PRACTICE PROBLEMS

1D MOTION (LINEAR MOTION)

Position and displacement

1. What variable do we typically use to represent the position of an object along the horizontal direction?
   - A x
   - B y
   - C v
   - D a

2. The SI unit for position is
   - A ft
   - B km
   - C m
   - D m/s

3. When an object moves, it can have a negative displacement.
   - A True
   - B False

4. An object's position must be a whole number.
   - A True
   - B False

5. The SI unit for displacement is
   - A m^2
   - B m
   - C m/s
   - D km

6. An object can have a negative value for position.
   - A True
   - B False

7. What variable do we typically use to represent the position of an object along the horizontal direction?
   - A x
   - B y
   - C v
   - D a

8. Fill in the blanks: The symbol Δ is called _____ and represents _____ .
   - A greater than, one value is greater than another value
   - B delta, displacement
   - C alpha, the sum of several values
   - D delta, the change in some quantity

9. The displacement of an object is
   - A the scalar quantity of the total distance an object travels along any path
   - B the final position of an object
   - C the vector quantity of the final position minus the initial position
   - D the length of an object

10. What symbols or variables do we typically use to represent displacement in the vertical direction?
    - A x
    - B y
    - C Δx
    - D Δy

11. A person goes for a walk around a park. They walk for 8 minutes and return to th exact position where they started. Which of the following is true? (Select all that apply)
    - A Their total distance traveled is zero
    - B Their total distance traveled is non-zero
    - C Their total displacement is zero
    - D Their total displacement is non-zero

12. A car drives 1.3 km along a straight road. What is the car's displacement in m?

13. A train is travelling west. At time t_1 the train is at a position of 0.4 km. At time t_2 the train is at a position of 0.1 km. What is the displacement of the train during that time?

14. A person rides their bike along a straight path. Over a period of t seconds, they travel a displacement of 6 m and reach a final position of 34 m. What was their position at the beginning of that period of time?

15. A person is running along a straight race track. During a period of time, they run from a position of 17 m to a position of -4 m. What is their displacement during that time?

16. A person is walking on a straight sidewalk. They walk in the positive direction for 12 m. Then they turn around and walk backwards for 3 m. Then they turn around and walk forwards again for 15 m. What is their total displacement?

17. A person is walking down a straight hallway and their motion is shown in Figure 1. Which of the following could describe their motion?

- A They walk forwards and then instantly walk backwards
- B They stop, then walk forwards, then stop, then walk backwards
- C They walk backwards, stop, then walk forwards
- D They stop, then walk backwards

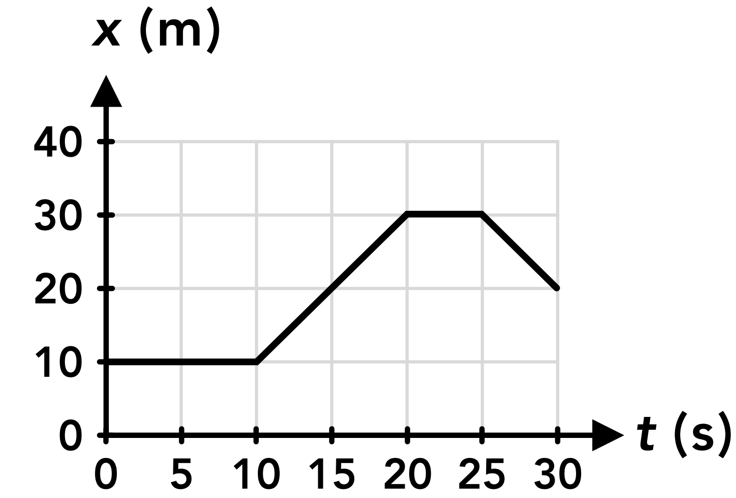

Figure 1

18. A person is walking down a straight hallway and their motion is shown in Figure 1. What is their displacement during the period of time between 5 seconds and 10 seconds?

19. A person is walking down a straight hallway and their motion is shown in Figure 1. What is their displacement during the period of time between 10 seconds and 20 seconds?

20. A person is walking down a straight hallway and their motion is shown in Figure 1. What is their displacement during the period of time between 25 seconds and 30 seconds?

