Larmor effect.

$$\vec{F}_L = -\frac{k_e q q'}{r^2}\hat{r}$$

1)
$$+ q\vec{v} \times \vec{B}$$

Rotating coordinate system

$$\vec{a}_{in} = \vec{a}_{rot} + 2\vec{\omega} \times \vec{V}_{rot}$$
$$+ \vec{\omega} \times (\vec{\omega} \times \vec{r})$$

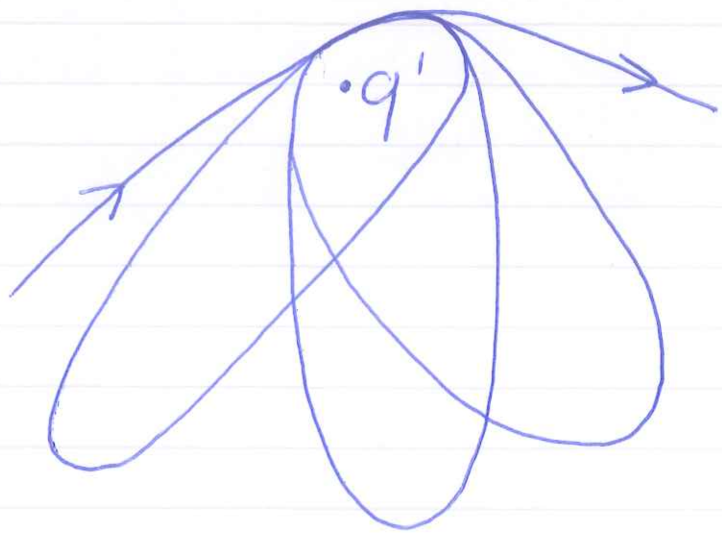
$$m\vec{a}_{rot} + 2m\vec{\omega} \times \vec{V}_{rot} + \vec{\omega} \times (\vec{\omega} \times \vec{r})$$
$$= -\frac{k_e q q'}{r^2}\hat{r} + q\vec{V}_{rot} \times \vec{B}$$
$$+ q(\vec{\omega} \times \vec{r}) \times \vec{B}$$

2) Choose $\vec{\omega} = -\frac{\vec{B} q}{2m}$

Then

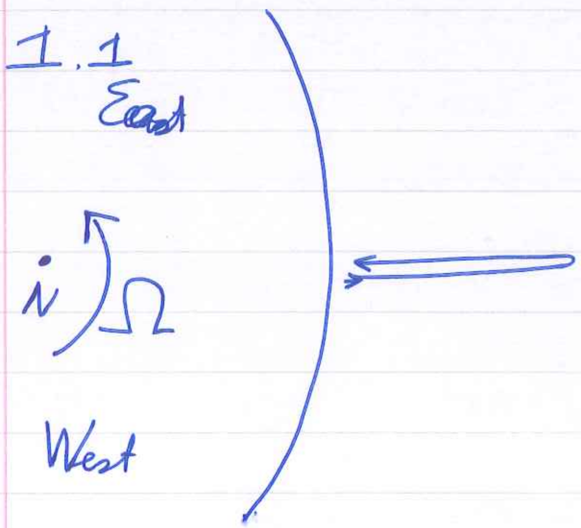
$$\vec{a}_{rot} = -\frac{k_e q q'}{m r^2}\hat{r}$$
$$+ \left(\frac{q}{2m}\right)^2 \vec{B} \times (\vec{B} \times \vec{r})$$

3)



Homework 6 Solutions.

1.1



Seen from an inertial frame, the speed in the direction of $\hat{\theta}$ is smaller at smaller radii.
20 $\Rightarrow$ When thrown up, the particle starts to lack behind with surface of the earth
$\Rightarrow$ Deflection is to the west.

