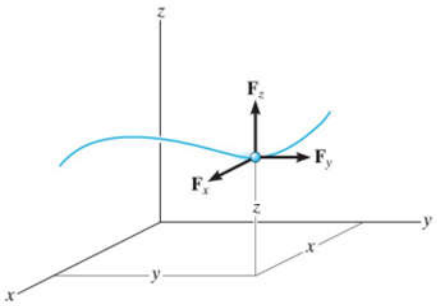
## จลนศาสตร์ของอนุภาค : แรงและความเร่ง

1. Equation of Motion: **Rectangular Coordinates**




$$\sum F_x = ma_x$$
$$\sum F_y = ma_y$$
$$\sum F_z = ma_z$$

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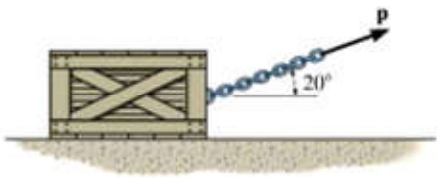
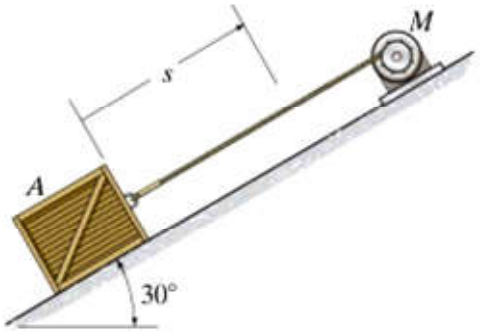
**1**

**13–11.** The crate has a mass of 80 kg and is being towed by a chain which is always directed at 20° from the horizontal as shown. Determine the crate's acceleration in $t = 2$ s if the coefficient of static friction is $\mu_s = 0.4$, the coefficient of kinetic friction is $\mu_k = 0.3$, and the towing force is $P = (90t^2)$ N, where $t$ is in seconds.



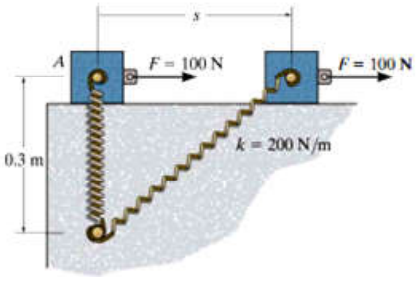
**2**

**F13–1.** The motor winds in the cable with a constant acceleration, such that the 20-kg crate moves a distance $s = 6$ m in 3 s, starting from rest. Determine the tension developed in the cable. The coefficient of kinetic friction between the crate and the plane is $\mu_k = 0.3$.

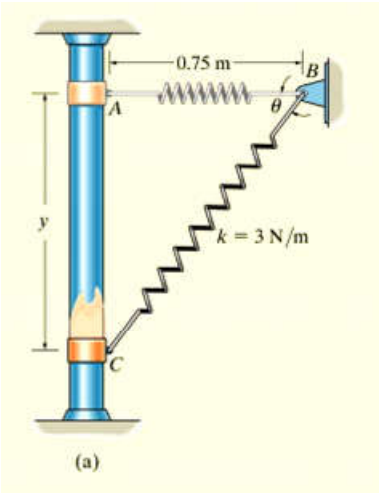


**3**

**F13–5.** The spring has a stiffness $k = 200$ N/m and is unstretched when the 25-kg block is at $A$. Determine the acceleration of the block when $s = 0.4$ m. The contact surface between the block and the plane is smooth.



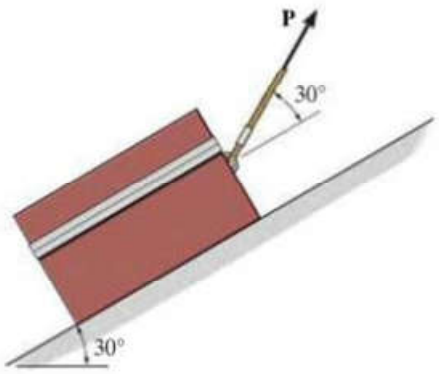
**4** A smooth 2-kg collar $C$, shown in Fig. 13–9$a$, is attached to a spring having a stiffness $k = 3$ N/m and an unstretched length of 0.75 m. If the collar is released from rest at $A$, determine its acceleration and the normal force of the rod on the collar at the instant $y = 1$ m.