Speed and velocity

21. The SI unit for velocity is

- A km/h
- B m/s
- C km/s
- D m/s^2

22. What variable represents the velocity of an object?

- A x
- B y
- C v
- D a

23. If an object is said to be "at rest" that means

- A the object's position is zero
- B the object has no energy
- C the object is sitting on the ground
- D the object's velocity is zero

24. What is the difference between “speed” and “velocity”? (Select all that apply)

A Speed is a scalar quantity and velocity is a vector quantity

B Velocity is a scalar quantity and speed is a vector quantity

C Speed is the magnitude of the velocity

D Velocity has a direction and speed does not

25. A ball is dropped from a window and falls to the ground. Which of the following would we typically use to represent the initial velocity of the ball in the vertical direction?

A v_{yi}

B v_{yf}

C v_y

D v_x

26. The speedometer in a car (which measures how fast the car is moving) describes which of the following?

A The average speed of the car

B The average velocity of the car

C The instantaneous speed of the car

27. A person is running on a straight road. It takes them a duration of Δt seconds to run from a position of x_i to a position of x_f. If we were given each of those values, which of the following could we determine? (Select all that apply)

A The average speed of the runner during that time period

B The instantaneous speed of the runner at any moment during that time period

C The instantaneous speed of the runner at the start of that time period

D The displacement of the runner during that time period

28. Speed can have a positive or negative value.

A True

B False

29. Which of the following equations involving velocity are valid?

A $v = \frac{\Delta x}{\Delta t}$

B $x_f = x_i + v\Delta t$

C $v = \frac{x_f - x_i}{t_f - t_i}$

D $\Delta x = v\,\Delta t$

30. If it takes a train 6 seconds to travel 162 m, what is the average speed of the train?

31. An elevator is moving at a constant 3 m/s. How far does it travel during a period of 7.5 seconds?

32. A bus is driving on a straight road. Over a period of 3 minutes they travel a displacement of 3.5 km. What is the average speed of the bus during that time in m/s?

33. During a race, a coach records a runner's position at two times. At t = 4 seconds, the runner is at a position of x_i . At t = 12 seconds, the runner is at a position of 35 m. The coach calculates the runner's average speed to be 2.5 m/s. What was the initial position of the runner, x_i ?

34. A subway makes its way through a city on a straight track. During the first part of its trip, it travels 1.5 km in a period of 0.8 hours. During the second part, it travels 2.3 km in a period of 1 hour. What is the average speed of the subway over the entire trip?

35. An elevator's motion is shown in Figure 2. Which of the following best describes its motion?
   - A It moves up, stops, and moves down
   - B It moves up, stops, and moves up
   - C It moves up, stops, moves up, stops, and moves down
   - D It moves down, stops, moves up, stops, and moves down

