Çankaya University
PHYS 131 – PHYSICS I

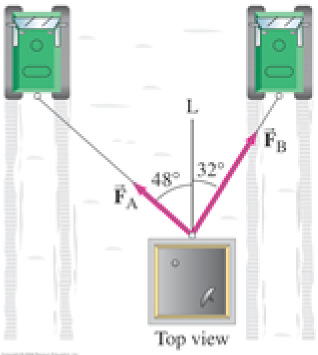
CHAPTER V

FORCE AND MOTION I

PROBLEM SET

1) A person stands on a bathroom scale in a motionless elevator. When the elevator begins to move, the scale briefly reads only 0.75 of the person's regular weight. Calculate the acceleration of the elevator, and find the direction of acceleration.
[Answer: $-2.5\ m/s^2$ down]

2) Two snowcats in Antarctica are towing a housing unit to a new location, as shown in Fig. 4–38. The sum of the forces $\vec{\mathbf{F}}_A$ and $\vec{\mathbf{F}}_B$ exerted on the unit by the horizontal cables is parallel to the line L, and $F_A = 4500$ N. Determine F_B and the magnitude of $\vec{\mathbf{F}}_A + \vec{\mathbf{F}}_B$.
[Answer: $\vec{F}_A$=6300 N, $\vec{F}_A+\vec{F}_B$= 8400 N]



3) A 3.0-kg object has the following two forces acting on it:

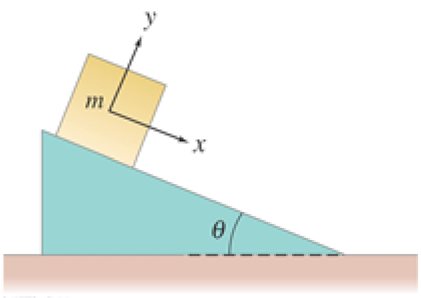
$\vec{\mathbf{F}}_1 = (16\hat{\mathbf{i}} + 12\hat{\mathbf{j}})$ N and $\mathbf{F_2}$=(-10$\hat{\mathbf{i}}$ + 22$\hat{\mathbf{j}}$) ***N***

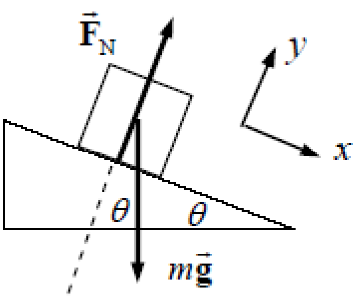
If the object is initially at rest, determine its velocity $\vec{\mathbf{v}}$ at $t = 3.0$ s.

[Answer: $\vec{v} = (6\hat{\imath} + 34\hat{\jmath})\ m/s$]

4) The block shown in Fig. 4–43 has mass $m = 7.0$ kg and lies on a fixed smooth frictionless plane tilted at an angle $\theta = 22.0^0$ to the horizontal. (*a*) Determine the acceleration of the block as it slides down the plane. (*b*) If the block starts from rest 12.0 m up the plane from its base, what will be the block's speed when it reaches the bottom of the incline?

[Answer: a) $3.67\ m/s^2$, b) 9.39 m/s]



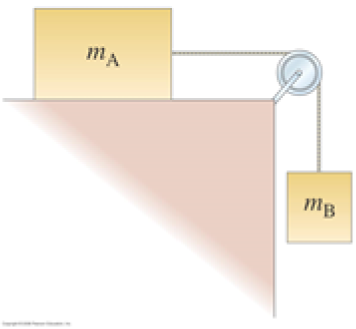


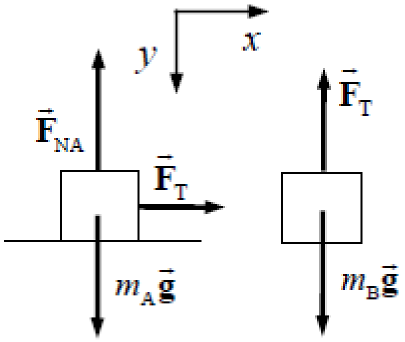
5) A block is given an initial speed of 4.5 m/s up the 22° plane shown in Fig. 4–43. (*a*) How far up the plane will it go? (*b*) How much time elapses before it returns to its starting point? Ignore friction. **[Answer: a) 2.8 m up the plane, b) 2.5 s]**

6) Figure 4–45 shows a block (mass m_A) on a smooth horizontal surface, connected by a thin cord that passes over a pulley to a second block (m_B), which hangs vertically. (*a*) Draw a free-body diagram for each block, showing the force of gravity on each, the force (tension) exerted by the cord, and any normal force. (*b*) Apply Newton's second law to find formulas for the acceleration of the system and for the tension in the cord. Ignore friction and the masses of the pulley and cord.

