ΔΥΝΑΜΙΚΗ

Περιγραφή εννοιών

- Αλληλεπίδραση
- Αδράνεια
- Αδρανειακά και μη αδρανειακά συστήματα

Θεμελιώδη μεγέθη

- Δύναμη
- Ορμή
- Μάζα
- ροπή
- Στροφορμή

Νόμοι Newton

- Αρχή της αδράνειας - 1ος Νόμος
- Επιτάχυνση σωμάτων - 2ος Νόμος
- Αλληλεπίδραση σωμάτων 3ος Νόμος

ΣΧΕΤΙΚΕΣ ΕΝΝΟΙΕΣ:

- Υποθετικές δυνάμεις - δυνάμεις αδράνειας
- Φυγόκεντρος - κεντρομόλος δύναμη

ΒΑΣΙΚΕΣ ΚΑΤΗΓΟΡΙΕΣ ΔΥΝΑΜΕΩΝ

ΒΑΡΥΝΤΙΚΗ
ΗΛΕΚΤΡΟΜΑΓΝΗΤΙΚΗ
ΑΣΘΕΝΗΣ ΠΥΡΗΝΙΚΗ
ΙΣΧΥΡΗ ΠΥΡΗΝΙΚΗ

ΒΑΡΥΤΙΚΗ ΔΥΝΑΜΗ

Νόμος Παγκόσμιας έλξης : $F = G \frac{m_1 m_2}{r^2}$, $G = 6{,}67 \cdot 10^{-11}\ Nm^2/kg^2$

Βάρος : $B = m \cdot g$

g : επιτάχυνση βαρύτητας
ένταση πεδίου βαρύτητας

$$F = B \Rightarrow G \frac{m \cdot M}{r^2} = mg \Rightarrow \boxed{g = G \frac{M}{r^2}}$$

ΗΛΕΚΤΡΟΜΑΓΝΗΤΙΚΗ ΔΥΝΑΜΗ

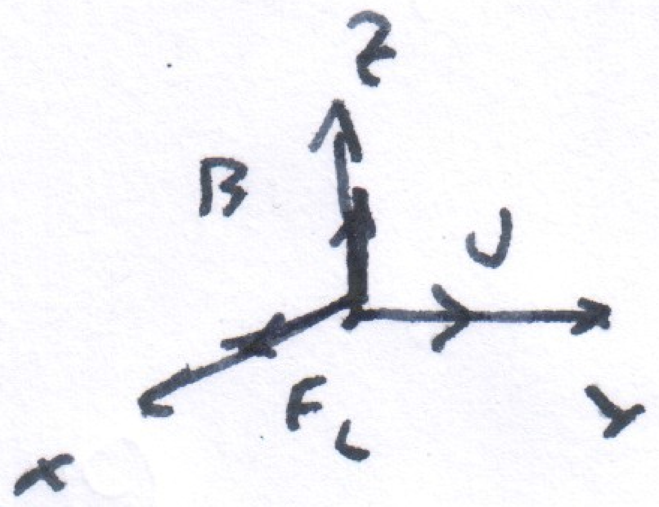
Νόμος Coulomb $F = k \frac{q_1 \cdot q_2}{r^2}$, $k = 9 \cdot 10^9\ Nm^2/C^2$

Ηλεκτρικό πεδίο $F = q \cdot E$

$F = k \frac{q \cdot Q}{r^2}$ $\boxed{E = k \frac{Q}{r^2}}$

ΔΥΝΑΜΗ ΣΕ ΚΙΝΟΥΜΕΝΟ ΦΟΡΤΙΟ

Δύναμη Lorentz: $F_L = q\vec{v}\times\vec{B}$



$$F_L = q\upsilon \cdot B \sin\theta \, \hat{u}_N$$

ΘΕΩΡΙΑ ΠΕΔΙΩΝ

- Δυνάμεις επαφής
- Δυνάμεις πεδίου (από απόσταση)
- Σύγχρονη τάση

ΜΕΛΕΤΗ ΕΙΔΙΚΩΝ ΠΕΡΙΠΤΩΣΕΩΝ

Δυνάμεις επαφής

- ΤΡΙΒΗ ΣΤΑΤΙΚΗ
- ΤΡΙΒΗ ΟΛΙΣΘΗΣΗΣ
- ΤΡΙΒΕΣ ΡΕΥΣΤΩΝ
  - Στρωτή ροή: $F = 6\pi r\eta \upsilon$ (Stokes)
  - Τυρβώδης ροή: $F_{αντ} = c \cdot S_{μετ.} \frac{\rho}{2} \upsilon^2$

ΜΕΛΕΤΗ ΚΙΝΗΣΗΣ ΣΩΜΑΤΙΟΥ ΥΠΟ ΤΗΝ ΕΠΙΔΡΑΣΗ ΤΡΙΒΗΣ ΡΕΥΣΤΟΥ ΤΥΠΟΥ Ν. STOKES

Στρωτή Ροή: $\vec{F}_{τρ} = -6\pi r\eta\vec{\upsilon}$

$\boxed{1\,Pa \cdot s = 10\ Poise}$

$1\,Pa = 1\,N\,m^{-2}$

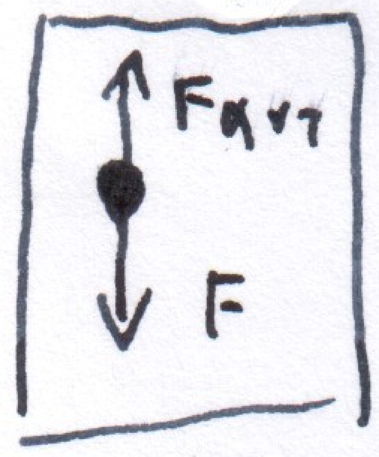
Διαστατική Ανάλυση: $[F] = [r][\eta][\upsilon] \Rightarrow N = m \cdot [\eta] \cdot m\,s^{-2}$