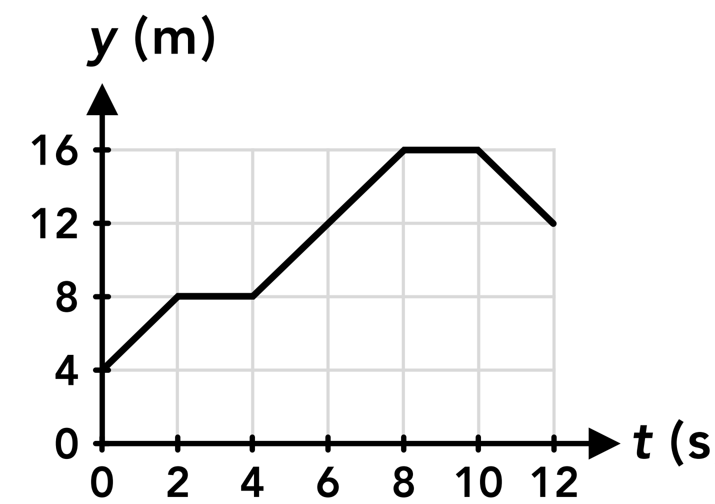

Figure 2

36. An elevator's motion is shown in Figure 2. What is its velocity at t = 3 s?

37. An elevator's motion is shown in Figure 2. What is its velocity at t = 5 s?

38. An elevator's motion is shown in Figure 2. What is its velocity at t = 11 s?

39. An elevator's motion is shown in Figure 2. What is its average velocity during the period between 0 s and 12 s?

40. A car's motion is shown in Figure 3. What is the displacement of the car during the period between 0 s and 6 s?

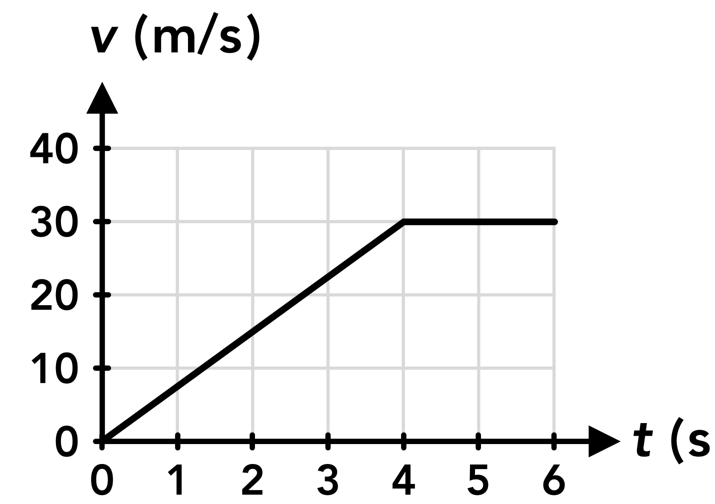

Figure 3

41. A train's motion is shown in Figure 4. The positive direction is east and the negative direction is west. Which of the following is true at t = 1 min?

    - A The train is not moving
    - B The train is moving in the east direction
    - C The train is moving in the west direction
    - D None of the above

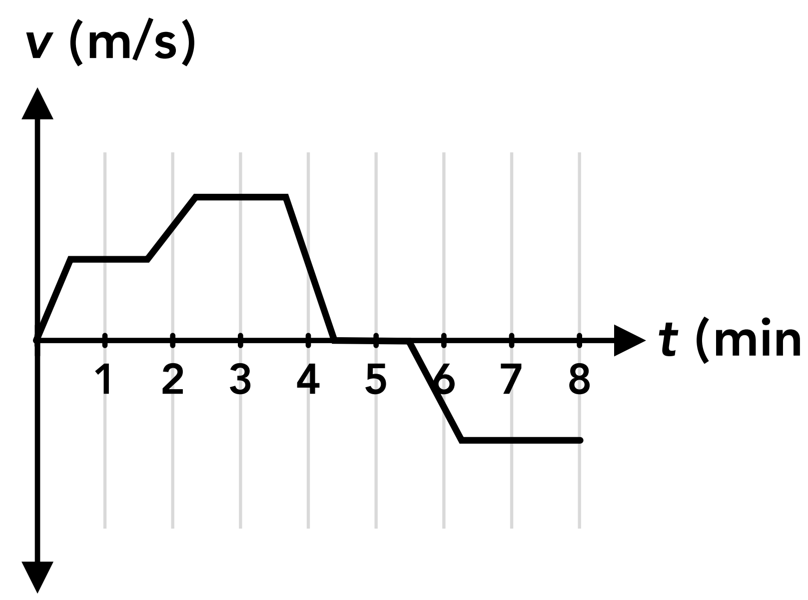

Figure 4

42. A train's motion is shown in Figure 4. The positive direction is east and the negative direction is west. Which of the following is true? (Select all that apply)

    - A The train is moving faster at t = 3 min than at t = 1 min
    - B The train is stopped at t = 7 min
    - C The train is moving in the east direction at t = 2 min
    - D The train is moving in the west direction at t = 4 min

Acceleration

43. What variable do we use to represent the acceleration of an object?

    - A x
    - B y
    - C v
    - D a

44. The SI unit for acceleration is

    - A m/s
    - B m
    - C m/s^2
    - D km/h

45. Fill in the blank: Acceleration is defined as the change in ____ over time.

    - A position
    - B displacement
    - C speed
    - D velocity

46. Which of the following includes an object that is accelerating? (Select all that apply)

A A race car speeding up at the start of a race

B A car slowing down at an intersection

C A pen falling from a desk onto the floor

D A moving elevator coming to a stop

47. If an object is accelerating, it must be speeding up.

A True

B False

48. Which of the following equations involving acceleration are valid?

A $a = \frac{\Delta v}{\Delta t}$

B $v_f = v_i + a\Delta t$

C $a = \frac{v_f - v_i}{t_f - t_i}$

D $\Delta v = a\,\Delta t$

49. A boat is traveling in a straight line when it speeds up from 5 m/s to 9 m/s over a period of 5 seconds. What is the acceleration of the boat?

50. At the start of a race, a runner accelerates from rest to a speed of 18 km/h in 4.5 seconds. What is their acceleration in m/s^2 ?

51. A person is riding their bike at 4 m/s when they speed up with a constant acceleration of 0.6 m/s^2. What is their speed after accelerating for 3 seconds?

