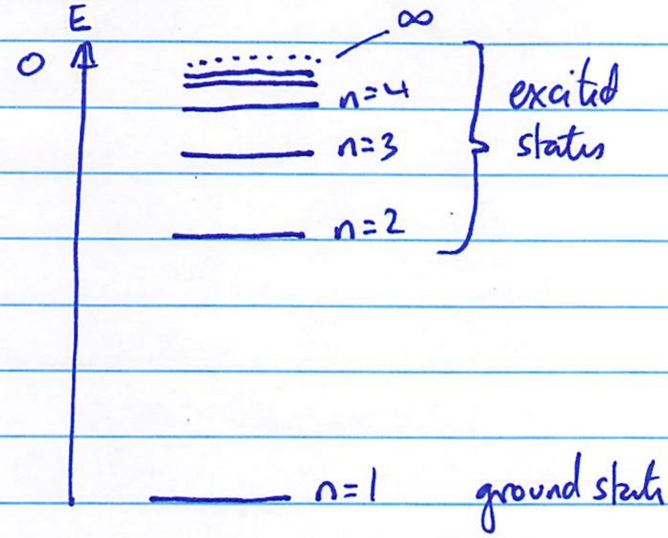
Bohr Model

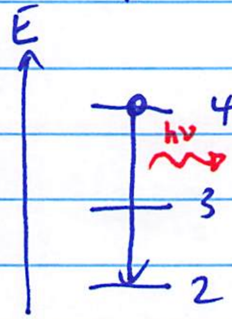


Bohr: $\boxed{E_n = -\frac{R_H}{n^2}}$ $R_H = 2.18 \times 10^{-18}\,J$

Can calculate λ of light absorbed/emitted during a transition!

ex: $n=4 \rightarrow n=2$ (emission)

ΔE



$$\Delta E = E_f - E_i$$
$$= E_2 - E_4$$
$$= \frac{-R_H}{2^2} - \frac{-R_H}{4^2}$$
$$= R_H\left(\frac{1}{4^2} - \frac{1}{2^2}\right)$$
$$= 2.18 \times 10^{-18}\,J\left(\frac{1}{16} - \frac{1}{4}\right)$$

$\Delta E = -4.09 \times 10^{-19}\,J$ (atom loses E)

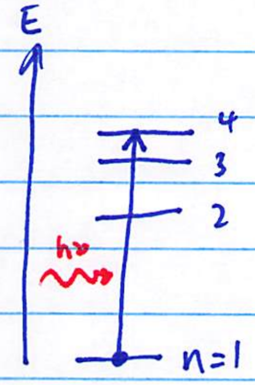
$E_{photon} = +4.09 \times 10^{-19}\,J = h\nu = hc/\lambda$

$$E_{photon} = 4.09 \times 10^{-19} J = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E_{photon}} = \frac{6.626 \times 10^{-34} \cancel{J} \cdot \cancel{s} \times 3.00 \times 10^{8} m/\cancel{s}}{4.09 \times 10^{-19} \cancel{J}}$$

$$= 4.86 \times 10^{-7} m$$
$$= 486 \times 10^{-9} m$$
$$= 486 \text{ nm} \qquad \text{BLUE light}$$

Q: What's λ of photon absorbed/emitted for transition: $n=1 \rightarrow n=4$



$$\Delta E = E_4 - E_1 \qquad E_n = -\frac{R_H}{n^2}$$

$$= -\frac{R_H}{4^2} \ominus -\frac{R_H}{1^2}$$

$$= +\frac{R_H}{1^2} - \frac{R_H}{4^2}$$

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

$$= 2.18 \times 10^{-18} J \left(1 - \tfrac{1}{16}\right)$$

$$= +2.04 \times 10^{-18} J. \qquad \text{(+ve... absorb photon)}$$

$$E_{photon} = 2.04 \times 10^{-18} J = h\nu = \frac{hc}{\lambda}$$

$$\lambda = hc / E_{photon}$$

$$\lambda = \frac{hc}{E_{photon}} = \frac{6.626 \times 10^{-34}\ J \cdot s \times 3.00 \times 10^{8}\ m/s}{2.04 \times 10^{-18}\ J}$$

$= 9.74 \times 10^{-8}$ m

$= \boxed{97.4\ nm}$ nm — UV

$97.4 \times 10^{-9}\ m$

Light: ✓ wave

✓ particle

Matter: ✓ particles

? wave

de Broglie: eQ

$$\lambda = \frac{h}{m \cdot v}$$

Planck's constant

wavelength (m)

mass (Kg)

speed (m/s)

Q: what's λ of an e^- moving @ 3730 m/s? $m_e = 9.11 \times 10^{-31}$ Kg

$$\lambda = h/m \cdot v = \frac{6.626 \times 10^{-34}\ J \cdot s}{9.11 \times 10^{-31}\ Kg \times 3730\ m/s}$$

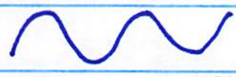
$= 1.95 \times 10^{-7}\ m$

$= 195\ nm$ (same λ as UV-light)

light microscope

resolution $\sim \lambda$

vis light



700 nm — 400 nm

RED — BLUE

only see things ~ 400 nm

$\leftarrow$ cell $\rightarrow$

1 μm

UV light: 10nm - 400nm

- 2 problems: - blind
  - can't focus w/ glass optics!

e^- microscopes: $\lambda = h/m \cdot v$

- generate varying λ by varying v! (easy)
- easy to focus w/ elec. fields!