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%. Certainity 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 = 3×10^8 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 = 6.62×10^{-34} Js and c = 3.0×10^8 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

$\varepsilon_0 = 8.854185 \times 10^{-12}$ 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. The highest value of the calculated spin only magnetic moment (in BM) among all the transition metal complexes is **[JEE (Main)-2019]**

(1) 5.92 (2) 6.93

(3) 4.90 (4) 3.87

14. 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 $-R_H$

15. 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]**

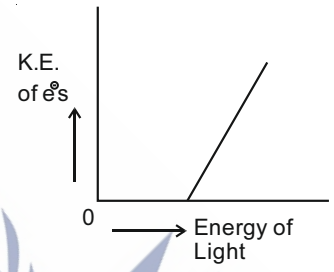
(1) (a), (d) (2) (b), (c)

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

16. 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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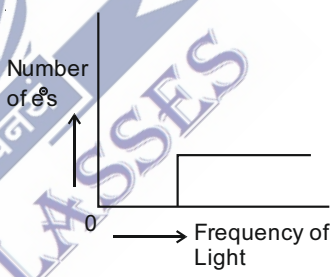

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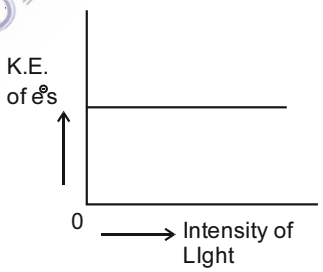

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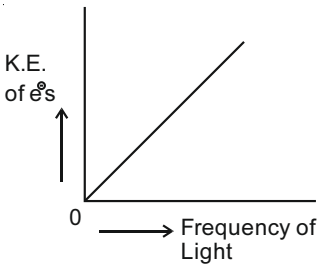


17. The ground state energy of hydrogen atom is –13.6 eV. The energy of second excited state of He^+ ion in eV is **[JEE (Main)-2019]**

(1) –27.2 (2) –6.04

(3) –54.4 (4) –3.4

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

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

[JEE (Main)-2019]

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

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

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

20. 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

21. 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

22. 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

23. 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) $\frac{1}{2}\lambda$

24. 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

25. 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]

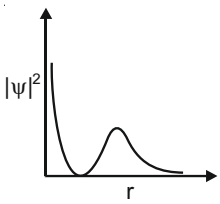
(1) The probability density of finding the electron is maximum at the nucleus

(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

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



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

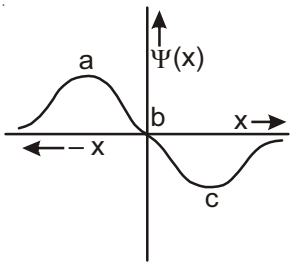
(3) 2p orbital (4) 3s orbital

27. 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

28. 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

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

(1) Li (2) K

(3) H (4) Na

30. 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

31. 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)

32. 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) $\frac{4a_0}{9}$

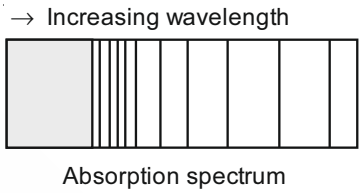
(3) $\frac{2a_0}{3}$ (4) $\frac{2a_0}{9}$

33. 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) $2\pi a_0$

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

(1)


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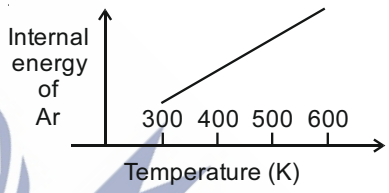

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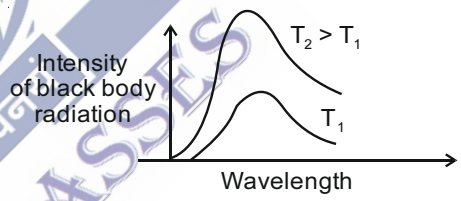

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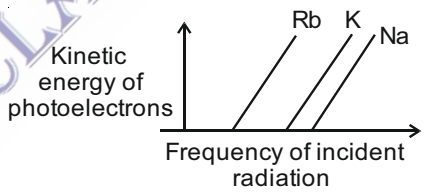

35. The number of subshells associated with n = 4 and m = –2 quantum numbers is **[JEE (Main)-2020]**

(1) 2 (2) 8

(3) 4 (4) 16

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

(1) Microwave (2) Ultraviolet

(3) Visible (4) Infrared

37. 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) $\frac{9\lambda_1}{5}$

38. The correct electronic configuration and spin-only magnetic moment (BM) of Gd^{3+} (Z = 64), respectively, are **[JEE (Main)-2020]**

(1) [Xe] $5f^7$ and 8.9

(2) [Xe] $4f^7$ and 7.9

(3) [Xe] $5f^7$ and 7.9

(4) [Xe] $4f^7$ and 8.9

39. 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

40. 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

41. 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]**

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