52. A book is dropped from rest off a balcony. If the book accelerates downwards at 9.8 m/s^2, how long does it take the book to reach a speed of 15 m/s?

53. A car is stopped at a red light. When the light turns green, the car accelerates at 4 m/s^2. How far does the car travel in 3 seconds?

54. An ice skater is moving in a straight line at 6 m/s when they begin to slow down at -0.8 m/s^2. How long does it take them to come to a stop?

55. A coconut falls from a tree at 9.8 m/s^2. How fast is the coconut moving after it falls 4 m?

56. A train is moving at 36 km/h when it begins to slow down at -2 m/s^2 before reaching a station. While slowing down, how far does the train move over a period of 5 seconds?

57. A car's motion is shown in Figure 5. Which of the following describes the motion of the car from t = 0 s to t = 4 s?

A The car is moving at a constant velocity
B The car has a positive acceleration
C The car is not moving
D The car has a negative acceleration

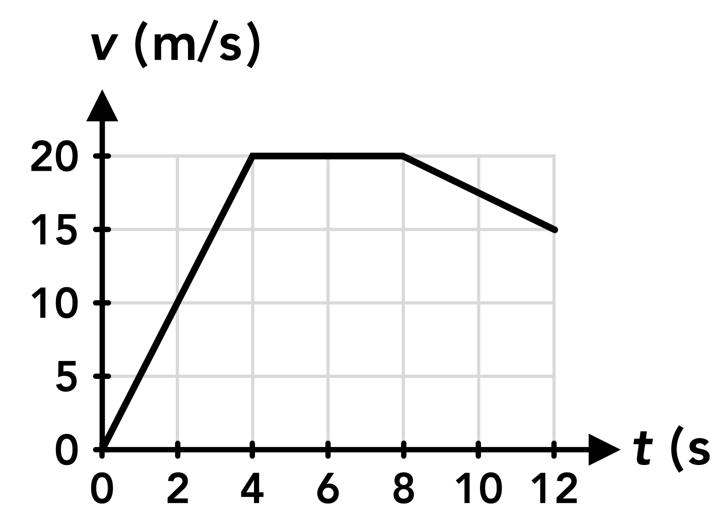

Figure 5

58. A car's motion is shown in Figure 5. Which of the following describes the motion from t = 4 s to t = 8 s?

A The car is not moving
B The car has a positive acceleration
C The car's acceleration is 0 m/s^2
D The car has a negative acceleration

59. A car's motion is shown in Figure 5. Which of the following describes the motion from t = 8 s to t = 12 s?

A The car has a negative velocity
B The car has a negative acceleration
C The car's acceleration is 0 m/s^2
D The car has a positive acceleration

60. A train's motion is shown in Figure 6. What is the train's acceleration at t = 1.5 s?

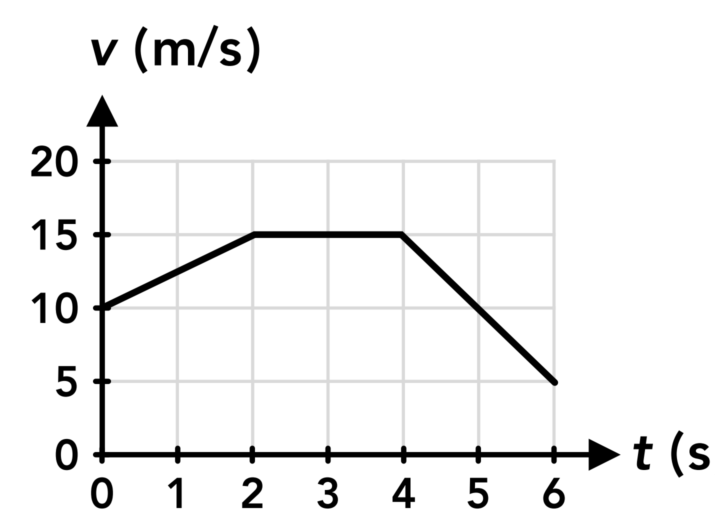

Figure 6

61. A train's motion is shown in Figure 6. What is the train's acceleration at t = 5 s?

62. A biker is moving in the positive direction and their motion is shown in Figure 7. Which of the following describes the motion of the biker?

