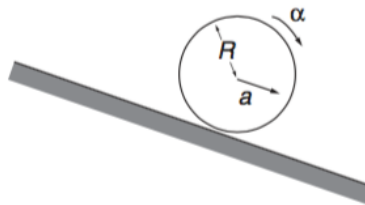


1. {17,19,21,24,25,27}

**1.17**

A drum of radius  $R$  rolls down a slope without slipping. Its axis has acceleration  $a$  parallel to the slope. What is the drum's angular acceleration  $\alpha$ ?

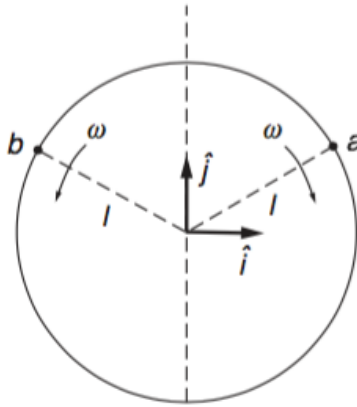


■

**1.19**

By relative velocity we mean velocity with respect to a specified coordinate system. (The term velocity, alone, is understood to be relative to the observers coordinate system.)

- (a) A point is observed to have velocity  $v_A$  relative to coordinate system  $A$ . What is its velocity relative to coordinate system  $B$ , which is displaced from system  $A$  by distance  $\mathbf{R}$ ? ( $\mathbf{R}$  can change in time.)
- (b) Particles  $a$  and  $b$  move in opposite directions around a circle with angular speed  $\omega$ , as shown. At  $t = 0$  they are both at the point  $r = l\hat{j}$ , where  $l$  is the radius of the circle. Find the velocity of  $a$  relative to  $b$ .



■

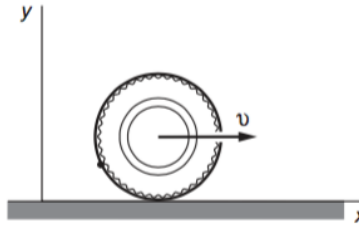
**1.21**

A particle moves in a plane with constant radial velocity  $\dot{r} = 4$  m/s, starting from the origin. The angular velocity is constant and has magnitude  $\dot{\theta} = 2$  rad/s. When the particle is 3 m from the origin, find the magnitude of (a) the velocity and (b) the acceleration.

■

**1.24**

A tire of radius  $R$  rolls in a straight line without slipping. Its center moves with constant speed  $V$ . A small pebble lodged in the tread of the tire touches the road at  $t = 0$ . Find the pebbles position, velocity, and acceleration as functions of time.



■

**1.25**

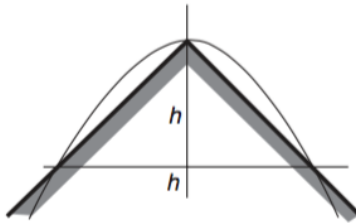
A particle moves outward along a spiral. Its trajectory is given by  $r = A\theta$ , where  $A$  is a constant.  $A = (1/\pi)$  m/rad.  $\theta$  increases in time according to  $\theta = \alpha t^2/2$ , where  $\alpha$  is a constant.

- (a) Sketch the motion, and indicate the approximate velocity and acceleration at a few points.
- (b) Show that the radial acceleration is zero when  $\theta = 1/\sqrt{2}$  rad.
- (c) At what angles do the radial and tangential accelerations have equal magnitude?

■

**1.27**

A peaked roof is symmetrical and subtends a right angle, as shown. Standing at a height of distance  $h$  below the peak, with what initial speed must a ball be thrown so that it just clears the peak and hits the other side of the roof at the same height?



■