U02L04 Assignment

Chapter Review Questions

1. What is the difference between average speed and instantaneous speed?

2. What is the difference between velocity and speed?

3. What is the definition of acceleration?

4. Under what condition can acceleration be calculated simply by dividing change in speed by change in time?

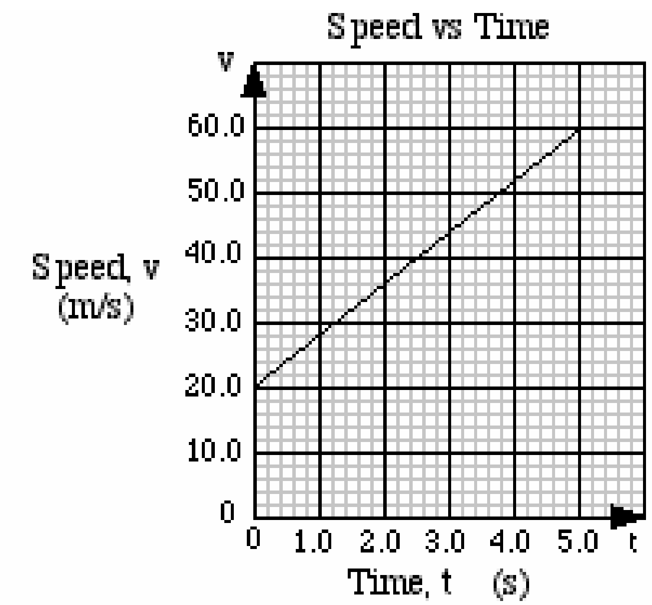


Figure 2.15

5. **Figure 2.15** is a speed-time graph for a vehicle.
   (a) What was the acceleration of the vehicle?
   (b) What was the average speed of the vehicle during its 5.00 s trip?
   (c) What distance did the vehicle travel during the 5.00 s?
   (d) Write a specific equation for this graph.

6. A high-powered racing car accelerates from rest at a rate of 7.0 m/s^2. How fast will it be moving after 10.0 s? Convert this speed to km/h.

7. **Figure 2.16** is a speed-time graph for a vehicle.
   (a) What was the acceleration of the vehicle?
   (b) Write a specific equation for this graph.
   (c) What was the average speed of the vehicle during its 5.00 s trip?
   (d) What distance did the vehicle travel during the 5.00 s trip?
   (e) Calculate the *area* of the triangle formed by the line and the axes of the graph, using the units and dimensions on the axes. Why does this area equal the distance travelled by the vehicle?

