DPP – 2

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Q 1. Which of the following is true ?
(a) Lyman series is a continuous spectrum
(b) Paschen series is a line spectrum in the infrared
(c) Balmer series is a line spectrum in the ultraviolet
(d) The spectral series formula can be derived from the Rutherford model of the hydrogen atom

Q 2. The wavelength of first line of Balmer series is 6563 Å. The wavelength of first line of Lyman series will be
(a) 1215.4 Å (b) 2500 Å (c) 7500 Å (d) 600 Å

Q 3. The wavelength of radiation required to excite an electron from first to third Bohr orbit in a doubly ionised lithium atom will be -
(a) 113.74 m (b) 113.74 cm
(c) 113.74 Å (d) 113.74 mm

Q 4. An excited hydrogen atom initially at rest in n = 3 state, emits a photon by making a transition to ground to state. Then the momentum of the hydrogen atom will be (in N.s) -
(a) 6.45×10^{-27} (b) 6.63×10^{-34}
(c) 2.15×10^{-27} (d) none of the above

Q 5. When a hydrogen atom emits a photon of energy 12.1 eV, its orbital angular momentum changes by -
(a) 1.05×10^{-34} J s
(b) 2.11×10^{-34} J s
(c) 3.16×10^{-34} J s
(d) 4.22×10^{-34} J s

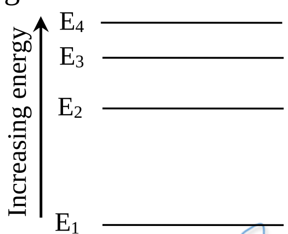
Q.6 The ionization potential of H-atom is 13.6 V. The H-atoms in ground state are excited by mono chromatic radiations of photon energy 12.09 eV. Then the number of spectral lines emitted by the excited atoms, will be -
(a) 1 (b) 2 (c) 3 (d) 4

Q 7. Consider the spectral line resulting from the transition n = 2 to n = 1 in the atoms and ions given below, the shortest wavelength is produced by -
(a) hydrogen atom
(b) deuterium atom

(c) singly ionized helium
(d) doubly ionized lithium

Q 8. Bohr's atom model assumes –
(a) the nucleus is of infinite mass and is at rest
(b) electron in a quantized orbit will not radiate energy
(c) mass of the electron remains constant
(d) all of these

Q 9. Figure represents in simplified form some of the energy levels of the hydrogen atom. The energy axis has a linear scale If the transition of an electron from E_4 to E_2 were associated with the emission of blue light, which transition could be associated with the absorption of red light ?



(a) E_4 to E_1 (b) E_3 to E_2
(c) E_2 to E_3 (d) E_1 to E_4

Q 10. A mixture of ordinary hydrogen and tritium, is excited and its spectrum observed. Then, the ratio of the wavelengths of the H_α lines of the two kinds of hydrogen would be nearly -
(a) 1 : 1
(b) 1 : 3
(c) 3 : 1
(d) nothing can be predicted

Q 11. In hydrogen atom Ha-line arises due to transition n = 3 → n = 2. In the spectrum of singly ionised helium there is a line having the same wavelength as the Ha line. This is due to the transition -
(a) n = 3 to n = 2 (b) n = 2 to n = 1
(c) n = 5 to n = 3 (d) n = 6 to n = 4

Q 12. Let υ_1 be the frequency of the series limit of the Lyman series, υ_2 be the frequency of the first line of the Lyman series, and υ_3 be the frequency of the series limit of the Balmer series -
(a) $\upsilon_1 - \upsilon_2 = \upsilon_3$ (b) $\upsilon_2 - \upsilon_1 = \upsilon_3$
(c) $\upsilon_3 = \frac{1}{2}(\upsilon_1 + \upsilon_2)$ (d) $\upsilon_1 + \upsilon_2 = \upsilon_3$

Q 13. Three photons coming from excited atomic-hydrogen sample are picked up. Their energies are 12.1 eV, 10.2 eV and 1.9 eV. These photons must come from -
(a) a single atom
(b) two atoms
(c) three atoms

(d) either two atoms or three atoms

Q 14. Radiations of wavelength l are incident on hydrogen in the ground state. A fraction of these radiations absorbed by these atoms. There are ten different wavelength in the emission spectrum of excited atoms. The l will be -

(a) 1211Å (b) 912 Å

(c) 1211Å (d) 950.7 Å

Q 15. In which of the following transitions will the wavelength be minimum ?

