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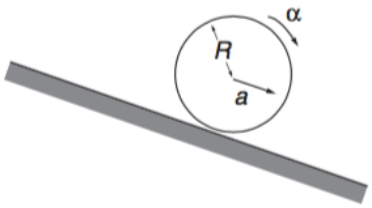
Physics 24a - Section 1
Polar Coordinate Systems
Monday, January 25, 2016

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 drums angular acceleration α?



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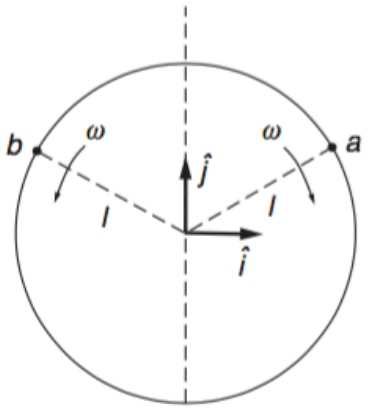
1.19

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 **R**? (**R** can change in time.)

(b) Particles a and b move in opposite directions around a circle with angular speed ω, 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.



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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.

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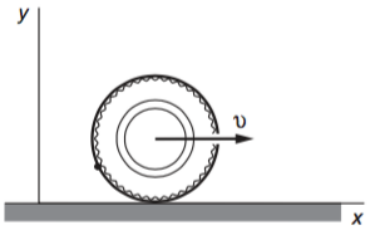
1.24
A tire of radius R rolls in a straight line without slipping. Its center moves with constant speed V. A small pebble lodged in the tread of the tire touches the road at $t = 0$. Find the pebbles position, velocity, and acceleration as functions of time.



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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. θ increases in time according to $\theta = \alpha t^2/2$, where α 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?

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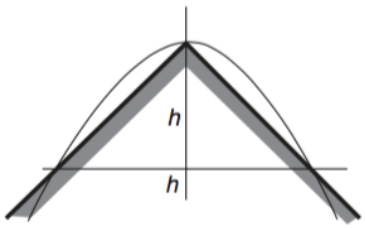
1.27
A peaked roof is symmetrical and subtends a right angle, as shown. Standing at a height of distance h below the peak, with what initial speed must a ball be thrown so that it just clears the peak and hits the other side of the roof at the same height?



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