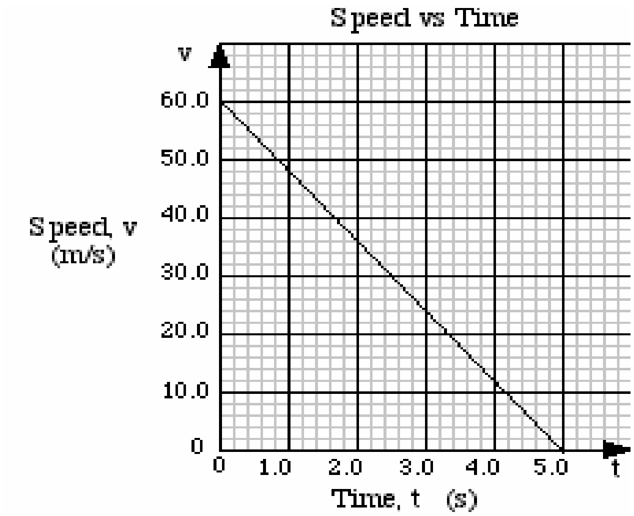


Figure 2.16

8. A child on a toboggan slides down a snowy hill, accelerating uniformly at 2.8 m/s^2. When the toboggan passes the first observer, it is travelling with a speed of 1.4 m/s. How fast will it be moving when it passes a second observer, who is 2.5 m downhill from the first observer?
9. A space vehicle is orbiting the earth at a speed of 7.58 x 10^3 m/s. In preparation for a return to earth, it fires retro-rockets, which provide a negative acceleration of 78.4 m/s^2. Ignoring any change in altitude that might occur, how long will it take the vehicle to slow down to
   1.52 x 10^3 m/s?
10. A truck is moving along at 80.0 km/h when it hits a gravel patch, which causes it to accelerate at -5.0 km/h/s. How far will the truck travel before it slows to 20.0 km/h?
11. A very frustrated physics student drops a physics textbook off the top of the CN tower. If the tower is 5.3 x 10^2 m high, how long will the book take to reach the ground, assuming there is negligible air resistance? (g = 9.8 m/s^2)
12. If an electron inside a TV tube accelerates in a space of 5.0 cm from rest to 1/10 c, (where c is the speed of light, which is 3.0 x 10^8 m/s), what is its acceleration?
13. Snoopy is taking off in his WW I biplane. He coasts down the runway at a speed of 40.0 m/s, then accelerates for 5.2 s at a rate of 1/2 g , where g is the acceleration due to gravity (9.81 m/s^2). How fast is the plane moving after the 5.2 s?
14. A woman biker (leader of the local chapter of *Heck's Angels*) is driving along the highway at 80.0 km/h, in a 60.0 km/h speed zone. She sees a police car ahead, so she brakes so that her bike accelerates at -8.0 km/h/s. How far along the road will she travel before she is at the legal speed limit?
15. Spiderman is crawling up a building at the rate of 0.50 m/s. Seeing Spiderwoman 56 m ahead of him, he accelerates at the rate of 2.3 m/s^2.
    (a) How fast will he be moving when he reaches Spiderwoman?
    (b) How much time will it take to reach Spiderwoman?
    (c) When he reaches Spiderwoman, Spiderman discovers that she is a Black Widow and, as you know, Black Widows eat their mates! He is 200.00 m from the road below. How long will it take him to fall to the safety of the road, if he drops with an acceleration of

g = 9.81 m/s^2?

(d) ***Riddle!*** Why will Spiderman not be killed by the fall?***

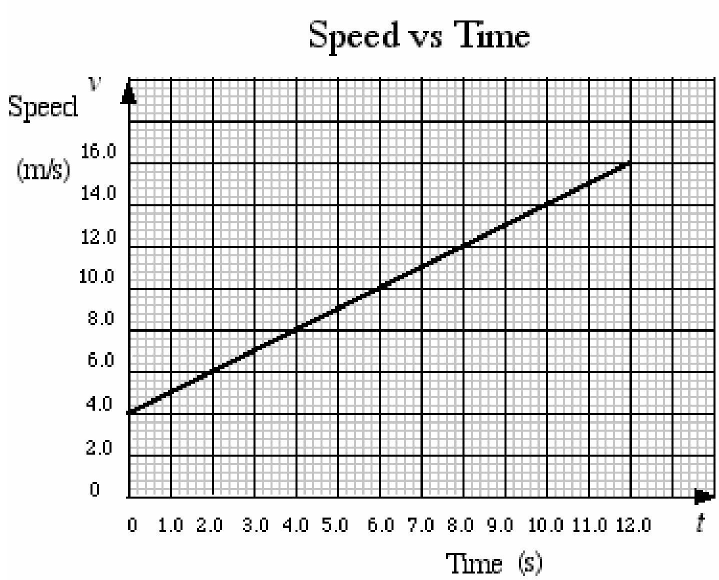
16. A stone is dropped from the top of a tall building. It accelerates at a rate of 9.81 m/s^2. How long will the stone take to pass a window that is 2.0 m high, if the top of the window is 20.0 m below the point from which the stone was dropped?
17. A glider on an air track is made to accelerate uniformly by tilting the track at a slight angle. The distance travelled by the glider was measured at the end of each 0.10 s interval, and the following data was gathered:

DISTANCE d (cm)		0	0.025	0.100	0.225	0.400	0.625
TIME	t (s)	0	0.100	0.200	0.300	0.400	0.500

(a) Plot a graph with distance d on the Y-axis and time t on the X-axis.
(b) Plot a second graph with distance d on the Y-axis and t^2 on the X-axis.
(c) Use the slope of your second graph to figure out the acceleration of the glider on the air
track. ***HINT!*** *Think about the third equation for uniform acceleration.*

*** Because a spider, no matter how far he falls, always has eight feet left to go!

Test Yourself!