- A They are moving at a constant speed
- B They are slowing down
- C They are speeding up
- D None of the above

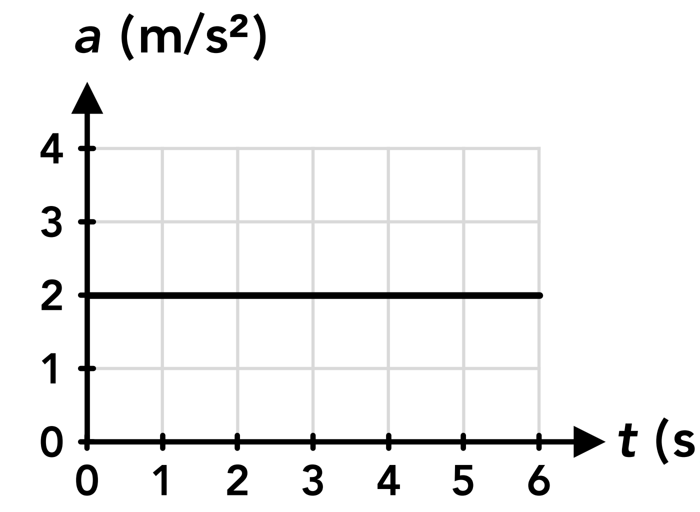

Figure 7

63. A biker is moving in the positive direction and their motion is shown in Figure 7. If their velocity is 3 m/s at t = 1 s, what is their velocity at t = 4 s?

64. The motion of two cars, car A and car B, is shown in Figure 8. Which of the following is true? (Select all that apply)

- A At t_1 car A and car B are moving at the same speed
- B After t_1 car A is moving faster than car B
- C Car B is accelerating
- D Car A is accelerating

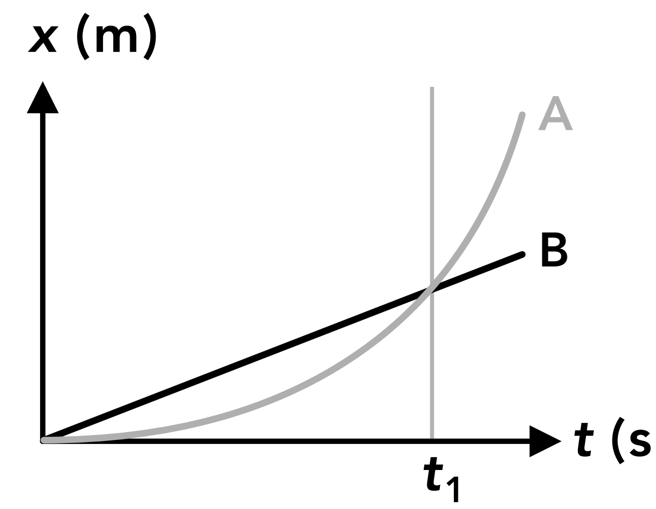

Figure 8

Answers - Position and displacement

1. Answer: A
   A) We typically use ***x*** to represent horizontal position
   B) We typically use ***y*** to represent vertical position
   C) The variable ***v*** represents velocity
   D) The variable ***a*** represents acceleration

2. Answer: C
   A) ft is a valid unit for position but is not the SI unit
   B) km is a valid unit for position but is not the SI unit
   C) m is the SI unit for position
   D) m/s is the SI unit for velocity

3. Answer: True
   Once we establish which directions are positive and negative, displacement can be in the positive or negative direction. If the value of the final position is less than the value of the initial position, the displacement is negative.

4. Answer: False
   The value of an object's position can be any real number.

5. Answer: B
   A) m^2 is the SI unit for area
   B) m is the SI unit for displacement
   C) m/s is the SI unit for velocity
   D) km is a valid unit for displacement but is not the SI unit

6. Answer: True
   Once we establish the origin (or zero point) and which directions are positive and negative, we describe the position of an object relative to the origin and the positive can be positive or negative.

7. Answer: B
   A) We typically use ***x*** to represent horizontal position
   B) We typically use ***y*** to represent vertical position
   C) The variable ***v*** represents velocity
   D) The variable ***a*** represents acceleration

8. Answer: D
   The symbol is the Greek letter "delta" and it represents the change in some quantity. By itself it does not represent displacement, Δx or Δy would represent displacement. For example, Δv means "change in velocity".

9. Answer: C
   Option A describes distance, not displacement. Displacement is a vector quantity (it has a magnitude and a direction) whereas distance is a scalar quantity and only has a magnitude. The displacement and can be calculated as the final position minus the initial position.

10. Answer: D
    A) We typically use ***x*** to represent horizontal position
    B) We typically use ***y*** to represent vertical position
    C) We typically use Δx to represent horizontal displacement
    D) We typically use Δy to represent vertical displacement

11. Answer: B, C
The distance traveled would be the total length of their path during the walk and would be non-zero. Displacement is defined as the difference between the initial position and the final position, so if the initial and final positions are the same, the displacement would be zero.

