

Questions

MathonGo

Q1 - 24 June - Shift 1

Consider the following pairs of electrons

Space for your notes:

(A) (a) $n = 3, l = 1, m_l = 1, m_s = +\frac{1}{2}$

(b) $n = 3, l = 2, m_l = 1, m_s = +\frac{1}{2}$

(B) (a) $n = 3, l = 2, m_l = -2, m_s = -\frac{1}{2}$

(b) $n = 3, l = 2, m_l = -1, m_s = -\frac{1}{2}$

(C) (a) $n = 4, l = 2, m_l = 2, m_s = +\frac{1}{2}$

(b) $n = 3, l = 2, m_l = 2, m_s = +\frac{1}{2}$

The pairs of electron present in degenerate orbitals

is/are:

(A) Only A

(B) Only B

(C) Only C

(D) (B) and (C)

Q2 - 24 June - Shift 2

The energy of one mole of photons of radiation of wavelength 300 nm is

Space for your notes:

(Given : $h = 6.63 \times 10^{-34}$ Js, $N_A = 6.02 \times 10^{23}$ mol⁻¹,
 $c = 3 \times 10^8$ ms⁻¹)

(A) 235 kJ mol⁻¹ (B) 325 kJ mol⁻¹

(C) 399 kJ mol⁻¹ (D) 435 kJ mol⁻¹

Q3 - 25 June - Shift 1

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The pair, in which ions are isoelectronic with Al^{3+} is :-

- (A) Br^- and Be^{2+} (B) Cl^- and Li^+
(C) S^{2-} and K^+ (D) O^{2-} and Mg^{2+}

Space for your notes:

Q4 - 25 June - Shift 1

The longest wavelength of light that can be used for the ionisation of lithium atom (Li) in its ground state is $x \times 10^{-8}$ m. The value of x is _____ . (Nearest Integer)

(Given : Energy of the electron in the first shell of the hydrogen atom is -2.2×10^{-18} J; $h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^8$ ms^{-1})

Space for your notes:

Q5 - 25 June - Shift 2

The minimum energy that must be possessed by photons in order to produce the photoelectric effect with platinum metal is:

[Given: The threshold frequency of platinum is 1.3×10^{15} s^{-1} and $h = 6.6 \times 10^{-34}$ J s.]

- (A) 3.21×10^{-14} J (B) 6.24×10^{-16} J
(C) 8.58×10^{-19} J (D) 9.76×10^{-20} J

Space for your notes:

Q6 - 26 June - Shift 1

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If the radius of the 3rd Bohr's orbit of hydrogen atom is r_3 and the radius of 4th Bohr's orbit is r_4 . Then :

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(A) $r_4 = \frac{9}{16} r_3$ (B) $r_4 = \frac{16}{9} r_3$

(C) $r_4 = \frac{3}{4} r_3$ (D) $r_4 = \frac{4}{3} r_3$

Q7 - 26 June - Shift 2

The number of radial and angular nodes in 4d orbital are, respectively

Space for your notes:

- (1) 1 and 2 (2) 3 and 2
(3) 1 and 0 (4) 2 and 1

Q8 - 27 June - Shift 1

If the uncertainty in velocity and position of a minute particle in space are, $2.4 \times 10^{-26} \text{ (ms}^{-1}\text{)}$ and 10^{-7} (m) respectively. The mass of the particle of g is _____ (Nearest integer)

Space for your notes:

(Given : $h = 6.626 \times 10^{-34} \text{ Js}$)

Q9 - 27 June - Shift 2

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Consider the following set of quantum numbers

Space for your notes:

	n	l	m _l
A.	3	3	-3
B.	3	2	-2
C.	2	1	+1
D.	2	2	+2

The number of correct sets of quantum numbers is

Q10 - 28 June - Shift 1

If the work function of a metal is 6.63×10^{-19} J, the maximum wavelength of the photon required to remove a photoelectron from the metal is _____

nm. (Nearest integer)