(a)

**5**

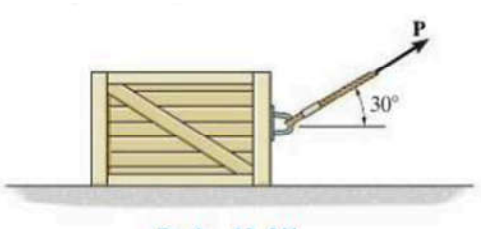
**13–6.** If $P = 400$ N and the coefficient of kinetic friction between the 50-kg crate and the inclined plane is $\mu_k = 0.25$, determine the velocity of the crate after it travels 6 m up the plane. The crate starts from rest.



## Homework 3

**1**

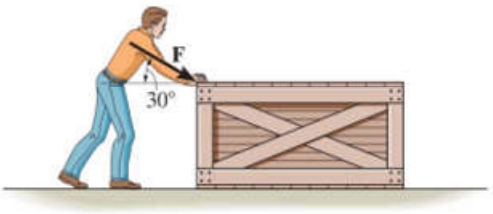
*13–4. If the 50-kg crate starts from rest and achieves a velocity of $v = 4$ m/s when it travels a distance of 5 m to the right, determine the magnitude of force **P** acting on the crate. The coefficient of kinetic friction between the crate and the ground is $\mu_k = 0.3$.




Probs. 13–3/4

**2**

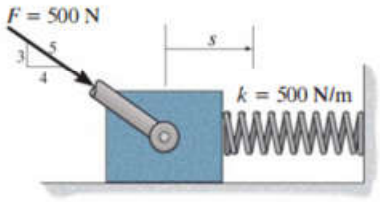
*13–16. The man pushes on the 60-lb crate with a force **F**. The force is always directed down at 30° from the horizontal as shown, and its magnitude is increased until the crate begins to slide. Determine the crate's initial acceleration if the coefficient of static friction is $\mu_s = 0.6$ and the coefficient of kinetic friction is $\mu_k = 0.3$.




Prob. 13–16

**3**

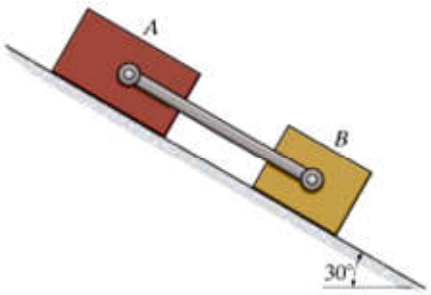
F13–3. A spring of stiffness $k = 500$ N/m is mounted against the 10-kg block. If the block is subjected to the force of $F = 500$ N, determine its velocity at $s = 0.5$ m. When $s = 0$, the block is at rest and the spring is uncompressed. The contact surface is smooth.



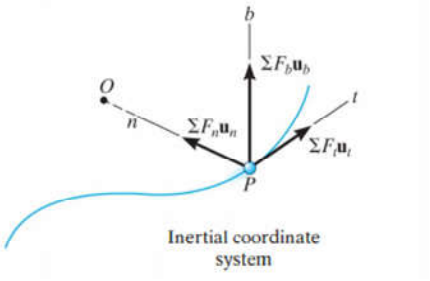

F13–3

**4**

•13–5. If blocks $A$ and $B$ of mass 10 kg and 6 kg, respectively, are placed on the inclined plane and released, determine the force developed in the link. The coefficients of kinetic friction between the blocks and the inclined plane are $\mu_A = 0.1$ and $\mu_B = 0.3$. Neglect the mass of the link.



## 2. Equation of Motion: **Normal and Tangential Coordinates**




$$\sum F_t = ma_t$$
$$\sum F_n = ma_n$$
$$\sum F_b = ma_b$$

**ความเร่ง**

ความเร่งในแนวแกน t $a_t = \dfrac{dv}{dt} = \dot{v}$

ความเร่งในแนวแกน n $a_n = \dfrac{v^2}{\rho}$

$a_t$ เป็น "+" มีทิศไปทางเดียวกับการเคลื่อนที่
$a_t$ เป็น "-" มีทิศตรงข้ามกับการเคลื่อนที่