12. Answer: 1300 m
$$\frac{\textbf{1.3 km}}{} \times \frac{\textbf{1000 m}}{\textbf{1 km}} = 1300 \text{ m}$$

13. Answer: -0.3 km
$\Delta x = x_f - x_i$ $\Delta x = (0.1 \text{ km}) - (0.4 \text{ km})$ $\Delta x = -0.3 \text{ km}$

14. Answer: 28 m
$\Delta x = x_f - x_i$ $(6 \text{ m}) = (34 \text{ m}) - x_i$ $x_i = 28 \text{ m}$

15. Answer: -21 m
$\Delta x = x_f - x_i$ $\Delta x = (-4 \text{ m}) - (17 \text{ m})$ $\Delta x = -21 \text{ m}$

16. Answer: 24 m
$\Delta x = (12 \text{ m}) + (-3 \text{ m}) + (15 \text{ m}) = 24 \text{ m}$

17. Answer: B
During 0-10 seconds they don't move. During 10-20 seconds they walk forwards (assuming the positive direction is forwards). During 20-25 seconds they don't move. During 25-30 seconds they walk backwards.

18. Answer: 0 m
$\Delta x = x_f - x_i$ $\Delta x = (10 \text{ m}) - (10 \text{ m})$ $\Delta x = 0 \text{ m}$

19. Answer: 20 m
$\Delta x = x_f - x_i$ $\Delta x = (30 \text{ m}) - (10 \text{ m})$ $\Delta x = 20 \text{ m}$

20. Answer: -10 m
$\Delta x = x_f - x_i$ $\Delta x = (20 \text{ m}) - (30 \text{ m})$ $\Delta x = -10 \text{ m}$

Answers - Speed and velocity

21. Answer: C
A) km/h is a valid unit for velocity but is not the SI unit
B) m/s is the SI unit for velocity
C) km/s is a valid unit for velocity but is not the SI unit
D) m/s^2 is the SI unit for acceleration

22. Answer: C
A) We typically use x to represent horizontal position
B) We typically use y to represent vertical position
C) The variable v represents velocity
D) The variable a represents acceleration

23. Answer: D
The phrase "at rest" means an object is not moving and its velocity is zero. It does not refer to an object's position, energy, or any other quantity.

24. Answer: A, C, D
Speed is a scalar quantity which means it only includes a magnitude or a value, while velocity is a vector quantity so it includes a magnitude and a direction. Speed is the magnitude of the velocity. For example, if the velocity of a car is 80 km/h west, 80 km/h is the magnitude of the velocity (which is the speed) and west is the direction of the velocity.

25. Answer: A
A) We typically use $\boldsymbol{v}_{yi}$ to represent initial vertical velocity
B) We typically use $\boldsymbol{v}_{yf}$ to represent final vertical velocity
C) We typically use $\boldsymbol{v}_{y}$ to represent vertical velocity in general, not the initial or final velocity
D) We typically use $\boldsymbol{v}_{x}$ to represent horizontal velocity

26. Answer: C
The speedometer describes the instantaneous speed of the car, which is the speed at any moment in time.

27. Answer: A, D
A) The average speed is $\frac{x_f - x_i}{\Delta t}$
B) We can not determine the instantaneous speed, only the average speed
C) We can not determine the instantaneous speed, only the average speed
D) The displacement is $x_f - x_i$

28. Answer: False
Speed is the magnitude of velocity and can only have a positive value (velocity can have a negative value).

29. Answer: A, B, C, D
The equation for velocity can be rearranged algebraically in different ways.

30. Answer: 27 m/s

$$v = \frac{\Delta x}{\Delta t} = \frac{(162\text{ m})}{(6\text{ s})} = 27\text{ m/s}$$

31. Answer: 22.5 m

$$\Delta x = v\,\Delta t = (3\text{ m/s})(7.5\text{ s}) = 22.5\text{ m}$$

32. Answer: 19.4 m/s

$$\frac{3\text{ min}}{} \times \frac{60\text{ s}}{1\text{ min}} = 180\text{ s} \qquad \frac{3.5\text{ km}}{} \times \frac{1000\text{ m}}{1\text{ km}} = 3500\text{ m} \qquad v = \frac{\Delta x}{\Delta t} = \frac{(3500\text{ m})}{(180\text{ s})} = 19.4\text{ m/s}$$

