Answers to selected problems from Essential Physics, Chapter 2

1. (a) 4 > 1=2=3 (b) 1=2=3=4

3. (a) This motion could be for you as you walk along a sidewalk. Let's say you're walking away from your house. The graph starts with you 20 m away from your house. For the first 5 seconds, you are tying your shoe, so you remain at rest. Then, you walk slowly, away from your house, for the next 10 seconds to a street, and then walk quickly for 5 seconds across the street. Just as you reach the far side, you realize that you forgot your iPod, so you decide to go back home to get it. You have to wait for 10 seconds for some cars to go by, and then you walk quickly 60 meters back home again.
(b) You're on the subway in Boston, which is notoriously slow, For the first 5 seconds, the train moves slowly along the track. It then accelerates, first gradually, then more quickly, until the train's speed is 6 m/s. It keeps moving at that speed for 10 seconds, until the driver sees a red signal light on the track up ahead. The driver lets the train coast to a stop, coming to rest right by the signal.

5. We don't even know in which direction the object was moving. At the very least, it would be helpful to have each of the positions of the object labeled with the time the object passed through these positions. It would also be helpful to know how far apart the black lines are in the diagram.

7. (a) 2.0 m (b) 2.0 m (c) 12 m (d) $+(2.0 \text{ m})\hat{x}$ (e) $-(2.0 \text{ m})\hat{x}$ (f) $+(2.0 \text{ m})\hat{x}$

9. (a) Any constant-velocity motion, such as traveling at constant velocity along a straight highway in a car. (b) Not possible.

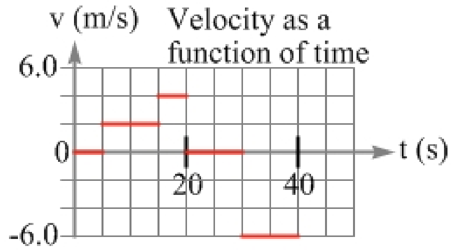
13. 16.8 m/s

15. (a) Kirsty Coventry. This is generally true in a race like this – the winner covers the distance in the least time, so the winner has the largest average speed.
(b) Aya Terakawa. At the instant Kirsty Coventry touches the wall, her net displacement is very close to zero, while Aya Terakawa's has a magnitude of a few meters at that time. The average velocity is the net displacement divided by the time, so Aya Terakawa's average velocity has the larger magnitude at that time.

17. (a) 4.8 m/s.

19. (a) $-(20 \text{ m})\hat{x}$ (b) 100 m

21. (a)



(b) 0 (c) $+(1.6 \text{ m/s})\hat{x}$

(d) $-(6 \text{ m/s})\hat{x}$

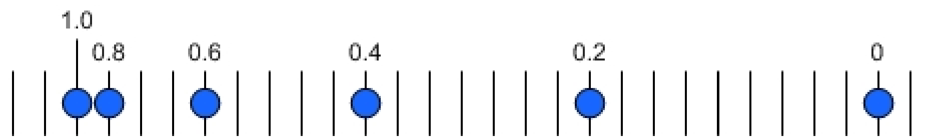
(e) $+(0.29 \text{ m/s})\hat{x}$

23. (a) $x = +42.5$ m, $v = +3$ m/s, $a = +0.2$ m/s^2
(b) $x = +115$ m, $v = +6$ m/s, $a = 0$
(c) $x = +167.5$ m, $v = +3$ m/s, $a = –0.6$ m/s^2

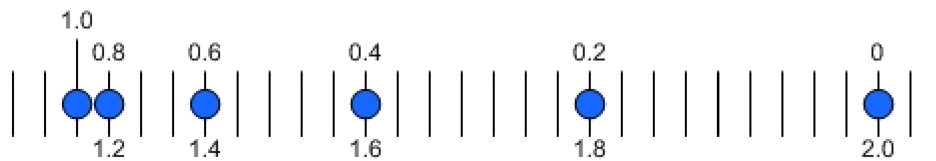
25. (a) 155 m (b) $+(155 \text{ m})\hat{x}$ (c) 3.88 m/s (d) $+(3.88 \text{ m/s})\hat{x}$

27. (a) We can’t say. (b) The acceleration is directed to the right.
(c) If the motion is left-to-right, it could be a car accelerating from rest with constant acceleration. If the motion is right-to-left, it could be a car slowing down to rest at a red light.

