CH 3

$e_f = J(f,T)\,A_f$ $\quad A_f = 1$ for BB

$$e_{total} = \int_0^\infty e_f\, df = \sigma T^4$$

$$e_{total} = a\sigma T^4$$

$e_{total} = \frac{P}{A}$ $\quad \sigma = 5.67\times10^{-8}\ \frac{W}{m^2 K^4}$

$e_i A_i = e_f A_f$ $\quad a = 1$, for BB

$$\lambda_{max} T = 2.898\times10^{-3}\ m\cdot K$$

λ_{max} is the corresponding λ to the maximum intensity

T is the temprature at the surface

$\bar{E} = kT \longrightarrow$ Rayleigh ✗

$\bar{E} = nhf \longrightarrow$ max-blank ✓

$$\bar{E} = \frac{hf}{e^{hf/kT} - 1}$$

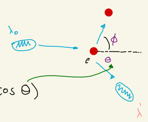
$K_{max} = \frac{1}{2} m_e v_{max}^2 = eV_s$ — stopping voltage

$K_{max} = hf - \phi$

$f^0 = \frac{\phi}{h}$ → cuttoff frequency

$2d\sin\theta = n\lambda$ $\quad$ cons : $n = 0, 1, 2 \dots$ $\quad$ distr : $n = \frac{1}{2}, \frac{3}{2}, \dots$

$p = \frac{h}{\lambda}$ → mv → momentum



$$\lambda' - \lambda_0 = \frac{h}{m_e c}(1 - \cos\theta)$$

$\frac{h}{m_e c} = 0.0243$ Å

CH 4

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

$R = 1.0973732\times10^{7}\ m^{-1}$

Lyman Series (uv)	$n_f = 1$	$n_i = 2, 3, 4, \dots$
Balmer Series (vis–uv)	$n_f = 2$	$n_i = 3, 4, 5, \dots$
Paschen Series (IR)	$n_f = 3$	$n_i = 4, 5, 6, \dots$
Brackett Series IR)	$n_f = 4$	$n_i = 5, 6, 7, \dots$
Pfund Series (IR)	$n_f = 5$	$n_i = 6, 7, 8, \dots$

$L = n\hbar$
$m_e v r = n\hbar$ → learn How to Prove it !

$U = \frac{kqq}{r}$

$F_{coulomb} = \frac{mv^2}{r}$ — centripetal acceleration

$\frac{kqq}{r^2} = \frac{mv^2}{r}$

$\frac{kq^2}{r} = m_e v^2$

$\frac{kq^2}{2r} = \frac{m_e v^2}{2} = K$

$E = K + U = \frac{1}{2} m_e v^2 - \frac{kq^2}{r}$

$E = \frac{kq^2}{2r} - \frac{kq^2}{r}$

$\boxed{PE = -2\,KE}$

$$-\frac{kq^2}{r} = \frac{kq^2}{2r}$$

$$E = -\frac{kq^2}{2r}$$

4.28 ← $r_n = \frac{n^2\hbar^2}{m_e k e^2}$

$r_n = n^2 a_0$ $\quad a_0 = 0.529$ Å

$mvr = n\hbar$

$v = \frac{n\hbar}{mr}$

$\frac{ke^2}{r} = \frac{n^2\hbar^2}{m^2 r^2}\, m$

$ke^2 = \frac{n^2\hbar^2}{mr}$

$r = \frac{n^2\hbar^2}{mke^2}$

4.30 ← $E_n = -\frac{ke^2}{2n^2 a_0}$

4.31 ← $E_n = -\frac{13.6}{n^2}\ eV$

$E_i - E_f = hf$ $\quad$ (4.23

$$-\frac{ke^2}{2n_i^2 a_0} + \frac{ke^2}{2a_0 n_f^2} = hf$$

4.33 ← $\frac{ke^2}{2a_0 hc}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = \frac{hf}{hc}$

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

4.34 ← $\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

---

other ionized elements than H, with only one electrone

4.35 ← $r_n = \frac{n^2 a_0}{Z}$

$F_{coulomb} = \frac{mv^2}{r}$

$mvr = n\hbar$ $\quad \boxed{v = \frac{n\hbar}{mr}}$

$\frac{kZe^2}{r^2} = \frac{m}{r}\,\frac{n^2\hbar^2}{m^2 r^2}$

$kZe^2 = \frac{n^2\hbar^2}{rm}$

$r_n = \frac{n^2\hbar^2}{mkZe^2} = a_0$

$\boxed{r_n = \frac{n^2 a_0}{Z}}$

4.36 ← $E_n = -\frac{ke^2}{2a_0}\frac{Z^2}{n^2}$ → ?.