(a) n = 5 to n = 4 (b) n = 4 to n = 3

(c) n = 3 to n = 2 (d) n = 2 to n = 1

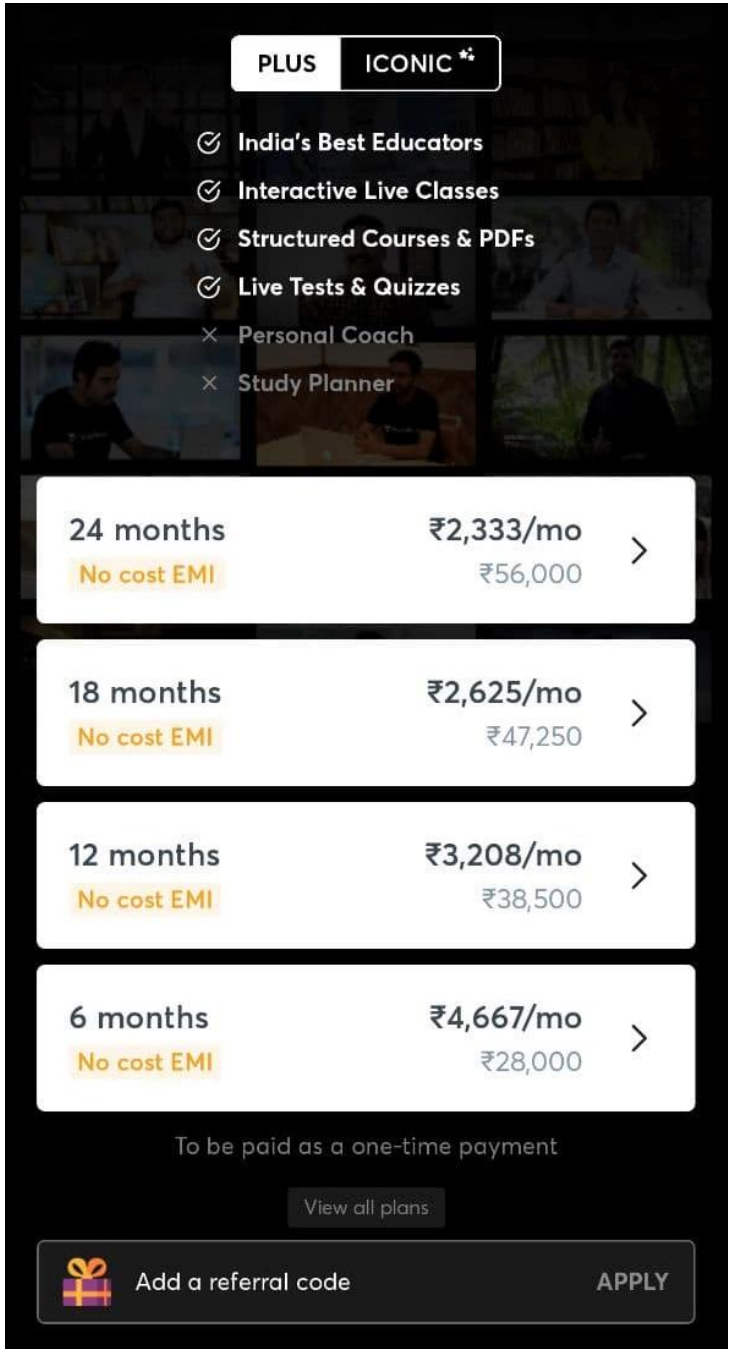
Q 16. If the wavelength of photon emitted due to transition of electron from third orbit to first orbit in a hydrogen atom is l, then the wavelength of photon emitted due to of electron from fourth orbit to second orbit will be –