29. (a)



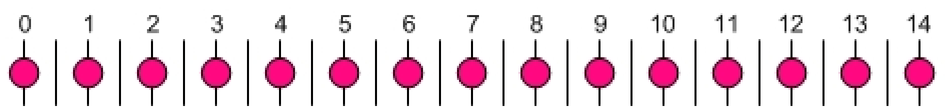
(b)



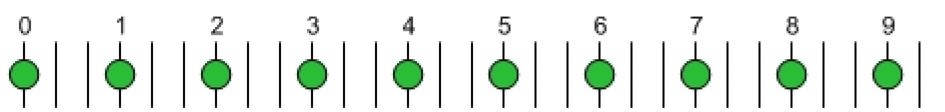
The object is at the same positions on the way back.

(c) a = 10 m/s^2, to the right (d) 10 m/s, directed left (e) 5 m/s, directed left

31. (a)

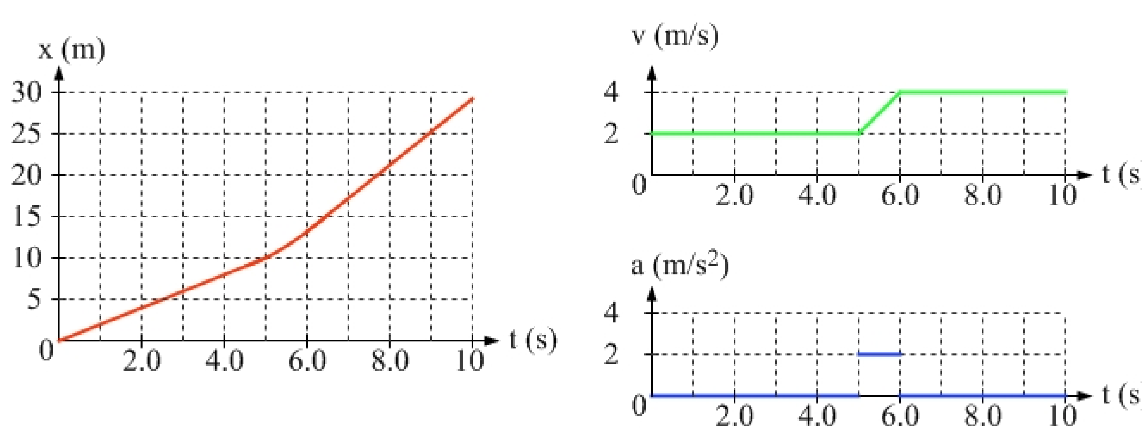


(b)

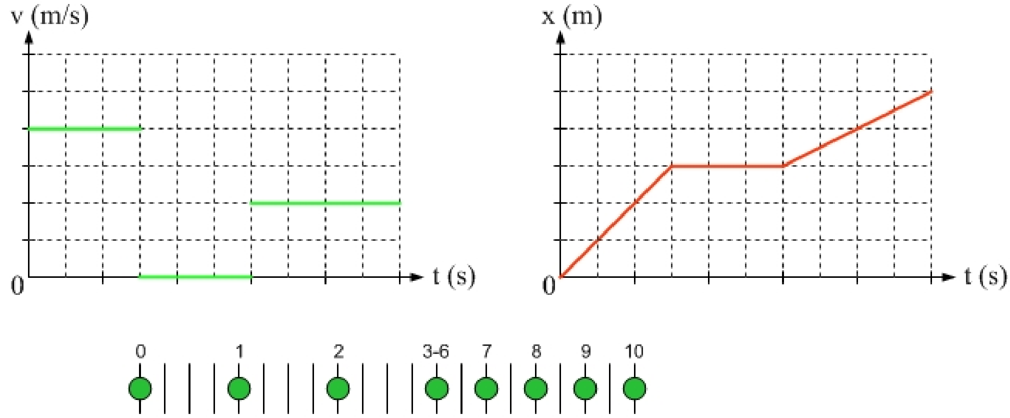


33. (a) 0 (b) 1.33 m/s^2, to the right (c) 0 (d) 0.4 m/s^2, to the right

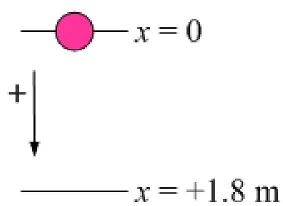
35.



37.



