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9-5 C

9-11

(1) 系统平衡时，有 $\begin{cases} mg\sin\theta = k_2 x_2 \\ k_1 x_1 = k_2 x_2 \end{cases}$

记物体沿~~支~~斜面移动位移为 X，弹簧伸长量分别为 ~~k_1、k_2~~ x_1'，x_2'

有 $X = x_1 + x_2$

$F = mg\sin\theta - k_2(x_2 + x_2')$

$k_1(x_1 + x_1') = k_2(x_2 + x_2')$

$\therefore F = -\dfrac{k_1 \cdot k_2}{k_1 + k_2} \cdot X$

$\because -\dfrac{k_1 \cdot k_2}{k_1 + k_2}$ 是常数

$\therefore$ 物体的运动是简谐振动.

(2) $\omega = \sqrt{\dfrac{k}{m}} = \sqrt{\dfrac{k_1 k_2}{m(k_1+k_2)}}$

$\nu = \dfrac{\omega}{2\pi}$

$\therefore$ 振动频率 $\nu = \dfrac{1}{2\pi}\sqrt{\dfrac{k_1 k_2}{m(k_1+k_2)}}$

9-17 由旋转矢量图可知 $\Delta t = \dfrac{\Delta\varphi}{2\pi} T$

(1)

$\Delta\varphi = \dfrac{\pi}{2}$

$\therefore \Delta t = \dfrac{T}{4}$

(2)

$\Delta\varphi = \dfrac{\pi}{6}$

$\therefore \Delta t = \dfrac{T}{12}$

(3)

$\Delta\varphi = \dfrac{\pi}{3}$

$\therefore \Delta t = \dfrac{T}{6}$

9-24

(1) 由 $\begin{cases} T = \dfrac{2\pi}{\omega} \\ \omega = \sqrt{\dfrac{k}{m}} \end{cases}$ 得 $T = 2\pi\sqrt{\dfrac{m}{k}}$

$\therefore$ 空盘 $T_1 = 2\pi\sqrt{\dfrac{m_1}{k}}$，此时 $T_2 = 2\pi\sqrt{\dfrac{m_1+m_2}{k}} > T_1$

(2) 自由落体 $v = \sqrt{2gh}$

动量守恒 $m_2 v = (m_1+m_2)v_0$

初位移 $x_0 = \dfrac{m_1 g}{k} - \dfrac{m_1 g + m_2 g}{k}$

$A = \sqrt{x_0^2 + \dfrac{v_0^2}{\omega'^2}}$

$\omega' = \sqrt{\dfrac{k}{m_1+m_2}}$

$\therefore$ 此时振幅 $A = \dfrac{m_2 g}{k}\sqrt{1 + \dfrac{2kh}{(m_1+m_2)g}}$

9-1 B

9-2 D

9-3 B

9-4 C

9-5 C

9-6 D

9-13

(1) 由机械能守恒有 $E_k + E_k' = \frac{1}{2}kx^2$。

$E_k = \frac{1}{2}mv^2$

$E_k' = \frac{1}{2}J\omega^2$

$\omega R = v$

$J = \frac{1}{2}mR^2$

∴ 平动动能 $E_k = 0.04J$，转动动能 $E_k' = 0.02J$。

(2) 记质心加速度为 a，角加速度为 α'，~~滚动~~滚动摩擦力为 F_f

有 $F - F_f = ma$

$a = \alpha' R$

$F_f R = J\alpha'$

$J = \frac{1}{2}mR^2$

∴ $-kx = \frac{3}{2}ma$，即系统作简谐振动。

∵ $a = -\omega^2 x$

∴ $\omega = \sqrt{\frac{2k}{3m}}$

9-15

(1) 振子平衡时，有 $k \cdot \Delta l = mg$

$\omega = \sqrt{\frac{k}{m}}$

∴ $\omega = 10s^{-1}$

$A_1 = \sqrt{x_0^2 + (\frac{v_0}{\omega})^2} = 8.0 \times 10^{-2} m$

$\varphi_1 = \pi$

∴ $x_1 = 8.0 \times 10^{-2} \times \cos(10t + \pi)$ (m)

(2) $A_2 = \sqrt{x_0'^2 + (\frac{v_0'}{\omega})^2} = 6 \times 10^{-2} m$

$\varphi_2 = \frac{\pi}{2}$

∴ $x_2 = 6 \times 10^{-2} \times \cos(10t + \frac{\pi}{2})$ (m)

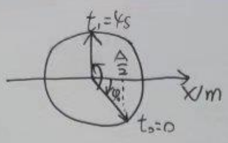
9-16

(1) $A=0.1m$

$\varphi_0=-\frac{\pi}{3}$

$\omega(t_1-t_0)=\frac{\pi}{2}-(-\frac{\pi}{3})$

$\omega=\frac{5\pi}{24}s^{-1}$



∴运动方程为 $x=0.1\cos(\frac{5\pi}{24}t-\frac{\pi}{3})$ (m)。

(2) 点P对应最大位移处，相位 $\varphi_P=0$。

(3) $\omega(t_P-t_0)=\frac{\pi}{3}$

∴ $t_P=1.6s$，即到达P点所需时间为1.6s。

9-19 由题可得 $\mu_s mg \geq mA\omega^2$

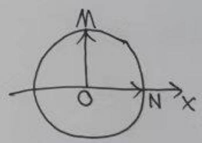
∴ $\mu_s \geq 0.03$

9-20

由题画出旋转矢量图，

OM表示第一个质点振动的，

ON表示第二个质点振动的。



∴ $\varphi_1-\varphi_2=\frac{\pi}{2}$

∴ $x_2=A\cos(\omega t+\varphi-\frac{\pi}{2})$

$\Delta\varphi=\frac{\pi}{2}$

9-27

记 $x=A\cos(\omega t+\varphi)$

$\omega=\sqrt{\frac{k}{(m_1+m_2)}}=40\ s^{-1}$

动量守恒有 $m_1 v=(m_1+m_2)v_0$

$v_0=1\ m/s$

$x_0=0$

$A=\sqrt{x_0^2+\frac{v_0^2}{\omega^2}}=2.5\times10^{-2}\ m$

∵ $\cos\varphi=0$

∴ $\varphi=\frac{\pi}{2}$ 或 $\varphi=\frac{3\pi}{2}$

$v_0=-A\omega\sin\varphi<0$

∴ $\sin\varphi>0$ 即 $\varphi=\frac{\pi}{2}$

∴ $x=2.5\times10^{-2}\times\cos(40t+0.5\pi)$ (m)

9-34

(1) 由题可得 $\varphi_2-\varphi_1=2k\pi \quad (k=0,\pm1,\pm2,\cdots)$

$\therefore \varphi_2=\varphi_1+2k\pi \quad (k=0,\pm1,\pm2,\cdots)$

同下拉A位移后同时释放。

(2) 由题可得 $\varphi_2-\varphi_1=(2k-1)\pi \quad (k=0,\pm1,\pm2,\cdots)$

$\therefore \varphi_2=\varphi_1+(2k-1)\pi \quad (k=0,\pm1,\pm2,\cdots)$

一个上压-A处释放，一个下拉A处释放。