Chapter 2

Structure of Atom

1. Calculate the wavelength (in nanometer) associated with a proton moving at 1.0×10^3 ms^{-1}

(Mass of proton = 1.67×10^{-27} kg and h = 6.63×10^{-34} Js) **[AIEEE-2009]**

(1) 0.40 nm (2) 2.5 nm

(3) 14.0 nm (4) 0.032 nm

2. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is ($h = 6.6 \times 10^{-34}$ kg m^2s^{-1}, mass of electron, $e_m = 9.1 \times 10^{-31}$ kg) **[AIEEE-2009]**

(1) 5.10×10^{-3} m (2) 1.92×10^{-3} m

(3) 3.84×10^{-3} m (4) 1.52×10^{-4} m

3. The energy required to break one mole of Cl – Cl bonds in Cl_2 is 242 kJ mol^{-1}. The longest wavelength of light capable of breaking a single Cl – Cl bond is

($c = 3 \times 10^8$ ms^{-1} and $N_A = 6.02 \times 10^{23}$ mol^{-1}) **[AIEEE-2010]**

(1) 494 nm (2) 594 nm

(3) 640 nm (4) 700 nm

4. Ionisation energy of He^+ is 19.6×10^{-18} $atom^{-1}$. The energy of the first stationary state (n = 1) of Li^{2+} is **[AIEEE-2010]**

(1) 8.82×10^{-17} J $atom^{-1}$

(2) 4.41×10^{-16} J $atom^{-1}$

(3) -4.41×10^{-17} J $atom^{-1}$

(4) -2.2×10^{-15} J $atom^{-1}$

5. The frequency of light emitted for the transition n = 4 to n = 2 of He^+ is equal to the transition in H atom corresponding to which of the following **[AIEEE-2011]**

(1) n = 4 to n = 3

(2) n = 3 to n = 1

(3) n = 2 to n = 1

(4) n = 3 to n = 2

6. The electrons identified by quantum numbers n and l

(a) n = 4, l = 1 (b) n = 4, l = 0

(c) n = 3, l = 2 (d) n = 3, l = 1

can be placed in order of increasing energy as **[AIEEE-2012]**

(1) (d) < (b) < (c) < (a)

(2) (b) < (d) < (a) < (c)

(3) (a) < (c) < (b) < (d)

(4) (c) < (d) < (b) < (a)

7. Energy of an electron is given by $E = -2.178 \times 10^{-18} J\left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom form level n = 1 to n = 2 will be

($h = 6.62 \times 10^{-34}$ Js and $c = 3.0 \times 10^8$ ms^{-1}) **[JEE (Main)-2013]**

(1) 1.214×10^{-7} m (2) 2.816×10^{-7} m

(3) 6.500×10^{-7} m (4) 8.500×10^{-7} m

8. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be **[JEE (Main)-2013]**

(1) –2.55 eV (2) –5.1 eV

(3) –10.2 eV (4) +2.55 eV

9. The correct set of four quantum numbers for the valence electrons of rubidium atom (Z = 37) is **[JEE (Main)-2014]**

(1) $5, 0, 0, +\frac{1}{2}$ (2) $5, 1, 0, +\frac{1}{2}$

(3) $5, 1, 1, +\frac{1}{2}$ (4) $5, 0, 1, +\frac{1}{2}$

10. Which of the following is the energy of a possible excited state of hydrogen? **[JEE (Main)-2015]**

(1) +13.6 eV (2) –6.8 eV

(3) –3.4 eV (4) +6.8 eV

11. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of $\frac{h}{\lambda}$ (where λ is wavelength associated with electron wave) is given by **[JEE (Main)-2016]**

(1) 2meV

(2) $\sqrt{meV}$

(3) $\sqrt{2meV}$

(4) meV

12. The radius of the second Bohr orbit for hydrogen atom is

(Planck's Const. h = 6.6262 × 10^{-34} Js;

mass of electron = 9.1091 × 10^{-31} kg;

charge of electron e = 1.60210 × 10^{-19} C;

permittivity of vacuum

ε_0 = 8.854185 × 10^{-12} kg^{-1} m^{-3} A^2)

[JEE (Main)-2017]

(1) 0.529 Å (2) 2.12 Å

(3) 1.65 Å (4) 4.76 Å

13. For emission line of atomic hydrogen from n_i = 8 to n_f = n, the plot of wave number ($\bar{\nu}$) against $\left(\frac{1}{n^2}\right)$ will be (The Rydberg constant, R_H is in wave number unit) **[JEE (Main)-2019]**

(1) Linear with slope R_H

(2) Linear with intercept $-R_H$

(3) Non-linear

(4) Linear with slope $-R_H$

14. Which of the following combination of statements is true regarding the interpretation of the atomic orbitals?

(a) An electron in an orbital of high angular momentum stays away from the nucleus than an electron in the orbital of lower angular momentum

(b) For a given value of the principal quantum number, the size of the orbit is inversely proportional to the azimuthal quantum number.