$\Rightarrow kg\, s^{-1} = m\, s^{-2}\, [\eta]$

$\Rightarrow \boxed{[\eta] = kg \cdot m^{-1} s^{-1}}$

$\boxed{Poise = g \cdot cm^{-1} \cdot s^{-1}}$

$$\Sigma F = ma \Rightarrow F - 6\pi r\eta\upsilon = m\alpha \Rightarrow \boxed{\alpha = \frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon}$$



$$\frac{d\upsilon}{dt} = \frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon \Rightarrow \boxed{\frac{d\upsilon}{\frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon} = dt}$$

$$\boxed{\xi = \frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon} \qquad d\xi = -\frac{6\pi r\eta}{m}d\upsilon \Rightarrow \boxed{d\upsilon = -\frac{m}{6\pi r\eta}d\xi}$$

$$\frac{d\upsilon}{\frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon} = dt \Leftrightarrow -\frac{m}{6\pi r\eta}\frac{d\xi}{\xi} = dt \Rightarrow \frac{d\xi}{\xi} = -\frac{6\pi r\eta}{m}dt$$

$$\Rightarrow \ln\xi\Big|_{\frac{F}{m} - \frac{6\pi r\eta}{m}0}^{\frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon} = -\frac{6\pi r\eta}{m}t \Leftrightarrow$$

$$\Rightarrow \ln\left[\frac{\frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon}{\frac{F}{m}}\right] = -\frac{6\pi r\eta}{m}t$$

$$\Rightarrow \frac{\frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon}{\frac{F}{m}} = e^{-\frac{6\pi r\eta}{m}t}$$

$$\Rightarrow \frac{F}{m} - \frac{6\pi r\eta}{m}\upsilon = \frac{F}{m}e^{-\frac{6\pi r\eta}{m}t} \Rightarrow$$

$$\Rightarrow \frac{F}{\cancel{m}}\left(1 - e^{-\frac{6\pi r\eta}{m}t}\right) = \frac{6\pi r\eta}{\cancel{m}}\upsilon$$

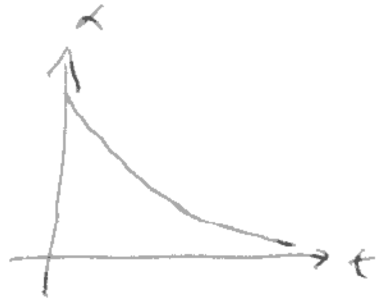
$$\Rightarrow \boxed{v = \frac{F}{6\pi r n}\left(1 - e^{-\frac{6\pi r n}{m}t}\right)}$$

$$\boxed{v_{op} = \frac{F}{6\pi r n}}$$

$$\left.\begin{aligned} \alpha &= \frac{F}{m} - \frac{6\pi r n}{m} v \\ v &= \frac{F}{6\pi r n}\left(1 - e^{-\frac{6\pi r n}{m}t}\right) \end{aligned}\right\} \Rightarrow$$

$$\Rightarrow \quad \alpha = \frac{F}{m} - \frac{F}{m}\left(1 - e^{-\frac{6\pi r n}{m}t}\right)$$

$$\Rightarrow \boxed{\alpha = \frac{F}{m} e^{-\frac{6\pi r n}{m}t}}$$



$$\frac{dy}{dt} = \frac{F}{6\pi r n}\left(1 - e^{-\frac{6\pi r n}{m}t}\right) \Rightarrow dy = \frac{F}{6\pi r n}\left(1 - e^{-\frac{6\pi r n}{m}t}\right)dt$$

$$\Rightarrow \quad y - 0 = \frac{F}{6\pi r n}t - \frac{F}{6\pi r n}\int e^{-\frac{6\pi r n}{m}t}\,dt$$

$$\boxed{u = \frac{6\pi r n}{m}t} \qquad du = \frac{6\pi r n}{m}\,dt \Rightarrow \boxed{dt = \frac{m}{6\pi r n}\,du}$$

$$\int e^{-\frac{6\pi r n}{m}t}\,dt = \frac{m}{6\pi r n}\int e^{-u}\,du = \frac{m}{6\pi r n}\, e^{-u}\Big]_0^{\frac{6\pi r n}{m}t}$$

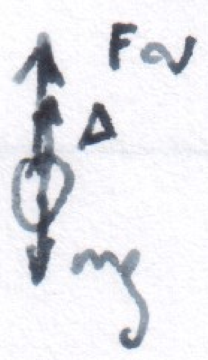
$$y = \frac{F}{6\pi r\eta} t - \frac{F}{6\pi r\eta} \frac{m}{6\pi r\eta} \left(1 - e^{-\frac{6\pi r\eta}{m} t}\right)$$

$$\upsilon_{op} = \frac{F}{6\pi r\eta}$$

$$\rightarrow y = \upsilon_{op} t - \upsilon_{op} \frac{m}{6\pi r\eta} \left(1 - e^{-\frac{6\pi r\eta}{m} t}\right)$$

$$\rightarrow \boxed{y = \upsilon_{op} \left(t - \frac{m}{6\pi r\eta} \left(1 - e^{-\frac{6\pi r\eta}{m} t}\right)\right)}$$

