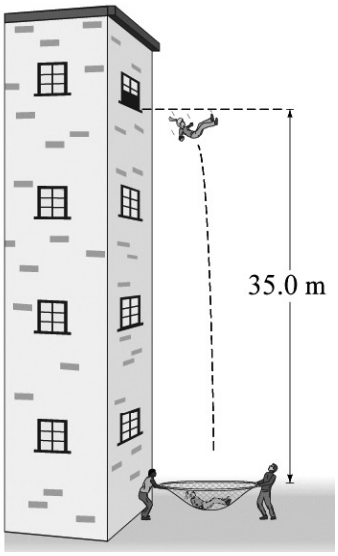
Sample Midterm Exam Problems, Phyx 135-1, Fall 2009

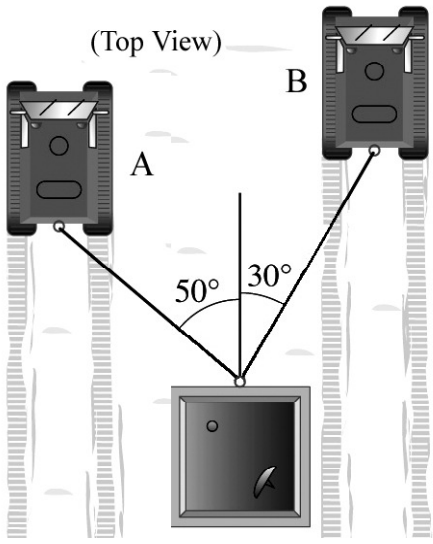


1) A college student jumps from a fourth-story window in a dormitory that is on fire. She jumps with a horizontal velocity of 1.5 m/s and a vertical velocity of zero. If the window is 35 meters off the ground, how far from the dormitory must the rescuers hold the net to catch her?

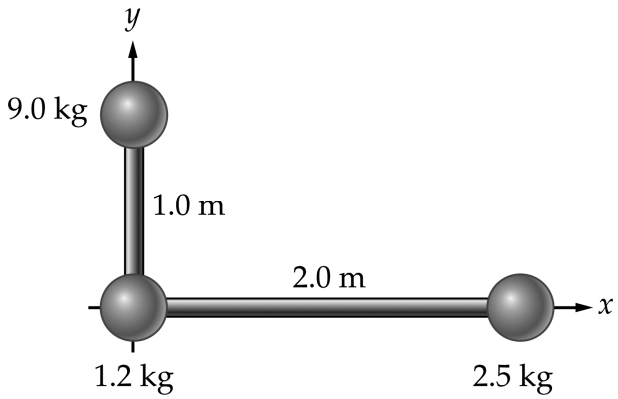
2) A car with a mass of 900 kg is being driven around a circular track which has a radius of 75 m. The track is not banked. If the coefficient of kinetic friction between the car and the track is 0.5, how fast can the car be driven without sliding off the track?

3) Direct sunlight provides 1.3 kW/m^2 of radiant energy. Suppose Physicsland Industries makes a perfectly frictionless, 580-kg electric car that is powered by a perfect solar panel (all the light hitting it is turned into kinetic energy). The panel has an area of 4.5 m^2. What would be the speed of the car after one minute in the sunlight?

4) In the figure at right, two tractors are pulling a 1200-kg safe across a snow-covered field. The safe is sliding on frictionless runners. The tractors are pulling at angles of –50˚ and 30˚ respectively from the forward direction, as shown. If the safe is accelerating at 0.6 m/s^2 in the forward direction (directly upwards in the figure) and if the safe has zero acceleration sideways (left or right in the figure), what are the tensions in cords A and B?



5) Three masses are arranged as shown below, with the 1.2 kg ball at the origin. They are floating in a vacuum, very far from any planet. They are connected by unbendable, massless, frictionless rods which have compressed air inside them. When both rods are punctured simultaneously at the origin by the hosts of the Mythbusters TV show (don't ask), the resulting blasts of air cause the vertical (1 m) rod to project 1000 N of force downward against the 1.2 kg mass, and the horizontal (2 m) rod to project 2000 N of force leftward against the 1.2 kg mass. The force from both rods is constant and lasts for 0.2 seconds. At the end of this time, what are the coordinates of all three masses?



Multiple Choice

6) Which of the following is NOT an example of accelerated motion?

A) A ball thrown directly upward
B) A swinging pendulum
C) A spring pushing a mass on a frictionless surface
D) Earth's motion about the Sun
E) The horizontal component of projectile motion
F) A moving car with its brakes applied

7) A ball is tossed straight up. At the highest point of its flight, which one of the following is true?

A) It has zero velocity, and zero acceleration
B) It has zero velocity, and is under constant acceleration
C) It has zero velocity, and is under increasing acceleration
D) It has zero velocity, and is under decreasing acceleration
E) It has a non-zero velocity, and zero acceleration
F) It has a non-zero velocity, and non-zero acceleration

8) Two objects, one with three times the mass of the other, are dropped from the same height in a vacuum. At the end of their fall, their velocities are equal because:

A) anything falling in a vacuum has constant velocity
B) all objects eventually reach the same terminal velocity
C) the acceleration of the larger mass is three times smaller because its mass is three times greater
D) the force due to gravity is the same on both masses
E) the acceleration due to gravity is the same for both masses
F) none of the above

9) A 60-kg woman is standing in an elevator that is moving upwards at a constant speed of 5.0 m/s. The force she is exerting on the floor of the elevator is:

A) 588 N
B) zero
C) 300 N
D) 47 N
E) 288 N
F) 888 N

10) If a telecommunications satellite is moving above the Earth's atmosphere in a circular orbit with constant speed, then:

A) its acceleration and velocity point in the same direction
B) its acceleration is zero
C) its acceleration is pointed towards the Earth
D) its velocity is constant
E) it will fall back to Earth when its fuel is used up
F) gravity is pulling it forward

11) An 80-kg passenger in a car is pressed against the car door with a force of 200 N as the car makes a turn at 12 m/s. The car door is defective, and will pop open under a force of 800 N. The minimum speed which will throw the passenger out of the car is:

A) 14 m/s B) 18 m/s C) 20 m/s D) 24 m/s E) 28 m/s F) 56 m/s

Possibly Useful Facts

$g = 9.8\ m/s^2$	1 hp = 746 watts	$F = mv^2/r$	
$v = v_0 + at$	$x = x_0 + v_0t + \frac{1}{2}\,at^2$	$v = at$	$d = \frac{1}{2}\,at^2$
$\Sigma \underline{F} = m\underline{a}_{net}$	weight = mg	$F = -kx$	$F = \mu N$
$W = \underline{F} \bullet \underline{d}$	$dW = F(x)dx$		
$p = mv$	$p_x = mv_x$	$p_y = mv_y$	p(before) = p(after)
$E = mgh$	$E = \frac{1}{2}\,mv^2$	$E = \frac{1}{2}\,kx^2$	
$P = \Delta E/\Delta t$	Newton = $kg\ m/s^2$	Joule = N – m	Watt = J /sec