(a) $\frac{128}{27}$l (b) $\frac{25}{9}$l

(c) $\frac{36}{7}$l (d) None of these

Answer Key

Q.1 b	**Q.2 a**	**Q.3 c**	**Q.4 a**	**Q.5 b**
Q.6 c	**Q.7 d**	**Q.8 d**	**Q.9 c**	**Q.10 a**
Q.11 d	**Q.12 a**	**Q.13 d**	**Q.14 d**	**Q.15 d**
Q.16 a				



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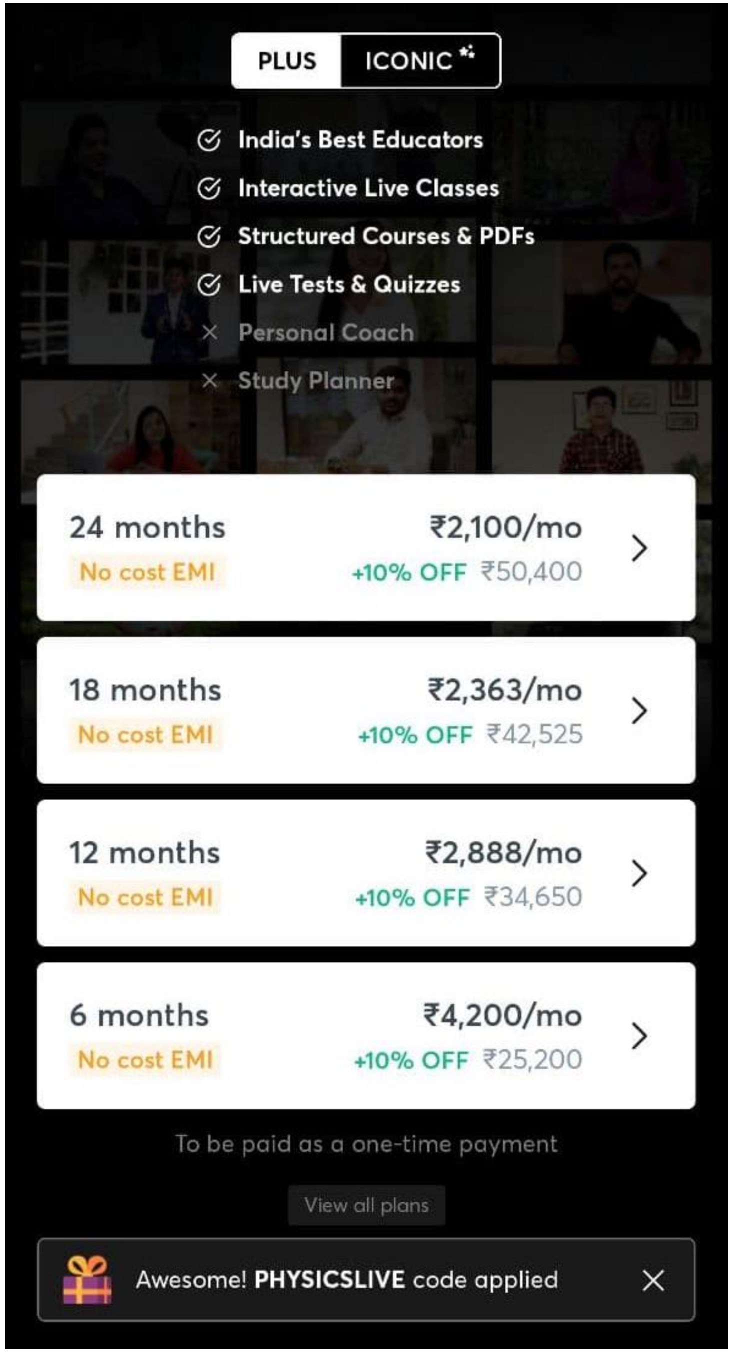


Physics DPP

DPP- 2 Bohr Model : Spectrum, Recoil of atom

By Physicsaholics Team

Q1) Which of the following is true ?