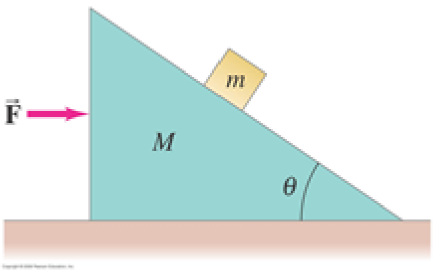
[Answer: a) figure below, b) expressions below

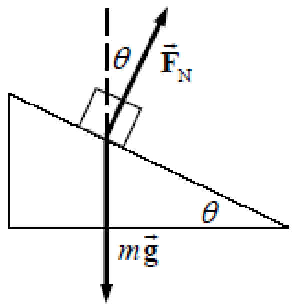
$$a = g\frac{m_B}{m_A + m_B} \qquad F_T = m_A a = g\frac{m_A m_B}{m_A + m_B}$$ **]**





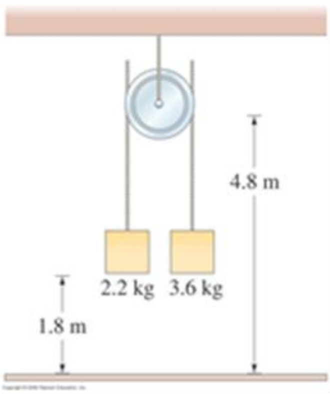
7) A small block of mass *m* rests on the sloping side of a triangular block of mass *M* which itself rests on a horizontal table as shown in Fig. 4–47. Assuming all surfaces are frictionless, determine the magnitude of the force $\vec{F}$ that must be applied to *M* so that *m* remains in a fixed position relative to *M* (that is, *m* doesn't move on the incline). [*Hint*: Take *x* and *y* axes horizontal and vertical.] **[Answer: $\vec{F}_{applied} = (m+M)g\tan\theta$]**

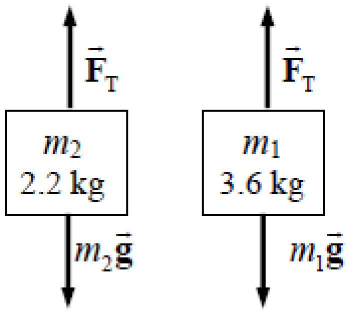




8) *** The two masses shown in Fig. 4–50 are each initially 1.8 m above the ground, and the massless frictionless pulley is 4.8 m above the ground. What maximum height does the lighter object reach after the system is released? [*Hint*: First determine the acceleration of the lighter mass and then its velocity at the moment the heavier one hits the ground. This is its "launch" speed. Assume the mass doesn't hit the pulley. Ignore the mass of the cord.]

[Answer: $\vec{a} = 2.366\ \mathrm{m/s^2}$, *v*=2.918 m/s, h=4.0 m]





9) *** Determine a formula for the magnitude of the force $\vec{F}$ exerted on the large block (m_C) in Fig. 4–51 so that the mass m_A does not move relative to m_C. Ignore all friction. Assume m_B does not make contact with m_C. **[Answer:**

$$\frac{(m_A + m_B + m_C)\, m_B}{\sqrt{(m_A^2 - m_B^2)}}\, g$$

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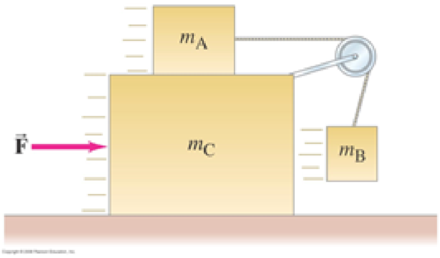

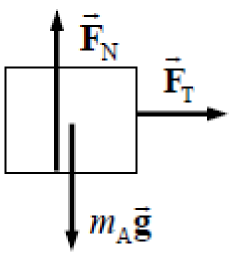

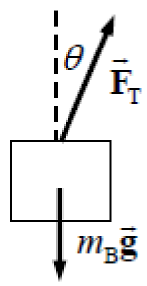

10) *** A 1.5-kg block rests on top of a 7.5-kg block (Fig. 4–63). The cord and pulley have negligible mass, and there is no significant friction anywhere. (*a*) What force *F* must be applied to the bottom block so the top block accelerates to the right at $2.5\ \mathrm{m/s^2}$? (*b*) What is the tension in the connecting cord? **[Answer: a) 23 N, b) 3.8 N]**