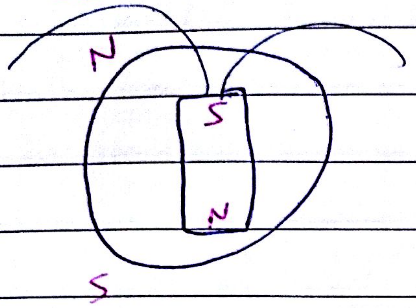
Subject Date No.

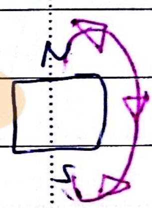
CH 29 Magnetic field

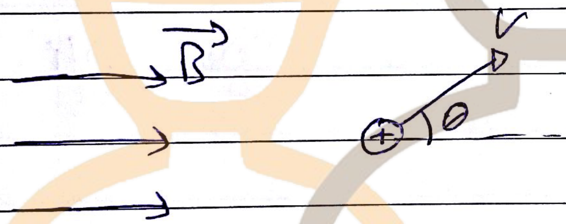


Tesla

* Any moving charge can produced a magnetic field

* Any magnet has two poles North and south

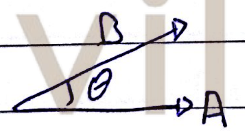




اذا كانت الشحنة سالبة وابتعى بالمجال.
الـ q بنعوضها في الشحنة

$F_B = q\,V \times B$

=



الإبهام V
الأصابع B

$A \times B = AB \sin\theta$

$\frac{N\,s}{C\,m} = \text{Tesla (T)}$

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work done by F_B

$$W = \int \vec{F} \cdot \vec{ds}$$

$$dw = F \cdot ds$$

$$dw = q(\bar{V} \times \bar{B}) \cdot ds$$

$$= q\left(\underbrace{\frac{ds}{dt} \times B) \cdot ds}_{0}\right.$$

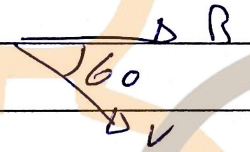
الناتج رح يطلع
عمودي على B
وعلى ds

$F_B \perp ds$

السرعة تبقى ثابتة مقدارًا
فقط تتغير كاتجاه

So $\Delta K = 0$

Ex



$B = 0.025\ T$ find the magnetic on electric

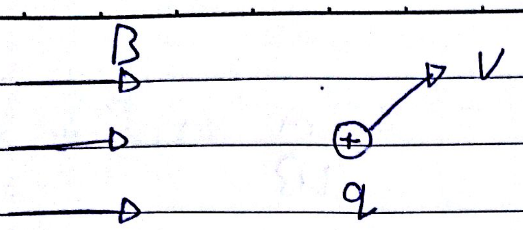
$V = 8 \times 10^6\ m/s$

$$F = qVB\sin\theta$$

$$= 1.6 \times 10^{-19} \times 8 \times 10^{6} \times 0.025 \times \sin 60\ N$$ in to the page

N O T E B O O K

Subject Date No.

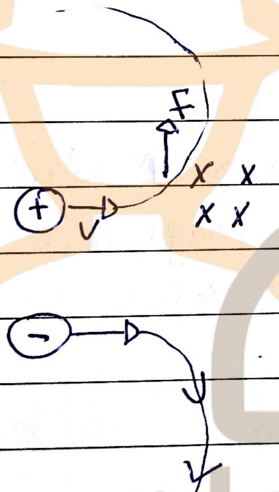


$$F_B = q\bar{V} \times \bar{B}$$

$$F_B = qVB\sin\theta$$

$\boxed{29.2}$ uniform field

x B x into the page ⊙ B out of the page



القوة باتجاه المركزية

$$\sum F = ma$$

$$qVB = m\frac{V^2}{r}$$

الزاوية = 90 دائماً

$$r = \frac{mV^2}{qVB} = \frac{mV}{qB}$$

Angular speed $\boxed{\omega = \frac{V}{r}}$ =

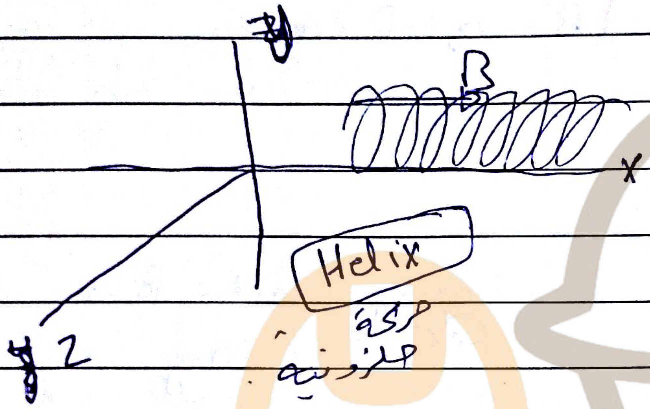
$$w = \frac{\frac{qB\cancel{r}}{m}}{\cancel{r}} \qquad \boxed{w = \frac{qB}{m}}$$

cyclotron frequency

Subject   Date   No.