Κίνηση υπό επίδραση $F_{αν}$, A, mg



Ισορροπία Σώματος $T + A = mg \Rightarrow 6\pi r\eta \upsilon_{op} + \varepsilon V = mg$

$$\rightarrow 6\pi r\eta \upsilon_{op} + d_0 g \frac{4}{3}\pi r^3 = d_\sigma \cdot \frac{4}{3}\pi r^3 g$$

$$\rightarrow 6\pi r\eta \upsilon_{op} = (d_\sigma - d_0) \frac{4}{3} \pi r^{3} g$$

$$\rightarrow \boxed{\upsilon_{op} = (d_\sigma - d_0) \frac{4 r^2}{18 \eta} g}$$

ΚΙΝΗΣΗ ΣΦΑΙΡΙΔΙΟΥ ΥΠΟ ΤΗΝ ΕΠΙΔΡΑΣΗ ΤΥΡΒΩΔΟΥΣ ΡΟΗΣ

$t=0 \quad U=0$

$$F_{\alpha\nu\tau} = \frac{1}{2} C d S U^2$$

$$\Sigma F = m\alpha \Rightarrow mg - F_{\alpha\nu\tau} = m\alpha \Rightarrow mg - \frac{CdS}{2} U^2 = m\frac{dU}{dt}$$

$$\Rightarrow g - \frac{CdS}{2m}U^2 = \frac{dU}{dt} \Rightarrow \boxed{\frac{dU}{g - \frac{CdS}{2m}U^2} = dt}$$

$$\Rightarrow \boxed{\frac{dU}{\frac{CdS}{2m}\left(\frac{2mg}{CdS} - U^2\right)} = dt} \qquad \boxed{B = \frac{CdS}{2m} \quad A^2 = \frac{2mg}{CdS} \quad A = \sqrt{\frac{2mg}{CdS}}}$$

$$\frac{dU}{\frac{CdS}{2m}\left(\frac{2mg}{CdS} - U^2\right)} = dt \Longrightarrow \frac{dU}{B(A^2 - U^2)} = dt \Rightarrow$$

$$\Rightarrow \boxed{\frac{dU}{A^2 - U^2} = B\,dt}$$

$$\frac{1}{A^2 - U^2} = \frac{\alpha}{A+U} + \frac{b}{A-U} \Leftrightarrow \frac{1}{\cancel{A^2-U^2}} = \frac{\alpha(A-U) + b(A+U)}{\cancel{(A+U)(A-U)}}$$

$$\Rightarrow 1 + 0U = \alpha A - \alpha U + bA + bU \Rightarrow 1 + 0U = (\alpha + b)A + (b - \alpha)U$$

$$\Rightarrow \quad (\alpha + b) A = 1 \quad \rightarrow \quad 2\alpha A = 1 \Rightarrow \boxed{\alpha = \frac{1}{2A}}$$

$$b - \alpha = 0 \Rightarrow \boxed{b = a} \quad \Rightarrow \quad \boxed{b = \frac{1}{2A}}$$

$$\frac{dU}{A^2 - U^2} = B\,dt \Rightarrow dU\left(\frac{\alpha}{A+U} + \frac{b}{A-U}\right) = B\,dt$$

$$\Rightarrow dU\left(\frac{1}{2A}\frac{1}{A+U} + \frac{1}{2A}\frac{1}{A-U}\right) = B\,dt$$

$$\Rightarrow \frac{1}{2A}\,dU\left(\frac{1}{A+U} + \frac{1}{A-U}\right) = B\,dt$$

$$\Rightarrow \frac{1}{2A}\,dU\left(\frac{1}{A+U} + \frac{1}{A-U}\right) = B\,dt$$

$$\Rightarrow dU\left(\frac{1}{A+U} + \frac{1}{A-U}\right) = 2AB\,dt$$

$$\Rightarrow -dU\left(\frac{1}{A+U} + \frac{1}{A-U}\right) = -2AB\,dt$$

$$\Rightarrow dU\left(-\frac{1}{A+U} - \frac{1}{A-U}\right) = -2AB\,dt$$

$$\Rightarrow dU\left(-\frac{1}{A+U} + \frac{1}{U-A}\right) = -2AB\,dt$$

$$\Rightarrow \boxed{dU\left(\frac{1}{U-A} - \frac{1}{U+A}\right) = -2AB\,dt}$$

$$\frac{dU}{U-A} - \frac{dU}{U+A} = -2AB\,dt \Rightarrow$$

$$\int_0^U \frac{dU}{U-A} - \int_0^U \frac{dU}{U+A} = -2AB\int_0^t dt$$

$$\Rightarrow \int_0^U \frac{dU}{U-A} - \int_0^U \frac{dU}{U+A} = -2AB\,t$$

$$\int_0^U \frac{dU}{U-A} = \int_{-A}^{U-A} \frac{d\xi}{\xi} = \Big[\ln \xi\Big]_{-A}^{U-A} = \ln(U-A) - \ln(-A)$$

$$\xi = U-A \Rightarrow d\xi = dU$$

$$\Rightarrow \int_0^U \frac{dU}{U-A} = \ln\frac{U-A}{-A} = \ln\frac{A-U}{A}$$

$$\Rightarrow \boxed{\int_0^U \frac{dU}{U-A} = \ln\frac{A-U}{A}}$$

$$\int_0^U \frac{dU}{U+A} = \int_A^{U+A} \frac{d\xi}{\xi} = \left[\ln \xi\right]_A^{U+A} = \ln(U+A) - \ln A$$