(a) Lyman series is a continuous spectrum
(b) Paschen series is a line spectrum in the infrared
(c) Balmer series is a line spectrum in the ultraviolet
(d) The spectral series formula can be derived from the Rutherford model of the hydrogen atom

Q2) The wavelength of first line of Balmer series is 6563 Å. The wavelength of first line of Lyman series will be

n=3 to n=2

n=2 to n=1

$\frac{1}{6563} = R\left(\frac{1}{4} - \frac{1}{9}\right) \Rightarrow \frac{1}{6563} = \frac{5R}{36}$

$\frac{1}{\lambda} = R\left(\frac{1}{1} - \frac{1}{4}\right) = \frac{3R}{4} = \frac{3}{4} \times \frac{36}{5 \times 6563} = \frac{27}{5 \times 6563}$

(a) 1215.4 Å (b) 2500 Å (c) 7500 Å (d) 600 Å

$\lambda = \frac{32815 \text{ Å}}{27} = 1215.4 \text{ Å}$

Q3) The wavelength of radiation required to excite an electron from first to third Bohr orbit in a doubly ionised lithium atom will be -

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

$$= 1.1 \times 10^7 \times 9 \left(\frac{1}{1} - \frac{1}{9} \right)$$

$$\frac{1}{\lambda} = 8.8 \times 10^7$$

(a) 113.74 m
(b) 113.74 cm
(c) 113.74 Å ✓
(d) 113.74 mm

$$\lambda = \frac{1 \times 10^{-7}}{8.8} = \frac{1000}{8.8} \text{Å}$$

Q4) An excited hydrogen atom initially at rest in n = 3 state, emits a photon by making a transition to ground to state. Then the momentum of the hydrogen atom will be (in N.s) -

H atom → Rest ← P + P (photon)

P of H atom = P of photon = $\frac{h}{\lambda}$ = $6.6 \times 10^{-34}\, R\left(\frac{1}{1} - \frac{1}{9}\right)$

(a) 6.45×10^{-27} (b) 6.63×10^{-34}

(c) 2.15×10^{-27} (d) none of the above

$P = \frac{6.6 \times 8}{9} \times 1.1 \times 10^{-34} \times 10^{7} = \frac{17.6 \times 11}{3} \times 10^{-27}$

$= \frac{193.6}{3} \times 10^{-27} = 6.45 \times 10^{-27}$

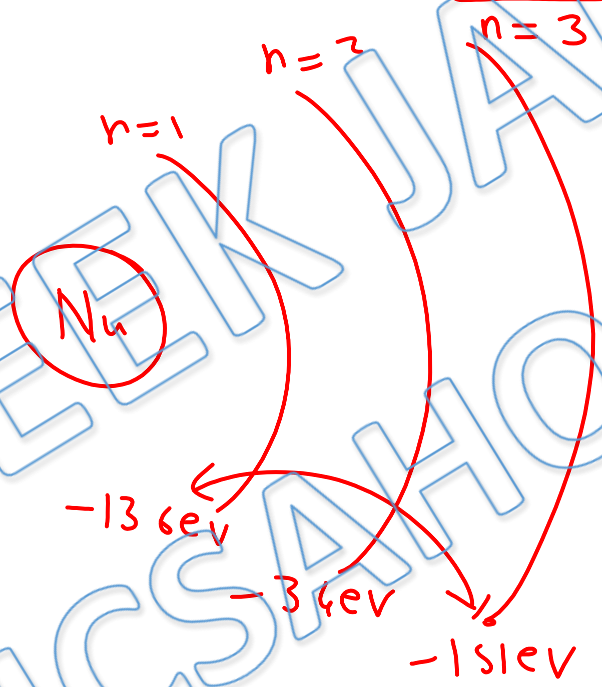
Q5) When a hydrogen atom emits a photon of energy 12.1 eV, its orbital angular momentum changes by -

