

APOLLO

Electron configurations

HL

Chemistry

First assessment 2025

14 questions | questions

2. Which of the following species have the same number of outer electrons?
The letters **do not** represent symbols of elements.



- A. X and Y
B. X and W
C. Z and Y
D. Z and W

— 3 —

2225-0201

4. Which diagram shows the correct electron configuration of a nitrogen atom in the ground state?

- A. 
1s 2s 2p
- B. 
1s 2s 2p
- C. 
1s 2s 2p
- D. 
1s 2s 2p

Turn over

2220-0207

6. Which of the following correctly shows the shape of s and p orbitals?

A.



s



p

B.



s



p

C.



s



p

D.



s



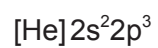
p

3. What is the maximum number of electrons that can occupy the $n = 3$ main energy level?
- A. 3
 - B. 8
 - C. 18
 - D. 28

— 3 —

2225-0213

6. What is the charge of the monatomic ion usually formed by the element with the following electron configuration?



- A. 3–
- B. 2+
- C. 3+
- D. 5+

16. What is the electron configuration of the Cr^{2+} ion?

- A. $[\text{Ar}] 4s^2 3d^2$
- B. $[\text{Ar}] 4s^1 3d^5$
- C. $[\text{Ar}] 3d^4$
- D. $[\text{Ar}] 3d^5$

5. What is the maximum number of electrons that can occupy the fourth main energy level of an atom?
- A. 8
 - B. 18
 - C. 32
 - D. 64

13. What is the electron configuration of an atom of Cu?

- A. $[\text{Ar}]3\text{d}^9$
- B. $[\text{Ar}]4\text{s}^23\text{d}^9$
- C. $[\text{Ar}]4\text{s}^24\text{d}^9$
- D. $[\text{Ar}]4\text{s}^13\text{d}^{10}$

— v —

Turn over

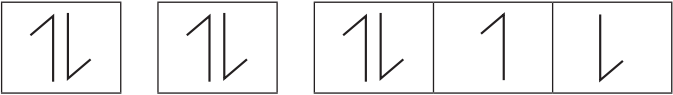
2220-0213

16. Which statement correctly explains the violet colour of the complex ion $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$, formed when copper(II) sulfate reacts with an excess of ammonia?
- A. Violet light is released as electrons move from higher to lower energy levels.
 - B. Violet light is absorbed as electrons move from lower to higher energy levels.
 - C. Yellow light is released as electrons move from higher to lower energy levels.
 - D. Yellow light is absorbed as electrons move from lower to higher energy levels.

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2225-0215

3. Which orbital diagram represents a correct ground state electron configuration based on the Pauli exclusion principle and Hund's rule?

A. 

1s 2s 2p

B. 

1s 2s 2p

C. 

1s 2s 2p

D. 

1s 2s 2p

16. Which aqueous solution of an ion is likely to be coloured based on the electron configuration of that ion?

- A. Ni^{2+}
- B. Sc^{3+}
- C. Cu^{+}
- D. Zn^{2+}

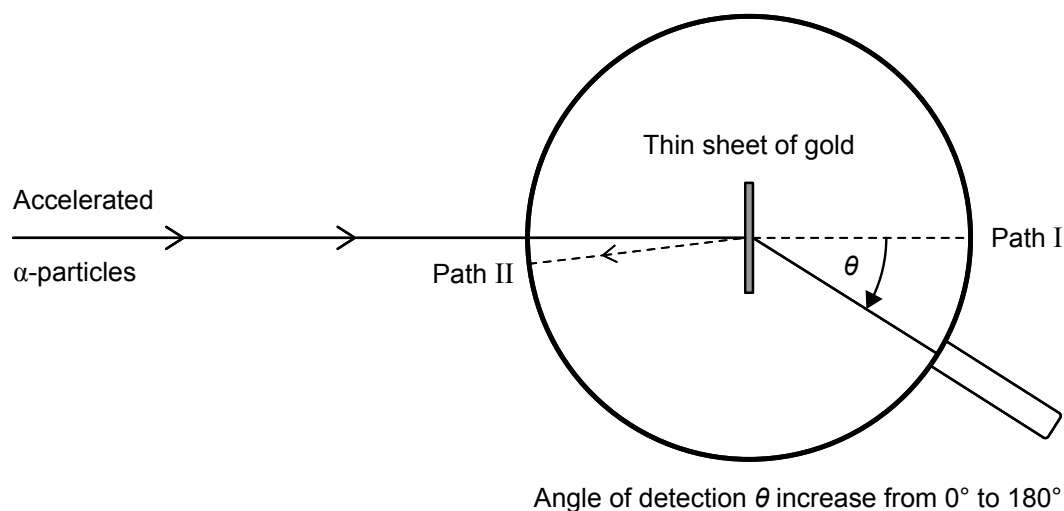
2. What is the best evidence that energy levels are closer together as distance from the nucleus increases?
- A. Hydrogen has a line emission spectrum in each of the UV, visible and IR regions.
 - B. First ionization energies decrease down a group.
 - C. Lines in an emission spectrum converge at higher energy.
 - D. First ionization energy generally increases across a period.

