Practice Problem Set 8: Engineering Mechanics (NMEC101)
Kinematics of Particles

Instruction: Figure numbers correspond to the problem numbers.

1. Point A oscillates with an acceleration $a = 40 - 160x$, where a and x are expressed in 2 m/s and meters, respectively. The magnitude of the velocity is 0.3 m/s when $x = 0.4$ m. Determine (a) the maximum velocity of A, (b) the two positions at which the velocity of A is zero.

2. The acceleration of point A is defined by the relation $a = 600x\,(1 + kx)$, where a and x are expressed in m/s^2 and m, respectively, and k is a constant. Knowing that the velocity of A is 7.5 m/s when $x = 0$ and 15 m/s when $x = 0.45$ m, determine the value of k.

3. Collar A starts from rest and moves to the right with a constant acceleration. Knowing that after 8 s the relative velocity of collar B with respect to collar A is 610 mm/s, determine (a) the accelerations of A and B, (b) the velocity and the change in position of B after 6 s.

4. Instruments in airplane A indicate that with respect to the air the plane is headed 30° north of east with an airspeed of 480 km/h. At the same time radar on ship B indicates that the relative velocity of the plane with respect to the ship is 416 km/h in the direction 33° north of east. Knowing that the ship is steaming due south at 20 km/h, determine (a) the velocity of the airplane, (b) the wind speed and direction.

5. At t = 0, wedge A starts moving to the left with a constant acceleration of 80 mm/s^2 and block B starts moving along the wedge toward the right with a constant acceleration of 120 mm/s^2 relative to the wedge. Determine (a) the acceleration of block B, (b) the velocity of block B when t = 3 s.

6. Racing cars A and B are traveling on circular portions of a race track. At the instant shown, the speed of A is decreasing at the rate of 8 m/s, and the speed of B is increasing at the rate of 3m/s . For the positions shown, determine (a) the velocity of B relative to A, (b) the acceleration of B relative to A.

7. A test rocket is fired vertically from a launching pad at B. When the rocket is at P the angle of elevation is $\theta = 47.0°$, and 0.5 s later it is $\theta = 48.0°$. Knowing that b = 4 km, determine approximately the speed of the rocket during the 0.5-s interval.

