Unit 3 · Atomic Structure

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

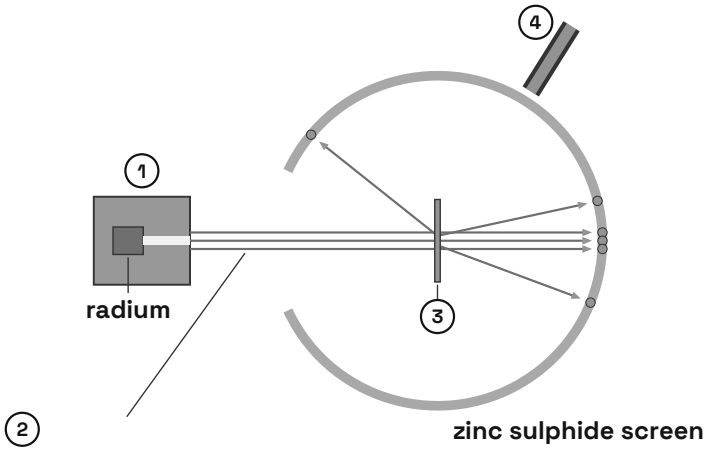
1 Key words [4]

Match each term in column A with its meaning in column B. Two meanings in column B are not needed. Each match carries 0.5 mark.

Column A		Column B	
1. Pauli's exclusion principle	☐	**a.**	orbitals of the same energy
2. Hund's rule	☐	**b.**	the position and the momentum of a particle can't both be known exactly
3. Aufbau principle	☐	**c.**	$\lambda = h/mv$
4. uncertainty principle	☐	**d.**	the region round the nucleus where an electron is most likely to be found
5. de Broglie's equation	☐	**e.**	no two electrons in an atom have the same set of four quantum numbers
6. orbital	☐	**f.**	a surface on which the probability of finding the electron is zero
7. degenerate orbitals	☐	**g.**	a fixed circular path at a fixed distance from the nucleus
8. node	☐	**h.**	the light given out when a metal salt is heated in a flame
		i.	orbitals are filled in increasing order of their energies
		j.	degenerate orbitals are filled singly, with parallel spins, before any pair up

2 Label the diagram [2]

The diagram shows Geiger and Marsden's alpha particle scattering experiment. Write the names of the parts 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. How many orbitals are there in a d subshell? [1]

a. 3 **b.** 5

c. 7 **d.** 10

ii. The greatest number of electrons the M shell (n = 3) can hold is: [1]

a. 8 **b.** 9

c. 18 **d.** 32

iii. Which set of quantum numbers is **not** allowed? [1]

a. $n = 3, l = 1, m = -1, s = +½$ **b.** $n = 2, l = 2, m = 0, s = +½$

c. $n = 4, l = 0, m = 0, s = -½$ **d.** $n = 3, l = 2, m = +2, s = -½$

iv. Which ion has the configuration [Ar] $3d^5$? [1]

a. Fe^{2+} **b.** Fe^{3+}

c. Cr^{3+} **d.** Cu^{2+}

v. In hydrogen, which jump of the electron gives a line in the visible part of the spectrum? [1]

a. $n = 2 \rightarrow n = 1$ **b.** $n = 4 \rightarrow n = 2$

c. $n = 5 \rightarrow n = 3$ **d.** $n = 3 \rightarrow n = 1$

4 Short answers [7]

Write short answers to the following questions.

a. Copper (Z = 29) is [Ar] $4s^1\ 3d^{10}$, not [Ar] $4s^2\ 3d^9$. Why? **[2]**

b. Write the four quantum numbers of the outermost electron of a sodium atom (Z = 11). **[2]**

c. Write the electronic configuration of sulphur (Z = 16) and of the sulphide ion, S^{2-}. How many unpaired electrons does each have? Which is diamagnetic? **[3]**

5 Long answer [4]

Write a long answer to the following question.

State the Aufbau principle and the (n + l) rule. Arrange the orbitals 4f, 5d, 6s and 5p in order of increasing energy. Write the electronic configuration of manganese (Z = 25) and give its number of unpaired electrons.

6 Numerical problems [8]

Solve the following problems. Show your working. Take h = 6.626×10^{-34} J s, c = 3.00×10^{8} m/s, $R_H = 1.097 \times 10^{7}$ m^{-1} and the mass of an electron 9.11×10^{-31} kg.

a. An electron in a hydrogen atom falls from n = 4 to n = 2. [4]

i. To which series does the line belong?

ii. Find the wavelength of the light, in nm.

iii. Find its frequency.

iv. Find the energy of one photon of it.

Answer: _____

b. i. An electron moves at 1.5×10^{6} m/s. Find its de Broglie wavelength. [4]

ii. The velocity of another electron is known to within 1.0×10^{4} m/s. What is the least uncertainty in its position?

Answer: _____

7 Think [3]

Bohr's model gives the radius of hydrogen's second orbit as $0.0529 \times 2^2 = 0.212$ nm. Pratik says, "So an electron in n = 2 always moves at exactly 0.212 nm from the nucleus." What would quantum mechanics say to him?

8 Activity: Lines or a rainbow?

(not marked)

Hold the shiny side of an old CD at a slant under a light source and look at the colored band it reflects (the fine grooves spread light into its colors like a prism). Try a bulb with a glowing filament, a white LED lamp, a tube light and, at night, an orange streetlight.

Light source	Continuous band or separate lines?	Colors you see
filament bulb		
white LED		
tube light		
orange streetlight		

Which sources give light from atoms of a gas? How can you tell?