

ME 104: Homework 1

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Due Tuesday, September 8th

Chapter 11, Problem 2

The motion of a particle is defined by the relation $x = 12t^3 - 18t^2 + 2t + 5$, where x and t are expressed in meters and seconds, respectively. Determine the position and the velocity when the acceleration of the particle is equal to zero.

Chapter 11, Problem 4

The motion of a particle is defined by the relation $x = 6t^2 - 8 + 40 \cos \pi t$, where x and t are expressed in inches and seconds, respectively. Determine the position, the velocity, and the acceleration when $t = 6$ s.

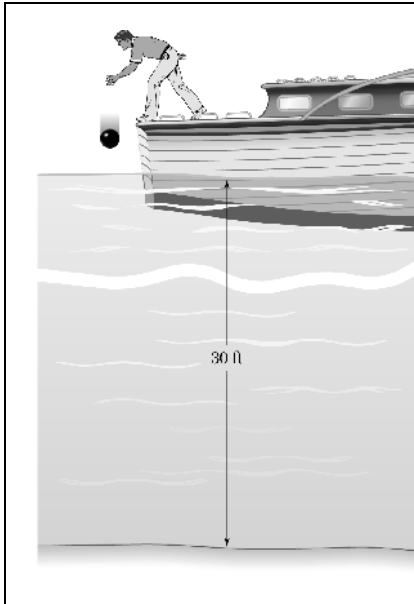
Chapter 11, Problem 7

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 $x = 0$.

Chapter 11, Problem 10

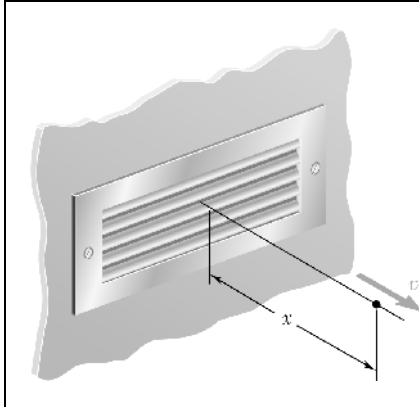
The acceleration of a particle is directly proportional to the square of the time t . When $t = 0$, the particle is at $x = 24$ m. Knowing that at $t = 6$ s, $x = 96$ m and $v = 18$ m/s, express x and v in terms of t .

Chapter 11, Problem 24



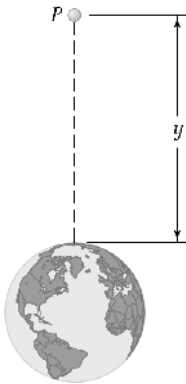
A bowling ball is dropped from a boat so that it strikes the surface of a lake with a speed of 25 ft/s. Assuming the ball experiences a downward acceleration of $a = 10 - 0.9v^2$ when in the water, determine the velocity of the ball when it strikes the bottom of the lake.

Chapter 11, Problem 28



Experimental data indicate that in a region downstream of a given louvered supply vent, the velocity of the emitted air is defined by $v = 0.18v_0/x$, where v and x are expressed in m/s and meters, respectively, and v_0 is the initial discharge velocity of the air. For $v_0 = 3.6$ m/s, determine (a) the acceleration of the air at $x = 2$ m, (b) the time required for the air to flow from $x = 1$ to $x = 3$ m.

Chapter 11, Problem 29

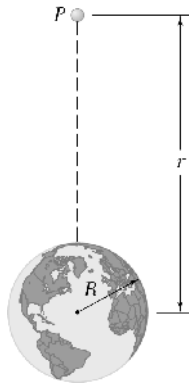


The acceleration due to gravity at an altitude y above the surface of the earth can be expressed as

$$a = \frac{-32.2}{[1 + (y/20.9 \times 10^6)]^2}$$

where a and y are expressed in ft/s^2 and feet, respectively. Using this expression, compute the height reached by a projectile fired vertically upward from the surface of the earth if its initial velocity is (a) 1800 ft/s, (b) 3000 ft/s, (c) 36,700 ft/s.

Chapter 11, Problem 30

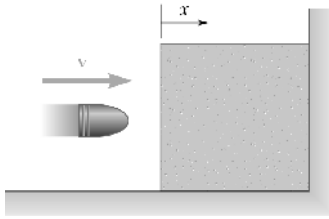


The acceleration due to gravity of a particle falling toward the earth is $a = -gR^2/r^2$, where r is the distance from the *center* of the earth to the particle, R is the radius of the earth, and g is the acceleration due to gravity at the surface of the earth. If $R = 3960$ mi, calculate the *escape 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 $r = \infty$.)

Chapter 11, Problem 183

The acceleration of a particle is defined by the relation $a = -60x^{-1.5}$, where a and x are expressed in m/s^2 and meters, respectively. Knowing that the particle starts with no initial velocity at $x = 4$ m, determine the velocity of the particle when (a) $x = 2$ m, (b) $x = 1$ m, (c) $x = 100$ mm.

Chapter 11, Problem 184



A projectile enters a resisting medium at $x = 0$ with an initial velocity $v_0 = 900$ ft/s and travels 4 in. before coming to rest. Assuming that the velocity of the projectile is defined by the relation $v = v_0 - kx$, where v is expressed in ft/s and x is in feet, determine (a) the initial acceleration of the projectile, (b) the time required for the projectile to penetrate 3.9 in. into the resisting medium.