$\xi = U+A \quad d\xi = dU$

$$= \ln \frac{U+A}{A} = \ln \frac{A+U}{A}$$

$$\boxed{\int_0^U \frac{dU}{U+A} = \ln \frac{A+U}{U}}$$

$$dU\left(\frac{1}{U-A}-\frac{1}{U+A}\right)=-2AB\,dt$$

$$\Rightarrow \int_0^U \frac{dU}{U-A}-\int_0^U \frac{dU}{U+A}=-2ABt$$

$$\Rightarrow \ln\frac{A-U}{A}-\ln\frac{A+U}{A}=-2ABt$$

$$\Rightarrow \ln\frac{\frac{A-U}{\cancel{A}}}{\frac{A+U}{\cancel{A}}}=-2ABt \Rightarrow \ln\frac{A-U}{A+U}=-2ABt$$

$$\Rightarrow \frac{A-U}{A+U}=e^{-2ABt} \Rightarrow A-U=(A+U)e^{-2ABt}$$

$$\Rightarrow A-U=Ae^{-2ABt}+Ue^{-2ABt} \Rightarrow$$

$$\Rightarrow A-Ae^{-2ABt}=U+Ue^{-2ABt} \Rightarrow$$

$$\Rightarrow A\left(1-e^{-2ABt}\right)=U\left(1+e^{-2ABt}\right)$$

$$\Rightarrow \boxed{U=A\,\frac{1-e^{-2ABt}}{1+e^{-2ABt}}}$$

$$U = \sqrt{\frac{2mg}{cds}} \cdot \frac{1 - e^{-2ABt}}{1 + e^{-2ABt}}$$

$$2AB = \cancel{2}\frac{cds}{\cancel{2}m} \sqrt{\frac{2mg}{cds}} = \frac{cds}{m} \sqrt{\frac{2mg}{cds}}$$

$$= \sqrt{\frac{c^2 d^2 s^2 \, 2mg}{\cancel{c}\cancel{d}\cancel{s}}} = \sqrt{2mgcds}$$

$$\Rightarrow \boxed{U = \sqrt{\frac{2mg}{cds}} \, \frac{1 - e^{-\sqrt{2mgcds}\,t}}{1 + e^{-\sqrt{2mgcds}\,t}}}$$

$$t \to \infty \qquad e^{-\sqrt{2mgcds}} \to 0$$

$$U \to \sqrt{\frac{2mg}{cds}} \; \frac{1}{1}$$

$$\Rightarrow \boxed{U_{op} = \sqrt{\frac{2mg}{cds}}}$$

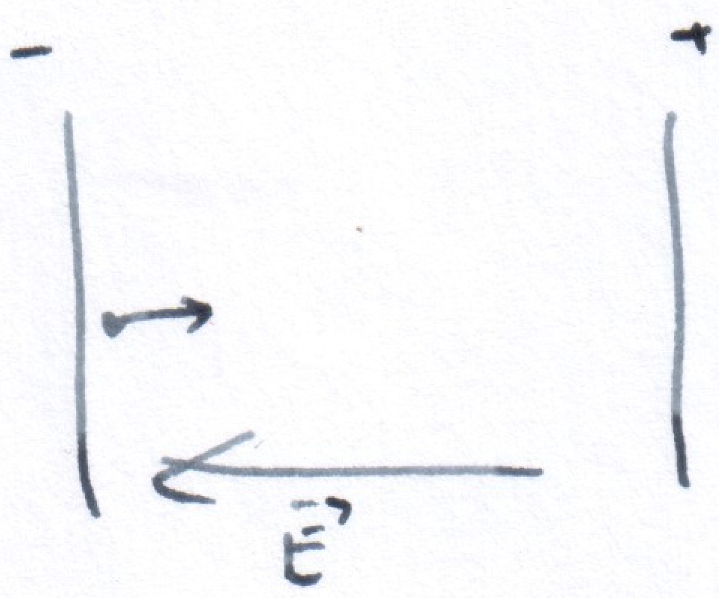
ΕΝΑΛΛΑΚΤΙΚΑ

$$\alpha = g - \frac{c\,d\,s}{2m} v^2 \xrightarrow[\alpha=0]{v=v_{op}} 0 = g - \frac{c\,d\,s}{2m} v_{op}^2$$

$$\Rightarrow \frac{c\,d\,s}{2m} v_{op}^2 = g \Rightarrow v_{op}^2 = \frac{2mg}{c\,d\,s} \Rightarrow v_{op} = \sqrt{\frac{2mg}{c\,d\,s}}$$

ΕΦΑΡΜΟΓΕΣ ΗΛΕΚΤΡΙΣΜΟΥ

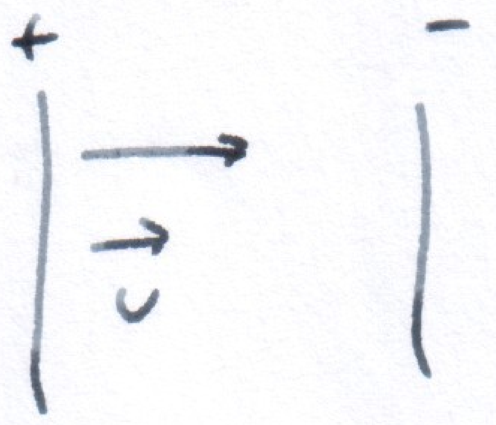
Κίνηση ηλεκτρονίου σε ηλεκτρικό πεδίο



$\vec F = m\vec\alpha \; x \Rightarrow \vec E \cdot e = m\vec\alpha \Rightarrow$

$$\boxed{\vec\alpha = \frac{\vec E \cdot e}{m}}$$

α) $\vec U_0 \uparrow\uparrow \vec E$: Επιβραδυνόμενη



$\alpha = \frac{E \cdot e}{m}$

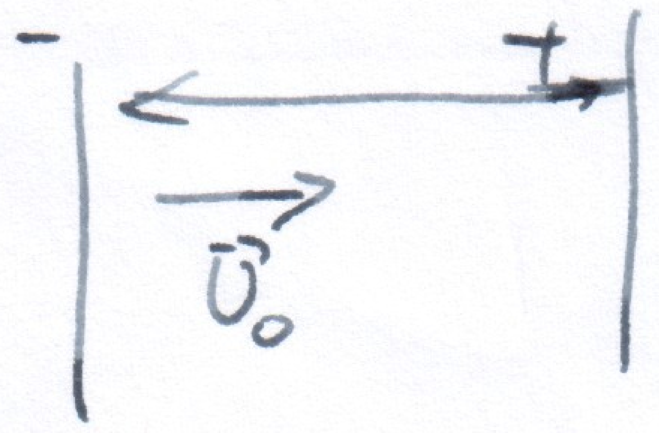
$U = U_0 - \alpha t$

$X = U_0 t - \frac{1}{2}\alpha t^2$

Χρόνος μέχρι να σταματήσει

$U = 0 \Rightarrow U_0 - \alpha t_{\sigma\tau} = 0 \Rightarrow \boxed{t_{\sigma\tau} = \frac{U_0}{\alpha}}$

