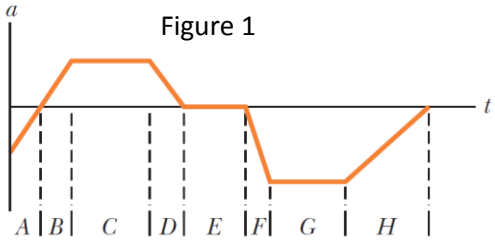
**Chapter 2, selected problems**

**Q1.** **Figure 1** gives the acceleration of a particle as a function of time. In which of the time intervals indicated does the particle move with constant speed?

Figure 1




**A) E**
B) C, G
C) C, E, G
D) A, B, H
E) D, F,

**Ans:**

Constant speed ⟹ Zero acceleration ⟹ E region

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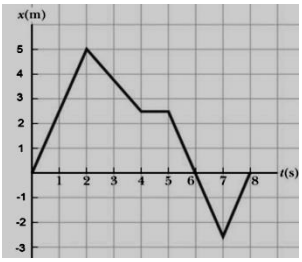
**Q2.** The position versus time for a certain particle moving along the x-axis is shown in **Figure 1**. The average velocity in the time interval 4.0 s to 7.0 s is:

Figure 1




A) – 1.7 m/s
B) Zero
C) 1.7 m/s
D) 0.80 m/s
E) – 0.80 m/s

**Ans:**

$$v = (x_2 - x_1)/(t_2 - t_1) = (-2.5 - 2.5)/3 = -1.7 \text{ m/s}$$

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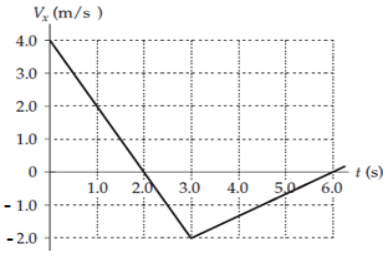
**Q3.** **Figure 1** shows the velocity $V_x$ (m/s) of a particle moving along the x-axis. If x = 2.0 m at t = 1.0 s, what is the position, measured in meters, of the particle at t = 6.0 s?

Figure 1




A) –1
B) –2
C) +1
D) +2
E) +6

**Ans:**

$X_6 - X_1$ = area from t = 1 s – 6 s = ½ (2-1)(2.0) – ½ (6 – 2)(2.0) =1 – 4 = -3.0 m

$X_6 - 2.0 = -3.0$ ➔ $X_6$ = -1.0 m

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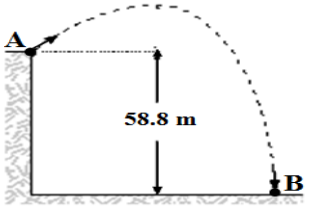
**Q4.** A stone is thrown outward from point A at the top of a 58.8 m high cliff with an upward velocity component of 19.6 m/s (see **Figure 2**). Assume that it lands on the ground, at point B, below the cliff, and that the ground below the cliff is flat. How long was the stone in the air? [Neglect the air resistance].

Figure 2




A) 6.00 s
B) 5.00 s
C) 4.00 s
D) 7.00 s
E) 8.00 s

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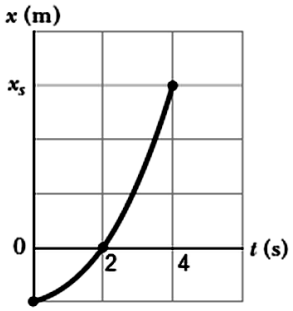
**Q5.** **Figure 3** illustrates the motion of a particle starting from rest and moving along an x-axis with a constant acceleration. The figure's vertical scaling is set by $x_s$ = 12 m. The particle's acceleration is

A) 2.0 m/s$^2$
B) 0.50 m/s$^2$
C) – 6.0 m/s$^2$
D) 6.0 m/s$^2$
E) –3.0 m/s$^2$

Figure 3

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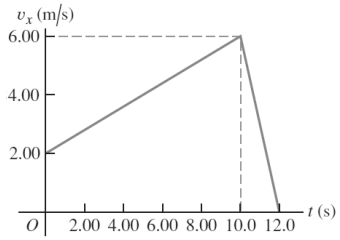
**Q6.** A ball is thrown directly downward from a height of 30.0 m. It takes 1.79 s to reach the ground. Find the magnitude of the initial velocity.