Period

$$T = \frac{2\pi r}{v} = \frac{2\pi}{\omega} = \frac{2\pi m}{qB}$$



$V = V_x i + V_y$

ما بتأثر
الحركة الخطية

$\boxed{\text{Ex } 29.2}$ A proton is moving in a circular orbit of radius 14 cm in a uniform magnetic field B = 0.35 T find the speed of proton.

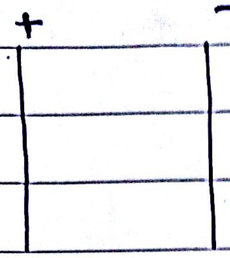
يعني حركة دائرية

$$q \cancel{v} B = \frac{m v^{\cancel{2}}}{r}$$

$m_p = 1.67 \times 10^{-27}$ Kg

$v = 4.7 \times 10^{6}$ m/s

Subject   Date   No.



$q\Delta V = \frac{1}{2}mv^2$

$\boxed{29.3}$ An electron is accelerated in a 350V potential it then enters a uniform field perpendicular to its velocity if the radius of electron path 7.5 cm find B.

$\Delta K = |-\Delta U|$

$q\Delta V = \frac{1}{2}mv^2$

$V = 1.11 \times 10^7$ m/s

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

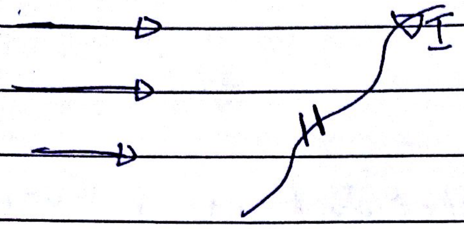
لما اساسا متعامدات حطيت [illegible]

$$\boxed{B = 8.4 \times 10^{-4}\ T}$$

$\omega = \frac{V}{r} = 1.5 \times 10^8$ rad/s

Subject   Date   No.

$\boxed{29.4}$ Magnetic Force on a wire with current



$$F_B = q\,\vec{V} \times \vec{B}$$

$$dF_B = dq \cdot \vec{V} \times \vec{B} \quad \Rightarrow \quad dF_B = I\,dt\,\vec{V} \times \vec{B} = I\,d\vec{s} \times \vec{B}$$

$$I = \frac{dq}{dt}$$

$$dq = I\,dt$$

$$V = \frac{ds}{dt}$$

$$\vec{F}_B = \int I\,ds \times B = I \int (ds \times B)$$

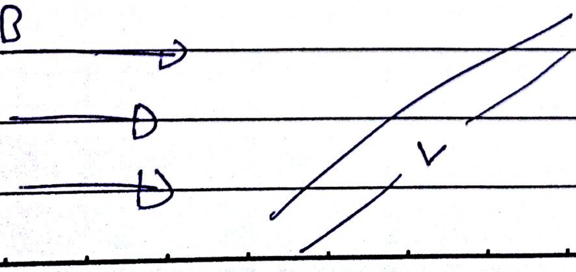
حالة خاصة

If the wire is straight and the B is uniform

أعلاه [illegible]

$$F = I\,\vec{L} \times \vec{B}$$

B



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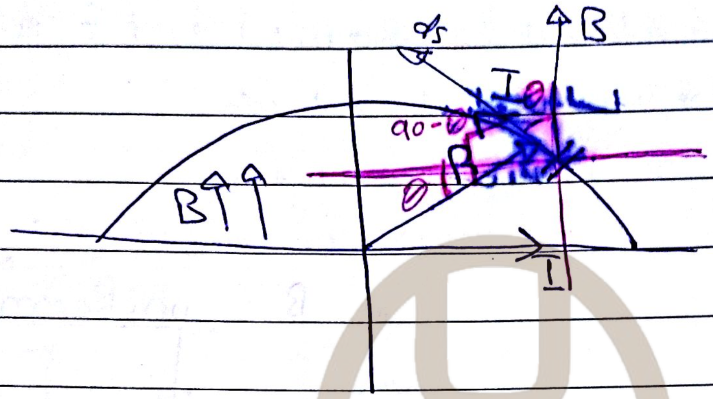
$\boxed{29.4}$ find the net magnetic force on a semicircular loop as shown B is uniform