$x_0 = U_0 t_{\sigma\tau} - \frac{1}{2}\alpha t_{\sigma\tau}^2 \Rightarrow \boxed{x_{\sigma\tau} = \frac{U_0^2}{2\alpha}}$

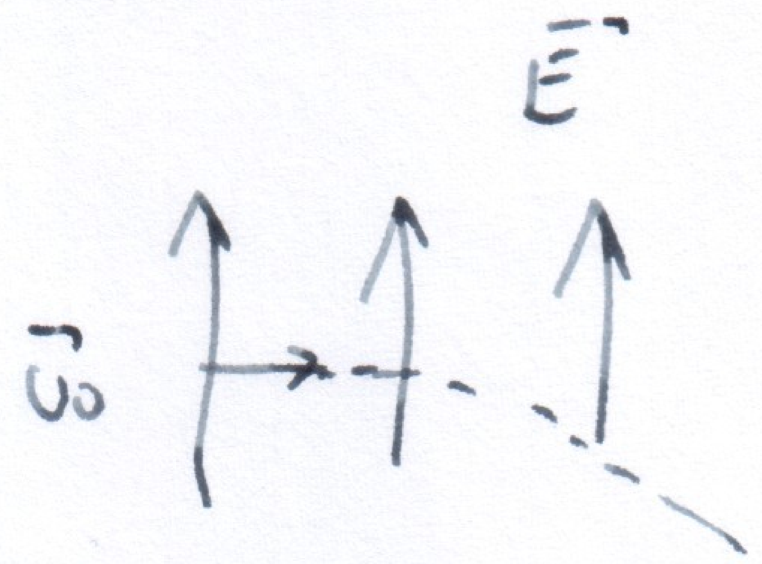
(β) 

$\vec{U} \uparrow\downarrow \vec{E}$ επιταχυνόμενη

$$\boxed{\vec{\alpha} = \frac{\vec{E} \cdot e}{m}}$$

$$U = U_0 + \alpha t$$
$$x = U_0 t + \frac{1}{2} \alpha t^2$$

(γ) $\vec{U} \perp \vec{E}$



x	y
$U_x = U_0$	$U_y = \alpha t$
$x = U_0 t$	$y = \frac{1}{2} \alpha t^2$

$$t = \frac{x}{U_0}$$

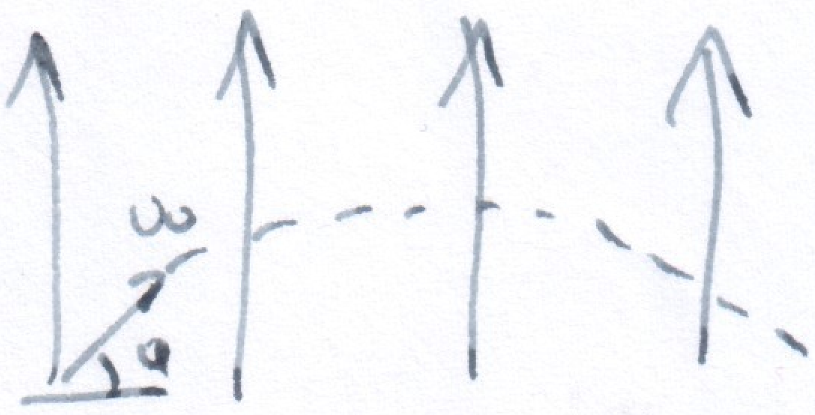
$$y = \frac{1}{2} \alpha \frac{x^2}{U_0^2} \quad \text{(παραβολή)}$$

Ταχύτητα $\vec{U} = \vec{U_x} + \vec{U_y}$

Ταχύτητα σε κάθε σημείο $U = \sqrt{U_x^2 + U_y^2}$

$$\tan\theta = \frac{U_x}{U_y}$$

(δ) $\vec{U_0}$ γωνία φ προς $\vec{E}$



$U_x = U_0 \cos\phi$

$x = U_x t \Rightarrow \boxed{x = U_0 \cos\phi\, t}$

$\alpha = \frac{E \cdot e}{m}$

$U_y = U_0 \sin\phi - \alpha t$

$$\boxed{y = U_0 \sin\phi - \frac{1}{2} \alpha t^2}$$

$$U = \sqrt{U_x^2 + U_y^2}$$

$$\tan\phi = \frac{U_x}{U_y}$$

Εξίσωση της τροχιάς

$$x = \upsilon_0 \cos\varphi \cdot t \Rightarrow \boxed{t = \frac{x}{\upsilon_0 \cos\varphi}}$$

$$y = \upsilon_0 \sin\varphi\, t - \frac{1}{2}\frac{E \cdot e}{m} t^2 \Rightarrow y = \cancel{\upsilon_0} \sin\varphi \frac{x}{\cancel{\upsilon_0} \cos\varphi} - \frac{1}{2}\frac{Ee}{m}\frac{x^2}{\upsilon_0^2 \cos^2\varphi}$$

$$\Rightarrow \boxed{y = \tan\varphi\, x - \frac{1}{2}\frac{Ee}{m\,\upsilon_0^2 \cos^2\varphi} x^2}$$

