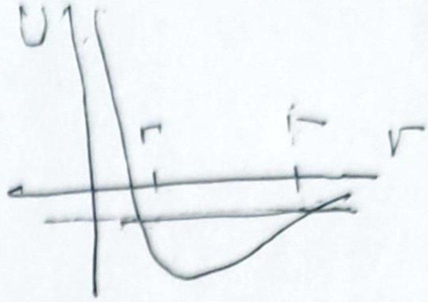
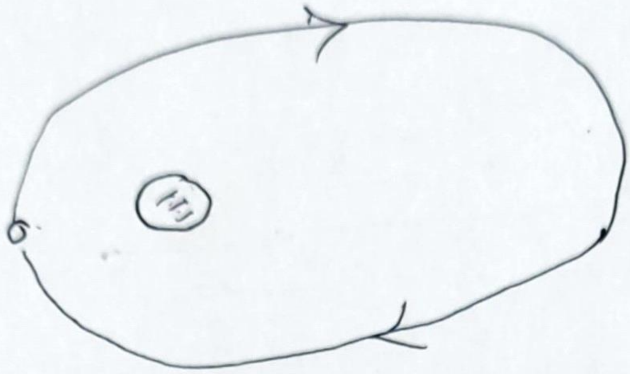
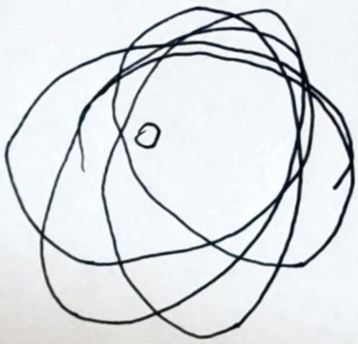
$$U = -\frac{\alpha}{r}$$





$$U = -\frac{\alpha}{r^{\beta}} \qquad \beta \neq 1$$

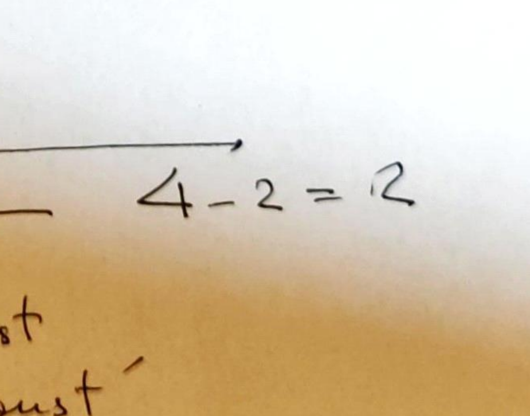


$- \quad 4-2=2$

$x,\ y,\ p_x,\ p_y$

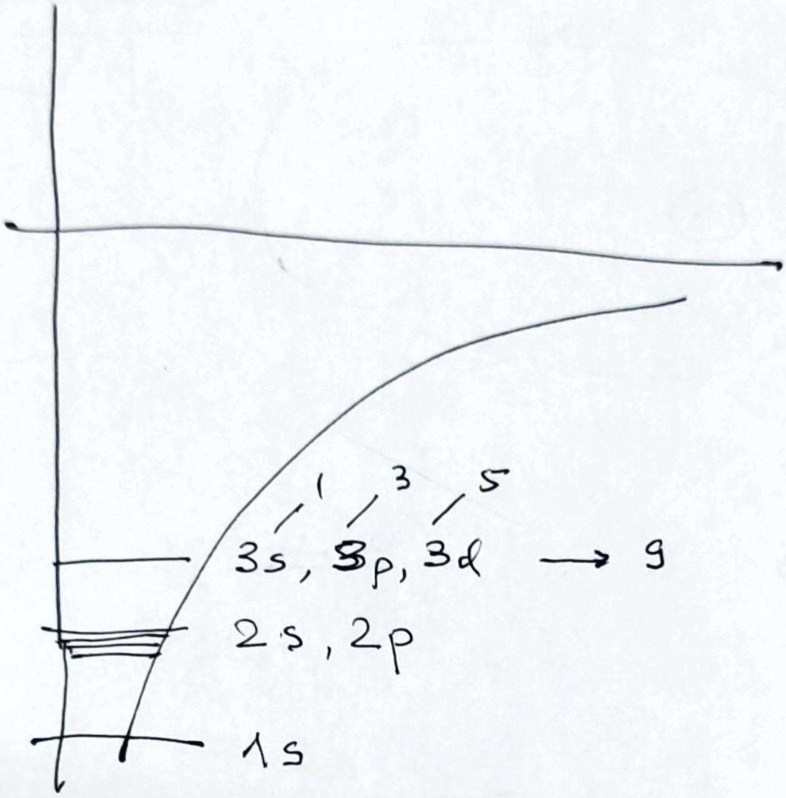
$$E = \frac{\vec{p}^{\,2}}{2m} - \frac{\alpha}{r} = \text{const}$$

