

Dynamics [Unit 4]

- You push an object, initially at rest, across a frictionless floor with a constant force for a time interval Δt , resulting in a final speed of v for the object. You then repeat the experiment, but with a force that is twice as large. What time interval is now required to reach the same final speed v ?
 A) $4\Delta t$ C) $2\Delta t$
 B) $\Delta t/2$ D) $\Delta t/4$
- Three forces acting on an object are given by $F_1 = (20\mathbf{i} - 12\mathbf{j})\text{ N}$, and $F_2 = (5\mathbf{i} + 20\mathbf{j})\text{ N}$, and $F_3 = (40\mathbf{i} - 5\mathbf{j})\text{ N}$. The mass of an object is 4 kg.
 A) What are the velocity components of the object after 10.0 s?
 B) If the object is initially at rest, what is its speed after 10.0 s?
- A 3 kg object is moving in a plane, with its x and y coordinates given by $x = 5t^2 + 1$ and $y = 3t^3 + 2$, where x and y are in meters and t is in seconds. Find the magnitude of the net force acting on this object at $t = 2$ s.
- Figure 1 shows loads hanging from the ceiling of an elevator that is moving at constant velocity. Find the tension in each of the three strands of cord supporting each load.

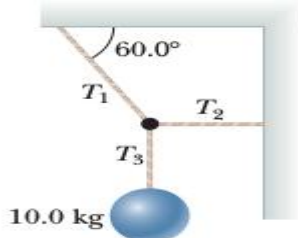


Fig. 1

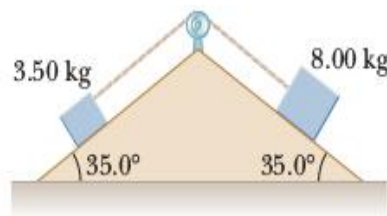


Fig. 2

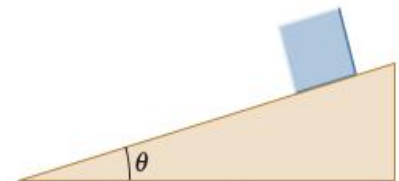


Fig. 3

- Two blocks of mass 3.50 kg and 8.00 kg are connected by a massless string that passes over a frictionless pulley (Fig. 2). The inclines are frictionless. Find
 A) the magnitude of the acceleration of each block and
 B) the tension in the string.
- A block is given an initial velocity of 5.00 m/s up a frictionless incline of angle $\theta = 30.0^\circ$ (Fig.3). How far up the incline does the block slide before coming to rest?
- Three objects are connected on a table as shown in Figure 4. The coefficient of kinetic friction between the block of mass m_2 and the table is 0.4. The objects have masses of $m_1 = 4.00\text{ kg}$, $m_2 = 1.00\text{ kg}$, and $m_3 = 2.00\text{ kg}$, and the pulleys are frictionless.
 A) Determine the acceleration of each object, including its direction.
 B) Determine the tensions in the two cords.

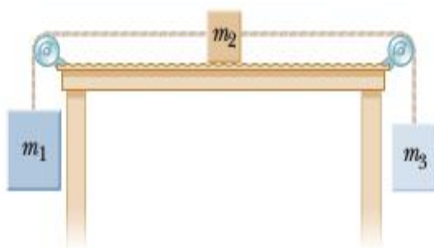


Fig. 4



Fig. 5

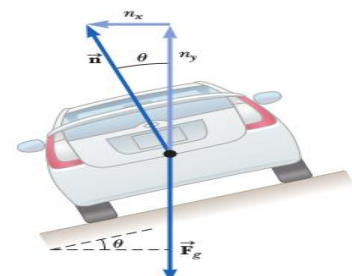


Fig. 6

- A 1500 kg car moving on a flat, horizontal road negotiates a curve as shown in Fig. 5. If the radius of the curve is 40 m and the coefficient of static friction between the tires and dry pavement is 0.5, find the maximum speed the car can have and still make the turn successfully.
- A civil engineer wishes to redesign the curved roadway in such a way that a car will not have to rely on friction to round the curve without skidding. In other words, a car moving at the designated speed can negotiate the curve even when the road is covered with ice. Such a road is usually banked, which means that the road-way is tilted toward the inside

of the curve as seen in the opening photograph for this chapter. Suppose the designated speed for the road is to be 15 and the radius of the curve is 30 m. At what angle should the curve be banked (see Fig. 6)?

- 10] A 1 500 kg car traveling east with a speed of 25.0 m/s collides at an intersection with a 2 500 kg truck traveling north at a speed of 20.0 m/s as shown in Figure 7. Find the direction and magnitude of the velocity of the wreckage after the collision, assuming the vehicles stick together after the collision.