39. (a)



(b)

Parameter	Value
Initial position	$x_i = 0$
Final position	$x_f = +1.8$ m
Initial velocity	$v_i = 0$
Final velocity	$v_f = ?$
Acceleration	$a = +10$ m/s^2
Time	$t = ?$

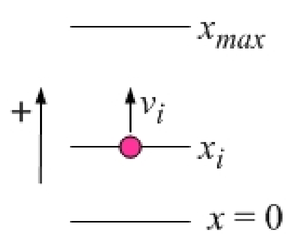
(c) $v_f^2 = v_i^2 + 2a(x_f - x_i)$

(d) 6.0 m/s down

(e) One possibility is $v_f = v_i + at$

(f) 0.60 s

41. (a)



(b)

Parameter	Value
Initial position	$x_i = ?$
Maximum height	$x_{\max} = ?$
Final position	$x_f = 0$
Initial velocity	$v_i = +12$ m/s
Velocity at maximum height	$v_{\max} = 0$
Final velocity	$v_f = ?$
Acceleration	$a = -10$ m/s^2
Time	$t_f = 2.6$ s

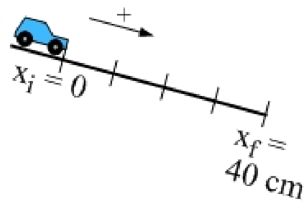
(c) $x_f = x_i + v_i t_f + \frac{1}{2} a t_f^2$

(d) 2.6 m above the ground

(e) $v_{\max}^2 = v_i^2 + 2a(x_{\max} - x_i)$

(f) 9.8 m above the ground

43. (a)



(b)

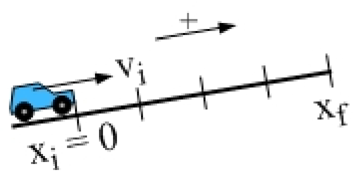
Parameter	Value
Initial position	$x_i = 0$
Final position	$x_f = +40$ cm
Initial velocity	$v_i = +20$ cm/s
Final velocity	$v_f = ?$
Acceleration	$a = ?$
Time	$t_f = 1.0$ s

(c) $x_f = x_i + v_i t_f + \frac{1}{2} a t_f^2$

(d) 40 cm/s^2 down the ramp

45. For this problem, we'll analyze half the motion, from the initial point to the point where the car is farthest from you. This takes exactly half of the time.

(a)



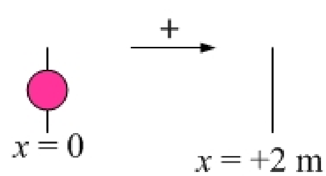
(b)

Parameter	Value
Initial position	$x_i = 0$
Final position	$x_f = ?$
Initial velocity	$v_i = +1.00$ m/s
Final velocity	$v_f = 0$
Acceleration	$a = ?$
Time	$t_f = 2.00$ s

(c) $x_f - x_i = v_{\text{average}} t_f$

(d) 1.0 m

47.



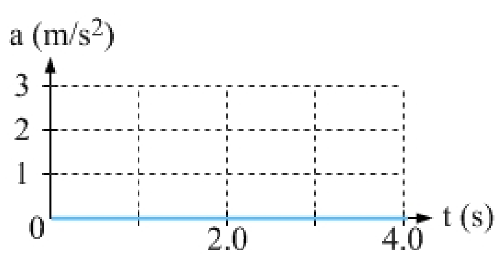
(b)

Parameter	Value
Initial position	$x_i = 0$
Final position	$x_f = 2.0$ m
Initial velocity	$v_i = 0$
Final velocity	$v_f = 150$ km/h $= 41.67$ m/s
Acceleration	$a = ?$
Time	$t_f = 0$

(c) 430 m/s^2

(d) 0.096 s

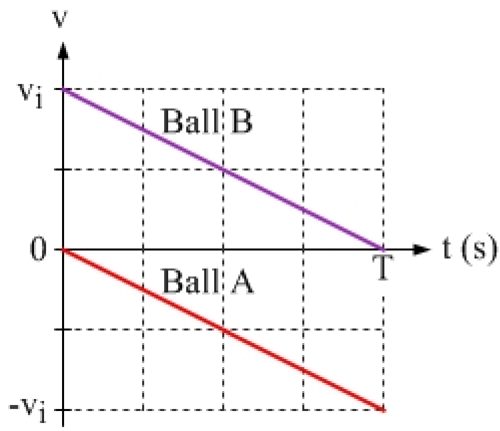
49. Because the velocity of each car is constant, the acceleration is zero for all three cars.



51. about 40 cm

55. (a) 0 (b) 10 m/s (c) 10 m/s^2 down

57. (a) equal for both (b) equal for both (c) 3*H*/4 above the ground
(d)



59.