$$L_z = p_x y - p_y x = \text{const}$$



$x(t),\ y(t)$

$p_x(t),\ p_y(t)$


1 3 5
3s, 3p, 3d → 9
2s, 2p
1s

$$H = \frac{\vec{p}^2}{2m} - \frac{\alpha}{r} = -|E| = -\frac{p_0^2}{2m}$$

$$\frac{\vec{p}^2 + p_0^2}{2m} = \frac{\alpha}{r} \rightarrow r = \frac{2m\alpha}{\vec{p}^2 + p_0^2}$$

$$L = \vec{p} \cdot \dot{\vec{r}} - H$$

$$S = \int dt\, L = \int \vec{p}\dot{\vec{r}}\, dt - \int H dt =$$

$$= \int \vec{p}\, d\vec{r} - Et$$

$$S = \tilde{S} - Et$$

$$dS = d\tilde{S} - E\,dt \qquad d\tilde{S} = \vec{p}\, d\vec{r}$$

$$d\tilde{S} = \vec{p}\, d\vec{r} + \vec{r}\, d\vec{p} - \vec{r}\, d\vec{p} =$$

$$= d(\vec{p} \cdot \vec{r}) - \vec{r}\, d\vec{p}$$

$$W = \tilde{S} - \vec{p}\vec{r} \qquad dW = -\vec{r}\, d\vec{p}$$

$$\vec{r} \cdot d\vec{p} = |\vec{r}|\, |d\vec{p}| \cos\gamma$$

$$\vec{p} = -\frac{\alpha \vec{r}}{r^3}$$

$$dW^2 = \vec{r}^2 (d\vec{p})^2 = \frac{(2m\alpha)^2}{(\vec{p}^2 + p_0^2)^2} [dp_x^2 + dp_y^2]$$

$$2\chi + \theta = \pi \qquad \chi = (\pi - \theta)/2 = \frac{\pi}{2} - \frac{\theta}{2}$$

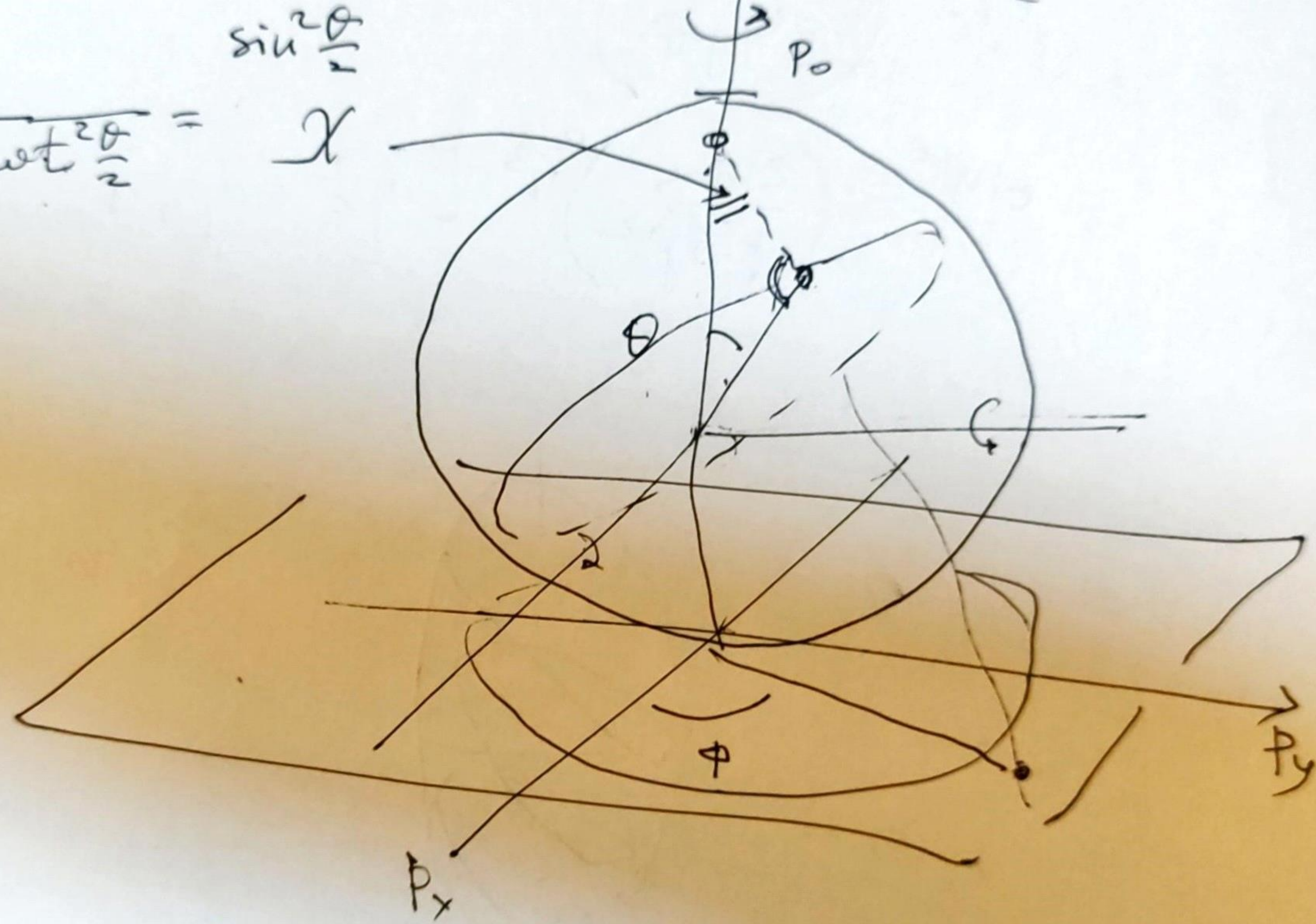
$$p_x = p_0 \tan\chi \cos\phi = p_0 \cot\frac{\theta}{2}\cos\phi \qquad \tan\chi = \tan\left(\frac{\pi}{2} - \frac{\theta}{2}\right)$$

