

問題 4

$$1) \quad x = r \cos \theta, \quad y = r \sin \theta$$

$$\frac{dx}{dt} = \frac{dr}{dt} \cos \theta - r \frac{d\theta}{dt} \sin \theta$$

$$= -v \cos \theta - r \omega \sin \theta$$

$$\frac{dy}{dt} = \frac{dr}{dt} \sin \theta + r \frac{d\theta}{dt} \cos \theta$$

$$= v \sin \theta + r \omega \cos \theta$$

$$\frac{d^2x}{dt^2} = -\frac{dv}{dt} \cos \theta + v \frac{d\theta}{dt} \sin \theta - \frac{dr}{dt} \omega \sin \theta - r \frac{d\omega}{dt} \sin \theta - r \omega \frac{d\theta}{dt} \cos \theta$$

$$= v \omega \sin \theta - v \omega \sin \theta - r \omega^2 \cos \theta = -r \omega^2 \cos \theta$$

$$\frac{d^2y}{dt^2} = -\frac{dv}{dt} \sin \theta - v \frac{d\theta}{dt} \cos \theta + \frac{dr}{dt} \omega \cos \theta + r \frac{d\omega}{dt} \cos \theta - r \omega \frac{d\theta}{dt} \sin \theta$$

$$= -v \omega \cos \theta + v \omega \cos \theta - r \omega^2 \sin \theta = -r \omega^2 \sin \theta$$

$$\begin{pmatrix} \frac{d^2x}{dt^2} \\ \frac{d^2y}{dt^2} \end{pmatrix} = \begin{pmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{pmatrix} \begin{pmatrix} \frac{d^2x}{dt^2} \\ \frac{d^2y}{dt^2} \end{pmatrix}$$

$$= \begin{pmatrix} -r \omega^2 \\ 0 \end{pmatrix}$$

2) i, j 軸方向の運動方程式は

$$m \frac{d^2i}{dt^2} = F_i, \quad m \frac{d^2j}{dt^2} = F_j \quad \therefore F_i = -m r \omega^2, \quad F_j = 0$$

よって、大きさ $m r \omega^2$, 円盤の中心方向