(c) According to wave mechanics, the ground state angular momentum is equal to $\frac{h}{2\pi}$

(d) The plot of ψ Vs r for various azimuthul quantum numbers, shows peak shifting towards higher r value. **[JEE (Main)-2019]**

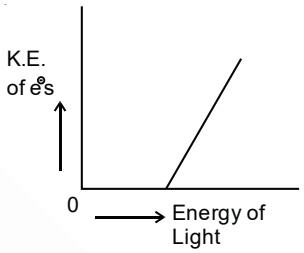
(1) (a), (d) (2) (b), (c)

(3) (a), (c) (4) (a), (b)

15. Which of the graphs shown below does not represent the relationship between incident light and the electron ejected from metal surface?

[JEE (Main)-2019]

(1)



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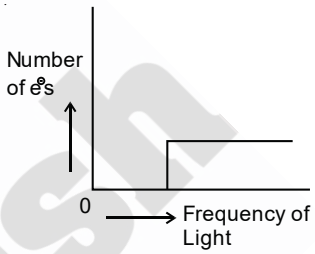

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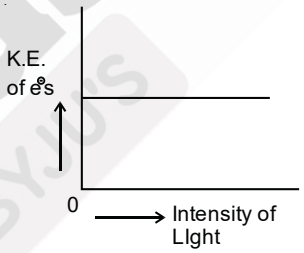

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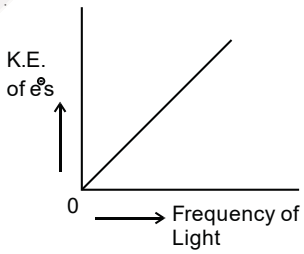


16. The ground state energy of hydrogen atom is –13.6 eV. The energy of second excited state of He^+ ion in eV is **[JEE (Main)-2019]**

(1) –27.2 (2) –6.04

(3) –54.4 (4) –3.4

17. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H-atom is suitable for this purpose?

[R_H= 1 × 10^5 cm, h = 6.6 × 10^{-34} Js, c = 3 × 10^8 ms^{-1}]

[JEE (Main)-2019]

(1) Balmer, $\infty \rightarrow 2$ (2) Lyman, $\infty \rightarrow 1$

(3) Paschen, $5 \rightarrow 3$ (4) Paschen, $\infty \rightarrow 3$

18. The de Broglie wavelength (λ) associated with a photoelectron varies with the frequency (ν) of the incident radiation as, [ν_0 is threshold frequency]

[JEE (Main)-2019]

(1) $\lambda \propto \frac{1}{(\nu - \nu_0)}$ (2) $\lambda \propto \frac{1}{(\nu - \nu_0)^{\frac{1}{4}}}$

(3) $\lambda \propto \frac{1}{(\nu - \nu_0)^{\frac{1}{2}}}$ (4) $\lambda \propto \frac{1}{(\nu - \nu_0)^{\frac{3}{2}}}$

19. What is the work function of the metal if the light of wavelength 4000 Å generates photoelectrons of velocity 6×10^5 ms^{-1} from it?

(Mass of electron = 9×10^{-31} kg

Velocity of light = 3×10^8 ms^{-1}

Planck's constant = 6.626×10^{-34} Js

Charge of electron = 1.6×10^{-19} JeV^{-1})

[JEE (Main)-2019]

(1) 4.0 eV (2) 2.1 eV

(3) 3.1 eV (4) 0.9 eV

20. If the de Broglie wavelength of the electron in n^{th} Bohr orbit in a hydrogenic atom is equal to $1.5\ \pi a_0$ (a_0 is Bohr radius), then the value of n/z is

[JEE (Main)-2019]