$a_n$ มีทิศพุ่งเข้าจุดศูนย์กลางเสมอ

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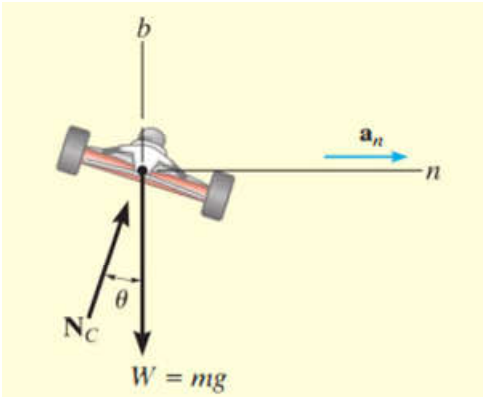
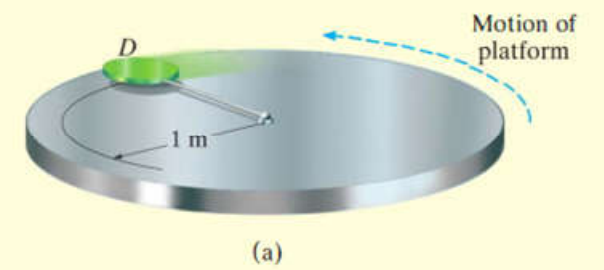
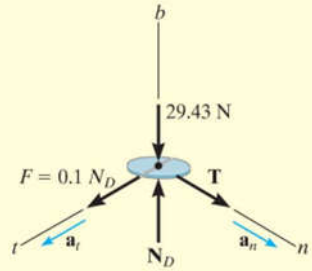
**1** Determine the banking angle $\theta$ for the race track so that the wheels of the racing cars shown in Fig. 13–12*a* will not have to depend upon friction to prevent any car from sliding up or down the track. Assume the cars have negligible size, a mass $m$, and travel around the curve of radius $\rho$ with a constant speed $v$.

**2** The 3-kg disk $D$ is attached to the end of a cord as shown in Fig. 13–13*a*. The other end of the cord is attached to a ball-and-socket joint located at the center of a platform. If the platform rotates rapidly, and the disk is placed on it and released from rest as shown, determine the time it takes for the disk to reach a speed great enough to break the cord. The maximum tension the cord can sustain is 100 N, and the coefficient of kinetic friction between the disk and the platform is $\mu_k = 0.1$.



(a)



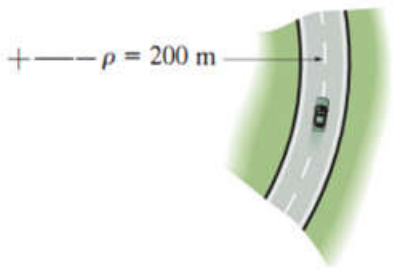
3

**13–63.** The vehicle is designed to combine the feel of a motorcycle with the comfort and safety of an automobile. If the vehicle is traveling at a constant speed of 80 km/h along a circular curved road of radius 100 m, determine the tilt angle $\theta$ of the vehicle so that only a normal force from the seat acts on the driver. Neglect the size of the driver.


Prob. 13–63

4

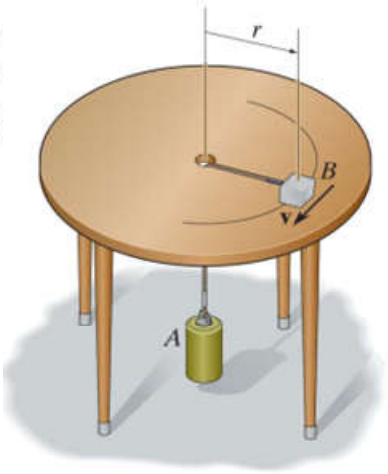
**13–66.** Determine the minimum coefficient of static friction between the tires and the road surface so that the 1.5-Mg car does not slide as it travels at 80 km/h on the curved road. Neglect the size of the car.



## Homework 4

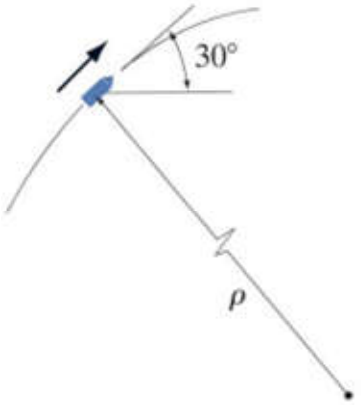
**1**

**•13–49.** The 2-kg block $B$ and 15-kg cylinder $A$ are connected to a light cord that passes through a hole in the center of the smooth table. If the block travels along a circular path of radius $r = 1.5\,\text{m}$, determine the speed of the block.




**2**

**13–50.** At the instant shown, the 50-kg projectile travels in the vertical plane with a speed of $v = 40\,\text{m/s}$. Determine the tangential component of its acceleration and the radius of curvature $\rho$ of its trajectory at this instant.




**3**

***13–56.** A man having the mass of 75 kg sits in the chair which is pin-connected to the frame $BC$. If the man is always seated in an upright position, determine the horizontal and vertical reactions of the chair on the man at the instant $\theta = 45°$. At this instant he has a speed of 6 m/s, which is increasing at $0.5\,\text{m/s}^2$.