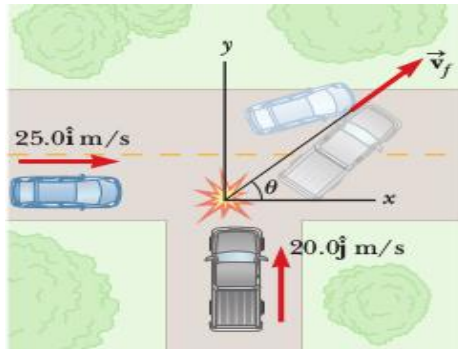


Fig. 7

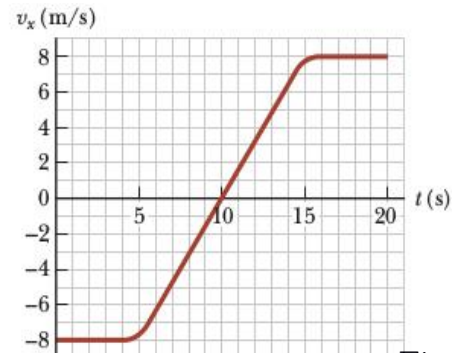
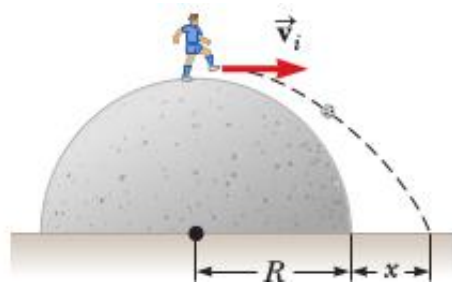


Fig. 8

Kinematics [Unit 3]

- 11] An object moves along the x axis according to the equation $x = 3t^2 + 2t - 3$, where x is in meters and t is in seconds. At what time is the object at rest?
- 12] A velocity–time graph for an object moving along the x axis is shown in Figure 8.
 A] Plot a graph of the acceleration versus time.
 B] Determine the average acceleration of the object in the time interval $t = 5\text{ s}$ to $t = 15\text{ s}$ and in the time interval $t = 0$ to $t = 20\text{ s}$.
- 13] At $t = 0$, one toy car is set rolling on a straight track with initial position 15 cm, initial velocity 25 cm/s, and constant acceleration 2.5 cm/s^2 . At the same moment, another toy car is set rolling on an adjacent track with initial position 10 cm, initial velocity 15 cm/s, and constant acceleration zero. At what time, if any, do the two cars have equal speeds?
- 14] A ball is thrown upward from the ground with an initial speed of 25 m/s; at the same instant, another ball is dropped from a building 15 m high. After how long will the balls be at the same height above the ground?
- 15] Two objects move with initial velocity 28 m/s, final velocity 16 m/s, and constant accelerations.
 A] The first object has displacement 20.0 m. Find its acceleration.
 B] The second object travels a total distance of 22.0 m. Find its acceleration.
- 16] A certain light truck can go around a curve having a radius of 150 m with a maximum speed of 32.0 m/s. To have the same acceleration, at what maximum speed can it go around a curve having a radius of 75.0 m?
- 17] The vector position of a particle varies in time according to the expression $\mathbf{r} = 3\mathbf{i} + 6t\mathbf{j}$, where $\mathbf{r}$ is in meters and t is in seconds. Calculate the particle's position and velocity at $t = 1\text{ s}$.
- 18] A rock is thrown upward from level ground in such a way that the maximum height of its flight is equal to its horizontal range R. At what angle θ is the rock thrown?
- 19] The speed of a projectile when it reaches its maximum height is one-half its speed when it is at half its maximum height. What is the initial projection angle of the projectile?
- 20] A person standing at the top of a hemispherical rock of radius R kicks a ball (initially at rest on the top of the rock) to give it horizontal velocity v_i as shown in Fig. 9.
 A] What must be its minimum initial speed if the ball is never to hit the rock after it is kicked?
 B] With this initial speed, how far from the base of the rock does the ball hit the ground?

