Ain Shams University
Faculty of Engineering
Physics & Mathematics Department
PHM132s - MECHANICS II (DYNAMICS)
SPRING 2024

Assignment (1)
Ch. 12 Kinematics of Particle

Name:			
ID:			
Group:		**Section:**	
Due Date: **Wednesday 3/4/2024 @ 12:30 PM**			

Q1)

The motion of a particle is defined by the relation $x = t^3 - 6t^2 - 36t - 40$, where x and t are expressed in feet and seconds, respectively. Determine (a) when the velocity is zero, (b) the velocity, the acceleration, and the total distance traveled when $x = 0$.

Q2)

The acceleration of a particle is defined by the relation $a = -8\ \text{m/s}^2$. Knowing that $x = 20$ m when $t = 4$ s and that $x = 4$ m when $v = 16$ m/s, determine (a) the time when the velocity is zero, (b) the velocity and the total distance traveled when $t = 11$ s.

Q3)

The acceleration of a particle is defined by the relation $a = -k/x$. It has been experimentally determined that $v = 15$ ft/s when $x = 0.6$ ft and that $v = 9$ ft/s when $x = 1.2$ ft. Determine (a) the velocity of the particle when $x = 1.5$ ft, (b) the position of the particle at which its velocity is zero.

Q4)

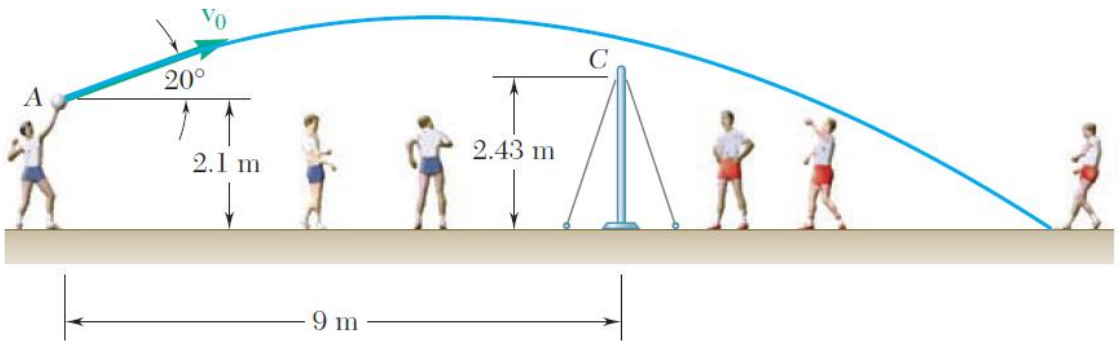
The acceleration of a particle is defined by the relation $a = -k\sqrt{v}$, where k is a constant. Knowing that $x = 0$ and $v = 81$ m/s at $t = 0$ and that $v = 36$ m/s when $x = 18$ m, determine (a) the velocity of the particle when $x = 20$ m, (b) the time required for the particle to come to rest.

Q5)

The acceleration due to gravity of a particle falling toward the earth is $a = -gR^2/r^2$, where r is the distance from the *center* of the earth to the particle, R is the radius of the earth, and g is the acceleration due to gravity at the surface of the earth. If $R = 3960$ mi, calculate the *escape velocity*, that is, the minimum velocity with which a particle must be projected vertically upward from the surface of the earth if it is not to return to the earth. (*Hint:* $v = 0$ for $r = \infty$.)

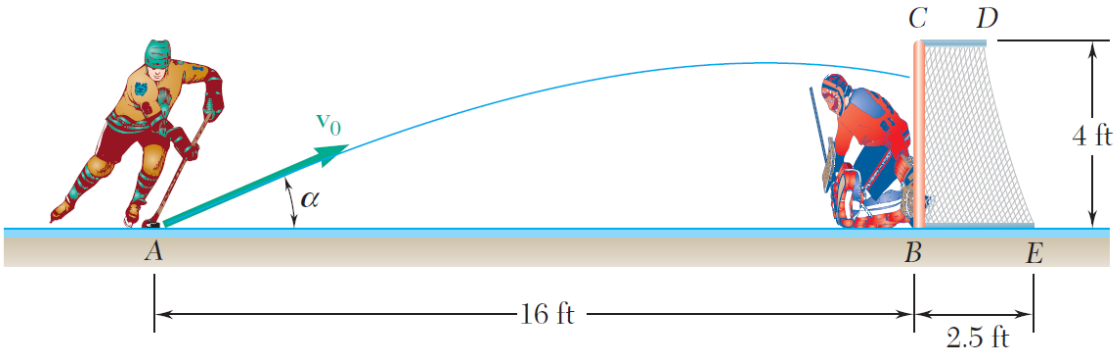
Q6)

A volleyball player serves the ball with an initial velocity $\mathbf{v}_0$ of magnitude 13.40 m/s at an angle of 20° with the horizontal. Determine (*a*) if the ball will clear the top of the net, (*b*) how far from the net the ball will land.



