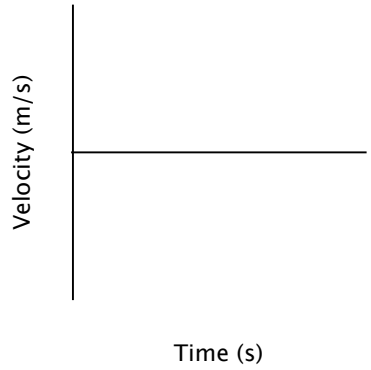
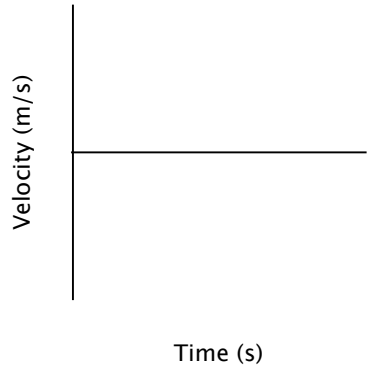
Worksheet 3-4 Acceleration Problems

1. A poorly tuned Geo Metro can accelerate from rest to a speed of 28 m/s in 20 s.
   a. What is the average acceleration of the car?

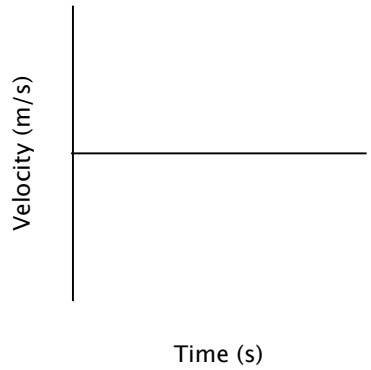
   b. What distance does it travel in this time?



2. At $t = 0$ a car has a speed of 30 m/s. At $t = 6$ s its speed is 14 m/s. What is its average acceleration during this time interval?

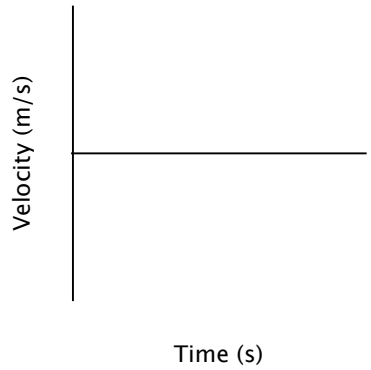


3. A bear spies some honey and takes off from rest, accelerating at a rate of 2 m/s^2. If the honey is 16 m away, how fast will his snout be going when it reaches the treat?

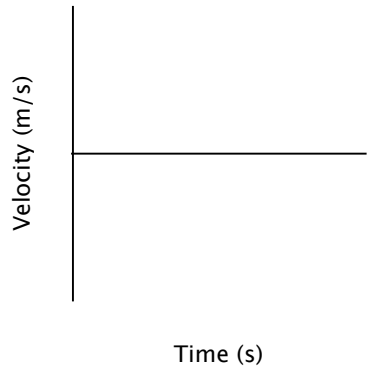


4. A bus moving at 20 m/s ($t = 0$) slows at a rate of 4 m/s each second.
   a. How long does it take the bus to stop?

   b. How far does it travel while braking?

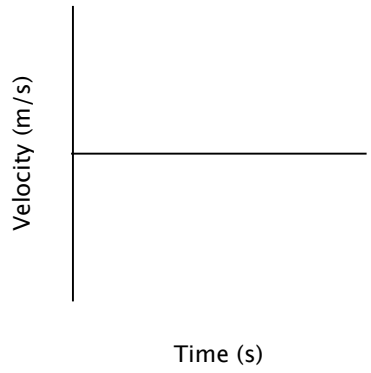


5. A student skis down a hill, accelerating at a constant 2 m/s^2. If it takes her 15 s to reach the bottom, what is the length of the slope?

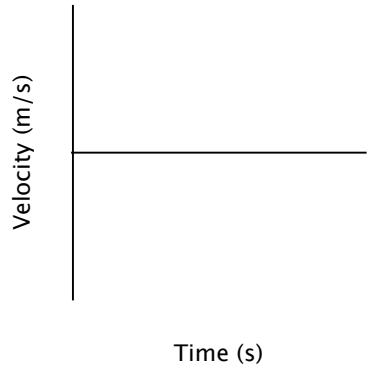


6. A dog runs down his driveway with an initial speed of 5 m/s for 8 s, then uniformly increases his speed to 10 m/s in 5 s.
   a. What was his acceleration during the 2nd part of the motion?

   b. How long is the driveway?