(1) 0.40 (2) 1.50

(3) 0.75 (4) 1.0

21. The quantum number of four electrons are given below

(I) $n = 4, l = 2, m_l = -2, m_s = -\frac{1}{2}$

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

(III) $n = 4, l = 1, m_l = 0, m_s = +\frac{1}{2}$

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

The correct order of their increasing energies will be **[JEE (Main)-2019]**

(1) IV < II < III < I (2) I < III < II < IV

(3) IV < III < II < I (4) I < II < III < IV

22. If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wavelength λ, then for 1.5 p momentum of the photoelectron, the wavelength of the light should be

(Assume kinetic energy of ejected photoelectron to be very high in comparison to work function):

[JEE (Main)-2019]

(1) $\frac{3}{4}\lambda$ (2) $\frac{4}{9}\lambda$

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

23. For any given series of spectral lines of atomic hydrogen, let $\Delta\bar{\nu} = \bar{\nu}_{max} - \bar{\nu}_{min}$ be the difference in maximum and minimum frequencies in cm^{-1}. The ratio $\Delta\bar{\nu}_{Lyman} / \Delta\bar{\nu}_{Balmer}$ is **[JEE (Main)-2019]**

(1) 9 : 4 (2) 27 : 5

(3) 4 : 1 (4) 5 : 4

24. Which one of the following about an electron occupying the 1s orbital in a hydrogen atom is incorrect? (The Bohr radius is represented by a_0)

[JEE (Main)-2019]

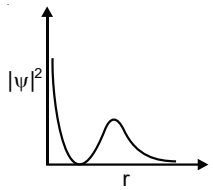
(1) The probability density of finding the electron is maximum at the nucleus

(2) The electron can be found at a distance $2a_0$ from the nucleus

(3) The magnitude of the potential energy is double that of its kinetic energy on an average

(4) The total energy of the electron is maximum when it is at a distance a_0 from the nucleus

25. The graph between $|\psi|^2$ and r(radial distance) is shown below. This represents **[JEE (Main)-2019]**



(1) 1s orbital (2) 2s orbital

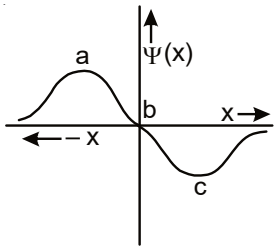
(3) 2p orbital (4) 3s orbital

26. The ratio of the shortest wavelength of two spectral series of hydrogen spectrum is found to be about 9. The spectral series are **[JEE (Main)-2019]**

(1) Paschen and Pfund (2) Brackett and Pfund

(3) Lyman and Paschen (4) Balmer and Brackett

27. The electrons are more likely to be found **[JEE (Main)-2019]**



(1) In the region a and c (2) Only in the region c

(3) Only in the region a (4) In the region a and b

28. Among the following, the energy of 2s orbital is lowest in **[JEE (Main)-2019]**

(1) Li (2) K

(3) H (4) Na

29. The number of orbitals associated with quantum numbers n = 5, $m_s = +\frac{1}{2}$ is **[JEE (Main)-2020]**

(1) 15 (2) 50

(3) 25 (4) 11

30. For the Balmer series in the spectrum of H atom, $\bar{\nu}=R_H\left\{\frac{1}{n_1^2}-\frac{1}{n_2^2}\right\}$, the correct statements among (I) to (VI) are

(I) As wavelength decreases, the lines in the series converge

(II) The integer n_1 is equal to 2

(III) The lines of longest wavelength corresponds to $n_2 = 3$

(IV) The ionization energy of hydrogen can be calculated from wave number of these lines

[JEE (Main)-2020]

(1) (I), (II), (III) (2) (II), (III), (IV)

(3) (I), (III), (IV) (4) (I), (II), (IV)

31. The radius of the second Bohr orbit, in terms of the Bohr radius, a_0, in Li^{2+} is **[JEE (Main)-2020]**

(1) $\frac{4a_0}{3}$ (2) $\frac{4a_0}{9}$

(3) $\frac{2a_0}{3}$ (4) $\frac{2a_0}{9}$

32. The de Broglie wavelength of an electron in the 4th Bohr orbit is **[JEE (Main)-2020]**

(1) $4\pi a_0$ (2) $6\pi a_0$

(3) $8\pi a_0$ (4) $2\pi a_0$

33. The figure that is not a direct manifestation of the quantum nature of atoms is **[JEE (Main)-2020]**

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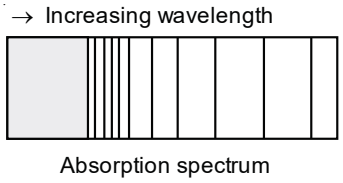

