1. The bar is smooth. The 10-kg slider at $A$ is given a downward velocity of 7.5 m/s. (as shown in Fig. 1) (20%)
   (a) Determine whether the slider will reach point $C$. If it does, what is the magnitude of its velocity at point $C$?
   (b) Determine whether the slider will reach point $D$. If it does, what is the magnitude of its velocity at point $D$?
   (c) What is the magnitude of the normal force the bar exerts on the slider as it passes point $B$?

![Figure 1](image1.png)

2. A ball is given a horizontal velocity of 3 m/s at 2 m above the smooth floor (as shown in Fig. 2). Determine the distance $D$ between the ball’s first and second bounces if the coefficient of restitution is $e = 0.6$. (15%)

![Figure 2](image2.png)
3. The car is traveling at 48 km/h when the traffic light 90 m ahead turns yellow (as shown in Fig. 3). The driver takes one second to react before he applies the brakes. (15%)
   (a) After he applies the brakes, what constant rate of deceleration will cause the car to come to a stop just as it reaches the light?
   (b) How long does it take the car to travel the 90 m?

![Figure 3]

4. The motorcycle shown in Fig. 4 has a mass of 125 kg and a center of mass at \( G_1 \), while the rider has a mass of 75 kg and a center of mass at \( G_2 \). Determine the minimum coefficient of static friction between the wheels and the pavement in order for the rider to do a “wheely,” i.e., lift the front wheel off the ground as shown in the photo. What acceleration is necessary to do this? Neglect the mass of the wheels and assume that the front wheel is free to roll. (25%)

![Figure 4]
5. Consider the mechanical system shown in Fig. 5. If the numerical values of $m$, $b$, $k$, $P$, and $\omega$ are given as $m = 10$ kg, $b = 30$ N-s/m, $k = 500$ N/m, $P = 10$ N, and $\omega = 2$ rad/s, what is the steady state response output of $x(t)$? The displacement $x$ is measured from the equilibrium position before the input $p(t)$ is given. (25%)