

Orbitals & electron spin

Question Paper

Level	Pre U
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Orbitals & electron spin-Atomic structure
Booklet	Question Paper

Time Allowed: 26 minutes

Score: /22

Percentage: /100

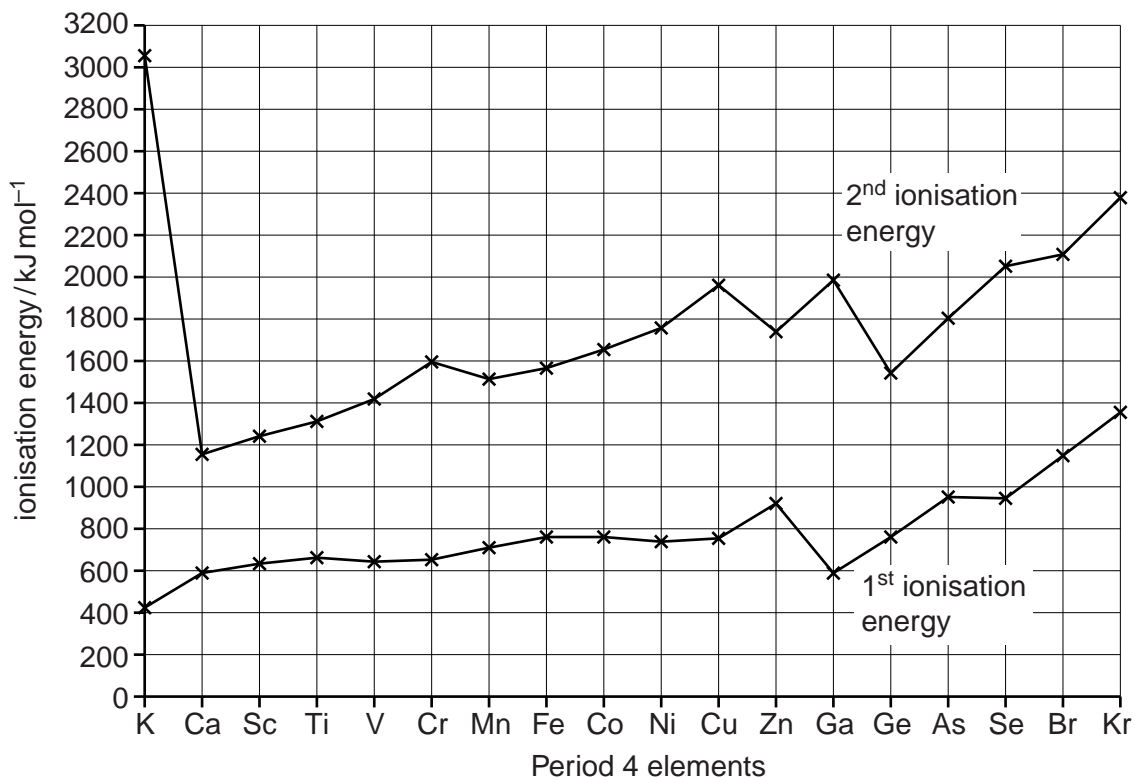
Grade Boundaries:

1 (a) Complete the full ground state electronic configurations for each of the following species.

Mn [Ar]

Fe²⁺ [Ar] [2]

(b) The patterns of the first and second ionisation energies across Period 4 are shown.



(i) Explain what is meant by the term *first ionisation energy*.

.....

 [3]

(ii) Explain why the first ionisation energies of the elements Sc to Cu are relatively constant.

.....

 [3]

(iii) Write the equation for the second ionisation energy of chromium.

..... [1]

- (iv) Explain why the **increase** between first and second ionisation energies for both Cr and Cu is bigger than for the rest of the transition elements shown.

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.....
.....[3]

- (c) One of the key characteristics of transition elements is their ability to exhibit a range of different oxidation states.

- (i) Describe and explain the pattern of **maximum** oxidation states for the elements from Sc to Zn.

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.....
.....[3]

- (ii) Suggest the formula and charge of the ferrate(VI) oxy-anion.

.....[1]

- (d) Alfred Werner was awarded the Nobel Prize in 1913 for his work on complexes of cobalt with ammonia.

The compounds with the formula $\text{Co}(\text{NH}_3)_6\text{Cl}_3$ exist in four isomeric forms, **W**, **X**, **Y** and **Z**.

W reacts with an aqueous solution of silver nitrate in a 1:3 mole ratio, forming a white precipitate.

X reacts with an aqueous solution of silver nitrate in a 1:2 mole ratio, forming a white precipitate.

Y and **Z** both react with aqueous silver nitrate in a 1:1 mole ratio, forming white precipitates in both cases.

- (i) Explain the conclusion that can be drawn from the different mole ratios of reaction with aqueous silver nitrate.

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

- (ii) Give the formulae of the complex ions present in each of **W** and **X**.

W **X**[2]

- (iii) Name the type of isomerism shown by **W** and **X**.

.....[1]

- (iv) Name the type of isomerism shown by **Y** and **Z**.

.....[1]

- (v) Draw three-dimensional diagrams of the structures of the complexes present in **Y** and **Z**.

[1]

[Total: 22]