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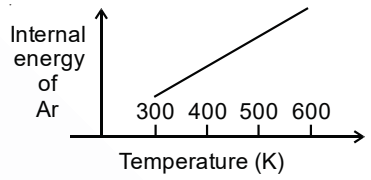

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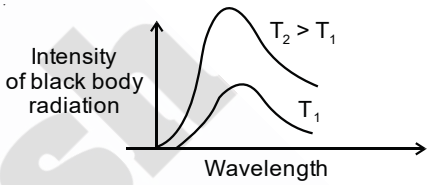

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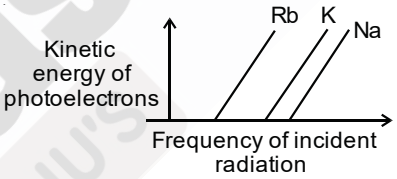


34. The number of subshells associated with n = 4 and m = –2 quantum numbers is **[JEE (Main)-2020]**

(1) 2 (2) 8

(3) 4 (4) 16

35. The region in the electromagnetic spectrum where the Balmar series lines appear is **[JEE (Main)-2020]**

(1) Microwave (2) Ultraviolet

(3) Visible (4) Infrared

36. The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmar series of He^+ is **[JEE (Main)-2020]**

(1) $\frac{5\lambda_1}{9}$ (2) $\frac{36\lambda_1}{5}$

(3) $\frac{27\lambda_1}{5}$ (4) $\frac{9\lambda_1}{5}$

37. The difference between radii of 3rd and 4th orbits of Li^{2+} is ΔR_1. The difference between the radii of 3rd and 4th orbits of He^+ is ΔR_2. Ratio $\Delta R_1 : \Delta R_2$ is **[JEE (Main)-2020]**

(1) 3 : 2 (2) 8 : 3

(3) 2 : 3 (4) 3 : 8

38. The correct statement about probability density (except at infinite distance from nucleus) is

[JEE (Main)-2020]

(1) It can never be zero for 2s orbital

(2) It can be zero for 3p orbital

(3) It can be zero for 1s orbital

(4) It can be negative for 2p orbital

39. The work function of sodium metal is 4.41×10^{-19} J. If photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be ($h = 6.63 \times 10^{-34}$ J s; $c = 3 \times 10^8$ m/s) _____ $\times 10^{-21}$ J.

[JEE (Main)-2020]

40. A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_p denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{Li}}{\lambda_p}$ is $x \times 10^{-1}$.

The value of x is _____. (Rounded off to the nearest integer)

[Mass of Li^{3+} = 8.3 mass of proton]

[JEE (Main)-2021]

41. According to Bohr's atomic theory:

(A) Kinetic energy of electron is $\propto \frac{Z^2}{n^2}$

(B) The product of velocity (v) of electron and principal quantum number (n), 'vn' $\propto Z^2$

(C) Frequency of revolution of electron in an orbit is $\propto \frac{Z^3}{n^3}$

(D) Coulombic force of attraction on the electron is $\propto \frac{Z^3}{n^4}$

Choose the most appropriate answer from the options given below: **[JEE (Main)-2021]**

(1) (A) only

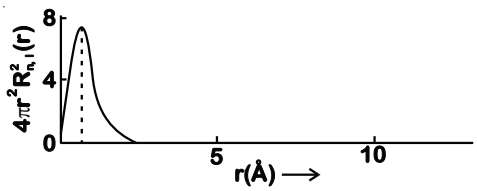
(2) (A) and (D) only

(3) (C) only

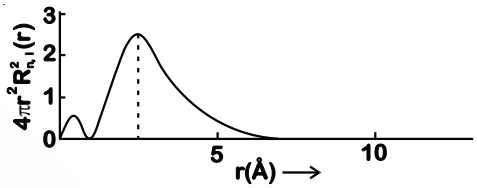
(4) (A), (C) and (D) only

42. The plots of radial distribution functions for various orbitals of hydrogen atom against 'r' are given below

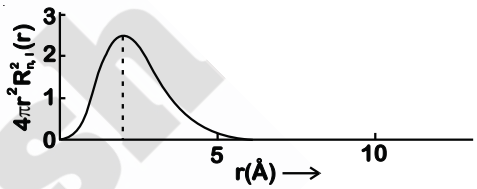
(A)