A) 7.99 m/s
B) 1.66 m/s
C) 10.0 m/s
D) 2.00 m/s
E) 3.75 m/s

**Q7.** A man is running in a straight line (along the x-axis). The graph in **Figure 4** shows the man's velocity as a function of time. During the first 12.0 s, the total distance traveled is

A) 46.0 m
B) Zero
C) 40.0 m
D) 8.00 m
E) 72.0 m

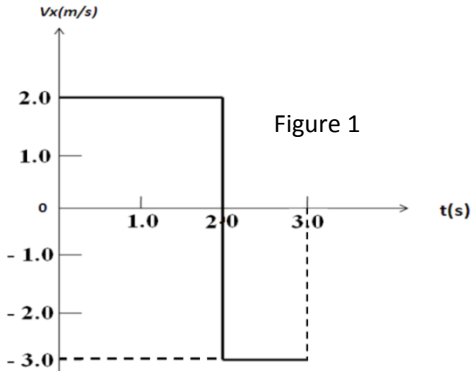
Figure 4




**Q8.** A ball moves in a straight line along the x-axis and **Figure 1** shows its velocity as a function of time t. What is the ball average velocity and average speed, respectively, over a period of 3.00 s.

A) 0.330 m/s, 2.33 m/s
B) 2.33 m/s , 0.330 m/s
C) 2.33 m/s , 2.33 m/s
D) 1.66 m/s, 2.33 m/s
E) 2.33 m/s, 1.66 m/s

Figure 1

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**Q9.** The position of an object moving along the *x*-axis is given by $x = 6.0 - 6.0\,t + 3.0\,t^2$, where *x* is in meters and *t* in seconds. Which statement about this object is ***correct***?

A) The object is momentarily at rest at $t$ = 1.0 s.

B) The object position is negative at t = 0 s.
C) The acceleration of the object is zero at t = 0 s.
D) The acceleration of the object is positive at all times.
E) The object is momentarily at rest at t = 2.0 s.

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**Q10.** A rock is thrown vertically upward from ground level at time $t$ =0.0 s. At $t$ =1.5 s it passes the top of a tall tower, and then 1.0 s later it reaches its maximum height. What is the height of the tower?

A) 26 m
B) 62 m
C) 36 m
D) 16 m
E) 20 m

---

**Q10.** At time $t$ = 0, a particle had a speed of 20 m/s in the positive $x$ direction. At time $t$ = 2.5 s, its speed was 40 m/s in the opposite direction. Find the average acceleration of the particle during the 2.5 s interval.

**A) -24 m/s$^2$**
B) +18 m/s$^2$
C) -8.0 m/s$^2$
D) +20 m/s$^2$
E) -30 m/s$^2$

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**Q11.** A car travels in a straight line. First, it starts from rest at point A and accelerates at a rate of 5.00 m/s$^2$ until it reaches a speed of 100 m/s at point B. The car then slows down at a constant rate of 8.00 m/s$^2$ until it stops at point C. Find the time the car takes for this trip (from point A to point C).

**A) 32.5 s**
B) 25.0 s
C) 10.5 s
D) 15.0 s
E) 45.0 s

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**Q12.** A parachutist jumps from an airplane at an altitude of $5.0\times10^3$ m. He falls with an acceleration g = 9.8 m/s$^2$ for the first 10 s. Then he opens his parachute and falls with a net vertical upward acceleration of 50 m/s$^2$ until his downward speed reaches 20 m/s. How far does he fall vertically downward when his net upward acceleration was 50 m/s$^2$?

**A) 92 m**
B) 50 m
C) 75 m
D) 67 m
E) 45 m

---

**Q13.** A ball is thrown vertically upwards with an initial velocity of 20 m/s. It takes 4.0 s for the ball to come back to its original position. What is the magnitude of the average velocity of the ball for the whole trip? (Neglect air resistance)

A) 0.0 m/s
B) 10 m/s
C) 4.0 m/s
D) 2.0 m/s
E) 5.0 m/s

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**Q14.** The position of a particle moving along an x-axis is given by $x = 6.00\ t^2 - 3.00\ t^3$, where x is in meters and t is in seconds. What is the acceleration of the particle at its maximum x-position?

A) $-12.0\ m/s^2$
B) $15.1\ m/s^2$
C) $-11.2\ m/s^2$
D) $9.51\ m/s^2$
E) $-19.5\ m/s^2$

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**Q15.** A particle is moving along an x-axis with a constant acceleration of $-3.0\ m/s^2$. The velocity of the particle is given by the equation $v\ (t) = 4.0 - 3.0t$, where $v$ is in m/s and t is in seconds. Find the displacement of the particle during the time interval t = 0 to t = 2.0 s.

