Daily Tutorial Sheet 2	JEE Main (Archive)

16.(A) The energy of an electron in a Bohr atom is expressed as $E_n = \frac{kZ^2}{n^2}$

where, k = Constant, $= -13.6\,eV$ for H (n = 1)

Z = Atomic number,

n = Orbit numberwhen $n = 2,\ E_2 = \frac{-13.6}{2^2} eV = -3.40\,eV$ (n can have only integral value 1, 2, 3,....... ∞)

17.(C) $E_n = -13.6\frac{Z^2}{n^2} eV$ for excited n > 1 state

18.(B) According to Aufbau principle.

19.(C) The wavelength of the visible photon will be higher than that of thermal electron.
Out of electron and neutron having same energy, the de-Broglie wavelength of electron will be higher because of lower mass of electron.

20.(D) Number of orbitals in n^{th} orbit $= n^2$
Number of orbitals in 5^{th} orbit = 25

21.(C) According to de-Broglie, the wavelength associated with a particle of mass m, moving with velocity v is given by the relation

$$\lambda = \frac{h}{mv}$$

$$K.E. = \frac{1}{2}mv^2 = eV$$

$$m^2v^2 = 2eVm$$

$$mv = \sqrt{2eVm}$$

22.(A) For H-atom (Z = 1), $r_n = 0.529\,n^2$ Å

23.(D) Shortest wavelength transition in Lyman series will be corresponding to

$$n = \infty \longrightarrow n = 1$$

$$\frac{1}{\lambda} = R_H(1)^2\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right],\ \lambda = \frac{1}{R_H}$$

Given wavelength for this transition is A therefore $\frac{1}{R_H} = A$ .... (i)

Longest wavelength transition for He^+ in Pachen series $4 \to 3$

$$\frac{1}{\lambda} = R_H(2)^2\left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

Putting value of R_H from equation (i)

$$\lambda = \frac{36A}{7}$$

24.(B) The orbital with radius 211.6 pm

$$r_n = n^2 a_0$$

$$211.6\,pm = n^2 \times 52.9\ pm$$

$n^2 = 4$, $\quad n = 2$

It will be Balmer series.

25.(D) K.E. $= h\nu - h\nu = E - W_0$

Where, K.E. = Kinetic energy of ejected electron = Stopping potential

E = Energy absorbed, W_0 = Work function

$$E = h\nu = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{250\times10^{-9}}$$

$= 7.9512\times10^{-19}\,J = 4.96\,eV$

Then, $0.5 = 4.96 + W_0$

$W_0 = 4.46 \simeq 4.5\,eV$

26.(B) $r_n = 0.529(n)^2\,\overset{o}{A}$

27.(C) When a black body is heated, more and more energy is absorbed by its atoms and they emit radiations of higher and higher frequency, i.e., black body emits radiation from higher wavelength to lower wavelength.

28.(A) $\bar{\nu} = R_H Z^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R_H\left[\frac{1}{64} - \frac{1}{n^2}\right]$ (Z = 1 for hydrogen)

$$\bar{\nu} = \frac{R_H}{64} - R_H\left(\frac{1}{n^2}\right)$$

Plot of $\bar{\nu}$ versus $\frac{1}{n^2}$ will be linear with slope $-R_H$ and intercept $= R_H/64$

29.(C) Fact

30.(D) Second excited state is n = 3

$$E = -13.6\times\frac{z^2}{n^2}eV = -13.6\times\frac{(2)^2}{(3)^2} = -13.6\times\frac{4}{9} = -6.04\,eV$$

31.(A) The wavelength of visible range is $360-720\,nm$, so wavelength of given radiation is in IR region. So, the line must not belong to Lyman and Balmer series.

$$\frac{1}{\lambda} = R_H\left[\frac{1}{9} - \frac{1}{\infty^2}\right] = \frac{R_H}{9}$$

$$\lambda = \frac{9}{R_H} = \frac{9}{10^5 cm} = 9\times10^{-7}m = 900\,nm$$

So, given spectral line of H-atom is $\infty \to 3$, Paschen series

32.(A) $h\nu = h\nu_0 + \frac{1}{2}mv^2$

$$\Rightarrow \qquad h\nu_0 = \frac{hc}{\lambda} - \frac{1}{2}mv^2 = \frac{12400}{4000}eV - \frac{\left(\frac{1}{2}\times9\times10^{-31}\times(6\times10^5)^2\right)}{1.6\times10^{-19}}eV$$

$= 3.1\,eV - 1.01\,eV = 2.09\,eV \approx 2.1\,eV$

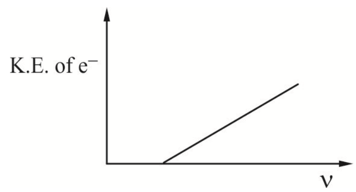
33.(B) $2\pi r = n\lambda$

$$2\pi \times a_0 \frac{n^2}{z} = n \times 1.5\pi a_0$$

$$2\pi \times \frac{n}{z} = 1.5\pi$$

$$\frac{n}{z} = \frac{1.5}{2} = 0.75$$

34.(A) Correct graph of KE of e^- v/s frequency of light (ν) is



Governing equation $h\nu = h\nu_0 + (KE)_{e^-}$

35.(C) $E = h\upsilon$

$(h\upsilon - hr_0) = K.E.$ (from photoelectric effect)

$$\lambda = \frac{h}{\sqrt{2m\,K.E.}}, \qquad \lambda \propto \frac{h}{\sqrt{(\upsilon - \upsilon_0)}} \Rightarrow \lambda \propto \frac{1}{(\upsilon - \upsilon_0)^{1/2}}$$

36.(A) Probability of finding electron is maximum at region a and c

37.(A) Energy of 2s orbital $\propto \frac{1}{(Z_{eff})^2}$

Z_{eff} : K = Na > Li > H & Z : K > Na

hence the force of attraction of the K nuclei at 2s electrons will be stronger than that of Na nuclei.

38.(C) As the distance from nucleus increases total energy increases and is minimum at distance a_0.

39.(A) $E = W + KE_{max}$

$$\frac{hc}{\lambda} = W + \frac{P^2}{2m}$$

$$(W \to 0)$$

$$\frac{\lambda_2}{\lambda_1} = \frac{P_1^2}{P_2^2}$$

$$\frac{\lambda_2}{\lambda} = \frac{P^2}{(1.5P)^2}$$

$$\frac{\lambda_2}{\lambda} = \frac{4}{9}$$