$$\Delta n = \frac{k^2 Z^2 e^4 N_n A}{4R^2\left(\frac{1}{2} m_\alpha v_\alpha^2\right)\sin^4\left(\frac{\phi}{2}\right)}$$

the number of Particles entering the detector per unit time

the distance between the gold and the detector

the angle of scattering

Here R and ϕ are defined in Figure 4.10, N is the number of nuclei per unit area of the foil (and is thus proportional to the foil thickness), n is the total number of α particles incident on the target per unit time, and A is the area of the detector. The dependence of scattering on foil thickness, α particle speed, and scattering angle was confirmed experimentally by Geiger and Marsden.[9]

Why is the angular momentum quantized

$v = wr$

$L = mvr$

$L = mwr^2$

$\frac{L}{r} = mv$

$E = -\frac{ke^2}{2r}$

$m\cdot\frac{ke^2}{r^2} = m\cdot m\frac{v^2}{r}$

$\frac{mke^2}{r^2} = \frac{m^2v^2}{r}$

$\frac{mke^2}{\cancel{r^2}} = \frac{L^2}{r^3}$

$\frac{mke^2}{L^2} = \frac{1}{r}$

$-\frac{ke^2}{2}\cdot\frac{mke^2}{L^2} = \frac{1}{r}\cdot\frac{-ke^2}{2}$ → $E = \frac{ke^2}{2r}$

$-\frac{mk^2e^4}{2L^2} = E$

$\boxed{\frac{mk^2e^4}{L^3} = \frac{dE}{dL}}$

$F_{coulomb} = \frac{mv^2}{r}$

$\frac{ke^2}{r^2} = \frac{mv^2}{r}$

$r\cdot\frac{ke^2}{vr} = \frac{mv^2}{v}\cdot r$

$\frac{ke^2}{v} = mvr = L$

$mvr\cdot L = \frac{ke^2}{v}\cdot mvr$

$mvr\cdot L^2 = mke^2r\cdot mvr$

$L^3 = mvr\ \ mke^2r$

$L^3 = \frac{ke^2}{v}\,mke^2r$ $\quad v = wr$

$L^3 = \frac{ke^2}{w\cancel{r}}\,mke^2\cancel{r}$

$\boxed{L^3 = \frac{mk^2e^4}{w}}$

$\boxed{\frac{mk^2e^4}{L^3} = \frac{dE}{dL}}$

$$\frac{mk^2e^4}{mk^2e^4/w} = \frac{dE}{dL}$$

$w = \frac{dE}{dL}$

$dE = w_e\, dL$

assuming that

$E_i - E_f = \Delta E = hf$

$w = 2\pi f$

$\Delta E = \hbar w_{photon}$

$dE = \Delta E$

$dL\, w_e = \hbar w_{photon}$

$w_e = w_{photon}$

$dL = \hbar$

$L = n\hbar$ $\quad$ 4.24

CH5

$p = \frac{h}{\lambda}$, $f = \frac{E}{h}$

$n\lambda = 2\pi r$

$V_g = V_p + k\frac{dV_p}{dk}$

$V_p = \frac{w}{k}$

$V_g = \frac{dw}{dk}\Big|_{k_0}$

$\Delta P_x\, \Delta x \geq \frac{\hbar}{2}$

$\Delta E\, \Delta t \geq \frac{\hbar}{2}$

the seperation

?.

$D\sin\theta = D\frac{y}{L} = n\lambda$; $n + \frac{\lambda}{2}$

the distance between the two slits and the screen

$w = 2\pi f$ → frequency of rev..

$W = 2\pi f$

angluar frequency

$v = wr$

L → is the angular momentum

$\boxed{k = \frac{2\pi}{\lambda}}$

$w = 2\pi f$

CH3

① Hertz's - Light as an EM wave

* Maxwell predicted that radiated waves are = light waves

* Hertz showed that Maxwell was right, that light is EM wave

② Wedgwood observation

all the objects in his oven become red
at the same T

③ Photoelectric effect

① Hertz: charge will emit when there are ultra violet
② Hallwachs: thes charges were negative
③ JJ thomson: thes charges are $\bar{e}$,
④ Lenard: K_{max} does not depend on the intensity