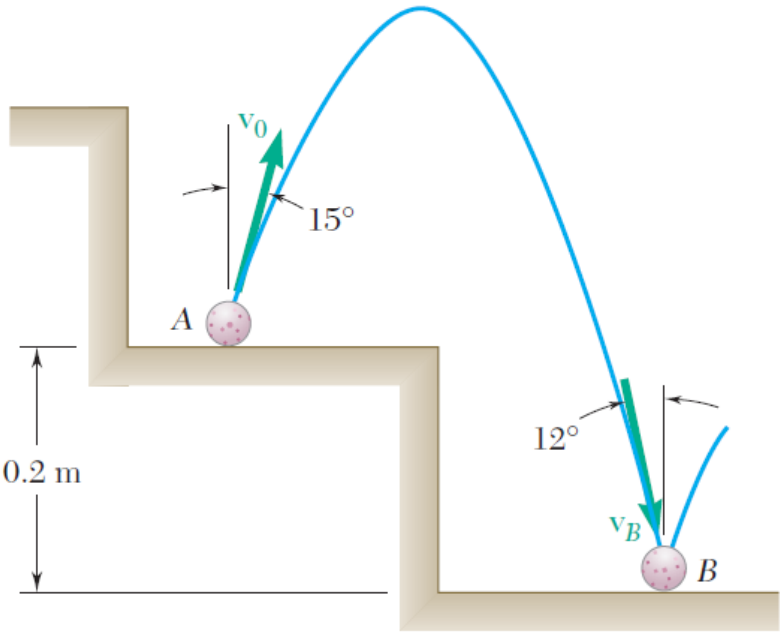
Q7)

The initial velocity $\mathbf{v}_0$ of a hockey puck is 105 mi/h. Determine (*a*) the largest value (less than 45°) of the angle α for which the puck will enter the net, (*b*) the corresponding time required for the puck to reach the net.



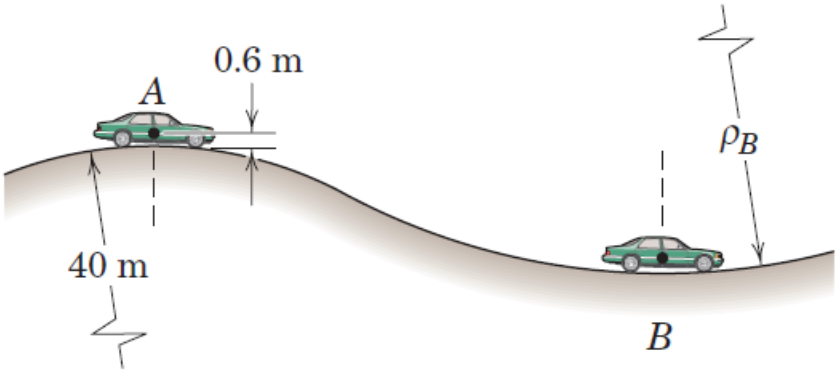
Q8)

A ball is dropped onto a step at point *A* and rebounds with a velocity $\mathbf{v}_0$ at an angle of 15° with the vertical. Determine the value of v_0 knowing that just before the ball bounces at point *B* its velocity $\mathbf{v}_B$ forms an angle of 12° with the vertical.



Q9)

The speed of a car increases uniformly with time from 50 km/h at A to 100 km/h at B during 10 seconds. The radius of curvature of the hump at A is 40 m. If the magnitude of the total acceleration of the mass center of the car is the same at B as at A, compute the radius of curvature ρ_B of the dip in the road at B. The mass center of the car is 0.6 m from the road.



Q10)

A particle which moves with curvilinear motion has coordinates in meters which vary with time t in seconds according to $x = 2t^2 + 3t - 1$ and $y = 5t - 2$. Determine the coordinates of the center of curvature C at time $t = 1$ s.