1.2. The Coriolis force is

$$F_{cor} = -2m\vec{\Omega} \times \vec{V_{rot}}$$

$$= -2m\vec{\Omega} \times \dot{r}\hat{r} = -2m\Omega\dot{r}\hat{\theta}$$

10 $$\Rightarrow r\ddot{\theta} + 2\dot{r}\dot{\theta} = -2\Omega\dot{r}$$

Assume $\dot{\theta} \ll \Omega$. This can be verified later

$$\Rightarrow R_e\ddot{\theta} = -2\Omega\dot{r} = -2\Omega(V_0 - gt)$$

$$\Rightarrow R_e\dot{\theta} = -\Omega V_0 t + \frac{1}{2}\Omega g t^2$$

10 $$\Rightarrow R_e\theta(t) = -\frac{1}{2}\Omega V_0 t^2 + \frac{1}{6}\Omega g t^3$$

The time T at which the particle

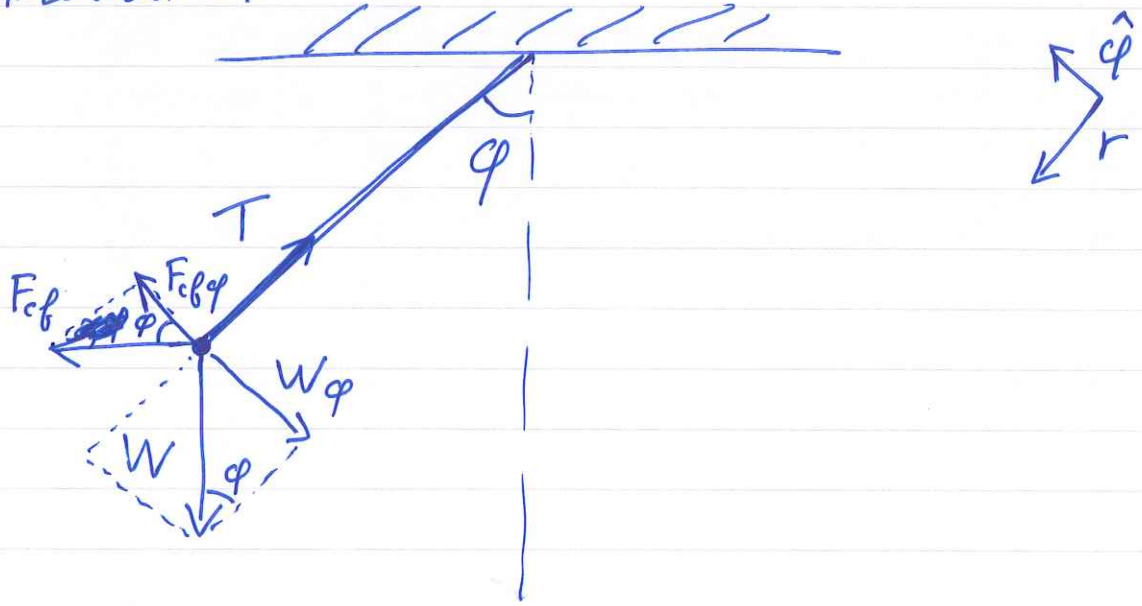
is given by $T = 2V_0/g$

$$\mathrm{Re}\,\Theta(T) = -\frac{1}{2}\Omega V_0^3/g^2 + \frac{1}{6}\Omega V_0^3/g^2$$

10 $$= -\frac{2}{3}\Omega\frac{V_0^3}{g^2}$$

$$\Longrightarrow d = \frac{2}{3}\Omega\frac{V_0^3}{g^2}$$

Problem 2.



20

$$F_{cf} = \left|-m\vec{\Omega}\times(\vec{\Omega}\times\vec{r})\right|$$

$$= m\Omega^2 l\sin\varphi$$

$$W = mg$$

$$\Longrightarrow F_\varphi = -mg\sin\varphi + m\Omega^2 l\sin\varphi\cos\varphi$$

$\Longrightarrow$ eq of motion

10 $$l\ddot{\varphi} = (-g + \Omega^2 l\cos\varphi)\sin\varphi$$