Κίνηση ηλεκτρονίου σε μαγνητικό πεδίο

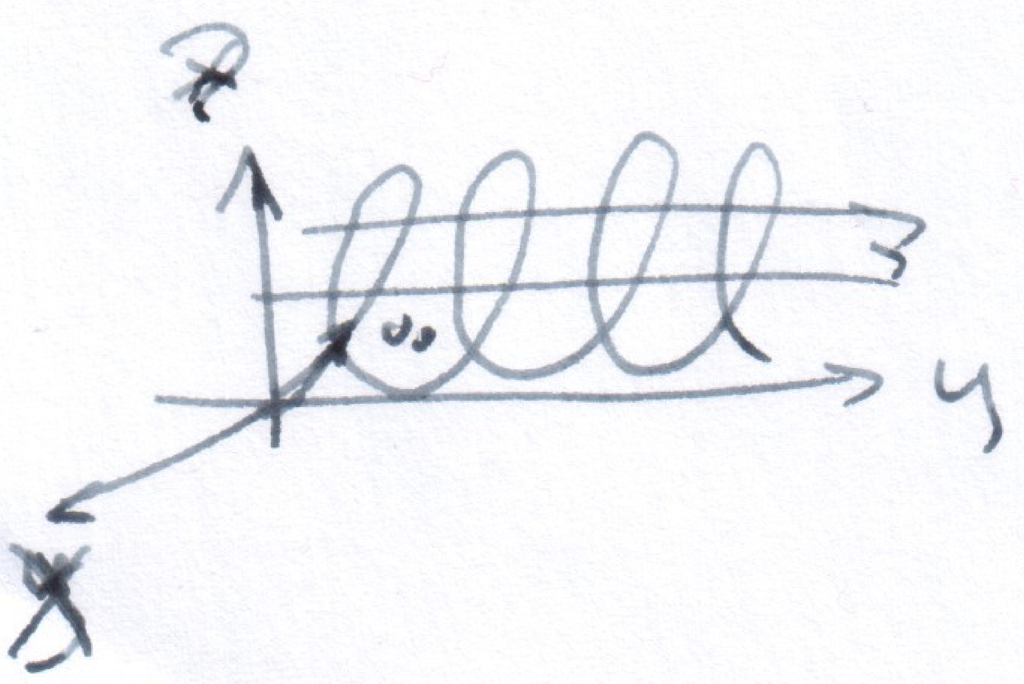
(α) $\vec{\upsilon} \perp \vec{B}$ $\quad F_L = F_{κεν} \Rightarrow e\,\upsilon B = \frac{m\upsilon^2}{R}$

$$\Rightarrow \boxed{R = \frac{m\upsilon}{Be}}$$

$$\upsilon = \omega \cdot R \Rightarrow \upsilon = \omega \frac{m\upsilon}{Be}$$

$$\Rightarrow \boxed{\omega = \frac{Be}{m}} \qquad \boxed{T = \frac{2\pi m}{Be}}$$

(β) $\vec{\upsilon}$ γωνία φ $\vec{B}$



$$\upsilon_{0x} = \upsilon_0 \cos\varphi$$

$$\upsilon_{0y} = \upsilon_0 \sin\varphi$$

$$\upsilon_x = \upsilon_0 \cos\varphi\, t$$

$$R = \frac{m\upsilon_{0y}}{Be} \Rightarrow \boxed{R = \frac{m\,\upsilon \sin\varphi}{Be}}$$

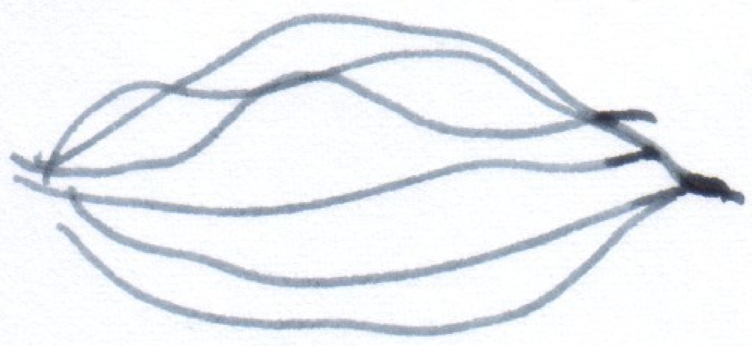
$$\beta = \upsilon_{0\cos\varphi} T = \upsilon_0 \cos\varphi \frac{2\pi m}{Bq}.$$

