Task 1 (A)

A — Oxygen II
B — Hydrogen - I
C — Hydrogen - I
D — Oxygen - II
E — Nitrogen - II
F — Hydrogen - I
G — Oxygen - I
H — Carbon - I

Ta

Task 1 (B)

The version of the Rydberg formula that generated the Lyman series for any 'H' ~~general~~ atom ~~is~~:

$$\frac{1}{\lambda} = R_H\left(1 - \frac{1}{n^2}\right) \quad \text{——— (1)}$$

for any general atom

$$E_{n,Z} = -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{Z^2}{n^2}$$

for 'H' atom $Z=1$, we get

$$E_n = -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{(1)^2}{n^2}$$

$$= -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{1}{n^2}$$

for Carbon atom $Z = 6$

$$E_{n,Z} = -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{Z^2}{n^2}$$

$$= -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{(6)^2}{n^2}$$

$$= -\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{36}{n^2}$$

$$E_{n,Z} = \left(-\frac{m_e e^4}{2(4\pi\epsilon_0\hbar)^2}\frac{1}{n^2}\right)\times 36$$

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for 'H' atom

$$\left(\lambda = \frac{hc}{E_i - E_f}\right)$$

$$E_{n,H} = \frac{-m_e e^4}{2(4\pi\epsilon_0 h)^2}\frac{1}{n^2} = \frac{-13.6\,eV}{n^2}$$

$$\lambda = \frac{12398.4\,eV}{E_i - E_f}\,\mathring{A}$$

$$\frac{1}{\lambda} = \frac{E_i - E_f}{12398.4\,eV}\,\mathring{A} = R_H\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$$

for Lyman $m = 1$

$$\frac{1}{\lambda} = R_H\left(1 - \frac{1}{n^2}\right)$$ } for 'H' atom

For any general atom having atomic no. (Z)

$$\frac{1}{\lambda} = R_H\left(1 - \frac{1}{n^2}\right)Z^2$$

for $Z = 6$

$$\frac{1}{\lambda} = R_H\left(1 - \frac{1}{n^2}\right)6^2$$

$$= \frac{1}{\lambda} = 36R_H\left(1 - \frac{1}{n^2}\right)$$

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Task 2

(1) Q.1

(1) 10^{14}

We have data.

$m_e = 9.11 \times 10^{-28}$

$c = 3.00 \times 10^{10}$ cm/s

$e = 4.80 \times 10^{-10}$ $cm^{3/2} g^{1/2} s^{-1}$

$z = 2.00$

$g_0 = 2$

$f = 0.4164$

$\Gamma = 6.265 \times 10^{8} s^{-1}$

$\nu_0 = 2.46607 \times 10^{15}$ Hz

$x = 0.1$

$n_H = 0.1 cm^{-3}$

$\nu = c/\lambda$

$\lambda = 1215.7$ Å $= 1215.7 \times 10^{-8}$ cm

[for energy jump from ground to the [first] excited state]

$\therefore \nu = 2.46771 \times 10^{15}$

$$\alpha(\nu) = \frac{e^2 f n_H}{4\pi m_e c} \frac{(1-x) g_0}{z} \frac{\Gamma}{(\nu-\nu_0)^2 + (\Gamma/4\pi)^2}$$

$$\tau(\lambda) = \exp[-\alpha(\nu) d]$$

$\alpha(v) = 4.314975494724473e-53$

$(v = 2.46771 \times 10^{15})$

$\alpha(v) = 4.314975494724473e-53$

$\tau_i = \exp[-\alpha(v) d_i]$

$d_1 = 10^{14}$

$d_2 = 10^{18}$

$d_3 = 10^{21}$

$\tau_1 = \exp[-4.31e-53 \times 10^{14}] = 0$

$\tau_2 = \exp[-4.31e-53 \times 10^{18}] = 0$

$\tau_3 = \exp[-4.31e-53 \times 10^{21}] = 0$

2) //