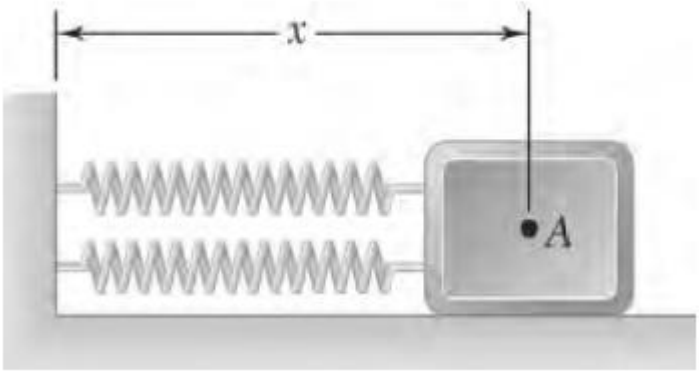

Fig. 1

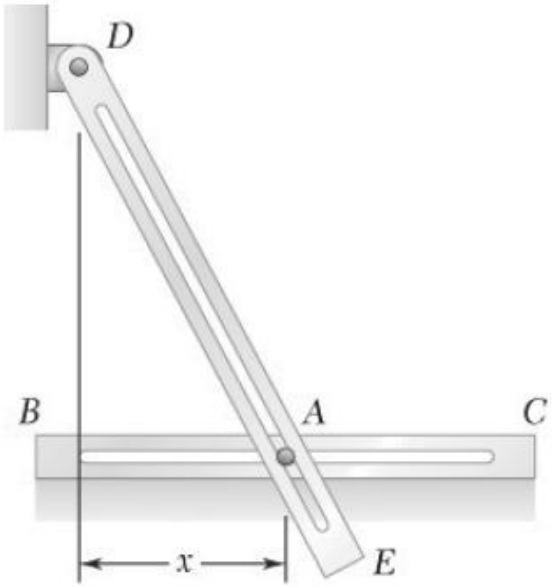

Fig. 2

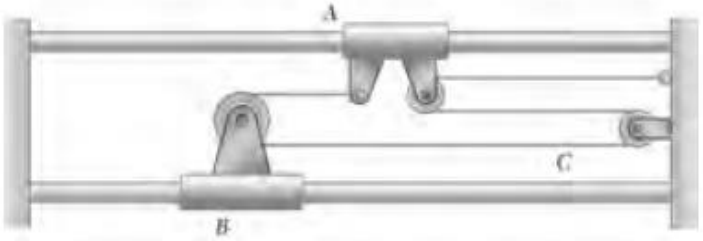

Fig. 3

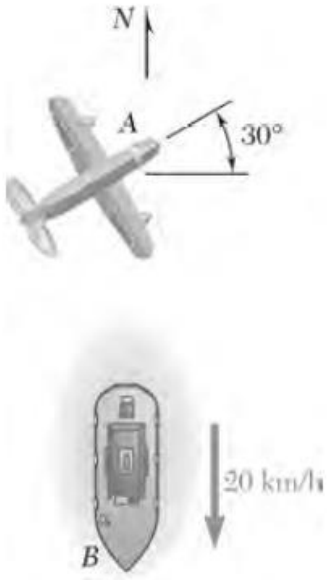

Fig. 4

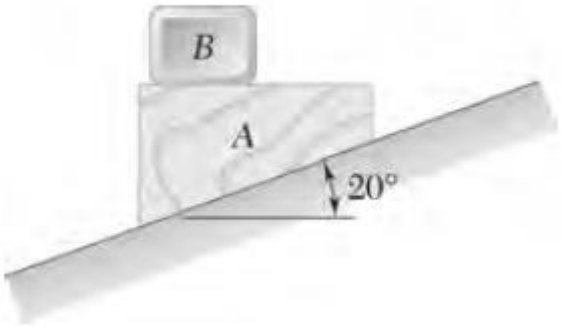

Fig. 5

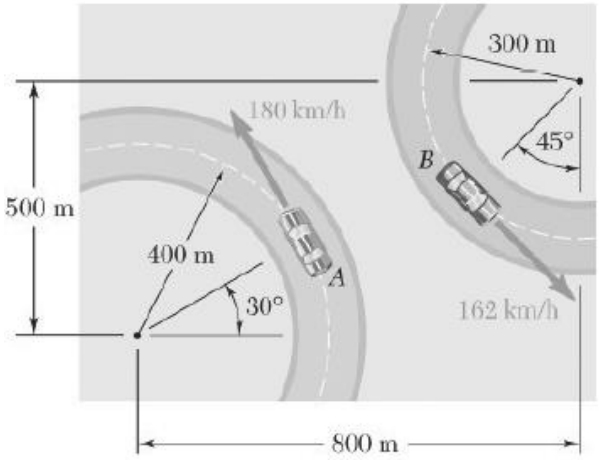

Fig. 6

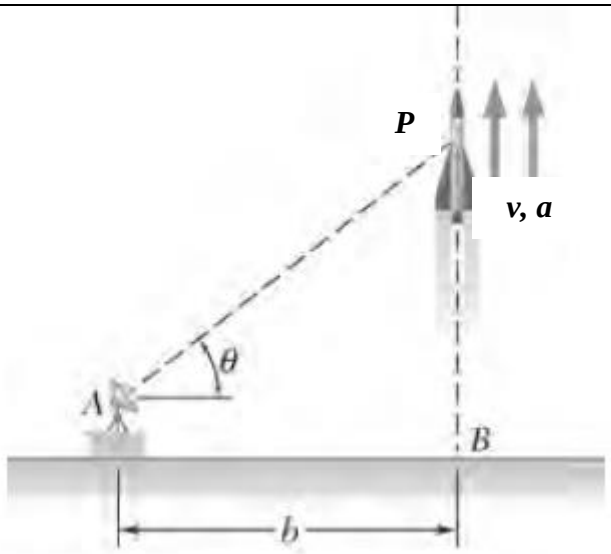

Fig. 7