33. Answer: 15 m

$$v = \frac{x_f - x_i}{t_f - t_i} \qquad (2.5\text{ m/s}) = \frac{(35\text{ m}) - x_i}{(12\text{ s}) - (4\text{ s})} \qquad x_i = 15\text{ m}$$

34. Answer: 2.1 km/h

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{1.5\text{ km} + 2.3\text{ km}}{0.8\text{ h} + 1\text{ h}} = 2.1\text{ km/h}$$

35. Answer: C

When the vertical position or height is increasing in value, the elevator is moving up. When the height is constant, the elevator is stopped. When the height decreases, the elevator is moving down.

36. Answer: 0 m/s

The velocity is given by the slope of the position-time graph. The slope of the line at t = 3 s is 0, so the velocity is 0 m/s.

37. Answer: 2 m/s

The velocity is given by the slope of the position-time graph. The slope of the line at t = 5 s can be found using 2 points, such as the points at 4 s and 8 s:

$$\text{velocity} = \text{slope} = \frac{\Delta y}{\Delta t} = \frac{(16\text{ m}) - (8\text{ m})}{(8\text{ s}) - (4\text{ s})} = 2\text{ m/s}$$

38. Answer: -2 m/s

The velocity is given by the slope of the position-time graph. The slope of the line at t = 11 s can be found using 2 points, such as the points at 10 s and 12 s:

$$\text{velocity} = \text{slope} = \frac{\Delta y}{\Delta t} = \frac{(12\text{ m}) - (16\text{ m})}{(12\text{ s}) - (10\text{ s})} = -2\text{ m/s}$$

39. Answer: 0.67 m/s

The average velocity of the elevator over that period of time would be its displacement during that period divided by the amount of time.

$$v = \frac{\Delta y}{\Delta t} = \frac{(12\text{ m}) - (4\text{ m})}{(12\text{ s})} = 0.67\text{ m/s}$$

40. Answer: 120 m

The displacement is given by the area under the curve of the velocity-time graph (the area between the line and the horizontal axis). This can be found by dividing the area into sections and adding the areas together.

0 s - 4 s: displacement = area = $\frac{1}{2}$(4 s - 0 s)(30 m/s - 0 m/s) = 60 m

4 s - 6 s: displacement = area = (6 s - 4 s)(30 m/s - 0 m/s) = 60 m

total displacement = (60 m) + (60 m) = 120 m

41. Answer: B

At t = 1 min the train has a positive velocity so the train is moving in the east direction.

42. Answer: A, C

A) The train is moving faster at t = 3 min than at t = 1 min because the velocity is greater at 3 min
B) The train is not stopped at t = 7 min, it has a constant negative velocity
C) The train is moving in the east direction at t = 2 min because the velocity is positive
D) The train is moving in the east direction at t = 4 min because the velocity is positive

Answers - Acceleration

43. Answer: D
    A) We typically use ***x*** to represent horizontal position
    B) We typically use ***y*** to represent vertical position
    C) The variable ***v*** represents velocity
    D) The variable ***a*** represents acceleration

44. Answer: C
    A) m/s is the SI unit for velocity
    B) m is the SI unit for position and displacement
    C) m/s^2 is the SI unit for acceleration
    D) km/h is a unit for velocity

45. Answer: D
    Acceleration is defined as the change in velocity (a vector), not the change in speed (a scalar). Speed is the magnitude of velocity and a change in speed is considered acceleration because the velocity is changing. However, a change in the direction of the velocity only (where the speed does not change) is also considered acceleration.

46. Answer: A, B, C, D
    A) The race car is accelerating because its speed is changing
    B) The car is accelerating because its speed is changing, even if its speed is decreasing
    C) The pen is accelerating as it falls because all object accelerate as they fall due to gravity
    D) The elevator is accelerating because its speed is changing, even if its speed is decreasing

47. Answer: False
    Acceleration is defined as the change in velocity, which could be a change in the direction or the magnitude (the speed) of the velocity. A decrease in speed (if an object is slowing down) is still considered acceleration. An object is also considered to be accelerating if the speed remains the same and only the direction changes.

