مدونة المناهج السعودية

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الموقع التعليمي لجميع المراحل الدراسية

في المملكة العربية السعودية

PHYS 101

Ch. 5

Applying Newton's Laws

Chapter 5

Chapter Fife
Applying Newton's Laws

- ***Using Newton's First Law: Particles in Equilibrium***
- ***Using Newton's Second Law: Dynamics of Particles***
- ***Friction Forces***
- ***Dynamics of Circular Motion***

Using Newton's 1st Law: Par. in Equ.

Example 1:

A cable hold a ball of weight 250 N in static equilibrium. The tension in the cord is:

Solution:

(C)

(A) zero
(B) 9.8 N
(C) 250 N
(D) 500 N

Using Newton's 2nd Law: Dy. of Par.

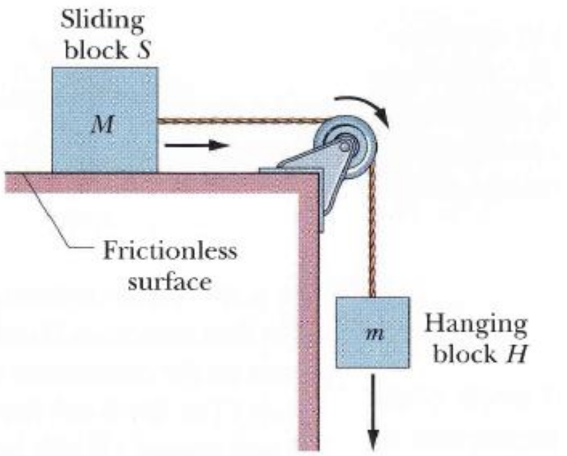
Example 2:

In the figure, M=2.5 kg is on a horizontal frictionless surface and m=1.5 kg is hanging. The acceleration of the blocks is:

Solution:

(B)

(A) 36.75 m/s^2
(B) 3.675 m/s^2
(C) 0.367 m/s^2
(D) Zero



Using Newton's 2nd Law: Dy. of Par.

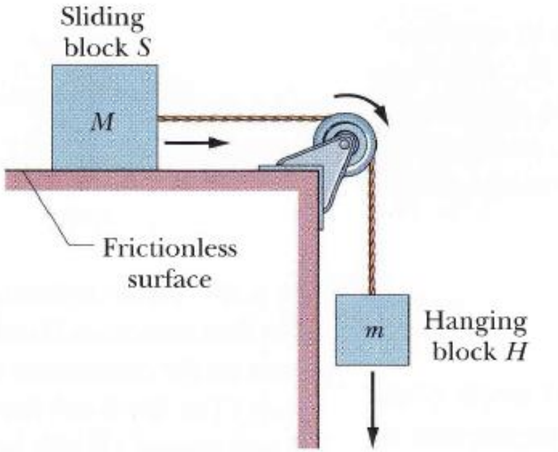
Example 3:

Refer to Example 2, the tension in the cord is:

Solution:

(C)

(A) Zero
(B) 91.9 N
(C) 9.19 N
(D) 0.91 N



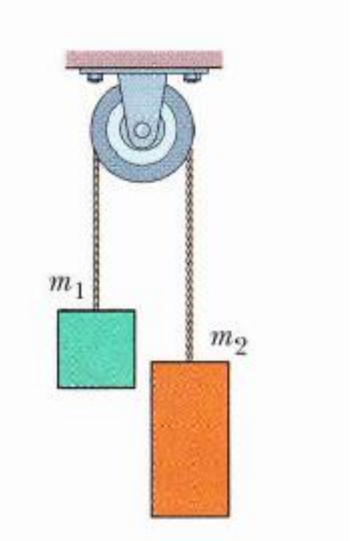
Using Newton's 2nd Law: Dy. of Par.