A) 2.0 m
B) 2.8 m
C) 1.4 m
D) 3.1 m
E) 7.7 m

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**Q16.** A stone is thrown vertically upwards with an initial speed of 4.0 m/s from a window which is 8.0 m above the ground. With what speed will the stone hit the ground? (Neglect air resistance)

A) 13 m/s
B) 1.0 m/s
C) 4.0 m/s
D) 22 m/s
E) 12 m/s

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**Q17.** The position of a particle moving along the *x* axis is given by: $x = 6.0\ t^2 - 1.0\ t^3$, where x is in meters and t is in seconds. What is the position of the particle at the instant when its acceleration is zero?

A) 16 m
B) 12 m
C) 32 m
D) 24 m
E) 20 m

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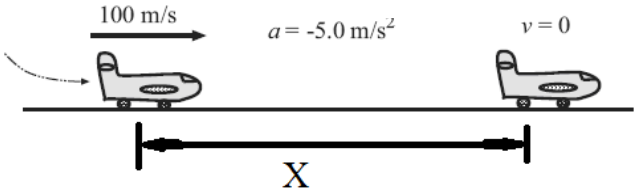
**Q18.** A jet plane lands with a speed of $100\ \text{m/s}$ and decelerates with $a = -5.00\ \text{m/s}^2$ as it comes to rest. From the instant it touches the runway; it moves a distance X and stops, as shown in **Figure 2**. What is the distance X, measured in meters?

Figure 2




A) 1000
B) 800
C) 1100
D) 100
E) 900

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**Q19.** An object is launched vertically upward with an initial speed $v_i$ . The object has an upward velocity of 18 m/s when it reaches one fourth of its maximum height, above its launch point. What is the value of $v_i$ , in m/s?

A) 21
B) 25
C) 30
D) 35
E) 17

## CHAPTER 2 REVIEW QUESTIONS

*For each of the multiple-choice questions below, choose the best answer. Unless otherwise noted, use g = 10 m/s$^2$ and neglect air resistance.*

1. Which of the following statements is true?
(A) Displacement is a scalar and distance is a vector.
(B) Displacement is a vector and distance is a scalar.
(C) Both displacement and distance are vectors.
(D) Neither displacement nor distance are vectors.
(E) Displacement and distance are always equal.

2. Which of the following is the best statement for a velocity?
(A) 60 miles per hour
(B) 30 meters per second
(C) 30 km at 45° north of east
(D) 40 km/hr
(E) 50 km/hr southwest

3. A jogger runs 4 km in 0.4 hr, then 8 km in 0.8 hr. What is the average speed of the jogger?
(A) 10 km/hr
(B) 3 km/hr
(C) 1 km/hr
(D) 0.1 km/hr
(E) 100 km/hr

4. A motorcycle starts from rest and accelerates to a speed of 20 m/s in a time of 8 s. What is the motorcycle's average acceleration?
(A) 160 m/s$^2$
(B) 80 m/s$^2$
(C) 8 m/s$^2$
(D) 2.5 m/s$^2$
(E) 0.4 m/s$^2$

5. A bus starting from a speed of +24 m/s slows to 6 m/s in a time of 3 s. The average acceleration of the bus is
(A) 2 m/s$^2$
(B) 4 m/s$^2$
(C) 6 m/s$^2$
(D) – 2 m/s$^2$
(E) – 6 m/s$^2$

6. A train accelerates from rest with an acceleration of 4 m/s$^2$ for a time of 20 s. What is the train's speed at the end of 20 s?
(A) 0.25 m/s
(B) 4 m/s
(C) 2.5 m/s
(D) 0.8 m/s
(E) 80 m/s

7. A football player starts from rest 10 meters from the goal line and accelerates away from the goal line at 5 m/s$^2$. How far from the goal line is the player after 4 s?
(A) 6 m
(B) 30 m
(C) 40 m
(D) 50 m
(E) 60 m

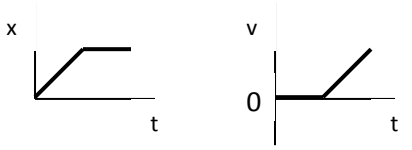
8. A ball is dropped from rest. What is the acceleration of the ball immediately after it is dropped?
(A) zero
(B) 5 m/s$^2$
(C) 10 m/s$^2$
(D) 20 m/s$^2$
(E) 30 m/s$^2$

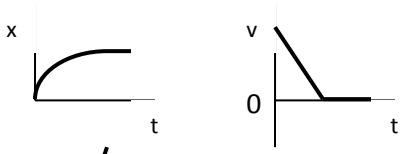
*Questions 9 – 11:*
A ball is thrown straight upward with a speed of +12 m/s.