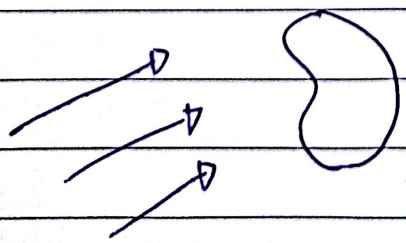
$$F_{stright} = I L B \quad (\hat{k})$$
$$= 2 I R B \hat{k}$$

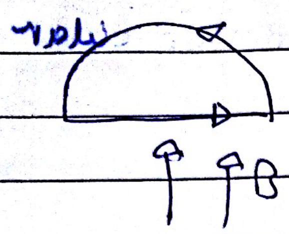
$$F = I \int \vec{ds} \times \vec{B} \qquad ds = R d\theta$$
$$= I \int_0^{\pi} R\, d\theta B \sin\theta$$

$$= -I R B \cos\theta \Big|_0^{\pi} = + 2 I R B (-\hat{k})$$

$$\boxed{F_{net} = \text{zero}}$$

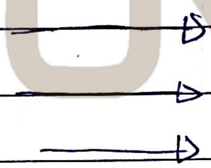
In a uniform field the net force on any closed loop is zero

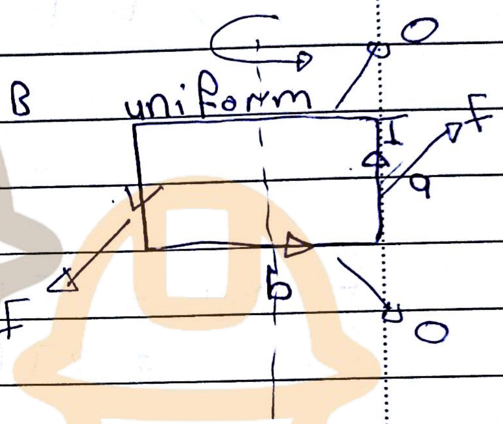




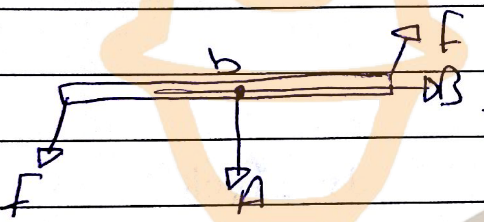
عند نحسب القوة على المستقيم
السهل وجدنا انه القوة المحصلة
تساوي صفر فنستنتج انه القوة
على الضلع الي فوق التاني نفس
المقدار وعكس الاشارة.

$\boxed{29.5}$ Torque





$$F_{net} = IaB - IaB = 0$$



٤ اصابع باتجاه
التيار، وابهام هو
الاتجاه.

$$\tau = r \times F = rF\sin\theta$$

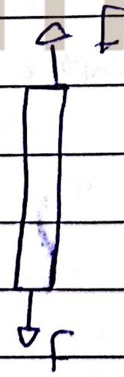
$$\tau = \frac{b}{2} * IaB + \frac{b}{2} IaB$$

$$= bIaB$$

$$= AIB \qquad = AIB\sin\theta$$

مساحة المستطيل ab

بين A و B



$$\boxed{\tau = 0}$$

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$\tau = I \vec{A} \times \vec{B}$

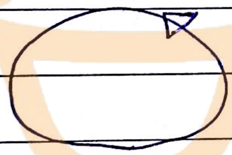
$M \equiv I A$ magnetic dipole moment

$M = N I A$

↳ # of turn

$\tau = \vec{M} \times \vec{B}$

اتجاه ال A اتجاه ال M



$I \pi r^2$

$\tau = M B \sin\theta$

Potential energy.

