ATOMIC STRUCTURE Core (SL & HL)

1. (a) Using the Periodic Table in the data booklet give **the symbol of:**

(i) An element with ground state electron configuration [Kr] $5s^2\ 4d^1$

[1]

Y (allow Yttrium) ✓

(ii) An ion with electron configuration $1s^2\ 2s^2\ 2p^6$, with a 2– charge

[1]

O^{2-} (allow oxide ion) ✓

(iii) **Two** elements with outer electron configuration $ns^2\ np^2$

[1]

C, Si or any group 14 element allowed ✓

(b) Show the outer electron configurations for iron and its ions, including electron spin, by completing the table below with arrows to represent electrons:

(Remember that 4s electrons are gained first and lost first!) [3]

	4s	3d					
Fe	↑↓	↑↓	↑	↑	↑	↑	✓
Fe^{2+}		↑↓	↑	↑	↑	↑	✓
Fe^{3+}		↑	↑	↑	↑	↑	✓

2. (a) A sample of oxygen in a lab contains isotopes in the following percentages:

^{16}O	98.20%
^{17}O	1.50%
^{18}O	0.30%

(i) Calculate the relative atomic mass of this sample of oxygen to four significant figures.

[2]

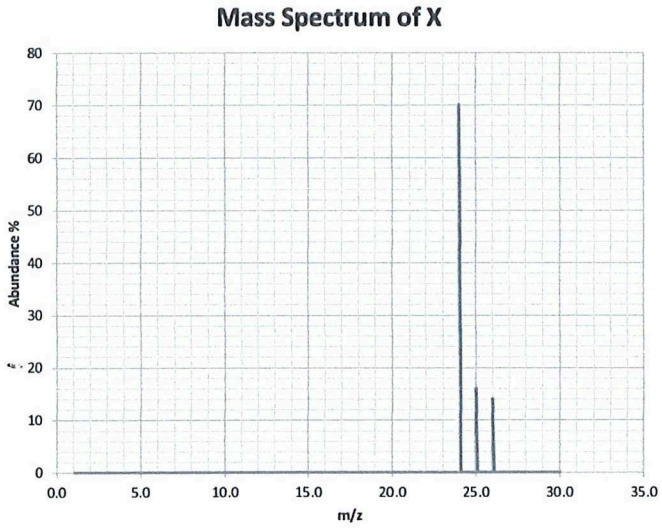
$\frac{(16 \times 98.20)+(17 \times 1.50)+(18 \times 0.30)}{100}$ ✓ = 16.02 (4 sig figs) ✓

(ii) Determine the number of neutrons in the atom of the least abundant oxygen isotope.

[1]

Neutrons = 18 − 8 = 10 ✓

3. (a) The mass spectrum of a sample of an element, X, is given below:



(i) Explain why there is more than one peak.

[1]

There are three isotopes of element X ✓

(ii) Calculate the relative atomic mass of the sample of the element to two decimal places.

[2]

$\frac{(24\times70)+(25\times16)+(26\times14)}{100}$ = 24.44 (2dp) ✓ ✓

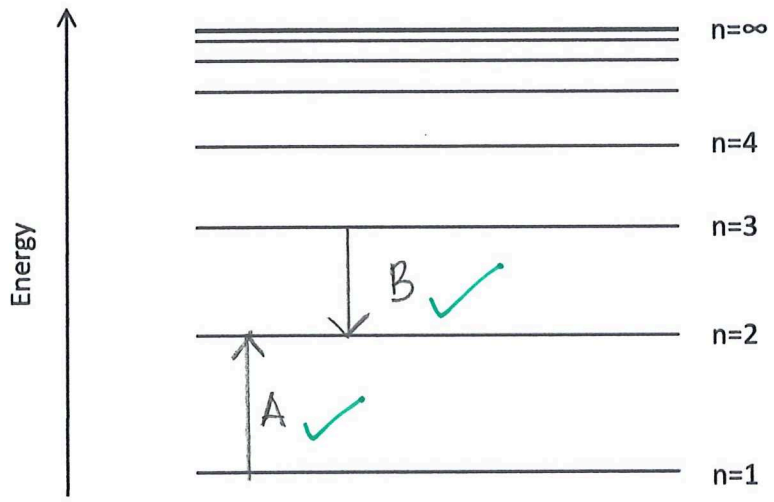
PTO

4. (a) Hydrogen gas may be placed in an electric discharge tube to generate an emission spectrum.
(i) Describe the emission spectrum of hydrogen.

[2]

A series of discrete lines at specific wavelength/ frequency/energy...
Converging at higher energy.
E
Diagram also appropriate (labelled) e.g | | | ||

(b) The diagram below represents some of the electronic energy levels in a hydrogen atom.



(i) Draw an arrow on the diagram to represent any electron transition in the absorption spectrum of hydrogen. Label the arrow A. (Any transition from n=1 to higher level) [1]

(ii) Draw an arrow on the diagram to represent the lowest energy transition in the visible emission spectrum of hydrogen. Label the arrow B. only n=3 → n=2 [1]

(c) State how a continuous spectrum is different from the hydrogen emission spectrum. [1]

A continuous spectrum shows all wavelengths/ frequencies/energies.

PTO

5, (a) Define the term *isotopes*.

[1]

Atoms of the same element (same number of protons) with different numbers of neutrons. ✓

(b) A sample of copper has a relative atomic mass of 63.60 and consists of two stable isotopes, copper-63 and copper-65. What is the relative percentage abundance of the two isotopes?

[2]

70% 63 and 30% 65 ✓✓ correct answer scores 2

$(x \times 63) + ((100-x) \times 65) = 63.60 \times 100$

$63x + 6500 - 65x = 6360$

$-2x = -140 \qquad 2x = 140 \qquad x = 70$

(c) State the electron configuration of the copper isotopes copper-63 and copper-65.

[1]

(Both the same) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$ ✓

allow shorthand

(d) State a physical property that is different for isotopes of the same element.

[1]

Density (or melting point / boiling point) ✓

Total Marks 22 (33 minutes)