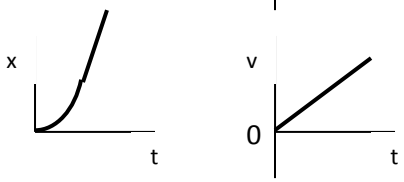
9. What is the ball's acceleration just after it is thrown?
(A) zero
(B) 10 m/s$^2$ upward
(C) 10 m/s$^2$ downward
(D) 12 m/s$^2$ upward
(E) 12 m/s$^2$ downward

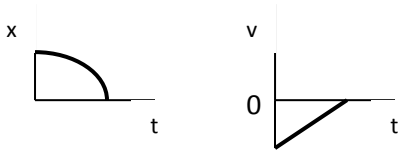
10. How much time does it take for the ball to rise to its maximum height?
(A) 24 s
(B) 12 s
(C) 10 s
(D) 2 s
(E) 1.2 s

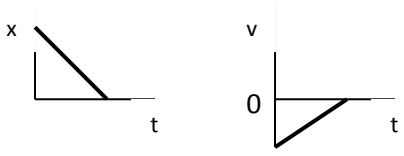
11. What is the approximate maximum height the ball reaches?
(A) 24 m
(B) 17 m
(C) 12 m
(D) 7 m
(E) 5 m

12. Which two of the following pairs of graphs are equivalent?
(A)


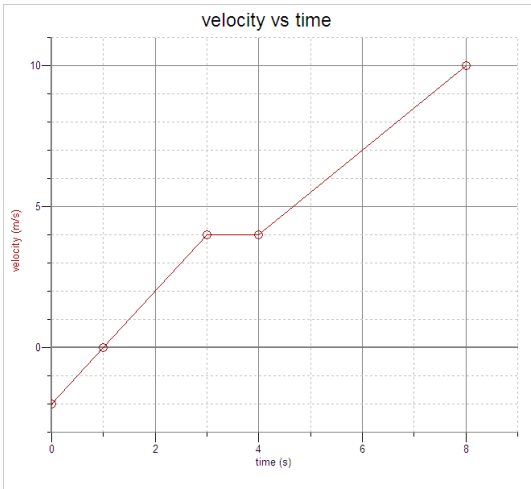
(B)


(C)


(D)


(E)


*Questions 13 – 14:*
Consider the *velocity vs. time* graph below:




13. A which time(s) is the object at rest?
(A) zero
(B) 1 s
(C) 3 s to 4 s
(D) 4 s only
(E) 8 s

14. During which interval is the speed of the object decreasing?
(A) 0 to 1 s
(B) 1 s to 3 s
(C) 3 s to 4 s
(D) 4 s to 8 s
(E) the speed of the object is never decreasing in this graph

**ANSWERS AND EXPLANATIONS TO CHAPTER 2 REVIEW QUESTIONS**

**Multiple Choice**

1. B
Displacement is the straight-line length from an origin to a final position and includes direction, whereas distance is simply length moved.

2. E
Velocity is a vector and therefore direction should be included.

3. A
Average speed is total distance divided by total time. The total distance covered by the jogger is 12 km and the total time is 1.2 hours, so the average speed is 10 km/hr.

4. D
$$a = \frac{\Delta v}{\Delta t} = \frac{20\,m/s}{8\,s} = 2.5\frac{m}{s^2}$$

5. E
$$a = \frac{v_f - v_o}{t} = \frac{6\,m/s - 24\,m/s}{3\,s} = -6\frac{m}{s^2}$$

6. E
$$v_f = v_i + at = 0 + \left(4\,m/s^2\right)\left(20\,s\right) = 80\,m/s$$

7. D
$$x_f = x_o + v_o t + \frac{1}{2}at^2 = (10\,m) + 0 + \frac{1}{2}\left(5\frac{m}{s^2}\right)(4s)^2 = 50\,m$$

8. C
The acceleration due to gravity is 10 m/s$^2$ at all points during the ball's fall.

9. C
After the ball is thrown, the only acceleration it has is the acceleration due to gravity, 10 m/s$^2$.

10. E
At the ball's maximum height, $v_f = 0$. Thus,
$$v_f = v_o - gt = 0$$
$$t = \frac{12\,m/s}{10\,m/s^2} = 1.2\,s$$

11. D

$$y = \frac{1}{2} g t^2 = \frac{1}{2}\left(10 \frac{m}{s^2}\right)(1.2\,s)^2 = 7.2\,m \approx 7\,m$$

12. B

Both of these graphs represent motion that begins at a high positive velocity, and slows down to zero velocity.

13. B

The line crosses the axis ($v$ = 0) at a time of 1 second.

14. A

The object begins with a high negative (backward) velocity at $t$ = 0, then its speed decreases to zero by a time of 1 s.