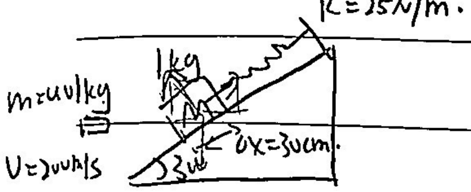
140.3-17



$$\frac{1}{2}Mv_1^2 - 0 = Mgx\sin\theta - \frac{1}{2}kx^2$$

$\Rightarrow v_1 = \frac{\sqrt{3}}{2}$ m/s，方向 ↙

$\cancel{M\vec{v_1} + m\vec{v} = (M+m)v}$ $M\vec{g}, m\vec{g}, \vec{F}_T$ 远小于内力,忽略.

$$(M+m)\vec{v}' - M\vec{v_1} - m\vec{v} = \int(M\vec{g} + m\vec{g} + \vec{F}_T + \vec{N})dt$$

水平上. $(M+m)v'\cdot\cos\theta + Mv_1\cos\theta - m\cdot v = -\int \vec{N}\cdot\sin\theta\, dt$.

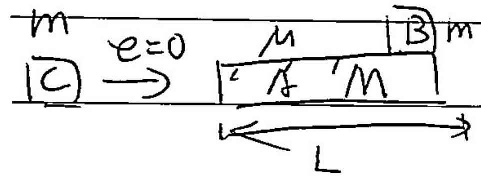
竖直上. $(M+m)v'\cdot\sin\theta + Mv_1\sin\theta = \int N\cdot\cos\theta\, dt$.

∴ $v' = \frac{\sqrt{3}}{2.02}$ m/s，方向 30°

≈ 0.857 m/s

140.3-19

B正好脱离.



光滑.

正好脱离 ∴ 共速时B在A左端

$mv_0 = (m+M)v_1 \Rightarrow v_1 = \frac{m}{m+M}v_0$ B还没动.

$mv_0 = (2m+M)v_2 \Rightarrow v_2 = \frac{m}{2m+M}v_0$ 共速(ABC).

∴ $\frac{1}{2}(2m+M)v_2^2 - \cancel{\frac{1}{2}mv_0^2}\ \frac{1}{2}(m+M)v_1^2 = -mg\mu L$

$\Rightarrow v_0 = \sqrt{\frac{2g\mu L(2m+M)(M+m)}{m}}$

3-25 (141)

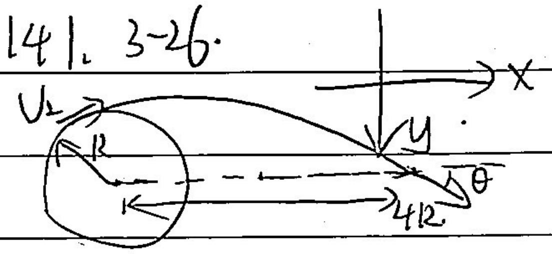
m, $\vec{r} = a\cos(\omega t)\vec{i} + b\sin(\omega t)\vec{j}$

$\vec{v} = \frac{d\vec{r}}{dt} = -a\omega\sin\omega t\,\vec{i} + b\omega\cos\omega t\,\vec{j}$

$\vec{a} = \frac{d\vec{v}}{dt} = -a\omega^2\cos\omega t\,\vec{i} - b\omega^2\sin\omega t\,\vec{j}$

$\therefore \vec{F} = m\vec{a}$, $\vec{M} = \vec{r}\times\vec{F} = 0$ $\vec{L} = \vec{r}\times m\vec{v} = abm\omega\vec{k}$

141, 3-26.



$\frac{1}{2}mv^2 - \frac{GMm}{4R} = \frac{1}{2}mv_2^2 - \frac{GMm}{R}$

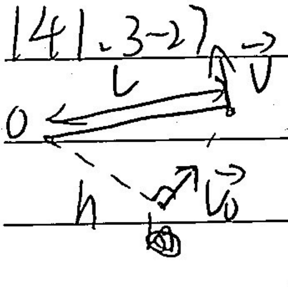
$\Rightarrow |v| = \frac{\sqrt{2}}{2}\sqrt{gR} = \frac{1}{2}v_2$

$\vec{R}\times m\vec{v_2} = 4\vec{R}\times m\vec{v}$

$\Rightarrow$ $mRv_2 = 4Rm\frac{1}{2}v_2\sin\theta \Rightarrow \theta = 30^\circ$.

$\therefore$ $v = \frac{\sqrt{2}}{4}\sqrt{gR}\,\vec{i} + \frac{\sqrt{2}}{4}\sqrt{gR}\,\vec{j}$

141, 3-27



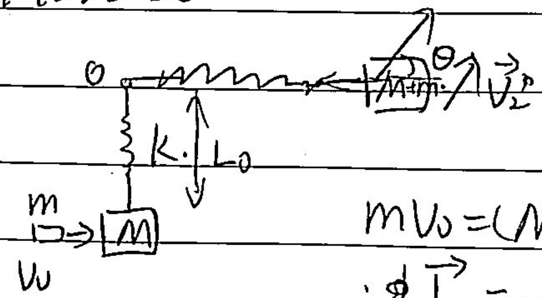
在竖直方向上角动量守恒.

$\vec{r_1}\times m\vec{v_0} = \vec{r_2}\times m\vec{v}$

$\Rightarrow$ $hmv_0 = lmv \Rightarrow v = \frac{h}{l}v_0 \Rightarrow \frac{v}{v_0} = \frac{h}{l}$

$\therefore$ $E_k/E_{k0} = v^2/v_0^2 = h^2/l^2$

142, 3-28.



竖直方向上角动量守恒.

$$mv_0=(M+m)v_1 \Rightarrow v_1=\frac{m}{M+m}v_0.$$

$$\therefore \vec{L} = -L_0\cdot(m+M)v_1\cdot\vec{k}$$
$$= -\vec{k}\,(\cancel{v_1}\, mv_0L_0).$$

$$\frac{1}{2}(M+m)v_2^2-\frac{1}{2}(M+m)v_1^2=-\frac{1}{2}k(L-l_0)^2.$$

$$\Rightarrow v_2=\sqrt{\frac{(M+m)v_1^2-k(L-L_0)^2}{M+m}}=\sqrt{v_1^2-\frac{k(L-L_0)^2}{M+m}}=\sqrt{\frac{m^2v_0^2}{(M+m)^2}-\frac{k(L-L_0)^2}{m+M}}$$

$$\cancel{L_0\cdot mv_0 = L\cdot mv_2\cdot\sin\theta \Rightarrow \sin\theta=\frac{L_0v_0}{Lv_2}}$$

$$\cancel{\theta=\arcsin\frac{L_0v_0}{Lv_2}+\pi}$$

$$L_0(m+M)v_1 = L\cdot(M+m)v_2\sin\theta \Rightarrow \sin\theta=\frac{L_0mv_0}{L(M+m)v_2}$$

$\therefore \theta=\pi-\arcsin\dfrac{L_0mv_0}{L(m+M)v_2}$ 其中 $v_2=---$