일반물리 Chapter. 11

15

$\vec{r} = 3m\hat{i} + 1m\hat{j}$

(a) $\vec{\tau} \times \vec{F} = (3m\hat{i} + 1m\hat{j}) \times (12N\hat{i})$

$= 36\,N\cdot m(\hat{i}\times\hat{i}) + 12\,N\cdot m(\hat{j}\times\hat{i})$

$= \underline{12\,N\cdot m(-\hat{k})}$

(b). $\vec{\tau} \times \vec{F} = (3m\hat{i} + 1m\hat{j}) \times (12N\hat{j})$

$= 36\,N\cdot m(\hat{i}\times\hat{j}) + 12\,N\cdot m(\hat{j}\times\hat{j})$

$= \underline{36\,N\cdot m\,\hat{k}}$

(c). $\vec{\tau} \times \vec{F} = (3m\hat{i} + 1m\hat{j}) \times 12N\hat{k}$

$= 36\,N\cdot m\,(\hat{i}\times\hat{k}) + 12\,N\cdot m(\hat{j}\times\hat{k})$

$= \underline{36\,N\cdot m\,(-\hat{j}) + 12\,N\cdot m\,\hat{i}}$

18.

(a). $\vec{L}=\int \vec{\tau}\,dt$, $\vec{\tau}=\vec{r}\times\vec{F}$, $\vec{F}=m\vec{a}$

$(kg)(m/s^2)(m)(s)=$ $\boxed{kg\cdot m^2/s}$

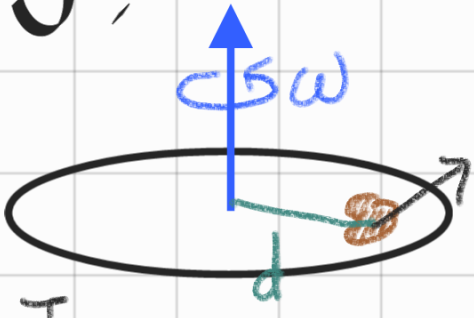
(b).

$(N)(m)(s)=$ $\boxed{N\cdot m\cdot s}$

(c).

$(J)(s)=$ $\boxed{J\cdot s}$

55.



$v=r\omega$

$\vec{L}=I\vec{\omega}$ (보존되는 양)

I

처음 각속력을 ω_i, 나중 각속력을 ω_f

(a) $I_{tot}=I+md^2$

$\vec{L}=I_{tot}\vec{\omega}=(I+md^2)\omega_i=(I+md^2)\omega_f$

$=I\omega+mvd=(I+md^2)\omega_f$

$$mvd = I(\omega_f - \omega) + md^2\omega_f$$

$$v = \frac{I}{mv}(\omega_f - \omega) + d\omega_f$$

$$v = \frac{I}{md} \cdot -\frac{1}{2}\omega + d\frac{1}{2}\omega$$

$$\therefore v = \frac{1}{2}\omega\left(d - \frac{I}{md}\right)$$

(b). $$v = \frac{I}{md} \cdot 0 + d\omega$$

$$\therefore v = d\omega$$

(c). $$v = \frac{-}{md}\omega + 2d\omega$$

$$\therefore v = 2\omega\left(1 + \frac{I}{2md}\right)$$

58. $\vec{L}=I\vec{\omega}$, 원판의 $I=\frac{1}{2}MR^2$

$L_i=\frac{1}{2}MR^2\omega_i$, $L_f=\frac{1}{2}(MR^2+mr^2)\omega_f$

$L=\frac{1}{2}MR^2\omega_i=\frac{1}{2}(MR^2+mr^2)\omega_f$

$\frac{1}{2}(440g)(3.5cm)^2(180rpm)$

$=\frac{1}{2}\{(440g)(3.5cm)^2+(270g)(2.2cm)^2\}\omega_f$

$\therefore \omega_f=$ 약 142.3 rpm (a)

회전 운동에너지 : $KE=\frac{1}{2}I\omega^2=\frac{1}{2}\frac{L^2}{I}$

$\frac{KE_i-KE_f}{KE_i}$ (잃어버린 회전 KE의 비율)

$=1-\frac{KE_f}{KE_i}=1-\left(\frac{\frac{1}{2}\frac{L_f}{I_f}}{\frac{1}{2}\frac{L_i}{I_i}}\right)=1-\frac{L_fI_i}{L_iI_f}$

$L_i=L_f$ 이므로

$1-\frac{I_i}{I_f}=$ 약 $0.21 \Rightarrow$ 약 21% (b)

59.

$I_{sphere} = \frac{2}{5}MR^2$, $\tau = -\mu_k MgR$ (구의 회전을 방해)

$\tau = I\alpha = -\mu_k MgR \rightarrow \alpha = \frac{-\mu_k MgR}{\frac{2}{5}MR^2} = -\frac{5}{2}\frac{\mu_k g}{R}$

(a). $\omega = \omega_0 + \alpha t$ 에 대입. $\omega = \omega_0 - \frac{5}{2}\frac{\mu_k g}{R}t$

$v = v_0 + at$ 를 이용하여 t를 구하자.

f(마찰력) $= \mu_k Mg = Ma \rightarrow a = \mu_k g$

⇒ 병진운동은 가속하지만, 회전운동은 방해

$v = v_0 + \mu_k g t$, $\omega = \omega_0 - \frac{5}{2}\frac{\mu_k g}{R}t$

초기 속력 $v_0 = 0$ 이므로, $v = \mu_k g t$. $\Rightarrow t = \frac{v}{\mu_k g}$

$\omega = \omega_0 - \frac{5}{2}\frac{\mu_k g}{R}\cdot\frac{v}{\mu_k g}$, 그리고 $v = R\omega$.

$\omega = \omega_0 - \frac{5}{2}\omega \Rightarrow \boxed{\omega = \frac{2}{7}\omega_0}$

(b). $t = \frac{v}{\mu_k g} = \frac{\omega R}{\mu_k g} = \boxed{\frac{2}{7}\frac{R\omega_0}{\mu_k g}}$