48. Answer: A, B, C, D
    The equation for acceleration can be rearranged algebraically in different ways.

49. Answer: $0.8\ m/s^2$

$$a = \frac{v_f - v_i}{\Delta t} = \frac{(9\ m/s) - (5\ m/s)}{(5\ s)} = 0.8\ m/s^2$$

50. Answer: $1.1\ m/s^2$

$$\frac{18\ km}{h} \times \frac{1000\ m}{1\ km} \times \frac{1\ h}{60\ min} \times \frac{1\ min}{60\ s} = 5\ m/s \qquad a = \frac{(5\ m/s) - (0\ m/s)}{(4.5\ s)} = 1.11\ m/s^2$$

51. Answer: 5.8 m/s

$$a = \frac{v_f - v_i}{\Delta t} \qquad (0.6\ m/s^2) = \frac{v_f - (4\ m/s)}{(3\ s)} \qquad v_f = 5.8\ m/s$$

52. Answer: 1.53 s

$$a = \frac{v_f - v_i}{\Delta t} \qquad (9.8\ m/s^2) = \frac{(15\ m/s) - (0\ m/s)}{\Delta t} \qquad \Delta t = 1.53\ s$$

53. Answer: 18 m

$$\Delta x = v_i t + \frac{1}{2}at^2 = (0\text{ m/s})(3\text{ s}) + \frac{1}{2}(4\text{ m/s}^2)(3\text{ s})^2 = 18\text{ m}$$

54. Answer: 7.5 s

$$a = \frac{v_f - v_i}{\Delta t} \qquad (-0.8\text{ m/s}^2) = \frac{(0\text{ m/s}) - (6\text{ m/s})}{\Delta t} \qquad \Delta t = 7.5\text{ s}$$

55. Answer: 8.85 m/s

$$v_f^2 = v_i^2 + 2a\Delta x = (0\text{ m/s})^2 + 2(9.8\text{ m/s}^2)(4\text{ m}) \qquad v_f = 8.85\text{ m/s}$$

56. Answer: 25 m

$$\frac{36\text{ km}}{\text{h}} \times \frac{1000\text{ m}}{1\text{ km}} \times \frac{1\text{ h}}{60\text{ min}} \times \frac{1\text{ min}}{60\text{ s}} = 10\text{ m/s}$$

$$\Delta x = v_i t + \frac{1}{2}at^2 = (10\text{ m/s})(5\text{ s}) + \frac{1}{2}(-2\text{ m/s}^2)(5\text{ s})^2 = 25\text{ m}$$

57. Answer: B
The slope of the velocity-time graph represents acceleration. During that period the graph has a constant, positive slope so the car has a positive acceleration.

58. Answer: C
The slope of the velocity-time graph represents acceleration. During that period the graph's slope is zero so the car's acceleration is zero.

59. Answer: B
The slope of the velocity-time graph represents acceleration. During that period the graph's slope is negative so the car has a negative acceleration.

60. Answer: 2.5 m/s²
The acceleration is given by the slope of the velocity-time graph. The slope of the line at t = 1.5 s can be found using the points at 0 s and 2 s:

$$\text{acceleration} = \text{slope} = \frac{\Delta v}{\Delta t} = \frac{(15\text{ m}) - (10\text{ m})}{(2\text{ s}) - (0\text{ s})} = 2.5\text{ m/s}^2$$

61. Answer: -5 m/s²
The acceleration is given by the slope of the velocity-time graph. The slope of the line at t = 5 s can be found using the points at 4 s and 6 s:

$$\text{acceleration} = \text{slope} = \frac{\Delta v}{\Delta t} = \frac{(5\text{ m}) - (15\text{ m})}{(6\text{ s}) - (4\text{ s})} = -5\text{ m/s}^2$$

62. Answer: C
The biker is moving in the positive direction and they have a positive acceleration, so they are speeding up.

63. Answer: 9 m/s
The change in velocity during a period of time is given by the area under the curve of the acceleration-time graph during that period (the area between the line and the horizontal axis). This change in velocity is added to the initial velocity at 1 s to find the final velocity at 4 s.

change in velocity = area = (4 s - 1 s)(2 m/s² - 0 m/s²) = 6 m/s

$\boldsymbol{v_f} = \boldsymbol{v_i} + \boldsymbol{\Delta v}$ = (3 m/s) + (6 m/s) = 9 m/s

64. Answer: B, D
Velocity is the slope of the position-time graph and acceleration is the change in velocity over time. Car A's position line is a curve and the slope is continuously increasing so car A is accelerating the entire time. Car B's position line is a straight line with a constant slope so car B is moving at a constant speed. At $\boldsymbol{t_1}$ and after $\boldsymbol{t_1}$ the slope of car A's line is greater than the slope of car B's line, so car A has a greater velocity than car B.