

- (1D Kinematics)** An unidentified flying object (UFO) flies from the Manhattan Beach to Brooklyn College along the Ocean Avenue. It flies for 3000 m arriving at Ave. Z with a constant speed of 10 m/s. It then accelerates its speed from Ave. Z to Ave. M at which the UFO's speed is 100 m/s. From Ave. M to Brooklyn College, the UFO's speed decreases to zero when it arrives at Brooklyn College, traveling another 3000 m.

  - How long it takes for the UFO to fly from Manhattan Beach and Ave. Z? Ans.  $\frac{3000}{10} = 300$  s
  - What is value of acceleration from Ave. Z to M if the distance between the two avenues is 6000 m?  
Ans.  $0.825 \text{ m/s}^2$
  - How long does the UFO fly from Ave. Z to Ave. M? Ans.  $\frac{6000}{100} = 60$  s
  - What is the value of de-acceleration between Ave. M and Brooklyn College? Ans.  $\frac{100^2}{2 \times 3000} = 1.67 \text{ m/s}^2$
  - How long does the UFO fly from Ave. M to Brooklyn College? Ans.  $\frac{3000}{100} = 30$  s
- (2D kinematics)** As shown in Fig.3, an object is launched from a 60-m hill top with a speed of 25 m/s in an angle of 45 degree from horizontal and lands on the ground. Use  $g = 10 \text{ m/s}^2$  for this and following problems.

  - What is horizontal initial launching speed? Ans.  $25 \cos 45 = 17.7 \text{ m/s}$
  - How long does the object take to reach to the maximum height? Ans.  $\frac{25 \sin 45}{g} = 1.77 \text{ s}$
  - What is the maximum height the object can reach above the ground? Ans.  $60 + \frac{(25 \sin 45)^2}{2g} = 75.63 \text{ m}$
  - How far horizontally the object can reach away from the hill when it lands? Ans.  $2 \times 17.7 \times 1.77 = 63.1 \text{ m}$
  - What is the vertical component of the velocity just before the object hits the ground? Ans.  $25 \sin 45 = 17.7 \text{ m/s}$
  - What is the horizontal speed just before it hits the ground? Ans.  $17.7 \text{ m/s}$
  - What is the magnitude of object's final velocity just before it hits the ground? Ans.  $25 \text{ m/s}$
- (Newton's Laws, gravitation, normal force, and friction force)** As shown in Fig.1, two objects (M, m) are connected by a rope.  $M = 100 \text{ kg}$ ,  $m = 40 \text{ kg}$ , and  $\theta = 30^\circ$ . The dynamic friction coefficient between the slope surface and object M is 0.01. Find:

  - Normal force on object M? Ans.  $100 \times 9.8 \cos 30 = 866 \text{ N}$  (indicate the direction on Fig. 1)
  - Dynamic friction force on the object M? Ans.  $0.01 \times 866 = 8.66 \text{ N}$  (indicate the direction on Fig. 1)
  - Gravitational force on the object M? Ans.  $1000 \text{ N}$  (indicate the direction on Fig. 1)
  - The acceleration of object M? Ans.  $0.65 \text{ m/s}^2$  (indicate the direction on Fig. 1)
  - The acceleration of object m? Ans.  $0.65 \text{ m/s}^2$  (indicate the direction on Fig. 1)
  - The value of tension in the rope? Ans.  $426 \text{ N}$

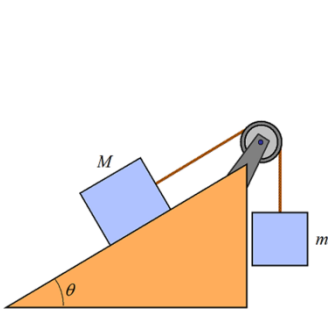


Fig. 1

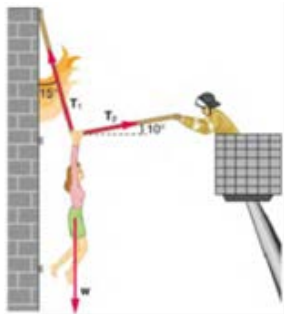


Fig.2

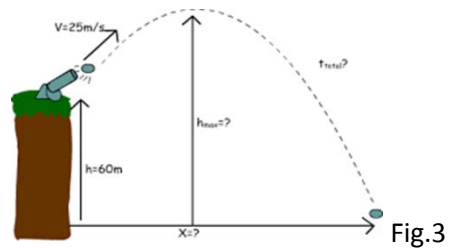


Fig.3

- (Newton's Laws, tension)** A 50-kg person is being pulled away with a constant speed from a burning building as shown in Fig.2. Find (a) the tension  $T_1$  in left rope, Ans.  $494 \text{ N}$  (b) the tension  $T_2$  in right rope, Ans.  $130 \text{ N}$

Kinematics ( $a = 0$ )	$x = v_0 t$		
Kinematics ( $a \neq 0$ )	$v = v_0 + at$	$x = x_0 + v_0 t + (1/2)at^2$	$v^2 = v_0^2 + 2a(x - x_0)$
Newton's Laws	$\mathbf{V}_0$ remains with $\mathbf{F}_{\text{net}} = 0$	$\mathbf{F}_{\text{net}} = m\mathbf{a}$	$\mathbf{F}_1 = -\mathbf{F}_2$