[Given : $h = 6.63 \times 10^{-34}$ J s, and $c = 3 \times 10^8$ m s⁻¹]

Q11 - 28 June - Shift 2

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Consider the following statements :

Space for your notes:

(A) The principal quantum number 'n' is a positive integer with values of 'n' = 1, 2, 3,

(B) The azimuthal quantum number 'l' for a given 'n' (principal quantum number) can have values as 'l' = 0, 1, 2, n

(C) Magnetic orbital quantum number 'm_l' for a particular 'l' (azimuthal quantum number) has (2l + 1) values.

(D) ±1/2 are the two possible orientations of electron spin.

(E) For l = 5, there will be a total of 9 orbital.

Which of the above statements are **correct**?

(A) (A), (B) and (C)

(B) (A), (C), (D) and (E)

(C) (A), (C) and (D)

(D) (A), (B), (C) and (D)

Q12 - 29 June - Shift 1

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Which of the following statements are **correct** ?

Space for your notes:

(A) The electronic configuration of Cr is $[\text{Ar}] 3d^5 4s^1$.

(B) The magnetic quantum number may have a negative value.

(C) In the ground state of an atom, the orbitals are filled in order of their increasing energies.

(D) The total number of nodes are given by $n - 2$.

Choose the **most appropriate** answer from the options given below :

(A) (A), (C) and (D) only

(B) (A) and (B) only

(C) (A) and (C) only

(D) (A), (B) and (C) only

Q13 - 29 June - Shift 1

The electronic configuration of Pt (atomic number 78) is:

Space for your notes:

(A) $[\text{Xe}] 4f^{14} 5d^9 6s^1$

(B) $[\text{Kr}] 4f^{14} 5d^{10}$

(C) $[\text{Xe}] 4f^{14} 5d^{10}$

(D) $[\text{Xe}] 4f^{14} 5d^8 6s^2$

Q14 - 29 June - Shift 2

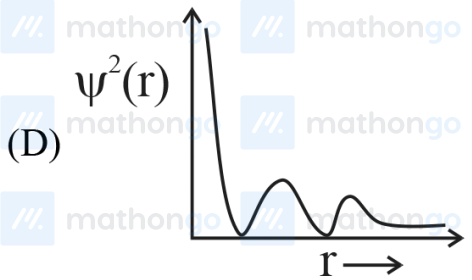
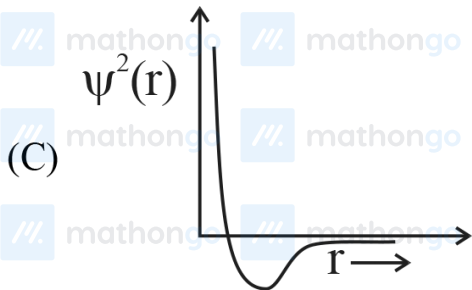
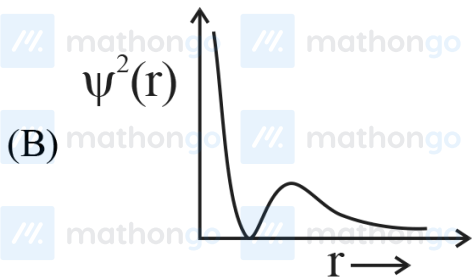
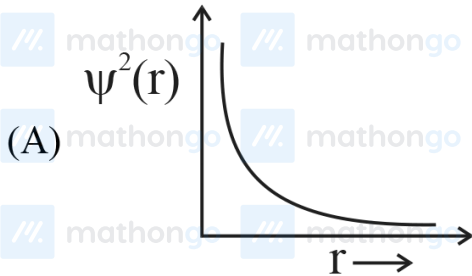
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Which of the following is the correct plot for the probability density $\psi^2(r)$ as a function of distance 'r' of the electron from the nucleus for 2s orbital?