15. Which statements best explain why copper(II) ions, $\text{Cu}^{2+}(\text{aq})$, are blue in aqueous solution?

- I. Copper(II) ions absorb orange light.
 - II. Blue light is emitted as electrons move to lower orbitals.
 - III. Electrons are promoted between d-orbitals.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

2. Scientific models are used to explain the structure of matter.

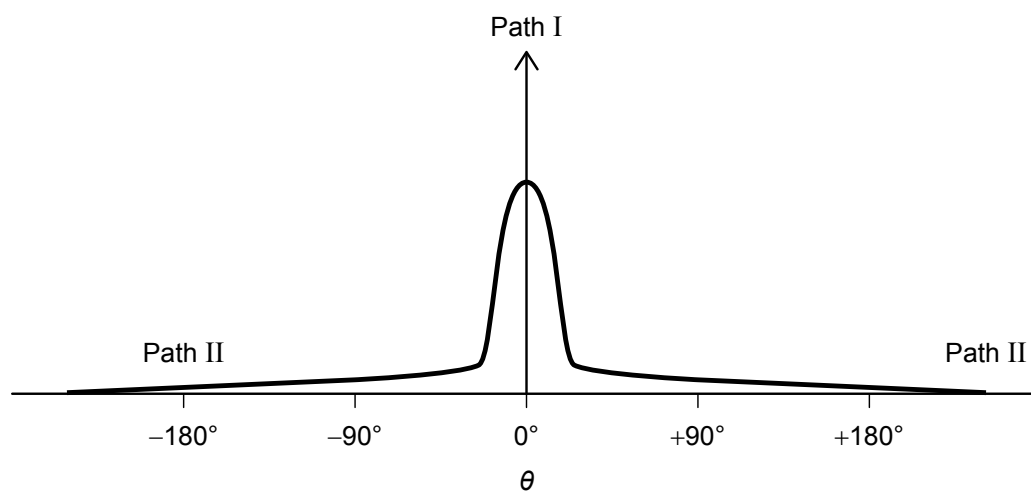
- (a) An α -particle is a helium-4 nucleus. In an experiment, α -particles are accelerated towards a thin sheet of gold and their resulting paths are detected, giving evidence of the positive charge of the nucleus.



The number of α -particles detected at different angles of deflection θ are shown.

Key:

— Number of α -particles detected



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28EP04

(Question 2 continued)

- (i) Explain why some α -particles follow path II, rebounding from the gold sheet. [1]

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- (ii) Most of the α -particles follow path I and pass straight through undeflected ($\theta = 0^\circ$). Suggest a conclusion that can be made about the structure of the atom based on this evidence. [1]

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28EP05

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(Question 2 continued)

(b) Helium was first identified by analysing spectra of solar radiation.

(i) Outline the appearance of the emission spectrum of helium.

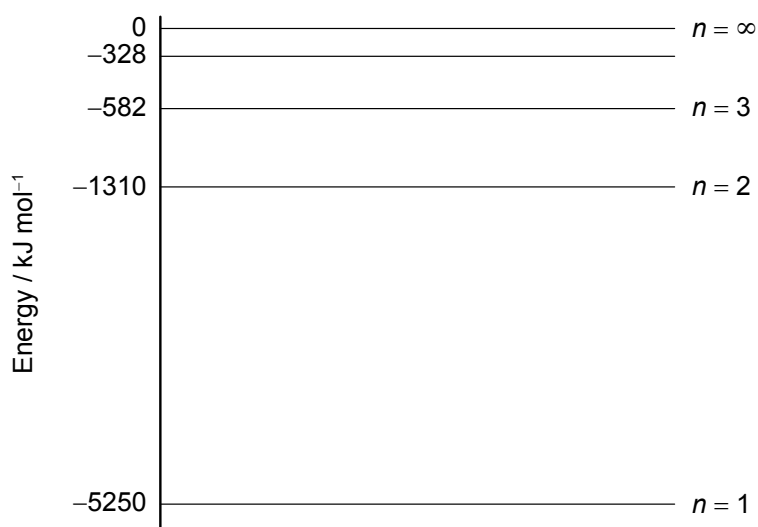
[1]

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Emission spectra of one-electron systems can be explained using a model with the electron attracted to the nucleus by an electrostatic force.

This model predicts that the electron occupies discrete energy levels. Some energy levels for the He^+ ion are shown.



(ii) Explain how the frequencies observed in emission spectra support the idea of the electron occupying discrete energy levels.

[2]

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28EP06

(Question 2 continued)

- (iii) Deduce the ionization energy of the He^+ ion from the energy levels shown. [1]

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- (iv) Suggest **two** reasons why the ionization energy of the hydrogen atom is significantly smaller than the ionization energy of the He^+ ion. [2]

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- (v) Suggest why the model outlined in (b)(ii) can predict the emission spectrum of He^+ but not He. [1]

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- (c) Outline why models of the atom have evolved over time. [1]

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28EP07

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