

Exercises in Physics
Assignment # 5

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P1.

(a)

$$\left(x - \frac{3}{2}\right)^2 + y^2 = \frac{9}{4}$$

$$x^2 - 3x + \frac{9}{4} + y^2 = \frac{9}{4}$$

$$x^2 - 3x + y^2 = 0$$

$$R^2 - 3x = 0$$

$$R = \sqrt{3x}$$

$$R = \sqrt{3R\cos\theta}$$

(b)

$$\sqrt{(x^2 + y^2)^3} = 3(x^2 - y^2)$$

$$\sqrt{(R^2)^3} = 3(x^2 - y^2)$$

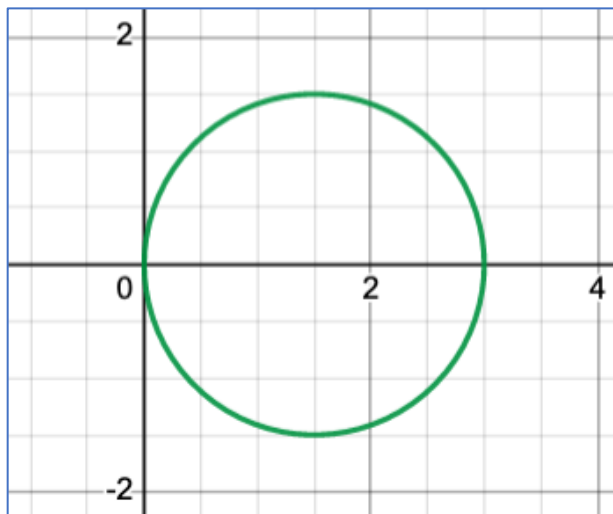
$$R^3 = \sqrt{3(x^2 - y^2)}$$

$$R = (3R^2 \cos^2 \theta - 3R^2 \sin^2 \theta)^{\frac{1}{6}}$$

P2.

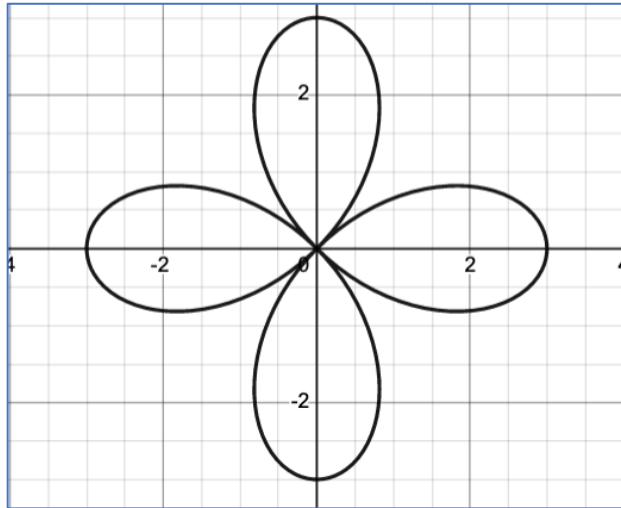
(a)

$$r = 3\cos\theta$$



(b)

$$r = 3\cos 2\theta$$



P3.

$$r = \frac{10}{\cos \theta} = 10 \sec \theta$$

$$\dot{r} = 10(\sec \theta \tan \theta) \dot{\theta}$$

$$\ddot{r} = 10(\sec \theta \tan^2 \theta) \cdot \dot{\theta}^2 + 10 \sec^3 \theta \cdot \dot{\theta}^2 + 10 \sec \theta \tan \theta \cdot \ddot{\theta}$$

$$\dot{\theta} = 0.02 \text{ rad/s} = \text{const}, \ddot{\theta} = 0$$

$$\theta = 60^\circ$$

$$r = \frac{10}{\cos 60} = 20$$

$$\dot{r} = 0.2(\sec 60 \tan 60) = \frac{2\sqrt{3}}{5}$$

$$\ddot{r} = 10(\sec 60 \tan^2 60) \cdot 0.02^2 + 10 \sec^3 60 \cdot 0.02^2 + 10 \sec 60 \tan 60 \cdot 0$$

$$\ddot{r} = 0.004(\sec 60 \tan^2 60 + \sec^3 60)$$

$$\ddot{r} = 0.004(\sqrt{2} + 504)$$

$$\ddot{r} = 2.022$$

$$v = \dot{r}e_r + r\dot{\theta}e_\theta$$

$$= \left(\frac{2\sqrt{3}}{5}e_r + 0.4e_\theta\right) \text{ km/s}$$

$$= \sqrt{\frac{2\sqrt{3}^2}{5} + 0.4^2}$$

$$= 0.8 \text{ km/s}$$

P4.