Space for your notes:



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Answer Key

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Q1 (B) **Q2 (C)** **Q3 (D)** **Q4 (4)**
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Q5 (C) **Q6 (B)** **Q7 (A)** **Q8 (22)**
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Q9 (2) **Q10 (300)** **Q11 (C)** **Q12 (D)**
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Q13 (A) **Q14 (B)**
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Hints and Solutions

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Q1 (B)

Based on “ $n + l$ ” rule only (B) has pair of electron in degenerate orbitals

Q2 (C)

Energy of one mole of photons = $\frac{hc}{\lambda} \times N_A$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9}} \times 6.02 \times 10^{23}$$

$$= 399.13 \times 10^3 \text{ Joule/mole}$$

$$= 399 \text{ kJ / mole}$$

Q3 (D)

Isoelectronic species have same no. of electrons

Al^{+3} , O^{2-} , Mg^{+2} all have 10 electrons.

Q4 (4)

We can not calculate I.E. of lithium atom.

Q5 (C)

$$W = hv$$

$$= 6.6 \times 10^{-34} \times 1.3 \times 10^{15}$$

$$= 8.58 \times 10^{-19} \text{ J}$$

Q6 (B)

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$$r = 0.529 \times \frac{n^2}{Z} \text{ \AA}$$

$$r_3 = 0.529 \times \frac{3^2}{1}$$

$$r_4 = 0.529 \times \frac{4^2}{1}$$

$$\frac{r_4}{r_3} = \frac{4^2}{3^2} = \frac{16}{9}$$

$$r_4 = \frac{16r_3}{9}$$

Q7 (A)

$$\begin{aligned} \text{Radial node} &= n - l - 1 \\ &= 4 - 2 - 1 \\ &= 1 \end{aligned}$$

$$\text{Angular node } (l) = 2$$

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Hints and Solutions

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Q8 (22)

$$\Delta V = 2.4 \times 10^{-26} \text{ ms}^{-1}$$

$$\Delta x = 10^{-7} \text{ m}$$

$$\therefore \Delta p \cdot \Delta x = \frac{h}{4\pi}$$

$$\therefore m \Delta V \cdot \Delta x = \frac{h}{4\pi}$$

$$\Rightarrow m \times 2.4 \times 10^{-26} \times 10^{-7} = \frac{6.626 \times 10^{-34}}{4 \times \pi}$$

$$m = \frac{6.626}{9.6 \times \pi} \times 10^{-1}$$

$$m = 0.02198 \text{ kg}$$

$$m = 21.98 \text{ gm}$$

$$\text{nearest integer} = 22$$

Q9 (2)

Quantum no. of set (B) and (C) can be correct.

(A) and (D) are wrong as $n = \ell$ is not possible.

Q10 (300)

$$\phi = 6.63 \times 10^{-19} \text{ J} = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{\lambda}$$

$$\Rightarrow \lambda = 3 \times 10^{-7} \text{ m} = 300 \text{ nm}$$

Q11 (C)

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Hints and Solutions

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(A) Number of values of $n = 1, 2, 3, \dots, \infty$ (B) Number of values of $\ell = 0$ to $(n - 1)$ (C.) Number of values of $m = -\ell$ to $+\ell$

$$\text{Total values} = 2\ell + 1$$

(D) Values of spin = $\pm \frac{1}{2}$ (E) For $\ell = 5$ number of orbitals = $2\ell + 1 = 11$ **Q12 (D)**(A) $\text{Cr} = [\text{Ar}]3d^5 4s^1$ (B) $m = -\ell$ to $+\ell$

(C) According to Aufbau principle, orbitals are filled in order of their increasing energies.

(D) Total nodes = $n - 1$ **Q13 (A)** ${}_{78}\text{Pt} = [\text{Xe}] 4f^{14} 5d^9 6s^1$ (Exceptional electronic configuration)**Q14 (B)**For 2s, number of radial nodes = $2 - 0 - 1 = 1$ and value of ψ^2 is always positive.

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