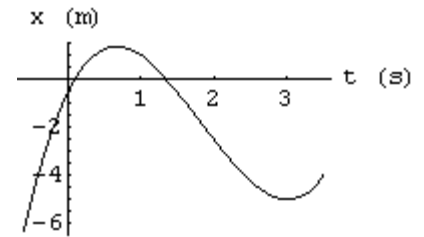


**Possibly Useful Information:** 1000 liter = 1 m<sup>3</sup>    1 ft = 0.3048 m    1 hr = 3600 s    g = 9.80 m/s<sup>2</sup>

**Problem 1** Multiple Choice (4 points each)



\_\_\_\_\_ [i] In the graph describe the velocity and acceleration at  $t = 0$ .

- (a)  $v < 0, a < 0$     (b)  $v < 0, a = 0$     (c)  $v < 0, a > 0$   
 (d)  $v = 0, a < 0$     (e)  $v = 0, a = 0$     (f)  $v = 0, a > 0$   
 (g)  $v > 0, a < 0$     (h)  $v > 0, a = 0$     (i)  $v > 0, a > 0$

\_\_\_\_\_ [ii] When a ball is dropped out of a window it hits the ground at a speed of 12 m/s. If the ball were thrown horizontally out of the same window at a speed of 5 m/s, then what would be its speed when it hits the ground?

- (a) 0 m/s    (b) 5 m/s    (c) 7 m/s    (d) 12 m/s    (e) 13 m/s    (f) 17 m/s    (g) none of the above

\_\_\_\_\_ [iii] A car decreases its speed while turning right. What is the direction of its acceleration?

- (a) left    (b) right    (c) forward    (d) backward    (e) left and forward    (f) left and backward  
 (g) right and forward    (h) right and backward    (i) cannot be determined

\_\_\_\_\_ [iv] A 120 lb man stands in an elevator that moves upward and has an downward acceleration of  $g/4$ . What is the normal force of the floor on the man?

- (a) 30 lb    (b) 90 lb    (c) 120 lb    (d) 150 lb    (e) 480 lb    (f) none of the above

\_\_\_\_\_ [v] A car moving at 20 mi/hr can stop on a wet surface in a minimum distance of 50 ft. What is the minimum stopping distance if the car moves on the same wet surface at 80 mi/hr? Assume the stopping acceleration is the same in both cases: (a) 50 ft    (b) 100 ft    (c) 200 ft    (d) 400 ft    (e) 800 ft    (f) 1600 ft

**Problem 2** A 23 kg crate is lowered down a frictionless inclined plane at a 48° angle. A person pushes up the incline with a force  $F$  so that the crate moves downward with constant *speed* of 3 m/s. What is  $F$ ? (7 points)

**Problem 3** A golfer hits a ball 210 m to the south for his first shot. His second shot is 80 m in the direction 25° south of west and his third shot is 30 m to the west. What is the net displacement of the ball? Also what are the magnitude and direction angle of the displacement? (8 points)

**Problem 4** (6 points each)

(a) A ball is thrown straight upward from a 6 m high window at 12 m/s. How long is does it take until the ball hits the ground?

(b) Water flows through a pipe at a rate of 300 ft<sup>3</sup>/hr. What is this in liter/s?

(c) What is the *smallest* speed that one must hit a golf ball to travel a horizontal distance of 280 m in the air on a level fairway?

**Problem 5** (7 points each)

(a) Junior pulls his 12 kg sled along a horizontal icy (frictionless) surface. If he pulls with a rope that makes an angle of 40° from horizontal, then what tension is necessary to give the sled a forward acceleration of 1.5 m/s<sup>2</sup>?

(b) A field-goal kicker kicks a football at an angle of 53° with a speed of 23 m/s. What is the speed of the football 3 s after it is kicked?

**Problem 6** (7 points each)

(a) The constants  $c$ ,  $G$  and  $h$  have dimensions:  $[c] = L/T$ ,  $[G] = L^3/(M \cdot T^2)$  and  $[h] = M \cdot L^2/T$ . What must  $m$ ,  $n$  and  $p$  be to make  $c^m G^n h^p$  a mass.

(b) A helicopter accelerates vertically from the ground from rest at  $2 \text{ m/s}^2$ . 3 s after the helicopter leaves the ground a mailbag is dropped from the helicopter. What is the *speed* of the mailbag just before it hits the ground? (The helicopter is moving when the bag is dropped.)

(c) A car drives East at 40 m/s under a bridge with a train moving North at 30 m/s. What is velocity of the train relative to the car? Take East to be the x-direction and North to be the y-direction.

**Problem 7** Suppose the displacement as a function of time for a 150 kg mass is given (in SI units) by:

$$\vec{r}(t) = \langle t^4 - 3t + 5, t^2 + 5t \rangle.$$

(a) What is the *average velocity* of the mass between 0 and 2 s? (6 points)

(b) What is the *magnitude* of the net force acting on the mass at 3 s? (6 points)