$$\Rightarrow \boxed{\beta = \upsilon_0 \cos\varphi \frac{2\pi m}{B q}}$$

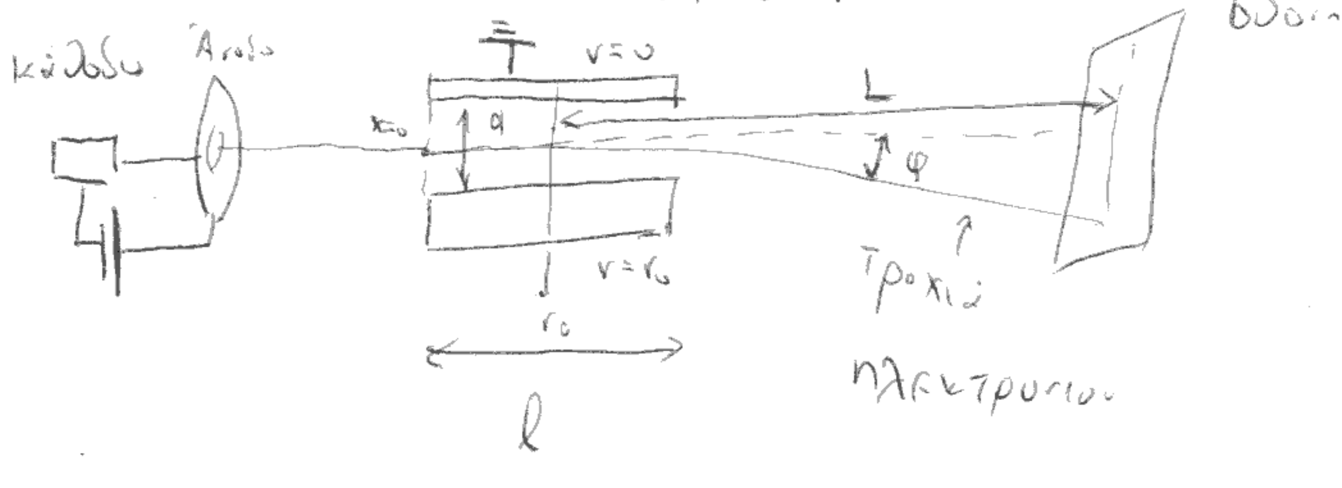
Αν $\varphi \ll \Rightarrow \cos\varphi \simeq 1$

$$\boxed{\beta = \upsilon_0 \frac{2\pi m}{B q}}$$

μαγνητικός φακός



ΗΛΕΚΤΡΟΣΤΑΤΙΚΗ ΑΠΟΚΛΙΣΗ ΠΑΛΜΟΓΡΑΦΟΥ



Ηλεκτρονικό τηλεβόλο

Πλάκες απόκλισης

— ΕΠΙΤΑΧΥΝΣΗ ΔΕΣΜΗΣ ΗΛΕΚΤΡΟΣΤΑΤΙΚΗ ΑΠΟΚΛΙΣΗ

$$\frac{1}{2} m v_0^2 = e V_0 \Rightarrow v_0^2 = \frac{2eV_0}{m} \Rightarrow v_0^2 = 2\left(\frac{e}{m}\right)V_0$$

$$\Rightarrow v_0^2 = 2nV_0 \Rightarrow \boxed{v_0 = \sqrt{2nV_0}}$$

ΠΑΡΑΒΟΛΙΚΗ ΤΡΟΧΙΑ

$$F_x = 0 \Rightarrow \alpha_x = 0 \Rightarrow v_x = v_0,\ \boxed{x = v_0 t}$$

$$F_y = E\cdot e \Rightarrow \alpha_y = E\frac{e}{m} \Rightarrow \boxed{\alpha_y = E\cdot n} \Rightarrow v_y = \alpha_y\cdot t \Rightarrow \boxed{v_y = En\cdot t}$$

$$\boxed{y = \frac{1}{2}En\,t^2}$$

$$t_{on}: \quad x = l \Rightarrow l = v_0\cdot t_{on} \Rightarrow \boxed{t_{on} = \frac{l}{v_0}}$$

Επίσης:

$$\left.\begin{aligned} y_0 &= \frac{1}{2}En\cdot t^2 \\ x &= v_0\cdot t \end{aligned}\right\} \quad y_0 = \frac{1}{2}En\cdot\frac{x^2}{v_0^2}$$

$$\left.\begin{aligned} &\Rightarrow \boxed{y = \frac{En}{2v_0^2}x^2} \\ &v_0 = \sqrt{2nV_0} \end{aligned}\right\} \quad y = \frac{En}{2\cdot 2nV_0}x^2$$

$$\left.\begin{aligned} &\Rightarrow \boxed{y = \frac{E}{4V_0}x^2} \\ &E = \frac{V_P}{d} \end{aligned}\right\} \quad \boxed{y = \frac{V_P}{4dV_0}x^2}$$

ΕΥΘΥΓΡΑΜΜΗ ΔΙΑΔΡΟΜΗ

$$\boxed{y - y_1 = \left(\frac{dy}{dx}\right)_{x=l}(x - x_1)}$$

$$y = \frac{V_P}{4dV_0}x^2 \Rightarrow \frac{dy}{dx} = \frac{2V_P}{4dV_0}x \Rightarrow \boxed{\frac{dy}{dx} = \frac{V_P}{2dV_0}x} \Rightarrow \boxed{\left(\frac{dy}{dx}\right)_{x=l} = \frac{V_P\,l}{2dV_0}}$$

$$y_1 = \frac{V_p}{4dV_0} x_1^2 \quad \Rightarrow \quad \boxed{y_1 = \frac{V_p}{4dV_0} l^2}$$

$$\boxed{x_1 = l}$$

T.E.Z.:

