Physics I

Chapter 2

# Motion in One Dimension

Fall 2022

IMPORTANT: Except for multiple-choice questions, you will receive no credit if you show only an answer, even if the answer is correct. Always show in the space on your answer sheet some sketches, words, or equations which clearly justify your answer. Show the equations you use and the values substituted into them whenever equations are necessary. If you go from an equation directly to an answer without showing the values used, you will lose points. Points will also be deducted for missing or erroneous units.

Each individual answer is weighted roughly evenly throughout the exam.

Name _____

$$\text{avg speed} = \frac{\ell}{\Delta t} \qquad \bar{\mathbf{a}} = \frac{\Delta \mathbf{v}}{\Delta t} \qquad v_f^2 = 2a\Delta x + v_0^2$$

$$\bar{\mathbf{v}} = \frac{\Delta \mathbf{x}}{\Delta t} \qquad \bar{v} = \frac{v_1 + v_2}{2} \qquad \Delta x = v_0\Delta t + \frac{1}{2}a\Delta t^2$$

1. The position vs. time graph for an object moving in a straight line is shown below. What is the instantaneous velocity at t = 2 s?
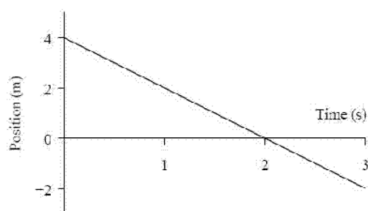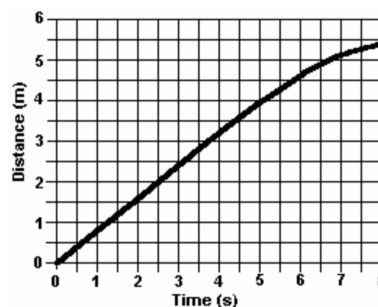

   (a) −2 m/s
   (b) 1/2 m/s
   (c) 0 m/s
   (d) 2 m/s

2. Shown below is the velocity vs. time graph for a toy car moving along a straight line. What is the maximum displacement from start for the toy car?
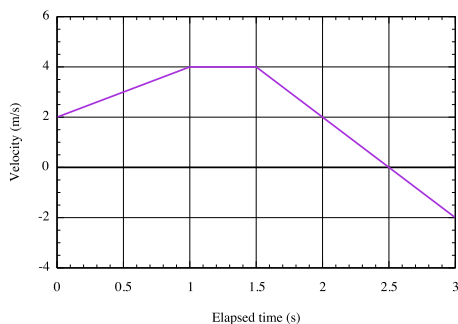
   (a) 5 m
   (b) 6.5 m
   (c) 7 m
   (d) 7.5 m

3. A car starts from rest and uniformly accelerates to a final speed of 20.0 m/s in a time of 15.0 s. How far does the car travel during this time?

   (a) 150 m
   (b) 300 m
   (c) 450 m
   (d) 600 m

4. The graph represents the relationship between distance and time for an object that is moving along a straight line. What is the velocity of the object at t = 2.0 seconds?

   (a) 0.0 m/s
   (b) 0.8 m/s
   (c) 2.5 m/s
   (d) 4.0 m/s

5. 55 mi/h is how many m/s? (1 mi = 1609 m.)

   (a) 90 m/s
   (b) 25 m/s
   (c) 49 m/s
   (d) 120 m/s

6. A runner ran the marathon (approximately 42.0 km) in 2 hours and 57 min. What is the average speed of the runner in m/s?

   (a) 124 m/s
   (b) 3.95 m/s
   (c) 14.2×10^3 m/s
   (d) 14.2 m/s

The motion of a circus clown on a unicycle moving in a straight line is shown in the graph below.

2
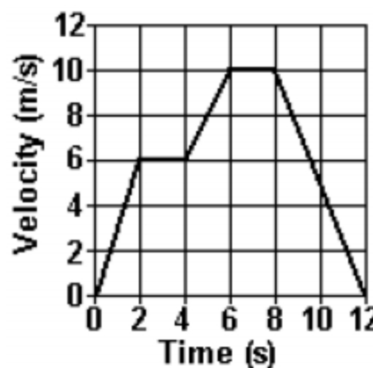
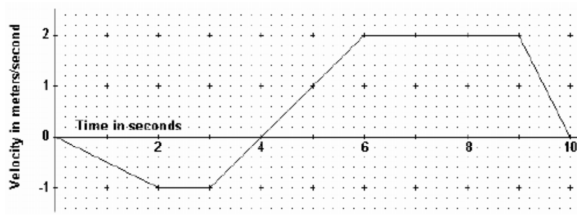7. What was the acceleration of the clown at exactly 5 s?