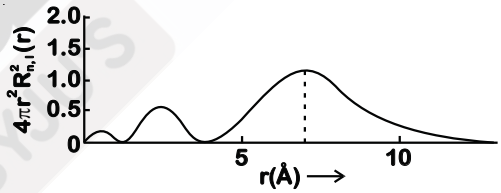
(B)



(C)



(D)



The correct plot for 3s orbital is

(1) (C) (2) (D)

(3) (B) (4) (A)

[JEE (Main)-2021]

43. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionise the atom of metal A. The ionization energy of metal A in kJ mol^{-1} is ____. (Rounded-off to the nearest integer)

[$h = 6.63 \times 10^{-34}$ Js, $c = 3.00 \times 10^8$ ms^{-1}, $N_A = 6.02 \times 10^{23}$ mol^{-1}] **[JEE (Main)-2021]**

44. The orbital having two radial as well as two angular nodes is : **[JEE (Main)-2021]**

(1) 3p (2) 4d

(3) 5d (4) 4f

45. A ball weighing 10 g is moving with a velocity of 90 ms^{-1}. If the uncertainty in its velocity is 5%, then the uncertainty in its position is _____ × 10^{-33} m. (Rounded off to the nearest integer)

[Given : h = 6.63 × 10^{-34} Js] **[JEE (Main)-2021]**

46. When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is ____ Å. (Round off to the Nearest Integer).

[Use : $\sqrt{3} = 1.73, h = 6.63 \times 10^{-34}$ Js

m_e = 9.1 × 10^{-31} kg; c = 3.0 × 10^8 ms^{-1} ; 1eV = 1.6 × 10^{-19}J] **[JEE (Main)-2021]**

47. The number of orbitals with n = 5, m_ℓ = +2 is _____.

(Round off to the Nearest Integer).

[JEE (Main)-2021]

48. A certain orbital has n = 4 and m_L = –3. The number of radial nodes in this orbital is _____.

(Round off to the Nearest Integer).

[JEE (Main)-2021]

49. In the ground state of atomic Fe(Z = 26), the spin-only magnetic moment is _____ × 10^{-1} BM. (Round off to the Nearest Integer).

[Given : $\sqrt{3} = 1.73, \sqrt{2} = 1.41$]

[JEE (Main)-2021]

50. Given below are two statements :

Statement I : Bohr's theory accounts for the stability and line spectrum of Li^+ ion.

Statement II : Bohr's theory was unable to explain the splitting of spectral lines in the presence of a magnetic field.

In the light of the above statements, choose the **most appropriate** answer from the options given below. **[JEE (Main)-2021]**

(1) Both statement I and statement II are true

(2) Statement I is false but statement II is true

(3) Both statement I and statement II are false

(4) Statement I is true but statement II is false

51. A certain orbital has no angular nodes and two radial nodes. The orbital is **[JEE (Main)-2021]**

(1) 2*p* (2) 3*p*

(3) 3*s* (4) 2*s*

52. The Azimuthal quantum number for the valence electrons of Ga^+ ion is _____.

(Atomic number of Ga = 31) **[JEE (Main)-2021]**

53. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $x \times 10^{-2}$ m. The value of *x* is _____. (Nearest integer)

Given: Mass of electron = 9.1 × 10^{-31} kg

Charge on an electron = 1.6 × 10^{-19} C

Planck's constant = 6.63 × 10^{-34} Js

[JEE (Main)-2021]

54. Number of electrons that Vanadium (Z = 23) has in p-orbitals is equal to _____. **[JEE (Main)-2021]**

55. A source of monochromatic radiation of wavelength 400 nm provides 1000 J of energy in 10 seconds. When this radiation falls on the surface of sodium, x × 10^{20} electrons are ejected per second. Assume that wavelength 400 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is _____. (Nearest integer)

(h = 6.626 × 10^{-34} Js) **[JEE (Main)-2021]**

56. An accelerated electron has a speed of 5 × 10^6 ms^{-1} with an uncertainty of 0.02%. The uncertainty in finding its location while in motion is $x \times 10^{-9}$ m. The value of *x* is _____. **[JEE (Main)-2021]**

[Use mass of electron = 9.1 × 10^{-31} kg, h = 6.63 × 10^{-34} Js, π = 3.14]

57. Given below are two statements :

Statement I : Rutherford's gold foil experiment cannot explain the line spectrum of hydrogen atom.