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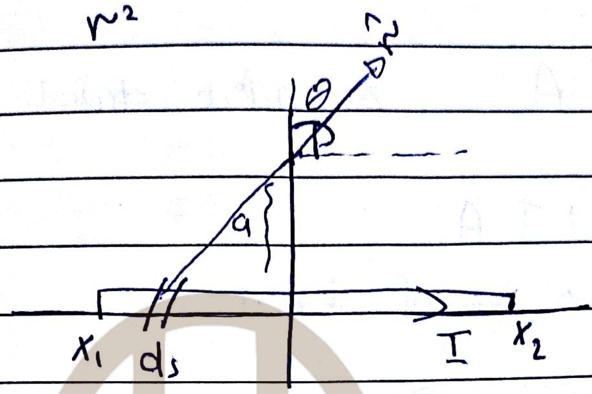
$$\vec{B} = \frac{\mu_0 I}{4\pi} \int_{wire} \frac{d\vec{s} \times \hat{r}}{r^2}$$

$\boxed{\text{Ex } 30.1}$



Find B at P

$d\vec{s} = dx\,\hat{i}$

$r = \sqrt{x^2+a^2}$

$\hat{r} = \cos\theta\,\hat{j} + \sin\theta\,\hat{i}$

$d\vec{s} \times \hat{r} = \cos\theta\, dx\, \hat{k}$ فبرا إ

$$B = \frac{\mu_0 I}{4\pi} \int_{x_1}^{x_2} \frac{\cos\theta\, dx\, \hat{k}}{x^2+a^2} \qquad \cos\theta = \frac{a}{\sqrt{x^2+a^2}}$$

$$= \frac{\mu_0 I}{4\pi} \int_{x_1}^{x_2} \frac{a\, dx\, \hat{k}}{\sqrt{x^2+a^2} * (x^2+a^2)} = \frac{\mu_0 I}{4\pi} \int_{x_1}^{x_2} \frac{a\, dx\, \hat{k}}{(x^2+a^2)^{3/2}}$$

$\tan\theta = \frac{x}{a} \rightarrow x = a\tan\theta$

$dx = \frac{a}{\cos^2\theta}\, d\theta$

$1 + \tan^2\theta = \frac{1}{\cos^2\theta}$

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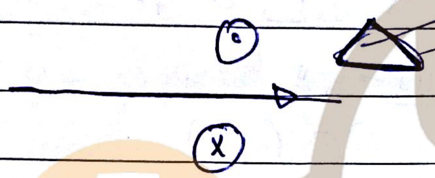
$$B = \frac{\mu . I}{4 \pi a} \int_{\theta_1}^{\theta_2} \cos\theta \, d\theta$$

$$\boxed{B = \frac{\mu . I}{4 \pi a} \left[\sin\theta_2 - \sin\theta_1 \right] \hat{r}} \rightarrow$$ حسب التيار



