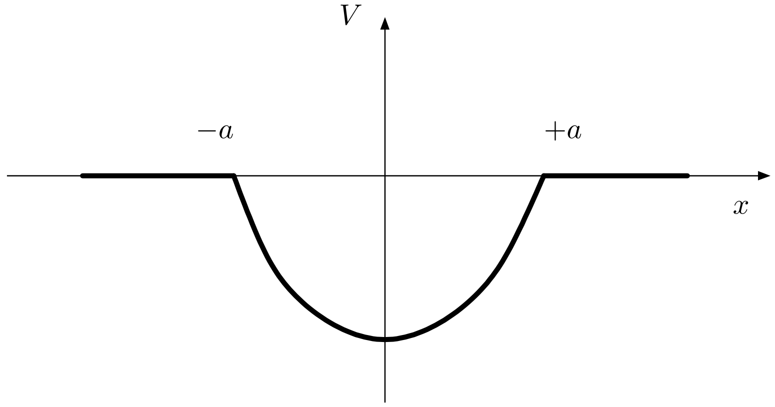
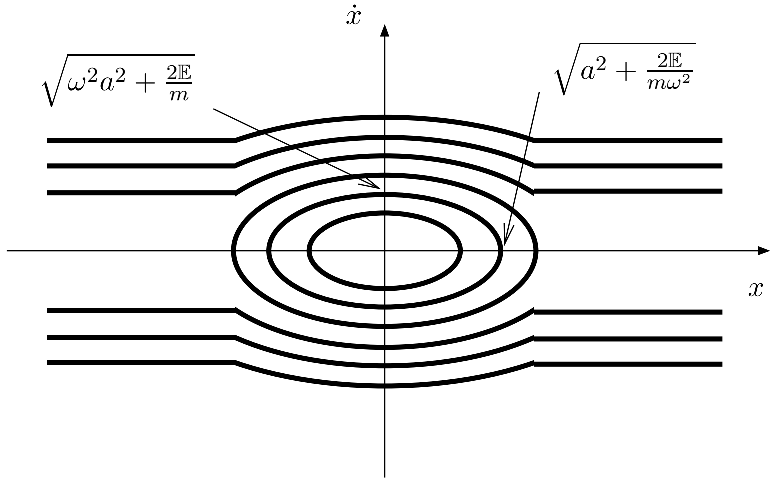
Dynamics and Stability AE3-914

Answers to recommended exercises—Week 1

1.112 (a)



(b)



(c) $x = \frac{v_0}{\omega}\sin\omega t - a\cos\omega t$ as long as $-a < x < a$. With which velocity will the particle reach $x = a$? What will happen then?

1.147

$$\mathbf{v}_p = a_0 t\mathbf{i} - \frac{\Omega d}{2}\sin\Omega t\mathbf{j} + \frac{\Omega d}{2}\cos\Omega t\mathbf{k} \quad \mathbf{a}_p = a_0\mathbf{i} - \frac{\Omega^2 d}{2}\cos\Omega t\mathbf{j} - \frac{\Omega^2 d}{2}\sin\Omega t\mathbf{k}$$

with $\Omega = \dfrac{\pi n}{30}$.

1.158 $d = \frac{2}{3}h\Omega\cos\phi\sqrt{\frac{2h}{g}}$ with $h = 1\,609\,\mathrm{m}$, $\Omega = \frac{2\pi}{24\cdot 60\cdot 60}\,\mathrm{s}^{-1}$, $\phi = 40^\circ$ and $g = 10\,\mathrm{m/s}^2$

Hint: Notice that the absolute acceleration is $\mathbf{a} = -g\mathbf{k}$ and that only the Coriolis term does not involve Ω^2.

1.169 *Hint:* Notice that the absolute acceleration is $\mathbf{a} = -g\mathbf{k}$ and that only the Coriolis term does not involve ω^2. Remove systematically any other terms in ω^2 which might appear.

1.190 $\mathbf{a}_p = [-\ddot{\theta} + \Omega\sin\theta(-\Omega\cos\theta - 6\Omega\sin\theta) - 6\dot{\theta}^2]\mathbf{i}$
$+ [6\ddot{\theta} - \dot{\theta}^2 + \Omega\cos\theta(-\Omega\cos\theta - 6\Omega\sin\theta)]\mathbf{j} + [-6\Omega\dot{\theta}\cos\theta + \Omega\dot{\theta}\sin\theta]\mathbf{k}$

1.207 $P = 2W\cos\theta$

Hint: The distance between ring and pulley can be expressed in terms of θ by the rule of sines and its virtual change is the opposite of the virtual displacement of P.

4.14(b)

$$T = \frac{1}{8}m(a^2 + 6l^2)\Omega^2$$

4.40

$$\Omega = \frac{\omega\sqrt{a^2+h^2}}{a} \qquad \mathbf{v}_A = -\frac{2\omega h^2}{\sqrt{a^2+h^2}}\mathbf{i}$$

4.41

$$T = \frac{1}{4}Mr^2\omega_1^2 + \frac{1}{8}Mr^2\omega_2^2 + \left(\frac{1}{8}Mr^2 + \frac{1}{2}Ml^2\right)\omega_3^2$$

Of course there are thousand ways of grouping terms. This one is explicit in the angular velocities.