1. (a) What is the **y-intercept** of the above graph? (Include **units**.)
   (b) What is the **slope** of the above graph? (Include **units**.)
   (c) What is the **equation** for the above graph? (Use **symbols** v, t, in the equation.)

2. An aircraft, preparing for take-off, accelerates uniformly from 0 m/s to 20.0 m/s, in a time of 5.00 s.

(a) What is the acceleration of the aircraft?
(b) How long will the plane take to reach its take-off speed of 36.0 m/s?

3. At an air show, a jet car accelerates from rest at a rate of 3*g*, where *g* is 9.80 m/s^2. How far does the jet car travel down the runway in a time of 4.0 s?

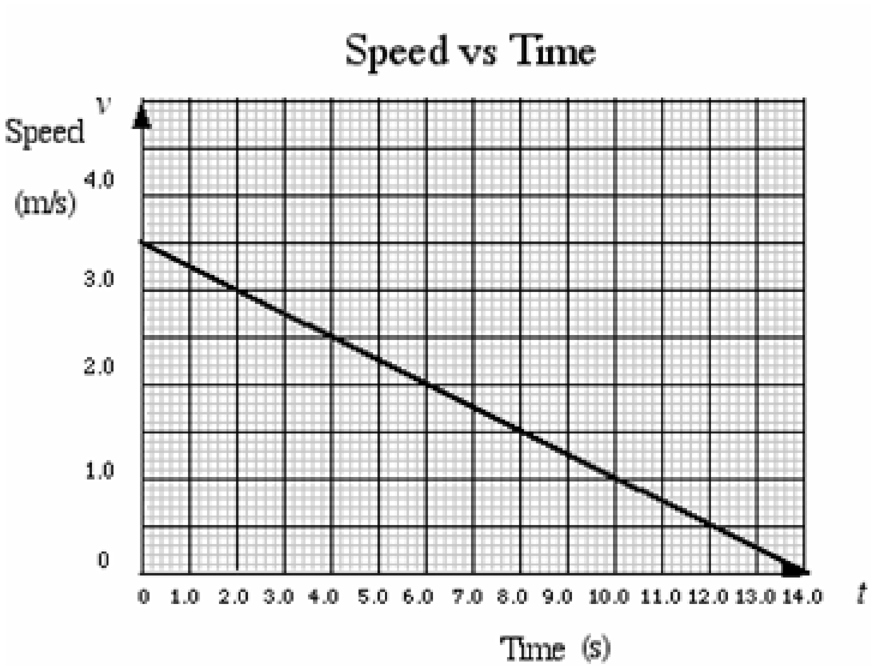
4. The CN Tower in Toronto is about 530 m high. If air friction did not slow it down, how long would it take a penny to fall from the top of the tower to the ground below? (g = 9.80 m/s^2)

5. A motocross rider is coasting at a speed of 2.00 m/s. He then decides to accelerate his bike at a rate of 3.00 m/s^2 for a distance of 100.0 m.

   (a) How fast is the bike moving, in m/s, at the end of the 100.0 m stretch?
   (b) Convert your answer to (a) from m/s to km/h.

6. A mountain bike rider, after coming down a steep hill, loses control of her bike while moving with a speed of 5.00 m/s. Fortunately, she collides with a haystack, which brings her to rest in a distance of 0.625 m. What was the acceleration of the bike and rider *while colliding with the haystack?*