(a) 1.05×10^{-34} J s

(b) 2.11×10^{-34} J s

(c) 3.16×10^{-34} J s

(d) 4.22×10^{-34} J s



n = 3 to n = 1

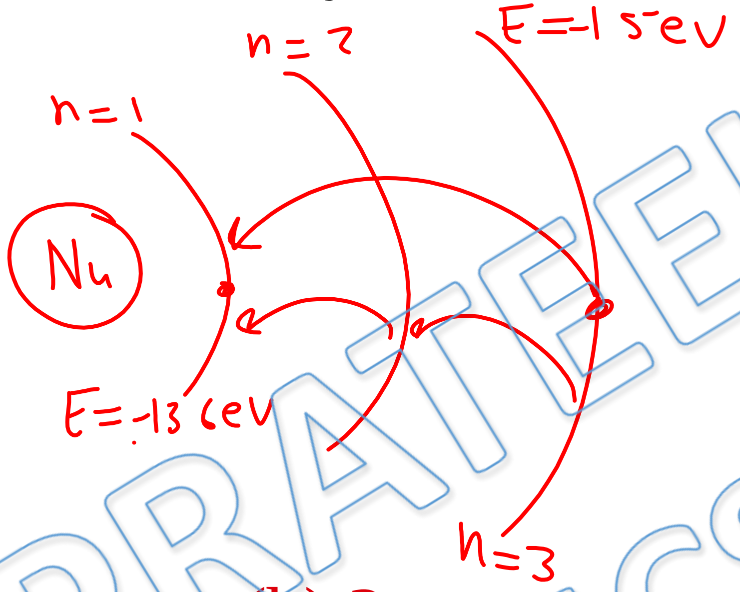
$\Delta L = \frac{3h}{2\pi} - \frac{h}{2\pi}$

$= h/\pi$

$= \frac{6.6 \times 10^{-34}}{3.14}$

$= 2.11 \times 10^{-34}$

Q6) The ionization potential of H-atom is 13.6 V. The H-atoms in ground state are excited by mono chromatic radiations of photon energy 12.09 eV. Then the number of spectral lines emitted by the excited atoms, will be -



$$13.6 - 12.1 = 1.5\,eV$$

$$E = -\frac{13.6\,eV}{n^2} = -1.5\,eV$$

$$n^2 = \frac{13.6}{1.5} \simeq 9 \Rightarrow n = 3$$

(a) 1 (b) 2 (c) 3 (d) 4

$n = 3$

$$\text{no of spectral lines} = \frac{n(n-1)}{2} = \frac{3(3-1)}{2} = 3$$

Q7) Consider the spectral line resulting from the transition n = 2 to n = 1 in the atoms and ions given below, the shortest wavelength is produced by -