ملاحظة

For long straight wire

$\tan\theta = \frac{x}{a}$

$\theta_2 \rightarrow \frac{\pi}{2}$

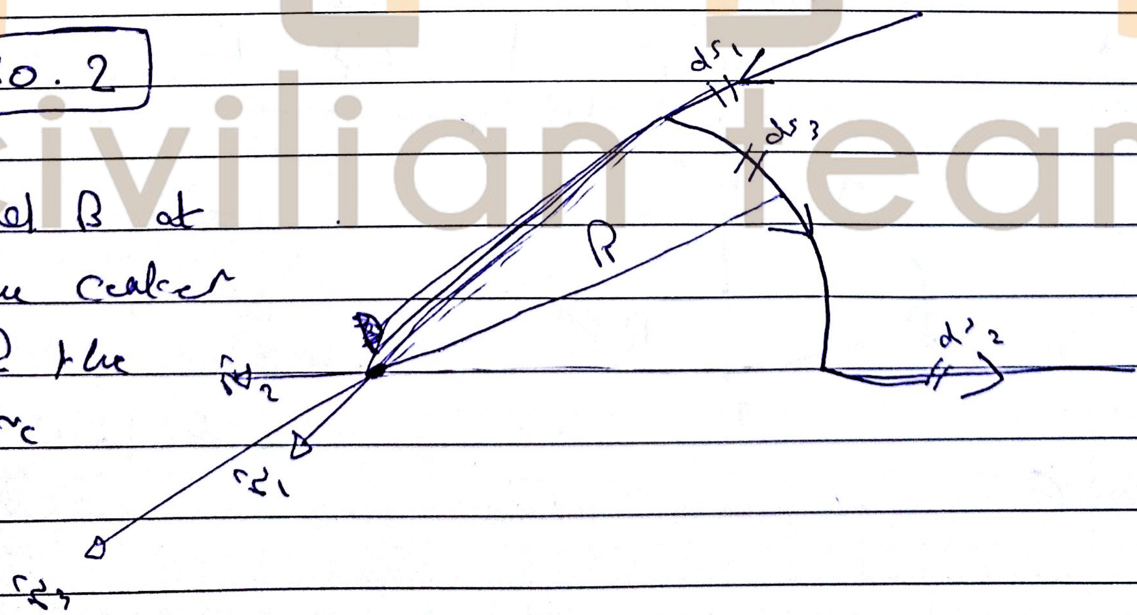
$\theta_1 \rightarrow -\frac{\pi}{2}$

$$= \boxed{\frac{\mu . I}{2 \pi a}}$$

سلك طويل مستقيم

$\boxed{30.2}$

Find B at the center of the arc



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$$B = \frac{\mu_0 I}{4\pi} \int \frac{ds \times \hat{r}}{r^2}$$

كل باتجاه الـ I وهي على
امتداد الـ $\hat{r}$ لذا تكون حاصل
الـ X بينهم يساوي صفر
ونفس الشيء للي تحت

straight

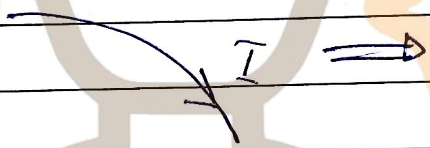
arc

الزاوية بين ds و R تساوي 90
درجة لأن نصف القطر عمودي على المماس

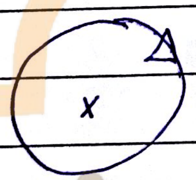
$$= \frac{\mu_0 I}{4\pi} \int \frac{ds(-\hat{k})}{R^2} = \boxed{\frac{\mu_0 I}{4\pi R^2} R\theta(-\hat{k})}$$

θ radian

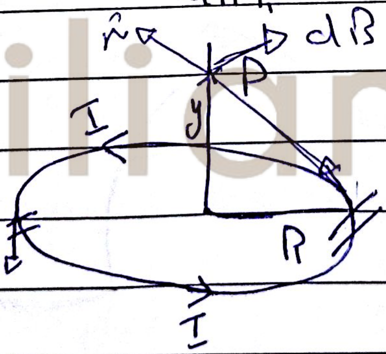
$$\boxed{B = \frac{\mu_0 I \theta}{4\pi R}}$$



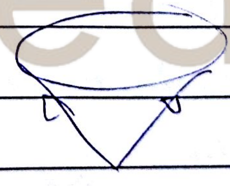
الأصابع باتجاه I
الإبهام B.



$$= \frac{\mu_0 I\, 2\pi}{4\pi R} = \boxed{\frac{\mu_0 I}{2R}}$$



30.3



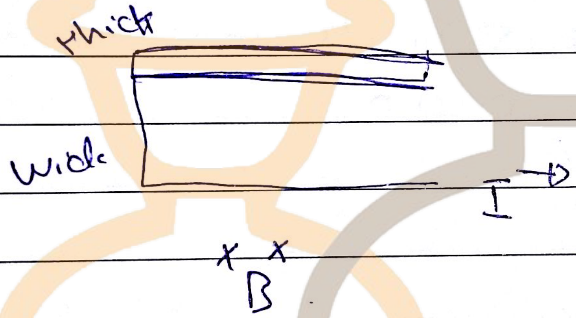
الأفقيات بيلغو بعض

$$dB_y = dB \cos\theta$$

$$\Delta V_H = \frac{IB}{nqt} = \frac{R_H IB}{t}$$

$R_H = \frac{1}{nq} \rightarrow$ with sign

$\boxed{29.7}$ A rectangular copper strip 1.5 cm x 0.1 cm ~~wide thick~~ carris $I = 5A$ find the voltage if $B = 1.2\,T$ applied perpendicular to the strip



assume one free e per atom

عدد الذرات في وحدة ح. $n = \frac{\rho}{M} N_A * 1$

$\Delta V_H = \frac{IB}{nqt}$

شحنة الالكترون

$\Delta V_H = 0.44\ \mu V$ $\boxed{t = 0.1 * 10^{-2}\,m}$

$E =$

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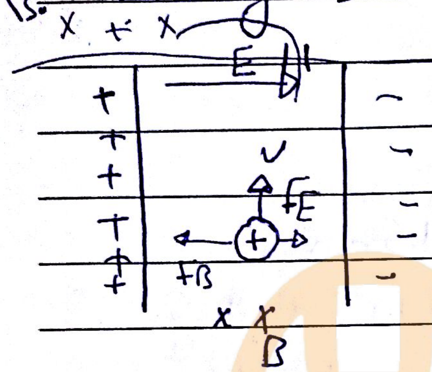
$F = q\bar{E} + qV \times B$ Lowentz Force