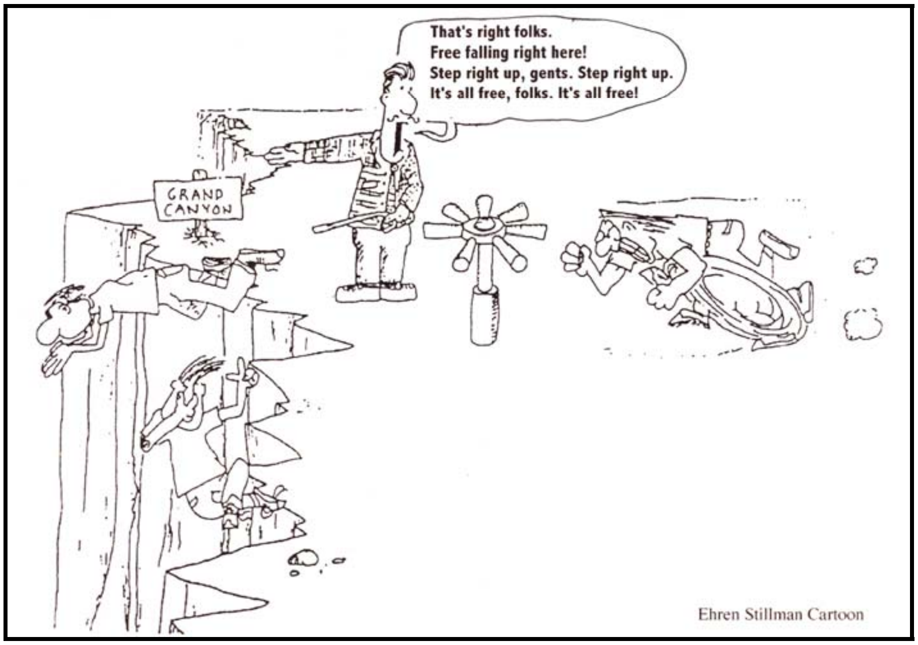
7. A policeman on a mountain bike is cruising at a speed of 4.00 m/s, when he sees a wanted
criminal standing on a corner, 100.0 m ahead of him. If the policeman accelerates at a rate of 2.00 m/s^2, how much time will he take to reach the corner?



8. The graph shows how the speed of an aging physics teacher varies with time, as he tries to run up a hill.

(a) What was the **starting speed** of the runner?
(b) What was the **acceleration** of the runner?
(c) What **distance** did the runner travel?

(d) What is the *specific* **equation** for the above graph?



ANS.

Chapter Review Questions

1. Instantaneous speed is a speed at a certain point. Average speed is the average speed between two points.
2. Speed is how fast you are going (scalar), Velocity is your speed in a certain direction.
3. Acceleration is the rate of change of velocity. It is a vector quantity.
4. When no change in direction occurs.
5. (a) $a = \dfrac{60.0\text{ m/s} - 20.0\text{ m/s}}{5.0\text{ s} - 0} = 8.00\text{ m/s}^2$

   (b) $\bar{v} = \dfrac{20.0\text{ m/s} + 60.0\text{ m/s}}{2} = 40.0\text{ m/s}$

   (c) $d = \bar{v}\,t$ =(40.0 m/s)(5.00 s)=2.00×10^2 m

   (d) $v_f = 20.0\text{ m/s} + (8.0\text{ m/s}^2)t$
6. $v_f = 0 + (7.0\text{ m/s}^2)(10.0\text{ s}) = 70.\text{ m/s}$

$70.\text{ m/s} = \dfrac{0.070\text{ km}}{\text{s}} \times \dfrac{3600\text{ s}}{\text{h}} = 2.5 \times 10^2\text{ km/h}$

7. (a) $a = \dfrac{0 - 60.0\text{ m/s}}{5.0\text{ s} - 0} = -12.0\text{ m/s}^2$

   (b) $v_f = 60.0\text{ m/s} - (12.0\text{ m/s}^2)t$

   (c) $\bar{v} = \dfrac{60.0\text{ m/s} + 0}{2} = 30.0\text{ m/s}$

   (d) $d = \bar{v}\,t = (30.0\text{ m/s})(5.0\text{ s}) = 1.5 \times 10^2\text{ m}$

   (e) Area = ½ height x base

$= \frac{1}{2}(60.0\ m/s)(5.0\ s) = 1.5 \times 10^2\ m$

Note! ½ height x base = average speed x time

(Same as (d)!)

8. $v_f^2 = v_o^2 + 2ad$

$= (1.4\ m/s)(1.4\ m/s) + 2(2.8\ m/s^2)(2.5\ m)$

$v_f^2 = 16\ m^2/s^2$.

