [s(1), p(3), d(5), f(7)]

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



s	p_x	p_y	p_z

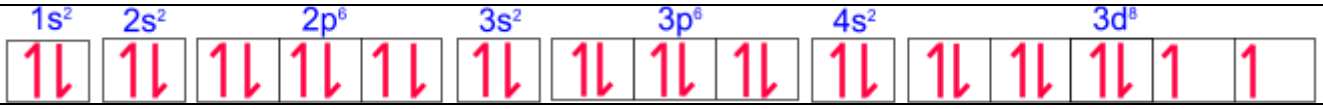
27 State the full electron configurations of: N P Ti Cr Fe Cu Se Kr

N	$1s^2\ 2s^2\ 2p^3$
P	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
Ti	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$
Cr	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$
Fe	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$
Cu	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
Se	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$
Kr	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

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

O	$[He]\ 2s^2\ 2p^4$
Cl	$[Ne]\ 3s^2\ 3p^5$
Mn	$[Ar]\ 4s^2\ 3d^5$
As	$[Ar]\ 4s^2\ 3d^{10}\ 4p^3$

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

B	
Si	
Ni	

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

Mg^{2+}	$1s^2\ 2s^2\ 2p^6$
S^{2-}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
Fe^{2+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$
Cu^{2+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$
Ga^{3+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$