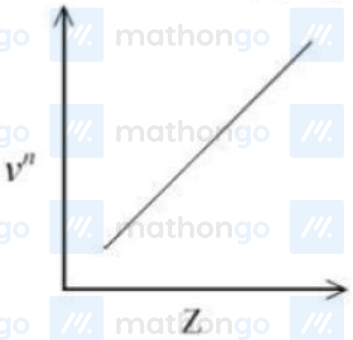
Q1 - 24 January - Shift 1

It is observed that characteristic X-ray spectra of elements show regularity. When frequency to the power 'n' i.e. ν^n of X-rays emitted is plotted against atomic number 'Z', following graph is obtained.



The value of 'n' is

(1) 1 (2) 2

(3) $\frac{1}{2}$ (4) 3

Space for your notes:

Q2 - 24 January - Shift 1

If wavelength of the first line of the Paschen series of hydrogen atom is 720 nm, then the wavelength of the second line of this series is _____ nm. (Nearest integer)

Space for your notes:

Q3 - 24 January - Shift 2

The number of s-electrons present in an ion with 55 protons in its unipositive state is

(1) 8 (2) 9

(3) 12 (4) 10

Space for your notes:

Q4 - 25 January - Shift 1

The radius of the 2nd orbit of Li^{2+} is x. The expected radius of the 3rd orbit of Be^{3+} is

(1) $\frac{9}{4}x$ (2) $\frac{4}{9}x$

(3) $\frac{27}{16}x$ (4) $\frac{16}{27}x$

Space for your notes:

Q5 - 25 January - Shift 1

How many of the following metal ions have similar value of spin only magnetic moment in gaseous state ?_____

(Given: Atomic number : V, 23 ; Cr, 24 ; Fe, 26 ; Ni, 28)

V^{3+}, Cr^{3+}, Fe^{2+}, Ni^{3+}

Space for your notes:

Q6 - 29 January - Shift 1

The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^{+} is

(1) $\frac{5}{9\lambda}$ (2) $\frac{9\lambda}{5}$

(3) $\frac{36\lambda}{5}$ (4) $\frac{5\lambda}{9}$

Space for your notes:

Q7 - 29 January - Shift 2

Assume that the radius of the first Bohr orbit of hydrogen atom is 0.6 Å. The radius of the third Bohr orbit of He^+ is _____ picometer. (Nearest Integer)

Space for your notes:

Q8 - 30 January - Shift 1

The energy of one mole of photons of radiation of frequency 2×10^{12} Hz in $J\,mol^{-1}$ is _____. (Nearest integer)

(Given: $h = 6.626\times10^{-34}$ Js

$N_A = 6.022\times10^{23}\,mol^{-1}$)

Space for your notes:

Q9 - 30 January - Shift 2

Maximum number of electrons that can be accommodated in shell with n = 4 are:

(1) 16

(2) 32

(3) 50

(4) 72

Space for your notes:

Q10 - 30 January - Shift 2

The wave function (Ψ) of 2s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{1/2}\left(2-\frac{r}{a_0}\right)e^{-r/2a_0}$$

At $r = r_0$, radial node is formed. Thus, r_0 in terms of a_0

(1) $r_0 = a_0$ (2) $r_0 = 4a_0$

(3) $r_0 = \frac{a_0}{2}$ (4) $r_0 = 2a_0$

Space for your notes:

Q11 - 31 January - Shift 1

Which transition in the hydrogen spectrum would have the same wavelength as the Balmer type transition from n=4 to n = 2 of He^+ spectrum

(1) n = 2 to n = 1

(2) n = 1 to n = 3

(3) n = 1 to n = 2

(4) n = 3 to n = 4

Space for your notes:

Q12 - 31 January - Shift 2

Arrange the following orbitals in decreasing order of energy ?

(A) n = 3, l = 0, m = 0

(B) n = 4, l = 0, m = 0

(C) n = 3, l = 1, m = 0

(D) n = 3, l = 2, m = 1

The correct option for the order is :

(1) B > D > C > A

(2) D > B > C > A

(3) A > C > B > D

(4) D > B > A > C

Space for your notes:

Q13 - 01 February - Shift 1

Electrons in a cathode ray tube have been emitted with a velocity of 1000 ms^{-1}. The number of following statements which is/are true about the emitted radiation is _____ .

Given : $h = 6 \times 10^{-34}$ Js, $m_e = 9 \times 10^{-31}$ kg.

(A) The deBroglie wavelength of the electron emitted is 666.67nm.

(B) The characteristic of electrons emitted depend upon the material of the electrodes of the cathode ray tube.

(C) The cathode rays start from cathode and move towards anode.

(D) The nature of the emitted electrons depends on the nature of the gas present in cathode ray tube.

Space for your notes:

Q14 - 01 February - Shift 2

Which one of the following sets of ions represents a collection of isoelectronic species?