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

$$\lambda \propto \frac{1}{Z^2}$$

(a) hydrogen atom

(b) deuterium atom

(c) singly ionized helium

(d) doubly ionized lithium ✓

Q8) Bohr's atom model assumes -

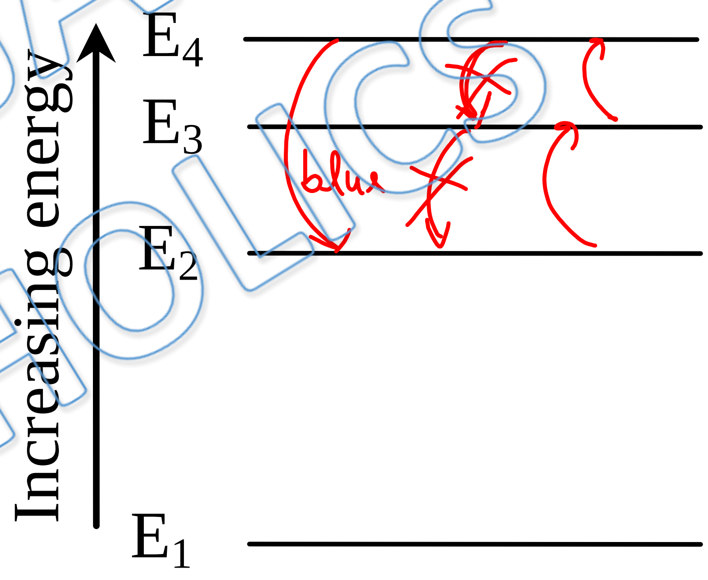
(a) the nucleus is of infinite mass and is at rest

(b) electron in a quantized orbit will not radiate energy

(c) mass of the electron remains constant

(d) all of these

Q9) Figure represents in simplified form some of the energy levels of the hydrogen atom. The energy axis has a linear scale If the transition of an electron from E_4 to E_2 were associated with the emission of blue light, which transition could be associated with the absorption of red light ?



(a) E_4 to E_1 (b) E_3 to E_2

(c) E_2 to E_3 (d) E_1 to E_4

Q10) A mixture of ordinary hydrogen and tritium, is excited and its spectrum observed. Then, the ratio of the wavelengths of the H_α lines of the two kinds of hydrogen would be nearly -

(a) 1 : 1

(b) 1 : 3

(c) 3 : 1

(d) nothing can be predicted

Q11) In hydrogen atom H_α-line arises due to transition $n = 3 \rightarrow n = 2$. In the spectrum of singly ionised helium there is a line having the same wavelength as the H_α line. This is due to the transition -

for H → $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ 3 → 2

for H like → $\frac{1}{\lambda} = R\left(\frac{Z^2}{n_1^2} - \frac{Z^2}{n_2^2}\right)$ 3×2 → 2×2, 6 → 4

(a) n = 3 to n = 2
(b) n = 2 to n = 1
(c) n = 5 to n = 3
(d) n = 6 to n = 4

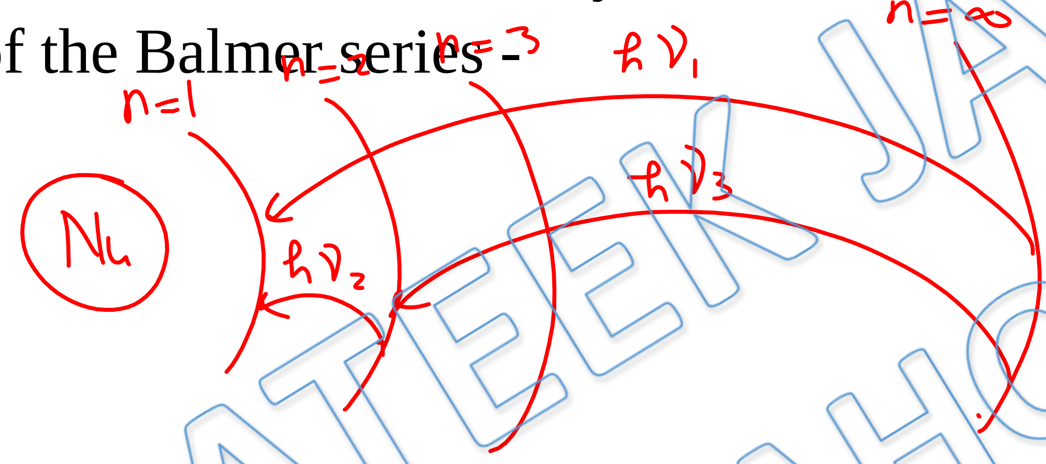
n_2 to n_1 trans in H atom
$n_2 Z$ to $n_1 Z$,, ,, H like
→ Same λ