Statement II : Bohr's model of hydrogen atom contradicts Heisenberg's uncertainty principle.

In the light of the above statement, choose the **most appropriate** answer from the options given below: **[JEE (Main)-2021]**

(1) Both **statement I** and **statement II** are false.

(2) **Statement I** is true but **statement II** is false.

(3) **Statement I** is false but **statement II** is true.

(4) Both **statement I** and **statement II** are true.

58. If the Thompson model of the atom was correct, then the result of Rutherford's gold foil experiment would have been : **[JEE (Main)-2021]**

(1) All α-particles get bounced back by 180°

(2) α-particles pass through the gold foil deflected by small angles and with reduced speed

(3) α-particles are deflected over a wide range of angles

(4) All of the α-particles pass through the gold foil without decrease in speed

59. Given below are two statements :

Statement I : According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in positive charges on the nucleus as there is no strong hold on the electron by the nucleus.

Statement II : According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in principal quantum number.

In the light of the above statements, choose the **most appropriate** answer from the options given below : **[JEE (Main)-2021]**

(1) Both **Statement I** and **Statement II** are false

(2) **Statement I** is false but **Statement II** is true

(3) Both **Statement I** and **Statement II** are true

(4) **Statement I** is true but **Statement II** is false

60. A metal surface is exposed to 500 nm radiation. The threshold frequency of the metal for photoelectric current is 4.3×10^{14} Hz. The velocity of ejected electron is _____ $\times 10^5$ ms^{-1}. (Nearest integer)

[Use : $h = 6.63 \times 10^{-34}$ Js, $m_e = 9.0 \times 10^{-31}$ kg]

[JEE (Main)-2021]

61. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$. The value of 10x is _____. (a_0 is radius of Bohr's orbit) (Nearest integer)

[Given : $\pi = 3.14$] **[JEE (Main)-2021]**

62. The number of photons emitted by a monochromatic (single frequency) infrared range finder of power 1 mW and wavelength of 1000 nm, in 0.1 second is x $\times 10^{13}$. The value of x is _____. (Nearest integer)

($h = 6.63 \times 10^{-34}$ Js, $c = 3.00 \times 10^8$ ms^{-1})

[JEE (Main)-2021]

63. Ge (Z = 32) in its ground state electronic configuration has x completely filled orbitals with $m_l = 0$. The value of x is _____.

[JEE (Main)-2021]

64. A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is x $\times 10^{20}$. The value of x is _____. (Nearest integer)

[Given : $h = 6.63 \times 10^{-34}$ Js and $c = 3.0 \times 10^8$ ms^{-1}]

[JEE (Main)-2021]

65. Consider the following pairs of electrons

[JEE (Main)-2022]

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

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

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

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

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

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

The pairs of electrons present in degenerate orbitals is /are:

(1) Only (A) (2) Only (B)

(3) Only (C) (4) (B) and (C)

66. The energy of one mole of photons of radiation of wavelength 300 nm is (Given $h = 6.63 \times 10^{-34}$Js, $N_A = 6.02 \times 10^{23}$ mol^{-1}, $c = 3 \times 10^8$ ms^{-1})

[JEE (Main)-2022]

(1) 235 kJ mol^{-1} (2) 325 kJ mol^{-1}

(3) 399 kJ mol^{-1} (4) 435 kJ mol^{-1}

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

[JEE (Main)-2022]

(1) Br^- and Be^{2+} (2) Cl^- and Li^+

(3) S^{2-} and K^+ (4) O^{2-} and Mg^{2+}

68. 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})

[JEE (Main)-2022]

69. 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 $h = 6.6 \times 10^{-34}$ Js.]

[JEE (Main)-2022]

(1) 3.21×10^{-14} J (2) 6.24×10^{-16} J

(3) 8.58×10^{-19} J (4) 8.58×10^{-19} J

70. 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 :

[JEE (Main)-2022]

(1) $r_4 = \frac{9}{16} r_3$ (2) $r_4 = \frac{16}{9} r_3$

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

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

[JEE (Main)-2022]

(1) 1 and 2 (2) 3 and 2

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

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

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

[JEE (Main)-2022]

73. Consider the following set of quantum numbers.

	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 _____.

[JEE (Main)-2022]

74. Consider the following statements :

[JEE (Main)-2022]

(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?