Example 4:

In the figure, two blocks connected together with cord over a pulley where m_1=2 kg and m_2 =3 kg. The acceleration of the blocks is:

Solution:

(B)



(A) 19.6 m/s^2
(B) 1.96 m/s^2
(C) 0.19 m/s^2
(D) zero

Using Newton's 2nd Law: Dy. of Par.

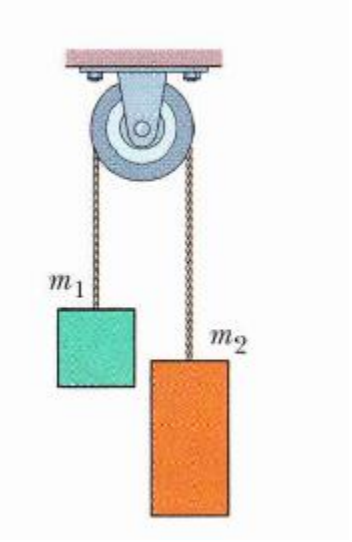
Example 5:

Refer to Example 4, the tension in the cord is:

Solution:

(A)

(A) 23.52 N
(B) 2.352 N
(C) 0.235 N
(D) 0.023 N



Using Newton's 2nd Law: Dy. of Par.

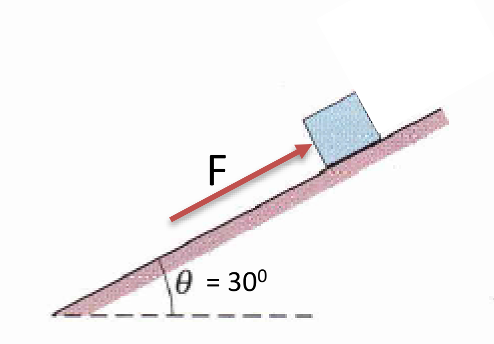
Example 6:

In the figure a 10 kg box is pushed at a constant speed up the frictionless ramp by a horizontal force F. the magnitude of F is:

Solution:

(C)

(A) 24.5 N
(B) 98 N
(C) 49 N
(D) 28.3 N



Using Newton's 2nd Law: Dy. of Par.

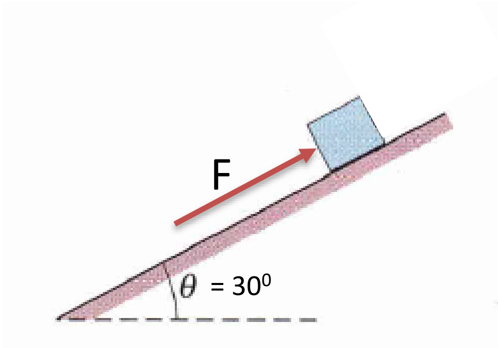
Example 7:

Refer to Example 6, the normal force on the box is:

Solution:

(B)

(A) 49 N
(B) 84.87 N
(C) Zero N
(D) 98 N



Using Newton's 2nd Law: Dy. of Par.

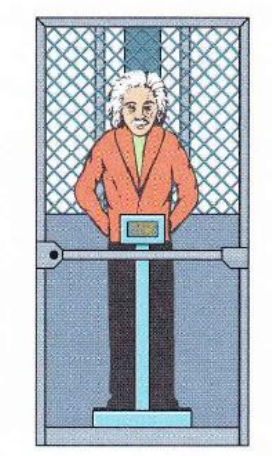
Example 8:

A 1000 kg elevator is moving up with acceleration 3 m/s^2. The tension in the cable is:

Solution:

(D)

(A) 9800 N
(B) 6800 N
(C) zero N
(D) 12800 N



Using Newton's 2nd Law: Dy. of Par.