④ X-rays

were discovered by William Roentgen

Compton confirmed that X-rays behave
like particles

Compton proved that X-rays scattering is CO
independent from the intensity

CH 4

① Faraday Experment in electrolysis by passing $\bar{e}$ through a chemical solution of Nacl

* Faraday reported that the mass of elements deposited at an electrode is directly proportional to the charge

: ① matter consists of molecules and these molecules consist of atoms

② the charge is quantized

③ sub atomic parts of atom are + and -, but their masses are unknown

② J.J Thomson, rays in low-pressure gas

* He discovered the e and He found the ratio $\frac{e}{m}$

$$\frac{e}{m} = \frac{V\theta}{B^2 l d}$$

the separation

magnetic field

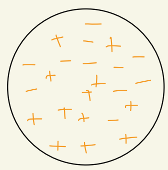
length of the electrodes

x e/me is independent of the discharge gas and the cathod metal

* He conclude that these particles are universal constituent of all matter

* He tried to find the charge of e by a cloud

Thomson atomic model



③ Millikan's Oil drop

He found the charge of e (He found its mass by $\frac{e}{m}$)

④ Rutherford - Scattering

He measured the size of the nucleus

* most of the atom was space, and the charge concentrated in the middle, or in the nucleus

⑤ Bohr

he combined the work of Einstein, Planck, and Rutherford

he assumed that the e move in an orbit about the ⊕ nucleus by coulomb force

he solved the "difficulties" by two ...

① e could move without radiating

② the atom radiate whe there is a transition $\longrightarrow E_i - E_f = hf$

$\lim_{n \to \infty}$ [quantum] = [classical]

⑥ the frank-Hertz experiment with mercury

to approve Bohr work $\Delta E = \frac{hc}{\lambda} \longrightarrow$ the first decrease

---

CH5

① the Davisson - Germer Experiment

they proved that e has a wavelength, which is equal to $\lambda = \frac{h}{p_e}$

$k = \frac{2\pi}{\lambda}$

$k = \frac{p}{\hbar}$

$E = \hbar w$

$L = \frac{n\lambda}{2}$

$$\frac{-\hbar^2}{2m}\frac{\partial \Psi(x,t)}{\partial x^2} + U(x)\,\Psi(x,t) = i\hbar\frac{\partial \Psi(x,t)}{\partial t}$$

$$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + U(x)\,\psi(x) = E\,\psi(x)$$

$E = \frac{p^2}{2m} = KE$

$E = \frac{\hbar^2 k^2}{2m}$

$w = \frac{\hbar k^2}{2m}$

$V_p = \frac{w}{k} = \frac{\hbar k}{2m}$

$V = \frac{dw}{dk} = X \longrightarrow$ one Particle

Free Particle :

$$E = \frac{\hbar^2 k^2}{2m}$$

$$p = \hbar k$$

Particle in a Box

$\psi = A\sin kx + B\cos kx$

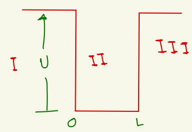
$$E_n = \frac{n^2\pi^2\hbar^2}{2mL^2}$$

$$\psi_n(x) = \sqrt{\frac{2}{L}}\,\sin\frac{n\pi x}{L}$$

the finite squeare Well case

$$U(x) = \begin{cases} U & \boxed{x<0} \\ 0 & 0<x<L \\ U & \boxed{x>L} \end{cases}$$

by the Particle in a Box



$$\alpha^2 = \frac{2m}{\hbar^2}(U-E)$$

$E < U$

$\psi_I(x) = A\,e^{\alpha x} \qquad x<0$

$\psi_{III}(x) = B\,e^{-\alpha x} \qquad x>L$

ψ' and ψ are cont

$$E_n = \frac{n^2\pi^2\hbar^2}{2m(L+2\delta)^2}$$

$$\delta = \frac{1}{\alpha}$$

the quantem ocsillator

$$U = \frac{1}{2} m w^2 x^2$$

$$\psi = C_0\, e^{-\alpha x^2} \leftarrow \text{Solution}$$

$$\alpha = \frac{mw}{2\hbar}$$

$$E = \frac{1}{2}\hbar w$$

$$C_0 = \left(\frac{mw}{\pi\hbar}\right)^{1/4}$$

$$\int_{-\infty}^{\infty} e^{-ax^2} = \sqrt{\frac{\pi}{a}}$$

$\psi_2 = C_2(1-2x^2)e^{-\alpha x^2}$

$E_n = (n+\frac{1}{2})\hbar w$