11. $m=10kg$ $R=0.3m$.

(a)

$F-f=ma$ 代入∴ $f=10-10\times0.6=4N$.

(b). $T=I\cdot\alpha=f\cdot R$

而 $\alpha=\frac{a}{R}$ 代入∴ $I=\frac{fR^2}{a}=\frac{4\times0.09}{0.6}=0.6kg\cdot m^2$.

12. (a). 能量守恒.

$mg(h-2R)=\frac{1}{2}mv^2+\frac{1}{2}I\omega^2$

又有 $mg=m\frac{v^2}{R}$.

代入∴ ~~$mg(h-2R)=\frac{1}{2}mgR$~~

~~∴ $h=\frac{5}{2}R=\frac{5}{2}\times12=30cm$.~~

代入∴ $h=0.324m$

(b). $h=6R$ Q点有能动能定理

(c) $\frac{1}{2}I\omega^2$ $\frac{1}{2}mv_Q^2-0=mg(h-R)=5mgR$.

~~∴ $v_Q^2=10gR$.~~

合外力 $F=m\frac{v^2}{R}=$ ~~$\frac{10\times9.8\times0.12}{0.12}$~~ $=$ ~~$3.2\times10^{-3}\times9.8$~~

方向向左.

~~$=3.136\times10^{-2}N$.~~

$\approx$ $1.346\times10^{-2}N$.

5:

(a) $v_1=-0.11\omega$.

(b) 滑动时 $ma=f_K=\mu mg$. $a=-2.058m/s^2$

(c) $T=I\cdot\alpha$. $I=\frac{2}{5}mR^2$

$T=f\cdot R$ 代入∴ $\alpha=-46.8\ rad\cdot s^{-2}$

(d) 有 $v_0+at=\alpha\cdot t\cdot R$.

代入∴ $t=1.18s$

(e). $d=v_0t+\frac{1}{2}at^2$ $d=8.6m$.

(f). 开始时 $v=v_0-at=6.07m/s$.

23.

(a) $\vec{\tau} = \vec{r} \times \vec{F}$

$= (-k - 1.5\hat{i} - 4\hat{j})\ N\cdot m.$

~~$\vec{\tau} = \vec{F} \times \vec{r}$~~

~~$= (2i - 3k) \times (0.5j - 2k)$~~

~~$= 1 - 4 - 15 = -45\ kg\cdot m^2$~~

(b). $\vec{r'} = (0.5\hat{j} - 2\hat{k}) - (2\hat{i} - 3\hat{k}) = -2i + 0.5\hat{j} + \hat{k}$

代入: $\vec{\tau} = \vec{r'} \cdot \vec{F} = (-1.5i - 4\hat{j} - \hat{k})\ N\cdot m$

31.

(a) 最高点时 $h = \frac{v^2}{2g} = \frac{1600}{2 \times 9.8} = \frac{800}{9.8}\ m. \approx 81.63m$

$\vec{\tau} = \vec{r} \times \vec{p} = 81.63 \times 0 \times \sin\theta = 0.$

(b). $\vec{L} = \vec{r} \times \vec{p} = m(\vec{r} \times \vec{v}) = 0.4 \times (\sqrt{(\frac{81.63}{2})^2 + 4} \times \sqrt{800} \times \sin\theta)$

$= 16\sqrt{2} \approx 22.6\ kg\cdot m^2\cdot s^{-1}.$

方向向里

(c). $\vec{\tau} = \vec{r} \times \vec{F} = \sqrt{4 + (81.63)^2} \times mg \times \frac{2}{\sqrt{\cdots}} = 2mg = 7.84\ kg\cdot m^2 s^{-2}$

(方向向里)

(d). $\vec{\tau} = \vec{r} \times \vec{F} = 2mg = 7.84\ kg\cdot m^2 s^{-2}.$

39.

(a). $\vec{\tau} = I\vec{\alpha} = \vec{r} \times \vec{F}$ $\quad \tau_{ave} = \frac{\Delta L}{\Delta t} = -1.47\ N\cdot m.$

$\vec{L} = \vec{r} \times \vec{p} = m(\vec{r} \times \vec{v}).$

(b) 恒定 α. $\quad I\cdot w_0 = L_1. \quad \tau = I\cdot\alpha.$

$\theta = w_0 t + \frac{\alpha}{2} t^2$ 代入 $\theta = 20.4\ rad.$

(c) $|W| = \frac{1}{2} I (\ \ ) \Delta w$. $w_1 = \frac{L_1}{I}$ $w_2 = \frac{L_2}{I}$

代入 $W = -29.86\ J.$

(d)

$P = \frac{|W|}{T} = 19.9\ w$

58. 能量守恒. 有 $I_1 = 590 kg m^2$ $I_2 = 365 kg \cdot m^2$

$$\frac{1}{2} m \cdot (\omega \cdot R)^2 + \frac{1}{2} I_1 \omega^2 = \frac{1}{2} m (\omega' \cdot \underset{0.5}{R})^2 + \frac{1}{2} I_2 \omega'^2.$$

$$代入 \cdot 30kg + \frac{1}{2} \times 590 \times 2.25 = \frac{1}{2}\, 30 \times \omega'^2 \times 0.25 + \frac{1}{2} \times 365 \times \omega'^2.$$

$$\omega' \approx \cancel{9 \, rad \cdot s^{-1}} \; 2.21 \, rad \cdot s^{-1}.$$

角动量守恒

$I \omega_f = I_r \omega_i$ 代入: $\omega' = \underbrace{2.43 \, rad \, s^{-1}}$.

61. $I' = I + ml^2 = 0.12 + 0.2 \times 0.36 = 0.192 \, kg \cdot m^2.$

$$I' \cdot \omega' = I \cdot \omega = 0.288 \, kg \, m^2 \cdot s^{-1}$$

代入: $\omega' = 1.5 \, rad \cdot s^{-1}$

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