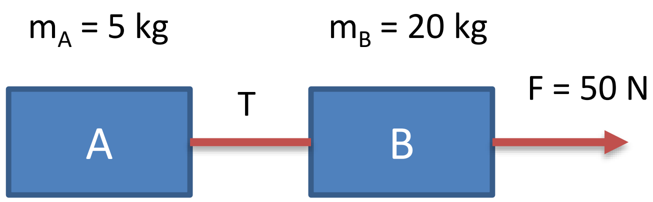
Example 9:

Two blocks (A and B) are in contact on a horizontal frictionless surface. A 50 N constant force is applied to B as shown. The tension in the cord is:

Solution:

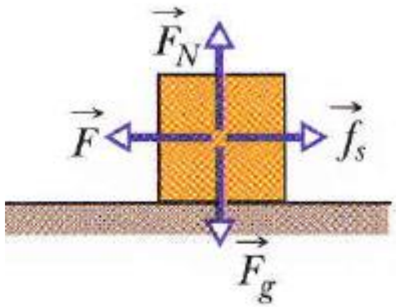
(C)

(A) 25 N
(B) 20 N
(C) 10 N
(D) 5 N



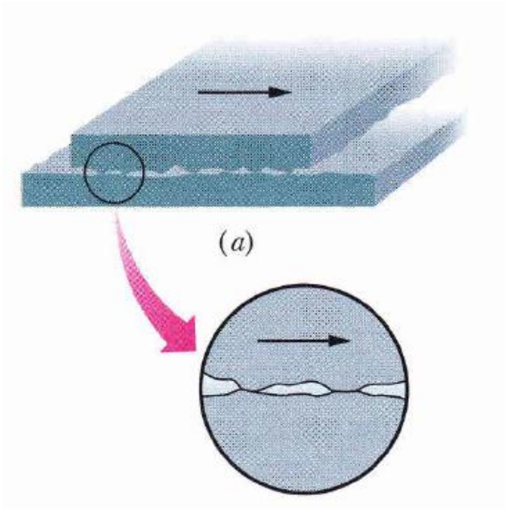
Friction Forces

Friction



- When a force ***F*** tends to slide a body along a surface, a fractional force from the surface acts on the body.

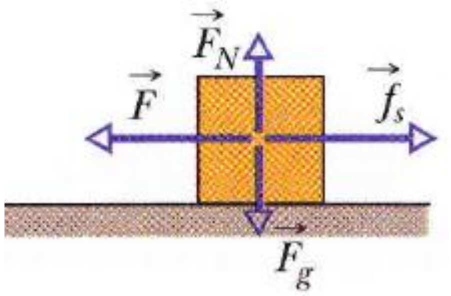
- The fractional force is parallel to the surface and directed so as to oppose the sliding.



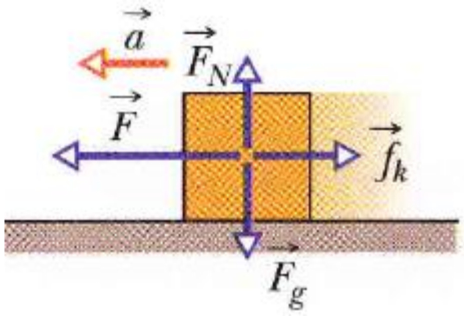
- It is due to bonding between the body and the surface.

Friction Forces

- If the body does not slide, the fractional force is a static fractional force $\boldsymbol{f_s}$.



- If the body does sliding, the fractional force is a kinetic fractional force $\boldsymbol{f_k}$.



Friction Forces

Properties of Friction

- If the body does not move, the static fractional force $\boldsymbol{f_s}$ and the component of $\boldsymbol{F}$ parallel to the surface are equal in magnitude, and $\boldsymbol{f_s}$ directed opposite that component.

- The magnitude of $\boldsymbol{f_s}$ has a maximum value given by:

$$f_{s,\max} = \mu_s F_N,$$

where μ_s is the coefficient of static friction and F_N is the magnitude of the normal force.

Friction Forces

- If the component of $\boldsymbol{F}$ parallel to the surface exceeds $f_{s,max}$, the body slide on the surface.