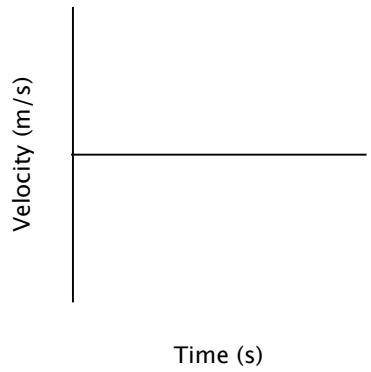


7. A mountain goat starts a rock slide and the rocks crash down the slope 100 m. If the rocks reach the bottom in 5 s, what is their acceleration?



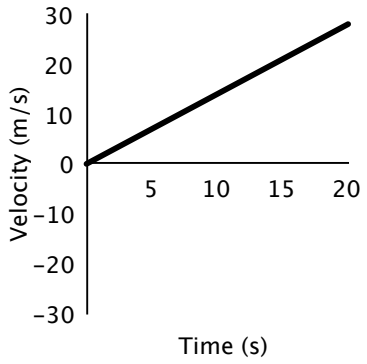
8. A car whose initial speed is 30 m/s slows uniformly to 10 m/s in 5 seconds.
   a. Determine the acceleration of the car.

   b. Determine the distance it travels in the 3rd second (t = 2 s to t = 3 s).



1a.

$$a \equiv \frac{\Delta v}{\Delta t}$$
$$a = \frac{28\ \text{m/s}}{20\ \text{s}}$$
$$a = \boxed{1.4\ \text{m/s}^2}$$

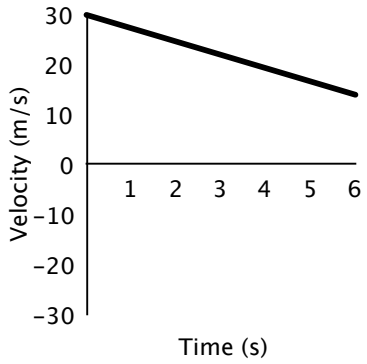


1b.

$$\Delta x = \tfrac{1}{2}\Delta t \Delta v$$
$$\Delta x = \tfrac{1}{2}(20\ \text{s})(28\ \text{m/s})$$
$$\Delta x = \boxed{280\ \text{m}}$$

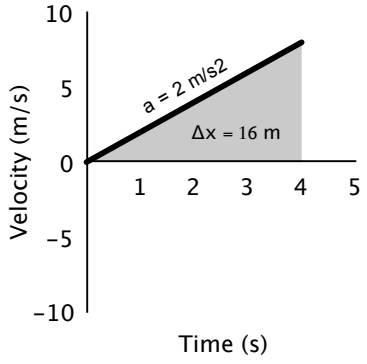
2.

$$a \equiv \frac{\Delta v}{\Delta t}$$
$$a = \frac{14\ \text{m/s} - 30\ \text{m/s}}{6\ \text{s}}$$
$$a = \boxed{-2.7\ \text{m/s}^2}$$



3.

$$\Delta x = \tfrac{1}{2}\Delta t \Delta v \qquad \Delta v = a\Delta t$$
$$(\Delta v)^2 = 2a\Delta x$$
$$\Delta v = \sqrt{2a\Delta x}$$
$$\Delta v = \sqrt{2(2\ \text{m/s}^2)(16\ \text{m})}$$
$$\Delta v = \boxed{8\ \text{m/s}}$$



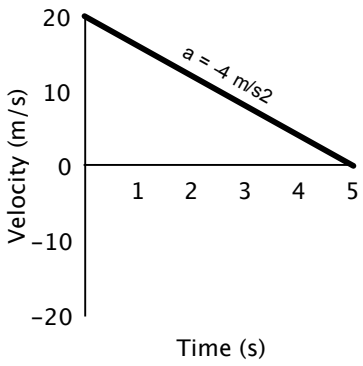
4a.

$a \equiv \frac{\Delta v}{\Delta t}$

$\Delta t = \dfrac{\Delta v}{a}$

$\Delta t = \dfrac{\text{-20 m/s}}{\text{-4 m/s}^2}$

$\Delta t = \boxed{5\ s}$



4b.