$\lambda' = \lambda$

n_2 to n_1 trans in H atom
$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$n_2 Z$ to $n_1 Z$ trans in H like
$\frac{1}{\lambda'} = R\left(\frac{Z^2}{n_1^2 Z^2} - \frac{Z^2}{n_2^2 Z^2}\right) = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = \frac{1}{\lambda}$

Q12) Let ν_1 be the frequency of the series limit of the Lyman series, ν_2 be the frequency of the first line of the Lyman series, and ν_3 be the frequency of the series limit of the Balmer series -



(a) $\nu_1 - \nu_2 = \nu_3$

(b) $\nu_2 - \nu_1 = \nu_3$

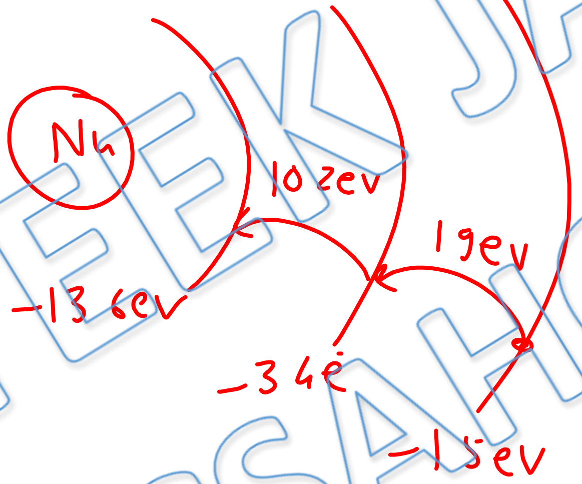
(c) $\nu_3 = \frac{1}{2}(\nu_1 + \nu_2)$

(d) $\nu_1 + \nu_2 = \nu_3$

$h\nu_2 + h\nu_3 = h\nu_1$

$\nu_3 = \nu_1 - \nu_2$

Q13) Three photons coming from excited atomic-hydrogen sample are picked up. Their energies are 12.1 eV, 10.2 eV and 1.9 eV. These photons must come from -



(a) a single atom

(b) two atoms

(c) three atoms

(d) either two atoms or three atoms

Q14) Radiations of wavelength λ are incident on hydrogen in the ground state. A fraction of these radiations absorbed by these atoms. There are ten different wavelength in the emission spectrum of excited atoms. The λ will be -

$$\frac{n(n-1)}{2} = 10$$

$$n(n-1) = 20$$

$$n = 5$$

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{5^2}\right)$$

$$= 11 \times 10^{7} \times \frac{24}{25}$$

$$\lambda = \left(\frac{25}{24 \times 11}\right) \times 10^{-7}$$

$$= \frac{25000}{26.4} \times 10^{-10}$$

(a) 1211Å

(b) 912 Å

(c) 1211Å

(d) 950.7 Å ✓

Q15) In which of the following transitions will the wavelength be minimum ?

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

(a) n = 5 to n = 4

(b) n = 4 to n = 3

(c) n = 3 to n = 2

(d) n = 2 to n = 1

Q16) If the wavelength of photon emitted due to transition of electron from third orbit to first orbit in a hydrogen atom is λ, then the wavelength of photon emitted due to of electron from fourth orbit to second orbit will be -

$$\frac{1}{\lambda} = R\left(1 - \frac{1}{9}\right)$$

$$\frac{1}{\lambda} = \frac{8R}{9} \quad \text{--- (1)}$$

(a) $\frac{128}{27}\lambda$

(b) $\frac{25}{9}\lambda$

(c) $\frac{36}{7}\lambda$

(d) None of these

$$\frac{1}{\lambda'} = R\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$= \frac{9}{8\lambda}\left(\frac{4-1}{16}\right)$$

$$\frac{1}{\lambda'} = \frac{27}{128\lambda} \Rightarrow \lambda' = \frac{128\lambda}{27}$$

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Chalo Niklo