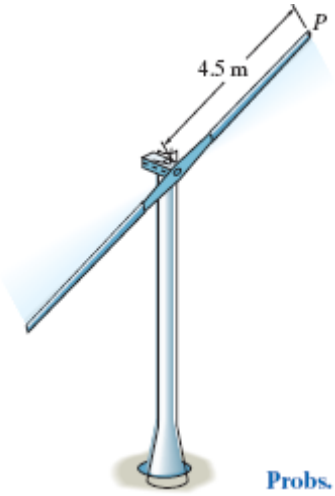
Exercises 5 & 6

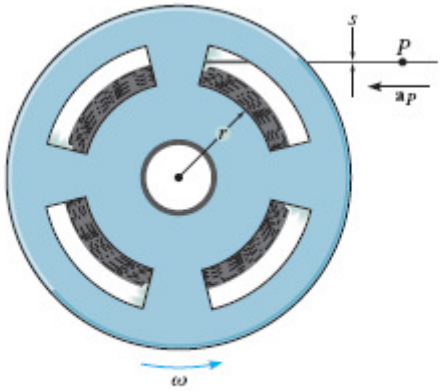
Translation and Rotation about a Fixed Axis

1. The 2-blade horizontal axis wind turbine is rotating with an initial (when *t=0*) angular velocity of $\omega_0 = 2 \ \ rad/s$. Each blade is measured *4.5 m* from root to tip. Point *P* is located at the tip of one of the blades.
   (a) [Prob. 16-16] If the blade rotates at $\omega = 5 \ \ rad/s$ when t = 3 sec. Determine the magnitude of the acceleration of point P at this instance.
   (b) [Prob. 16-17] If the blade rotates with a constant angular acceleration of $\alpha = 0.6 \ \ rad/s^2$, determine the magnitude of acceleration of point *P* at *t = 3 sec*.

2. [Prob. 16-30] A tape cartridge is turning at a constant rate of ω. The turning action draws the tape of thickness *s* into the cartridge. Given that the unwound portion always remains horizontal and *r* is the radius of the wound up tape in the cartridge.
   (a) Show that $\frac{dr}{dt} = \omega \frac{s}{2\pi}$.
   (b) Determine the acceleration of point P of the unwound tape



Probs. 16–16/17

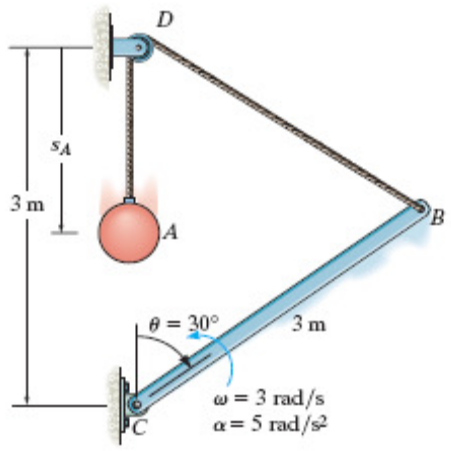


Prob. 16–30

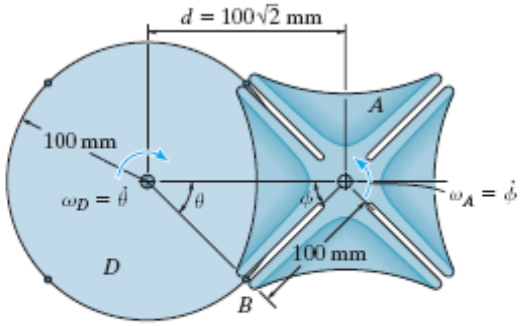
Absolute Motion Analysis

3. [Prob. 16-47] Determine the velocity and acceleration of the weight *A*. Given that the cord is *6 m* long.

4. [Prob. 16-49] The disc D rotates with a constant angular velocity ω_D. Four equally spaced pins are located around the circumference of the disc. These pins connect with the slots in the Geneva wheel A. Determine ω_A the angular velocity of wheel A as a function of ω_D and θ.