- If the body begins to slide on the surface, the magnitude of the fractional force rapidly decreases to a constant value f_k given by:

$$f_k = \mu_k F_N,$$

where μ_k is the coefficient of kinetic friction.

Friction Forces

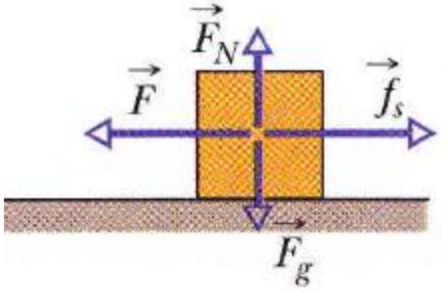
Example 10:

The fractional force on a moving body is proportional to the:

Solution:

(D)

(A) force casing the motion
(B) weight of the body
(C) acceleration of the body
(D) normal force on the body



Friction Forces

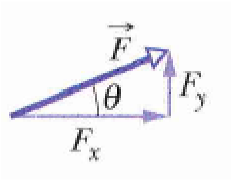
Example 11:

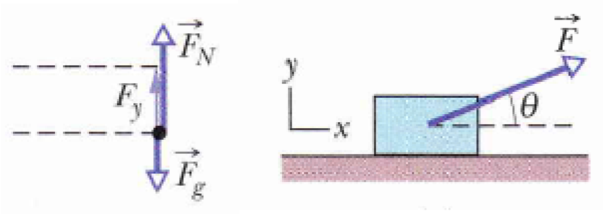
A boy pulls a wooden box along a rough horizontal floor at constant speed. Which of the following must be true?

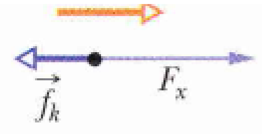
Solution:

(D)

(A) $F\cos\theta > f_k$ and $N = W$
(B) $F = f_k$ and $N > W$
(C) $F > f_k$ and $N < W$
(D) $F\cos\theta = f_k$ and $N = W - F\sin\theta$







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Friction Forces

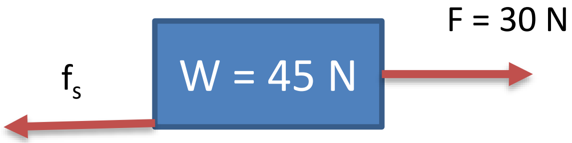
Example 12:

A block slide on a rough surface (see figure). The block start to slide when a parallel force of 30 N is applied. The coefficient of static friction μ_s is:

Solution:

(A)

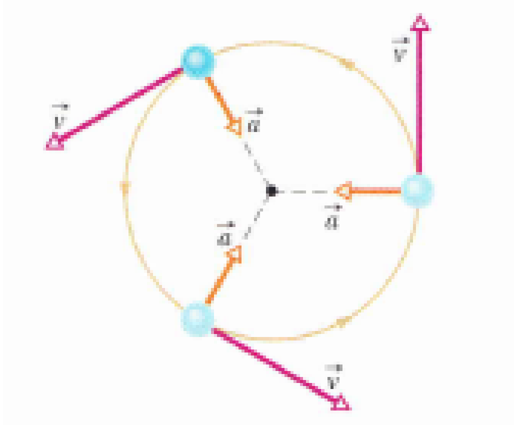
(A) 0.67
(B) 0.33
(C) 0.4
(D) 1



Dynamics of Circular Motion

Uniform Circular Motion

- If a particle moves in a circle with constant radius at constant speed, it is in uniform circular motion.



