$$\Delta x = v_{0,x}t + \frac{1}{2}a_X t^2 \quad \text{or} \quad \Delta y = v_{0,y}t + \frac{1}{2}a_y t^2$$

$$\Delta x = \frac{1}{2}(v_f + v_0)t \quad \text{or} \quad \Delta y = \frac{1}{2}(v_f + v_0)t$$

$$v_f = v_0 + at$$

$$v_f^2 = v_0^2 + 2a\Delta x \quad \text{or} \quad v_f^2 = v_0^2 + 2a\Delta y$$

$$\theta_v = tan^{-1}\left(\frac{v_y}{v_x}\right) \quad \text{for a vector } \bar{v}$$

$$\Sigma F = ma$$

$$F_W = mg$$

$$F_F = \mu_s F_N \quad \text{or} \quad \mu_k F_N$$

(10 Points) A sailboat sails for 120 m at 25° N of E, then for 80 m directly north, and then for 50 m at 55° N of W. Determine
   a) the magnitude of the boat's resultant displacement.
   b) the direction of the boat's resultant displacement.

(15 Points) A soccer ball, initially at rest, is kicked directly toward a fence from a point 32.0 m away, as shown above. The velocity of the ball as it leaves the kicker's foot is 20.0 m/s at an angle of 37.0° above the horizontal. The top of the fence is 2.50 m high. Assume air resistance is negligible.
   a) Determine the time it takes for the ball to reach the plane of the fence.
   b) Will the ball hit the fence? If so, how far below the top of the fence will it hit? If not, how far above the top of the fence will it pass?

(10 Points) A 282-kg baby grand piano is being pushed by two people toward the right. The coefficient of static friction between the floor and the legs of the piano is 0.550.
   a) How much force must each person exert to set the piano in motion?
   b) If they continue applying this force and the piano begins to accelerate at 2.50 m/s^2, what is the coefficient of kinetic friction between the floor and the legs of the piano?

(15 Points) A 110-kg crate is situated on a ramp with an incline of 25°.
   a) If the crate is at rest, what is the coefficient of friction between the crate and the ramp?
   b) If the coefficient of kinetic friction is half the value of the coefficient of static friction, what is the acceleration of the crate down the ramp?
   c) How far has the crate slid down the ramp after reaching a velocity of 4 m/s from rest?

(Bonus) A soccer player runs 20 m straight down the pitch with the ball close to her feet, and then passes the ball to her teammate, who is standing 30 m away at an angle of 30° from the direction of her motion. Determine
- a) the magnitude of the ball's resultant displacement.
- b) the direction of the ball's resultant displacement.

1. A car traveling at a speed of v_0 applies its brakes, skidding to a stop over a distance x. Assuming that the deceleration due to the brakes is constant, what would be the skidding distance of the same car if it were traveling with twice the initial speed?
A. $2x$
B. $3x$
C. $4x$
D. $8x$

2. Starting from rest, object 1 falls freely for 4.0 s, and object 2 falls freely for 8.0 s. Compared to object 1, object 2 falls
A) half as far.
B) twice as far.
C) three times as far.
D) four times as far.

3. Which one of the following statements is true concerning the motion of an ideal projectile launched at an angle above the horizontal?
A) The acceleration is negative on the way up and also negative on the way down.
B) The velocity at the top of the trajectory is zero.
C) The object's total speed remains constant during the entire flight.
D) The vertical speed decreases on the way up and increases on the way down.

4. A stone is thrown horizontally with an initial velocity of 30 m/s from a bridge. Find the stone's velocity when it enters the water 4 s later, assuming that air resistance is negligible.
A) 30 m/s
B) 40 m/s
C) 50 m/s
D) 60 m/s

5. A 12.0-kg box starts at rest and reaches a velocity of 3.45 m/s after traveling 12.0 m. What was the magnitude of the force exerted on the box?
A) 0.0410 N
B) 0.496 N
C) 2.95 N
D) 19.0 N
E) 5.95 N

6. In 1971, astronaut Alan Shepard hit two golf balls on the Moon, where the gravitational acceleration is lower by a factor of 6. By what factor would the range of each golf ball differ from that of a golf ball hit on Earth with the same initial velocity?
A) $\frac{1}{6}$
B) 6
C) 12
D) 36

7. A raft on a river is being guided by two currents, one of which applies a force of 125 N directed north and the other of which applies a force of 225 N directed west. What is the direction of the net force on the raft?
A) 29.1°
B) 60.9°
C) 119°
D) 150°

8. The same net force is applied to object A and object B. Object A has an acceleration three times that of object B. Which of the following is correct?
A) Object A has three times the mass of object B.
B) Object A has one-third the mass of object B.
C) Object A has a different, less streamlined shape than object B.
D) Object A has more friction than object B.

9. A 5-kg box slides across the floor with an initial velocity of 5 m/s. If the coefficient of kinetic friction between the box and the floor is 0.10, after how much time will the box come to a stop?
A) 5.1 s
B) 0 s
C) −5.1 s
D) −3.2 s
E) 3.2 s

10. A track star in the long jump goes into the jump at 12 m/s and launches herself at 20.0° above the horizontal. How long is she in the air before returning to the ground?
A) 1.5 s
B) 1.2 s
C) 0.42 s
D) 0.83 s