 (a) 1.6 m/s^2

 (b) 8.0 m/s^2

 (c) 2.0 m/s^2

 (d) 3.4 m/s^2

8. After 4 seconds, how far is the clown from her original starting point?

 (a) 0 m

 (b) 18 m

 (c) 47 m

 (d) 74 m

For the next two items

The accompanying graph describes the motion of a toy car across the floor for 10 seconds.

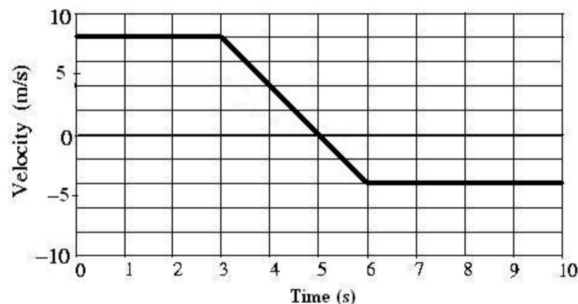9. What is the acceleration of the toy car at t = 4 s?

 (a) −1 m/s^2

 (b) 0 m/s^2

 (c) 1 m/s^2

 (d) 2 m/s^2

10. What was the total displacement of the toy car for the entire 10 second interval shown?

 (a) 0 meters

 (b) 6.5 meters

 (c) 9 meters

 (d) 10 meters

For the next two items

The velocity vs. time graph for the motion of a car on a straight track is shown below. The car starts at the origin x = 0.

11. At which time is the car the greatest distance from its initial position?

 (a) t = 10 s

 (b) t = 5 s

 (c) t = 3 s

 (d) t = 0 s

12. What is the average speed of the car for the 10 second interval?

 (a) 1.20 m/s

 (b) 1.40 m/s

 (c) 3.30 m/s

 (d) 5.00 m/s

13. A toy car moves 3.0 m to the North in one second. The car then moves at 9.0 m/s due South for two seconds. What is the average speed of the car for this three second trip?

 (a) 4.0 m/s

 (b) 5.0 m/s

 (c) 6.0 m/s

 (d) 7 m/s

14. An airplane increases its speed from 100 m/s to 160 m/s, at the average rate of 15 m/s^2. How much time does it take for this increase in speed?

 (a) 17 s

 (b) 0.25 s

 (c) 4.0 s

 (d) 0.058 s

3

15. A car travels at 15 m/s for 10 s. It then speeds up with a constant acceleration of 2.0 m/s^2 for 15 s. At the end of this time, what is its velocity?

    (a) 45 m/s

    (b) 30 m/s

    (c) 15 m/s

    (d) 375 m/s

16. A bullet moving horizontally to the right (+x direction) with a speed of 500 m/s strikes a sandbag and penetrates a distance of 10.0 cm. What is the average acceleration of the bullet in the sandbag?

    (a) -1.25×10^3 m/s^2

    (b) -1.25×10^6 m/s^2

    (c) -2.50×10^3 m/s^2

    (d) -2.50×10^6 m/s^2

17. The first 10 meters of a 100-meter dash are covered in 2 seconds by a sprinter who starts from rest and accelerates with a constant acceleration. The remaining 90 meters are run with the same velocity the sprinter had after 2 seconds.

(a) Determine the sprinter's constant acceleration during the first 2 seconds. 5 m/s^2

(b) Determine the sprinter's velocity after 2 seconds have elapsed. 10 m/s

(c) Determine the total time needed to run the full 100 meters. $2s + 9s = 11s$

18. The vertical position of an elevator as a function of time is shown below.
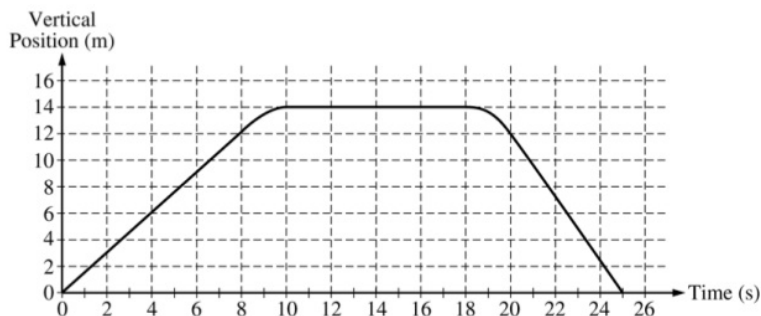
(a) On the grid below, graph the velocity of the elevator as a function of time.
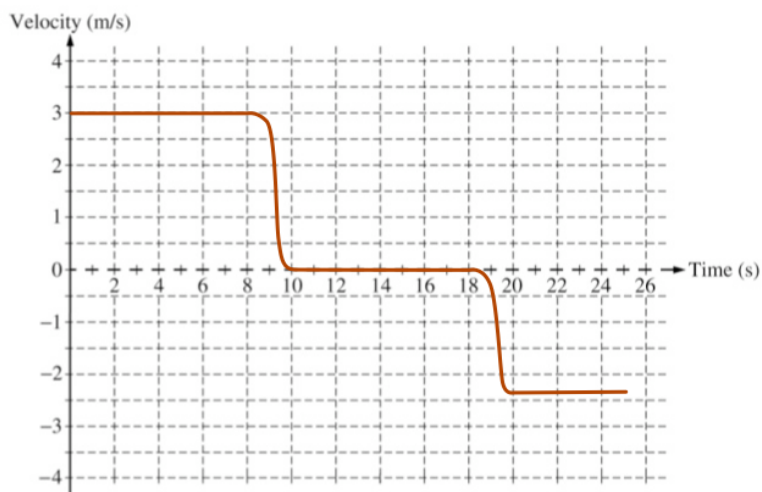
i. Calculate the average acceleration for the time period $t = 8$ s to $t = 10$ s.