(Given : Atomic Number : F :9 , Cl : 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

(1) (Li^+ , Na^+ , Mg^{2+} , Ca^{2+}

(2) (Ba^{2+} , Sr^{2+} , K+ , Ca^{2+}

(3) (N^{3-} , O^{2-} , F^- , S^{2-}

(4) (K^+ , Cl^- , Ca^{2+} , Sc^{3+}

Space for your notes:

Answer Key

(As per Official NTA Key released on 2 Feb)

Q1 (3)	**Q2** (492)	**Q3** (4)	**Q4** (3)
Q5 (2)	**Q6** (2)	**Q7** (270)	**Q8** (798)
Q9 (2)	**Q10** (4)	**Q11** (1)	**Q12** (2)
Q13 (2)	**Q14** (4)		

Q1 (3)

According to Henry Moseley $\sqrt{\nu}\ \alpha\ z - b$

So $n = \frac{1}{2}$

Q2 (492)

$$\frac{1}{(\lambda_1)_P} = R_H Z^2 \left(\frac{1}{9} - \frac{1}{16}\right)$$

$$\frac{1}{(\lambda_2)_P} = R_H Z^2 \left(\frac{1}{9} - \frac{1}{25}\right)$$

$$\frac{(\lambda_2)_P}{(\lambda_1)_P} = \frac{\frac{7}{16\times 9}}{\frac{16}{25\times 9}} = \frac{25\times 7}{16\times 16}$$

$$(\lambda_2)_P = \frac{25\times 7}{16\times 16}\times 720$$

Q3 (4)

$Z = 55$ [Cs] $\Rightarrow$ [Xe] $6s^1$

$[Cs^+] \Rightarrow$ [Xe] i.e. upto 5s count e^- of s-subshell

i.e. 1s, 2s, 3s, 4s, 5s $\Rightarrow$ 10 electrons

Q4 (3)

Li^{2+} | Be^{3+}

$r_2 = x = k \times \frac{2^2}{3} = \frac{4k}{2}$ | $r_3 = y = k \times \frac{3^2}{4}$

$$\frac{y}{x} = \frac{9}{4} \times \frac{3}{4} = \frac{27}{16}$$

$$y = \frac{27}{16}x$$

Q5 (2)

$\mu_s = \sqrt{n(n+2)}BM$ (n=no. of unpaired electrons)

	n
V^{3+} : [Ar] $3d^2 4s^0$	2
Cr^{3+} : [Ar] $3d^3 4s^0$	3
Fe^{2+} : [Ar] $3d^6 4s^0$	4
Ni^{3+} : [Ar] $3d^7 4s^0$	3

Cr^{3+} & Ni^{3+} have same value of μ_s

Q6 (2)

For H: $\frac{1}{\lambda} = R_H \times 1^2 \left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$ ...(1)

$\frac{1}{\lambda_{He^+}} = R_H \times 2^2 \times \left(\frac{1}{4} - \frac{1}{9}\right)$ .... (2)

From (1) & (2) $\frac{\lambda_{He^+}}{\lambda} = \frac{9}{5}$

$\lambda_{He^+} = \lambda \times \frac{9}{5}$

$\lambda_{He^+} = \frac{9\lambda}{5}$

Q7 (270)

$r \propto \frac{n^2}{Z}$

$r_{He^+} = r_H \times \frac{n^2}{Z}$

$r_{He^+} = 0.6 \times \frac{(3)^2}{2}$

$= 2.7$ Å

$r_{He^+} = 270\text{pm}$

Q8 (798)

For one photon E = hv

For one mole photon,

$E = 6 \cdot 023 \times 10^{23} \times 6 \cdot 626 \times 10^{-34} \times 2 \times 10^{12}$

$= 798 \cdot 16$ J

≈ 798 J

Q9 (2)

The number of electrons in the orbitals of sub-shell of n = 4 are

4s	2
4p	6
4d	10
4f	14
(Total)	**32**

Q10 (4)

$$\text{At node } \Psi_{2s} = 0$$

$$\therefore 2 - \frac{r_0}{a_0} = 0$$

$$\therefore r_0 = 2a_0$$

Q11 (1)

He^+ ion :

$$\frac{1}{\lambda(H)} = R(1)^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda(He^+)} = R(2)^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

Given $\lambda(H) = \lambda(He^+)$

$$R(1)^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R(4)\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$\frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{1}{1^2} - \frac{1}{2^2}$$

On comparing n_1=1 & n_2=2

Ans. 1

Q12 (2)

(A) n = 3; l = 0; m = 0 ; 3s orbital
(B) n = 4; l = 0; m = 0 ; 4s orbital
(C) n = 3; l = 1; m = 0 ; 3p orbital
(D) n = 3; l = 2; m = 0 ; 3d orbital

As per Hund's rule energy is given by (n+*l*) value.
If value of (n+*l*) remains same then energy is given by n only.

Q13 (2)

(A) $V_e = 1000$ m/s ; $h = 6 \times 10^{-34}$ Js ;

$m_e = 9 \times 10^{-31}$ kg

$$\lambda = \frac{h}{mv} = \frac{6\times10^{-34}}{9\times10^{-31}\times1000} = 666.67 \times 10^{-9}\text{m}$$

$= 666.67$ nm

(B) The characteristic of electrons emitted is independent of the material of the electrodes of the cathode ray tube.

(C) The cathode rays start from cathode and move towards anode.

(D) The nature of the emitted electrons is independent on the nature of the gas present in cathode ray tube.

Q14 (4)

K^+ Cl^1 Ca^{2+} Sc^{3+}

18 18 18 18