B. Velocity selector



$\cancel{q}VB = \cancel{q}E$ يمشي بجسم مستقيما

$$\boxed{V = \frac{E}{B}}$$

السرعة بطلع مستقيم

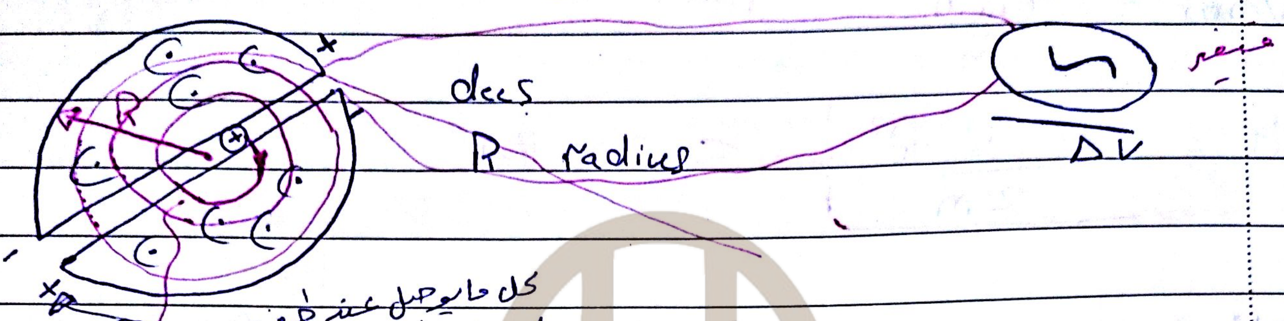
Mass spectrometer : separate ions according to mass - to - charge radis

$$qVB_0 = \frac{mV^2}{r}$$

$$\frac{m}{q} = \frac{B_0 r}{V}$$

$$= \frac{B_0 r}{\frac{E}{B}} = \frac{B B_0 r}{E}$$

cyclotron : device used to accelerate charged particles to a very high speeds



كل ما يوصل عند طرف
يجب ان نعكس الأقطاب
فيكتسب طاقة حركية
$K = q\Delta V$

عند هذه اللحظة نعكس الأقطاب فيتسارع وحركته

وكلما تزداد السرعة يزداد نصف القطر حتى يخرج البروتون من الـ Dees

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

$$\boxed{v = \frac{qBr}{m}}$$

Period $T = \frac{2\pi r}{v} = \boxed{\frac{2\pi m}{qB}}$

at $t=0$	$t=\frac{T}{2}$	t
+ -	- +	+ -

$$F = \frac{1}{T}$$

$$K = \frac{1}{2} m v^2$$

$$V_{max} = \frac{qBR}{m} \rightarrow$$ نصف قطر ال Dees

$$\boxed{K = \frac{q^2 B^2 R^2}{2m}} \quad < 20 \text{ MeV}$$

CH 30 sources of the magnetic field

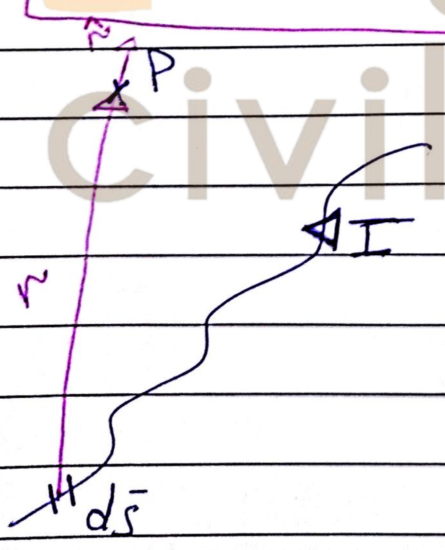
Biot - savart law

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I \, d\vec{s} \times \hat{r}}{r^2}$$

$$\boxed{\vec{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{s} \times \hat{r}}{r^2}}$$

$$\mu_0 = 4\pi \times 10^{-7} \ \frac{T \cdot m}{A}$$

Permenbility of free space



ds باتجاه ال I

الإبهام مع ds أي باتجاه ال I
الأصابع باتجاه ال $\hat{r}$ ارجع
و الكف هو اتجاه المجال المغناطيسي