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

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

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

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

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

[JEE (Main)-2022]

(A) The electronic configuration of Cr is [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 :

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

(2) (A) and (B) only

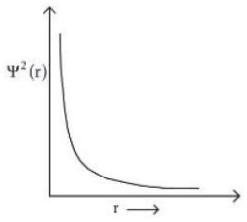
(3) (A) and (C) only

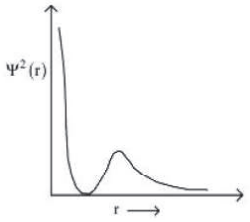
(4) (A), (B) and (C) only

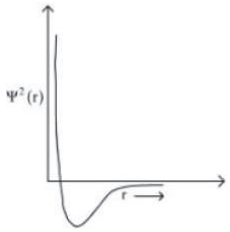
76. Which of the following is the correct plot for the probability density $\psi^2(r)$ as a function of distance 'r' of the electron from the nucleus for 2s orbital?

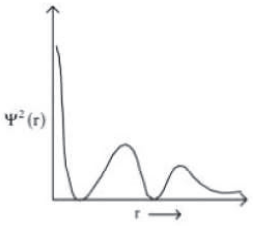
[JEE (Main)-2022]

(1)



(2) 

(3) 

(4) 

77. Which of the following sets of quantum numbers is not allowed?

[JEE (Main)-2022]

(1) $n = 3, l = 2, m_l = 0, s = +\frac{1}{2}$

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

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

(4) $n = 3, l = 0, m_l = 0, s = -\frac{1}{2}$

78. When the excited electron of a H atom from n = 5 drops to the ground state, the maximum number of emission lines observed are ____.

[JEE (Main)-2022]

79. The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is _____. (Nearest integer)

(Mass of electron is 9.1×10^{-31} kg and mass of neutron is 1.6×10^{-27} kg) **[JEE (Main)-2022]**

80. Consider an imaginary ion $^{48}_{22}X^{3-}$. The nucleus contains 'a'% more neutrons than the number of electrons in the ion. The value of 'a' is _____. [nearest integer] **[JEE (Main)-2022]**

81. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Energy of 2s orbital of hydrogen atom is greater than that of 2s orbital of lithium.

Reason R : Energies of the orbitals in the same subshell decrease with increase in the atomic number.

In the light of the above statements, choose the ***correct*** answer from the options given below.

[JEE (Main)-2022]

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

82. The correct decreasing order of energy for the orbitals having, following set of quantum numbers:

(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

[JEE (Main)-2022]

(1) (D) > (B) > (C) > (A) (2) (B) > (D) > (C) > (A)

(3) (C) > (B) > (D) > (A) (4) (B) > (C) > (D) > (A)

83. Identify the incorrect statement from the following.

[JEE (Main)-2022]

(1) A circular path around the nucleus in which an electron moves is proposed as Bohr's orbit.

(2) An orbital is the one electron wave function (Ψ) in an atom.

(3) The existence of Bohr's orbits is supported by hydrogen spectrum.

(4) Atomic orbital is characterised by the quantum numbers n and l only.

84. If the wavelength for an electron emitted from H-atom is 3.3×10^{-10} m, then energy absorbed by the electron in its ground state compared to minimum energy required for its escape from the atom, is _____ times. (Nearest integer)

[Given : $h = 6.626 \times 10^{-34}$ J s]

[Mass of electron = 9.1×10^{-31} kg]

[JEE (Main)-2022]

85. The minimum uncertainty in the speed of an electron in one dimensional region of length $2a_0$ (Where a_0 = Bohr radius 52.9 pm) is ___ km s^{-1}.

(Given : Mass of electron = 9.1×10^{-31} kg, Planck's constant h = 6.63×10^{-34} Js) **[JEE (Main)-2022]**

86. Given below are the quantum numbers for 4 electrons.

A. $n = 3, l = 2, m_l = 1, m_s = +1/2$

B. $n = 4, l = 1, m_l = 0, m_s = +1/2$

C. $n = 4, l = 2, m_l = -2, m_s = -1/2$

D. $n = 3, l = 1, m_l = -1, m_s = +1/2$

The correct order of increasing energy is

[JEE (Main)-2022]

(1) D < B < A < C (2) D < A < B < C

(3) B < D < A < C (4) B < D < C < A

87. 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}]

[JEE (Main)-2022]

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