Fig. 9



Vectors [Unit 2]

- 21] A particle undergoes 3 consecutive displacements: $r_1 = (5\mathbf{i} + \mathbf{j} - \mathbf{k})\text{cm}$, $r_2 = (\mathbf{i} - \mathbf{j} + 2\mathbf{k})\text{cm}$, and $r_3 = (3\mathbf{i} - 4\mathbf{j} + \mathbf{k})\text{cm}$. Find the unit-vector in the direction of the resultant vector.
- 22] Consider the two vectors $A = 3\mathbf{i} - 2\mathbf{j}$ and $B = 4\mathbf{i} + \mathbf{j}$. At what angle does the magnitude of $|A + B|$ equals to $|A - B|$?
- 23] Consider the S three displacement vectors $A = (3\mathbf{i} + 3\mathbf{j})\text{m}$, $B = (\mathbf{i} + 4\mathbf{j})\text{m}$, and $C = (2\mathbf{i} - 5\mathbf{j})\text{m}$. Determine the magnitude and direction of $R = 2A - 3B + 4C$.
- 24] Three displacement vectors of a croquet ball are shown in Figure 9, where $A = 20$ units, $B = 40$ units, and $C = 30$ units. Find the resultant in unit vector notation and magnitude and direction of the resultant displacement.

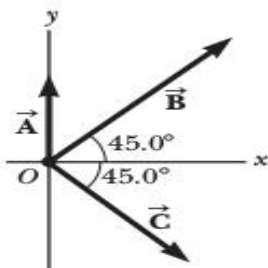


Fig. 8

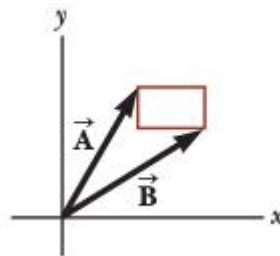


Fig. 9

- 25] Taking $A = (6\mathbf{i} - 8\mathbf{j})$ units, $B = (8\mathbf{i} + 4\mathbf{j})$ units, and $C = (2\mathbf{i} + 4\mathbf{j})$ units, determine a and b such that $aA + bB + C = 0$.
- 26] The rectangle shown in Figure 9 has sides parallel to the x and y axes. The position vectors of two corners are $A = 10\text{ m}$ at 53° and $B = 20\text{ m}$ at 45° . Find the perimeter of the rectangle.
- 27] Two vectors A and B have precisely equal magnitudes. For the magnitude of $|A + B|$ to be 100 times larger than the magnitude of $|A - B|$, what must be the angle between them?
- 28] A vector is given by $R = 2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$. Find the angles between R and the x , y , and z axes.
- 29] Vectors A and B have equal magnitudes of 5.00 . The sum of A and B is $6\mathbf{j}$. Determine the angle between A and B .
- 30] Given the displacement vectors $A = (3\mathbf{i} + 4\mathbf{j} - 4\mathbf{k})\text{m}$ and $B = (2\mathbf{i} + 3\mathbf{j} - 7\mathbf{k})\text{m}$ are the two sides of a triangle, find the area of the triangle.

Physics and measurement [Unit 1]

- 31] A solid cube of aluminum (density 2.7 g/cm^3) has a volume of 0.20 cm^3 . Determine the mass of the cube?
- 32] A rectangular plate has a length of $(40.0 \pm 0.3)\text{ cm}$ and a width of $(8.00 \pm 0.2)\text{ cm}$. Find the area of the plate and the uncertainty in the calculated area.
- 33] One gallon of paint (volume $= 4.00 \times 10^{-3}\text{ m}^3$) covers an area of 20.0 m^2 . What is the thickness of the paint on the wall?
- 34] Determine the number of significant figures in the following measured values:
 A] 23 cm B] 3.589 s C] $4.67 \times 10^3\text{ m/s}$ D] 0.0032 m .
- 35] The radius of a circle is measured to be $10.5 \pm 0.2\text{ m}$. Calculate the area and circumference of the circle and give the uncertainty in each value.

- 36] Carry out the following arithmetic operations:
- A] the sum of the measured values 756, 37.2, 0.83, and 2.5;
 - B] the product 0.0030×300
- 37] Which of the following statement is correct about errors in measurement?
- A] Experimental error is the same as a mistake.
 - B] Errors occur in every scientific investigation.
 - C] Errors make measured values same as accepted value.
 - D] Errors can be avoided by using modern measuring instruments.
- 38] What can be concluded when the number of significance figures increases?
- A] True reading increases
 - B] Uncertainty in increases
 - C] Precision increases
 - D] Accuracy increases
- 39] A grade 11 physics teacher ordered four of his students to measure the length of a class room. He provided them the following length measuring instruments. The instruments are meter rule with millimeter division, vernier calipers, micrometer screw gauge and meter tape with centimeter scale, but its zero reading is not visible. Which one of these instruments is appropriate for the task?
- A] Meter rule
 - B] Meter tape
 - C] Vernier calipers
 - D] Micrometer screw gauge
- 40] Which one of the following grammatical representation displays both inaccurate and imprecise?