$$y - y_1 = \left(\frac{dy}{dx}\right)_{x=l} (x - x_1)$$

$$\left(\frac{dy}{dx}\right)_{x=l} = \frac{V_p l}{2dV_0}$$

$$x_1 = l$$

$$y_1 = \frac{V_p}{4dV_0} l^2$$

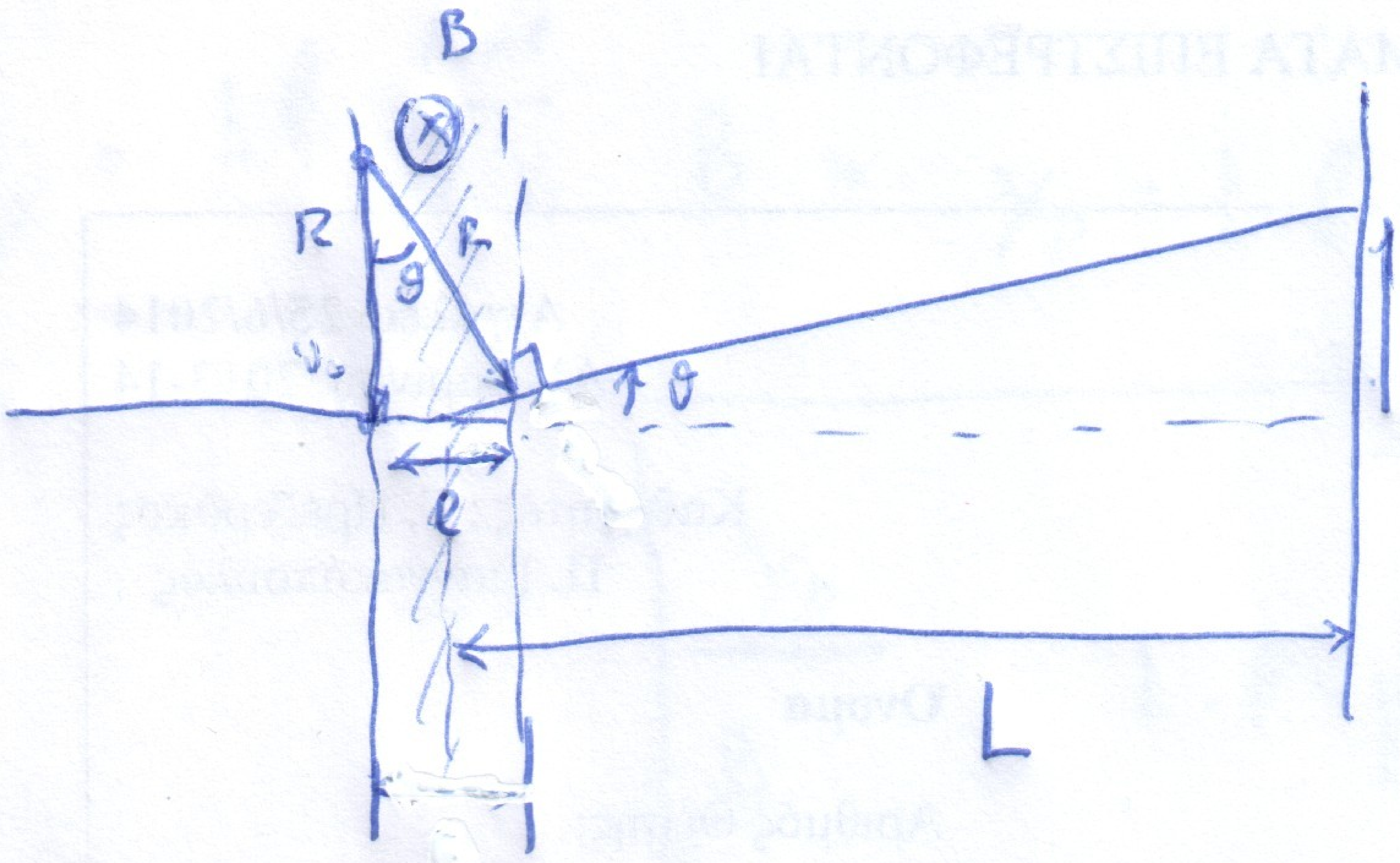
$$y - \frac{V_p}{4dV_0} l^2 = \frac{V_p l}{2dV_0}(x - l)$$

$$\Rightarrow y = \frac{V_p l^2}{4dV_0} + \frac{V_p l}{2dV_0} x - \frac{V_p l^2}{2dV_0}$$

$$\Rightarrow y = \left(\frac{V_p l^2}{4dV_0} - \frac{2V_p l^2}{4dV_0}\right) + \frac{V_p l}{2dV_0} x$$

$$\Rightarrow \boxed{y = -\frac{V_p l^2}{4dV_0} + \frac{V_p l}{2dV_0} x}$$

ΜΑΓΝΗΤΙΚΗ ΑΠΟΚΛΙΣΗ



ΕΝΤΟΣ ΜΑΓΝΗΤΙΚΟΥ ΠΕΔΙΟΥ

$$F_{\mu\alpha\gamma} = F_{\kappa\varepsilon\nu} \Rightarrow q v_0 B = \frac{m v_0^2}{R} \Rightarrow qB = \frac{m v_0}{R} \Rightarrow R = \frac{m v_0}{B q}$$

$$\Rightarrow \boxed{R = \frac{v_0}{nB}}$$

Για μικρές γωνίες θ ισχύει

$$\tan\theta \simeq \sin\theta$$

Αλλά

$$\tan\theta = \frac{\ell}{R}$$

$$\sin\theta \simeq \frac{\ell}{R} \xrightarrow{\theta \simeq \sin\theta} \boxed{\theta \simeq \frac{\ell}{R}}$$

Από την άλλη πλευρά

$$\tan\theta = \frac{y_P}{L + \ell/2} \xrightarrow{L \gg \ell} \tan\theta \simeq \frac{y_P}{L} \quad \boxed{\theta \simeq \frac{y_P}{L}}$$

και επειδή $\tan\theta \simeq \sin\theta \simeq \theta$

$$\theta \simeq \frac{y_P}{L}, \quad \theta \simeq \frac{\ell}{R} \quad \frac{y_P}{L} = \frac{\ell}{R} \Rightarrow y_P = \frac{L \cdot \ell}{R}$$

$$R = \frac{v_0}{nB} \quad y_P = \frac{L \cdot \ell \, nB}{v_0}$$

$$v_0 = \sqrt{2n V_0} \quad y_P = \frac{L \cdot \ell \, n B}{\sqrt{2 n V_0}}$$

$$\Rightarrow \quad Y_p = L\ell \sqrt{\frac{ne}{2eV_0}} \; B \quad \Rightarrow \quad Y_p = L \cdot \ell \sqrt{\frac{n}{2V_0}} \cdot B$$

$$\Rightarrow \quad \boxed{\frac{Y_p}{B} = L \cdot \ell \sqrt{\frac{n}{2V_0}}}$$