- Its centripetal acceleration magnitude is given by:

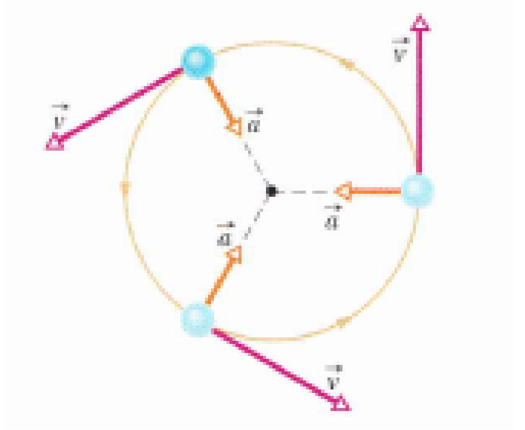
$$a = \frac{v^2}{R} \qquad \text{(centripetal acceleration).}$$

Dynamics of Circular Motion

- The acceleration is due to a net centripetal force on the particle, with magnitude given by:

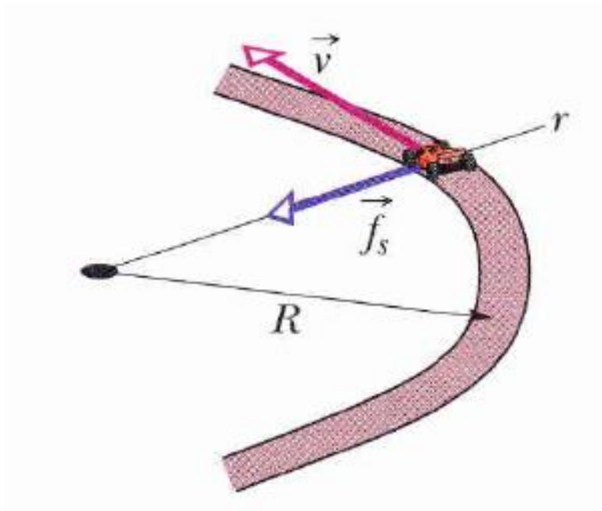
$$F = m\frac{v^2}{R} \qquad \text{(magnitude of centripetal force).}$$

where m is the particle mass.

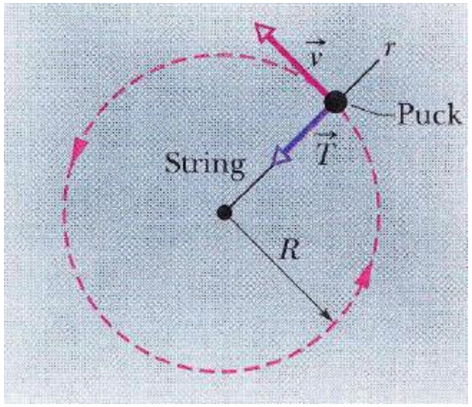


- The vector quantities of acceleration and force are directed toward the centre of curvature of the particle's path.

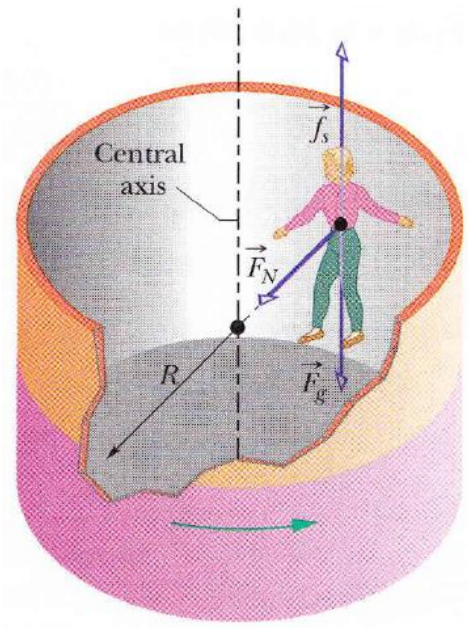
Dynamics of Circular Motion



- Static Fractional Force



- Tension



- Normal force

Dynamics of Circular Motion

Example 13:

A car has mass of 1700 kg is moving with a constant speed of 25 m/s in a circular track of a radius 200 m. The car tires static friction coefficient with the road is:

Solution:

(C)

(A) 0.67
(B) 0. 4
(C) 0.32
(D) 1