01 Atomic Structure

Set A Foundations

Name | Time 1 hour | Total 38 marks | Score ____ / 38

A Data Booklet may be used.

A From the lesson

16 MARKS

1 Complete the table. The first row is done for you.

species	protons	neutrons	electrons
^{23}Na	11	12	11
$^{23}Na^{+}$			
$^{32}S^{2-}$			
$^{56}Fe^{3+}$			

[3]

/3

Source: Learners' Alley, Atomic Structure slides

2 COMMON Under certain conditions, a beam of $^{1}H^{+}$ is deflected by +12°. Under the same conditions, calculate the angle of deflection of

(a) $^{2}H^{+}$

[1]

(b) $^{4}He^{2+}$

[1]

(c) $^{16}O^{2-}$

[1]

/3

Source: Learners' Alley, Atomic Structure slides

3 Magnesium is 79.0% ^{24}Mg, x% ^{25}Mg and the rest ^{26}Mg. The A_r of magnesium is 24.32. Calculate x.

[2]

/2

Source: Learners' Alley, Atomic Structure slides

4 CHALLENGE Chlorine is 75% ^{35}Cl and 25% ^{37}Cl. Each Cl_2 molecule contains two Cl atoms picked at random. Calculate the relative abundances of the three kinds of Cl_2 molecule, of masses 70, 72 and 74.

[2]

/2

Source: Learners' Alley, Atomic Structure slides

5 Write the full electronic configurations of

(a) K (proton number 19)

..... **[1]**

(b) Mn (proton number 25)

..... **[1]**

(c) Br (proton number 35)

..... **[1]**

/3

Source: Learners' Alley, Atomic Structure slides

6 COMMON Element Y is in Period 3. Its first five ionisation energies, in kJ mol^{-1}, are

578 1817 2745 11 577 14 842

State the Group of Y and identify Y.

.....

..... **[1]**

/1

Source: Learners' Alley, Atomic Structure slides

7 CHALLENGE Element Z has these successive ionisation energies, in kJ mol^{-1}:

496 4562 6912 9543

State the Group of Z, and explain why its second ionisation energy is so much larger than its first.

.....

.....

..... **[2]**

/2

Source: Learners' Alley, Atomic Structure slides

B Practice

22 MARKS

8 COMMON What do the ions $^{18}O^{2-}$ and $^{19}F^{-}$ have in common?

A They have more electrons than neutrons.

B They have 10 neutrons in their nuclei.

C They have an outer electronic configuration of $3s^2\ 3p^6$.

D They contain the same number of nucleons in their nuclei.

Answer ☐ **[1]**

/1

Source: 2024 RI J2 Prelim P1 Q3

9 Which of the following species has no unpaired electrons?

A Fe^{3+} **B** Ge^{+} **C** Cu^{+} **D** Ti^{3+}

Answer ☐ **[1]**

/1

Source: RVHS 2017 Promo, via EJC 2022 Atomic Structure Topical Revision, Q7

10 Which particle would, on losing an electron, have a half-filled set of p orbitals?

A C^{-} **B** N^{-} **C** O^{+} **D** P^{+}

Answer ☐ **[1]**

/1

Source: IJC 2017 Promo, via EJC 2022 Atomic Structure Topical Revision, Q8

11 Hydrogen exists as the isotopes ^{1}H, ^{2}H and ^{3}H. Complete the table.

species	number of protons	number of neutrons	number of electrons
^{2}H			
$^{1}H_2^{+}$			
$^{3}H_3^{+}$			

[3]

/3

Source: 2024 NYJC J2 Prelim P2 Q1(c)

12 Magma, the molten rock under the Earth's surface, is rich in oxygen and silicon.

(a) State the electronic configuration of an atom of silicon.

.....

[1]

(b) Describe one similarity and one difference between a 3s orbital and a 3p orbital.

.....

.....

.....

[2]

(c) Describe one difference between a 2p orbital and a 3p orbital.

.....

.....

[1]

/4

Source: 2022 HCI J1 Promo P3 Q1(a)

13 COMMON Ions of $^{28}Si^{+}$ and X^{+} are passed through the same electric field. Their angles of deflection are 5.6° and 2.0° respectively.

(a) Deduce, by calculation, the identity of X.

[2]

(b) Suggest why another beam is detected with an angle of deflection of 1.9°.

.....

.....

[1]

/3

Source: 2024 CJC J2 Prelim P2 Q1(d)

14 COMMON This question is about the first ionisation energies of the Period 3 elements, sodium to argon.

(a) Explain the general increase in first ionisation energy from sodium to argon.

.....

.....

.....

[2]

(b) Explain the fall in first ionisation energy between magnesium and aluminium.

.....

.....

..... **[2]**

(c) Explain the fall in first ionisation energy between phosphorus and sulfur.

.....

.....

..... **[2]**

/6

Source: EJC 2022 JC1 Atomic Structure Tutorial, A3(b) to (d)

15 CHALLENGE Boron and its compounds have many uses in industry.

(a) Write an equation to represent the fourth ionisation energy of boron.

..... **[1]**

(b) Explain why the fourth ionisation energy of boron is much higher than that of carbon.

.....

.....

..... **[2]**

/3

Source: 2024 RI J2 Prelim P2 Q1(a)