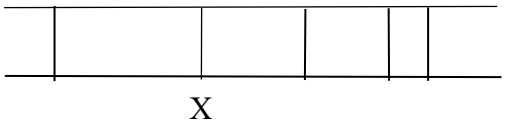
2018 / 2019

2 (a) The wavelength that produces a line, **B** in Brackett series is 2165.6 nm.
(i) Determine the transition that forms the **B** line.
(ii) Calculate the energy emitted for the transition.
(iii) Another line, **C** was formed with wavelength of 1817.5 nm. Explain qualitatively, whether line **B** or line **C**, has the higher energy emitted.
[8 marks]

(b) The electronic configuration of element D is $1s^2 2s^2 2p^6 3s^2 3p^3$.
(i) Give a set of quantum numbers for the 9th electron.
(ii) Draw the orbital diagram of the valence electron.
(iii) Draw and label the 3D shape of orbitals occupied by the valence electrons.
[13 marks]

2019 / 2020

2 (a) The line spectrum of hydrogen atom in the visible region is shown in the following diagram [10 marks]



i) Name the series of the line spectrum
ii) Sketch an energy level diagram of a hydrogen atom for the formation of line X. Explain how line X is formed.
iii) Calculate the wavelength corresponding to line X
iv) Determine the energy involved in 2(a)(iii)

(b) Describe the anamalous electronic configuration of chromium atom [3 marks]

2020/2021

2 (a) Calculate the energy emitted and the wavelength of the spectrum line when an electron moves from $n = 6$ to $n = 3$. State the series and electromagnetic region of the spectrum line [6 marks]

(b) An electron has the following quantum numbers $n = 3$, $\ell = 2$. Identify its orbital. Draw the spatial orientation for all the possible orbitals. [4 marks]

2021/2022

9 A line in the Brackett series of a hydrogen emission spectrum has a wavelength of 2625 nm. Determine the electron transition that produces the line.

10 **FIGURE 1** below shows line spectrum of a hydrogen atom in the Balmer series. Calculate energy emitted in the formation of line **K**

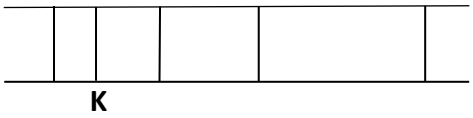
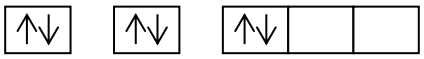
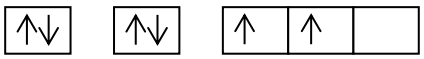
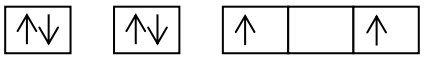


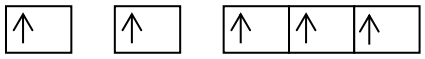
FIGURE 1

11 Choose the orbital diagram that does not obey Hund's rule

A. 

B. 

C. 

D. 

12 An element **Q** can form an ion with a charge of 2-. Choose the correct electronic configuration that represents element **Q**

A. $1s^2\ 2s^2\ 2p^6$
B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

2022 / 2023

2 (a) Sketch an energy level diagram to show the first five lines involved when electrons fall between energy levels in the Lyman series. Determine the wavelength of the radiation that emits the highest frequency for this series. [6 marks]

(b) An atom X has proton number of 13. Determine the number of electron(s) in an orbital with the quantum number, ℓ=0. Draw the orbital(s) of the valence electrons with ℓ=1. [4 marks]

2023 / 2024

2 (a) The frequency of a line in the Paschen series of the hydrogen atom is $2.74 \times 10^{14}\ s^{-1}$. Determine the electron transition that produces this line. [4 marks]

(b) The proton number of element **Q** is **26**. **Q** can form two ions with +2 and +3 oxidation number.

(i) Determine which ion is more stable.

(ii) Draw the shape of orbitals of the highest energy electron in element **Q** and $\mathbf{Q^{3+}}$ ion. [6 marks]

2024 / 2025

2 (a) **FIGURE 2** shows a visible region of emission spectrum of hydrogen. The lines in this spectrum correspond to the electronic transitions.

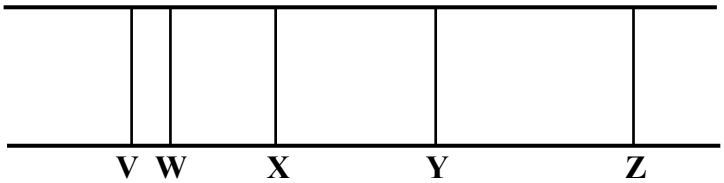


FIGURE 2

(i) Determine the line that corresponds to the shortest wavelength of radiation.

(ii) Determine the wavelength of the photon emitted (in nm) of line **X**. [5 marks]

The proton number of element **E** is 25.

(b) (i) Write the electronic configuration of $\mathbf{E^{2+}}$ ion.
(ii) Determine the number of unpaired electron(s) in **E**.
(iii) Write a set of quantum numbers for the 9^{th} electron in **E**.
(iv) Draw the shape of the orbital occupied by the outermost electron(s) in **E**. [5 marks]