-1.5 m/s^2

ii. What is the direction of the average acceleration for the time period $t = 8$ s to $t = 10$ s?

It is in the negative direction: -1.2 m/s^2

19. The position vs. time graph for an object moving in a straight line is shown below. What is the instantaneous velocity at t = 2 s? [slope = v = -2 m/s
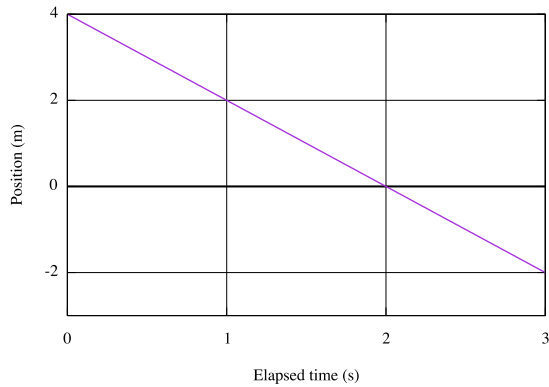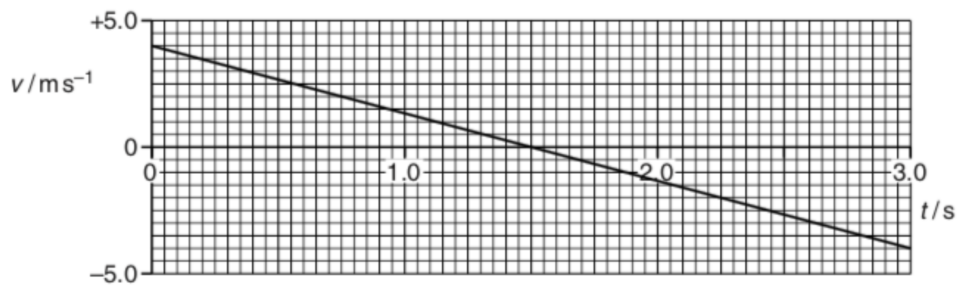
20. Shown below is the velocity vs. time graph for a toy car moving along a straight line. What is the maximum displacement from start for the toy car? ["area" = 7 m (There are seven boxes altogether under the plot from the start at $t = 0$ until $t = 2.5$ s.]
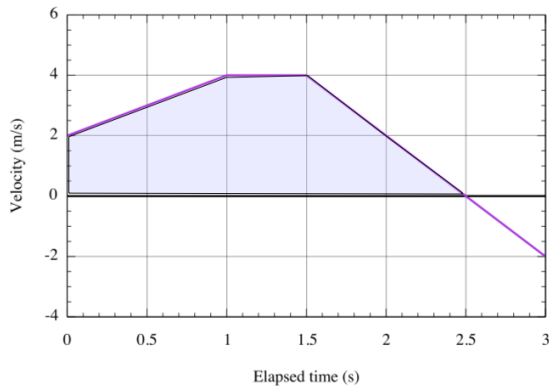
21. The figure below shows a ball rolling up a ramp.
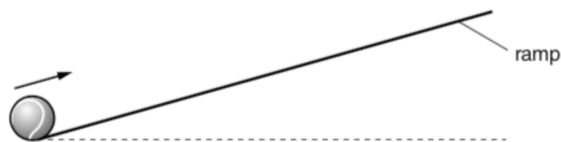
The following graph shows the plot of the velocity of the ball as a function of time.

(a) Describe qualitatively the motion of the ball from $t = 0$ to $t = 3.0$ s.

(b) Calculate the maximum distance D traveled by the ball up the ramp. 3m

(c) Calculate the acceleration of the ball at $t = 1$ s and at $t = 2$ s. slope = a = −2.7 m/s²