Prob. 16–47

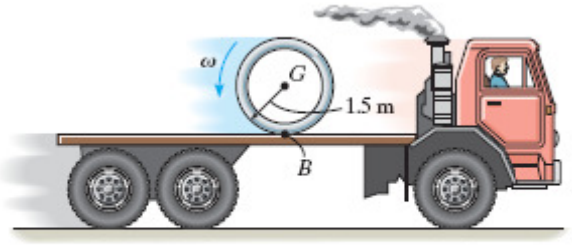


Prob. 16–49

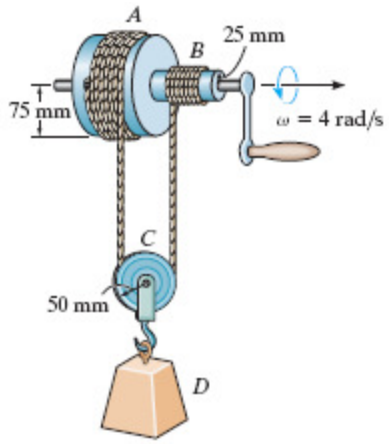
Relative Motion Analysis: Velocity

5. A pipe of radius *1.5m* is rolling on a truck with an angular velocity ω which is moving to the right hand side. The pipe is in contact with the truck at point B and it is assumed to roll without slipping. Point *G* represents the position of the centre of the pipe.
   (a) [Prob. 16-61] Given that the truck is traveling at a *3 m/sec* and $\omega = 8$ *rad* / sec , determine the velocity of point *G*
   (b) [Prob. 16-81] Given that the truck is traveling at a *3 m/sec* and $\omega = 8$ *rad* / sec , determine the velocity of point *G*. Use the instantaneous centre of zero velocity method
   (c) [Prob. 16-62] Given that the truck is traveling at *8 m/sec*, determine the angular velocity of the pipe which makes the centre of the pipe appear stationary to an observer on the ground.
   (d) [Prob. 16-82] Given that the truck is traveling at *8 m/sec*, determine the angular velocity of the pipe which makes the centre of the pipe appear stationary to an observer on the ground. Use the instantaneous centre of zero velocity method

6. [Prob. 16-73] When the crank is turned, the rope on shaft A unwinds while that on shaft B winds up. Assuming that the rope does not slip around the shaft and pulley and the rope segment on either side of the pulley is vertical. Given also that the crank is turned at a constant rate of *4 rad/sec*.
   (a) Determine the speed of block D
   (b) Determine the angular velocity of the pulley at C (Rope does not slip on pulley)



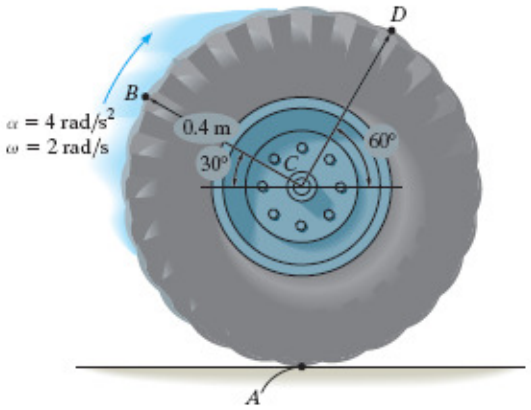
Probs. 16–61/62



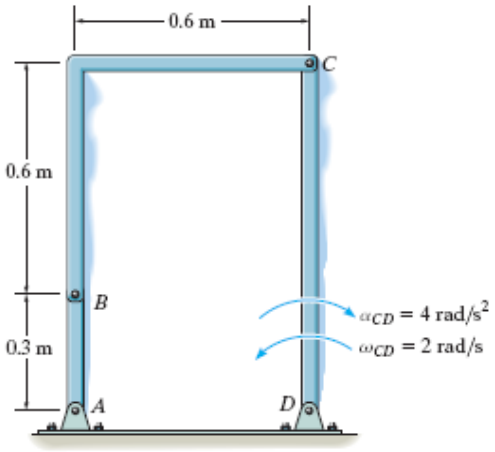
Prob. 16–73

Relative Motion Analysis: Acceleration

7. [Prob. 16-109] The wheel is rolling without slip on a horizontal surface. The dimensions, angular velocity and acceleration are as described in the figure. Determine the acceleration of point B.
8. [Prob. 16-127] Determine the angular acceleration of link AB.



Prob. 16–109



Prob. 16–127