$\Delta x = \frac{1}{2}\Delta t \Delta v$

$\Delta x = \frac{1}{2}(5\text{ s})(20\text{ m/s})$

$\Delta x = \boxed{50\text{ m}}$

5.

$a \equiv \frac{\Delta v}{\Delta t}$

$\Delta v = a\Delta t$

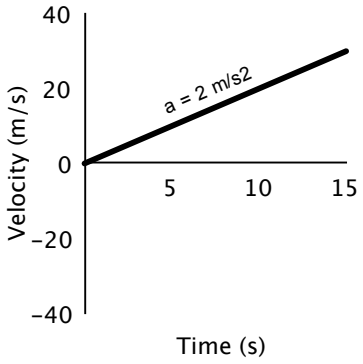
$\Delta v = (2\text{ m/s}^2)(15\text{ s})$

$\Delta v = 30\text{ m/s}$

$\Delta x = \frac{1}{2}\Delta t \Delta v$

$\Delta x = \frac{1}{2}(15\text{ s})(30\text{ m/s})$

$\Delta x = \boxed{225\text{ m}}$

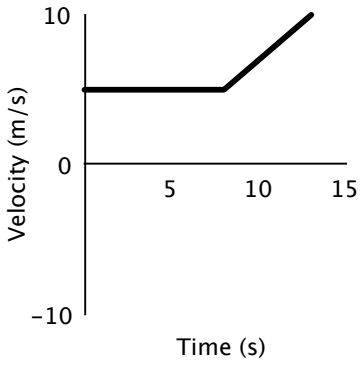


6a.

$a \equiv \dfrac{\Delta v}{\Delta t}$

$a = \dfrac{10\text{ m/s} - 5\text{ m/s}}{5\text{ s}}$

$a = \boxed{1\text{ m/s}^2}$



6b. For the first 8 s:

$\Delta x = \bar{v}\Delta t$

$\Delta x = (5\text{ m/s})(8\text{ s})$

$\Delta x = 40\text{ m}$

For the second 5 s:

$\Delta x = v_i\Delta t + \frac{1}{2}\Delta t \Delta v$

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

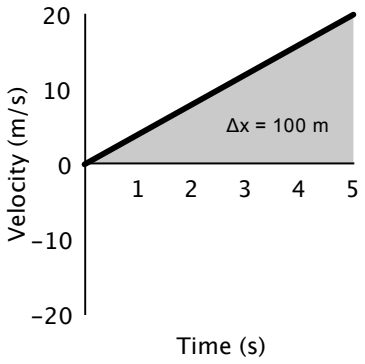
$\Delta x = 37.5\text{ m}$

The total distance is:

$\Delta x = 40\text{ m} + 37.5\text{ m}$

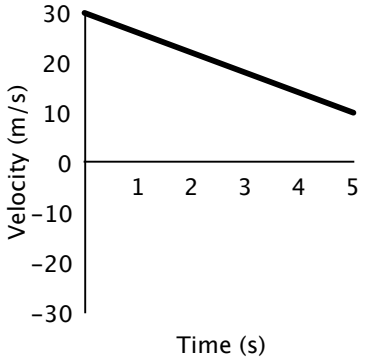
$\Delta x = \boxed{77.5\text{ m}}$

7.



$$\Delta x = \tfrac{1}{2}\Delta t \Delta v$$
$$\Delta v = \frac{2\Delta x}{\Delta t}$$
$$\Delta v = \frac{2(100\text{ m})}{5\text{ s}}$$
$$\Delta v = 20\text{ m/s}$$
$$a \equiv \frac{\Delta v}{\Delta t}$$
$$a = \frac{20\text{ m/s} - 0}{5\text{ s}}$$
$$a = \boxed{4\text{ m/s}^2}$$

8a.



$$a \equiv \frac{\Delta v}{\Delta t}$$
$$a = \frac{10\text{ m/s} - 30\text{ m/s}}{5\text{ s}}$$
$$a = \boxed{-4\text{ m/s}^2}$$

8b.

$$\Delta x = v_f \Delta t + \tfrac{1}{2}\Delta t \Delta v$$
$$\Delta x = (18\text{ m/s})(1\text{ s}) + \tfrac{1}{2}(1\text{ s})(4\text{ m/s})$$
$$\Delta x = \boxed{20\text{ m}}$$