$$p_y = p_0 \cot\frac{\theta}{2} \sin\phi \qquad = \cot\frac{\theta}{2}$$

$$\vec{p}^{\,2} + p_0^2 = p_0^2\left[1 + \cot^2\frac{\theta}{2}(\sin^2\phi + \cos^2\phi)\right] = p_0^2\left(1 + \cot^2\frac{\theta}{2}\right)$$

$$\sin^2\frac{\theta}{2}$$

$$\frac{1}{1 + \cot^2\frac{\theta}{2}} = \chi$$

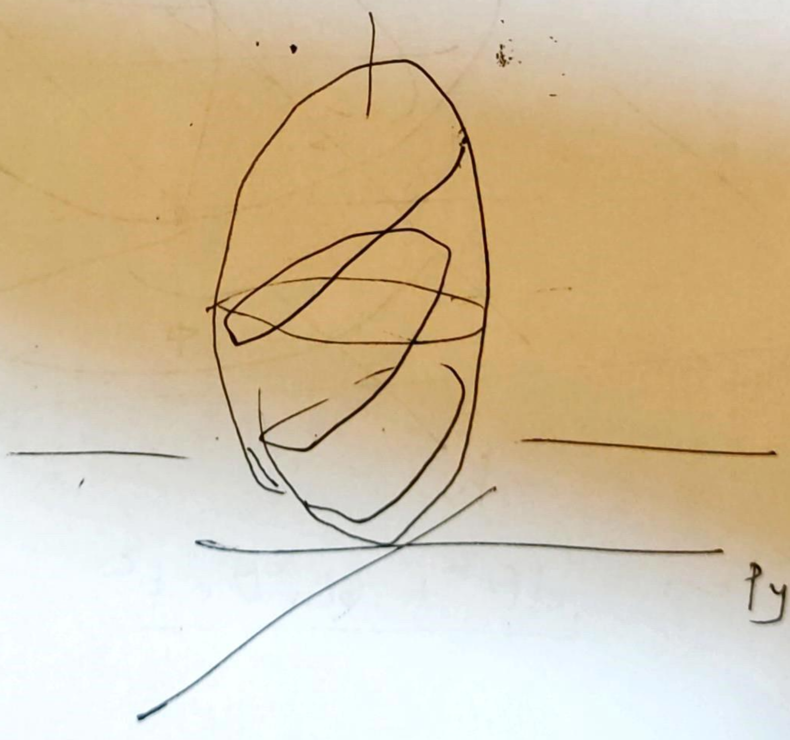


$$dW^2 \sim d\theta^2 + \sin^2\theta\, d\phi^2$$

$$U(r) = -\frac{\alpha}{r^\beta}$$

$$r = \left(\frac{2m\alpha}{p^2 + p_0^2}\right)^{\frac{1}{\beta}}$$

$$dW^2 = \left(\frac{2m\alpha}{p^2 + p_0^2}\right)^{2/\beta} \left[dp_x^2 + dp_y^2\right]$$



$E \neq 0$

$, \quad E > 0$

$$\frac{p^2}{2m} - \frac{\alpha}{r} = +\frac{p_0^2}{2m}$$

$$r = \frac{2m\alpha}{p^2 - p_0^2}$$

$$dW^2 = \frac{(2m\alpha)^2}{(p^2-p_0^2)^2}\left[dp_x^2 + dp_y^2\right]$$

$$\frac{1}{1+\cot^2} = \sin^2$$

$$\frac{1}{\coth^2 - 1}$$