3-16 (1) $W=\Delta E_k$

$f\cdot 2\pi r=-\frac{1}{2}mV_0^2+\frac{1}{2}\cdot m(\frac{1}{2}V_0)^2$

$W_f=-\frac{3}{8}mV_0^2$

(2) 设摩擦因数为μ.

$W_f=f\cdot s=\mu mg\cdot 2\pi r=\frac{3}{8}mV_0^2$

$\mu=\frac{3V_0^2}{16\pi rg}$

(3) 设n圈

$W=\Delta E=\frac{1}{2}mV_0^2=n\cdot\frac{3}{8}mV_0^2$

$n=\frac{4}{3}$

3-18 (1) $F=G\frac{Mm}{r^2}=mV^2/r$

$G\frac{mm_E}{(2R)^2}=\frac{m\cdot V^2}{2R}$

$V^2=\frac{Gm_E}{2R}$

$E_k=\frac{1}{2}mV^2=\frac{Gmm_E}{4R}$

(2) $E_p=-\frac{Gmm_E}{2R}$

(3) $E=E_k+E_p$

$=-\frac{Gmm_E}{4R}$

3-23 (1) $\Delta E_k=\frac{1}{2}mV^2-\frac{1}{2}mV_0^2$

$=-75J$

$E_{k木}<75$

$\frac{1}{2}mV^2<75$

$V^2<1875<2500$

∴子弹能穿出

(2)

3-25 (1) $E_0=E'$

$mgh=\frac{1}{2}kx^2$

$10\cdot 10\cdot h=\frac{1}{2}\cdot 100\cdot 4$

$h=2\ m$

$\therefore S=\frac{h}{\sin 30^\circ}=4m$

(2) $E_0=E_{碰}$.

$mgh=mgh'+\frac{1}{2}mv^2$

$10\cdot 10\cdot 2=10\cdot 10\cdot 1+\frac{1}{2}\cdot 10\cdot V^2$

$V^2=20$

$V\approx 4.47\ m/s$

3-26 (1) 设原高度为零势能面, F压下X_1m, 跳起时高X_2m.

压时: $F+m_1g=kX_1$

$X_1=\frac{F+m_1g}{k}$

跳起时: $m_2g=kX_2$

$X_2=\frac{m_2g}{k}$

由机械能守恒.

$\frac{1}{2}kX_1^2-m_1gX_1=\frac{1}{2}kX_2^2+m_1gX_2$

$F=(m_1+m_2)g$

(2) 不变化

3-27. (1). 动量守恒.

$m_B V_B = m_B V_B' + m_A V_A$

$1 \cdot 4 = 1 \cdot (-2) + 10 \cdot V_A$

$V_A = 0.6 m/s$

A与弹簧系统能量守恒.

$E_0 = E'$

$\frac{1}{2} m_A V_A^2 = \frac{1}{2} k x^2$

$\frac{1}{2} \cdot 10 \cdot 0.6^2 = \frac{1}{2} \cdot 1000 \cdot x^2$

$x = 0.06 m$

(2) $e = \frac{V_2' - V_1'}{V_1 - V_2} = \frac{0.6+2}{4-0} = 0.65$ ∴非完全弹性碰撞.

(3). (1) 动量守恒.

$m_B V_B = (m_A + m_B) V'$

$1 \cdot 4 = (10+1) V'$

$V' = \frac{4}{11} m/s$

机械能守恒

$E_k = E_p$

$\frac{1}{2} \cdot 11 \cdot (\frac{4}{11})^2 = \frac{1}{2} \cdot 1000 \cdot x^2$

$x \approx 0.038 m$

(2) $e = 0$.

完全非弹性碰撞.

3-28. 设子弹刚进入A时速度为V'

子弹与A动量守恒

$m V_0 = (m+M) V'$

$V' = \frac{m V_0}{m+M}$

B弹簧压缩, B开始运动, 当$V_B = V_A = V$时, 弹簧的压缩距离max

动量守恒: $m V_0 = (2M+m) V_A$

$V = \frac{m V_0}{2M+m}$

机械能守恒 $E_k = E_p + E_k'$

$\frac{1}{2}(m+M)(\frac{m V_0}{m+M})^2 = \frac{1}{2}(2M+m)(\frac{m V_0}{2M+m})^2 + \frac{1}{2} k x^2$

化简 $x = \sqrt{\frac{(m+M)(\frac{m V_0}{m+M})^2 - (2M+m)(\frac{m V_0}{2M+m})^2}{k}}$

3-30  $\cos\theta = \frac{2\sqrt{2}}{3}$. 设小球质量m, 大球4m, 大球速度为$V_1$, 小球速度$V_2$

动量守恒. $4m \cdot V_0 = 4m V_1 + 2 \cdot m \cdot V_2 \cos\theta$ ①

动能守恒 $\frac{1}{2} 4m V_0^2 = \frac{1}{2} 4m V_1^2 + 2 \cdot \frac{1}{2} m V_2^2$ ②

由① $V_2 = \frac{2V_0 - 2V_1}{\cos\theta}$ 代入②

$2V_0^2 = 2V_1^2 + (\frac{2V_0 - 2V_1}{\cos\theta})^2$

$V_0 + V_1 = \frac{2(V_0 - V_1)}{\cos\theta^2}$

$V_1 = \frac{(4 - 2\cos^2\theta) V_0}{2\cos^2\theta + 4} = \frac{5}{13} V_0$

A+

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