$v_f = \sqrt{16\ m^2/s^2} = 4.0\ m/s$

9. $v_f = v_o + at$

$1.52 \times 10^3\ m/s = 7.58 \times 10^3\ m/s + (-78.4\ m/s^2)t \quad t = -\frac{7.58 \times 10^3\ m/s + 1.52 \times 10^3\ m/s}{-78.4\ m/s^2} = 77.3\ s$

10. The truck decelerates from 80.0 km/h to 20.0 km/h, so Δv = 60.0 km/h. It would take a time of t = 12 s if the acceleration is -5.0 km/h/s.

$$d = \bar{v}\,t = \frac{80.0\ km/h + 20.0\ km/h}{2} \times 12\ s$$

$$d = 50.0\frac{km}{h} \times \frac{12\ s}{3600\ \frac{s}{h}} = 0.167\ km$$

$d \cong 167\ m$ or $1.7 \times 10^2\ m$

11. $d = \frac{1}{2}at^2$, so $t^2 = 2d/g$

$t^2 = 2 \times 5.3 \times 10^2\ m/9.8\ m/s^2 = 108\ s^2$

$t = \sqrt{108\ s^2} = 1.0 \times 10^1\ s$

12. $v_f^2 = 2ad$

$$a = \frac{v_f^2}{2d} = \frac{(3.00 \times 10^7\ \frac{m}{s})(3.00 \times 10^7\ \frac{m}{s})}{2 \times 5.0 \times 10^{-2}\ m}$$

$$= 9.0 \times 10^{15}\ m/s^2$$

13. $v_f = v_o + at$

$v_f = 40.0\ m/s + \frac{1}{2}(9.81\ m/s^2)(5.2\ s) = 66\ m/s$

14. $\Delta t = \frac{\Delta v}{a} = \frac{(60\ km/h - 80\ km/h)}{-8.0\ km/h/s} = 2.5\ s$

$$\Delta d = \bar{v}\,\Delta t = \frac{(60\ km/h + 80\ km/h)}{2} \times \frac{2.5\ s}{3600\ s/h}$$

$$\Delta d = 49\ m$$

15. (a) $v_f^2 = v_o^2 + 2ad$

$v_f^2 = (0.50\ m/s)^2 + 2(2.3\ m/s^2)(56\ m)$

$v_f^2 = 258.25\ m^2/s^2$

$v_f = 16\ m/s$

(b) $t = \frac{v_f - v_o}{a} = \frac{16\ m/s - 0.50\ m/s}{2.3\ m/s^2}$

$t = 6.7\ s$

(c) $t^2 = 2d/g = 400\ m/9.81\ m/s^2 = 40.8\ s^2$

$t = \sqrt{40.8\ s^2} = 6.4\ s$

16. $d_1 = 20.0\ m$

$t_1 = \sqrt{\frac{2d_1}{g}} = \sqrt{\frac{2 \times 20.0\ m}{9.81\ m/s^2}} = 2.02\ s$

$d_2 = 22.0\ m$

$$t_2 = \sqrt{\frac{2d_2}{g}} = \sqrt{\frac{2 \times 22.0 \text{ m}}{9.81 \text{ m/s}^2}} = 2.12 \text{ s}$$

$\Delta t = t_2 - t_1 = 0.10$ s to pass the window.

17. (a) Graph of *d vs t* is a parabola.
    (b) Graph of *d vs* t^2 is a straight line, with a slope of k = 2.5 cm/s^2. So $d = kt^2$.
    Since $d = ½at^2$, the slope k must equal ½*a*.
    Therefore, $a = 2k = 5.0$ cm/s^2.

Test Yourself

Chapter 2

1. (a) 4.0 cm/s
   (b) 1.0 cm/s^2
   (c) $v = 4.0 \text{ cm/s} + (1.0 \text{ cm/s}^2)t$
2. (a) 4.00 m/s^2
   (b) 9.0 s
3. 2.4×10^2 m
4. 10.4 s
5. (a) 24.6 m/s
   (b) 88.5 km/h
6. -20.0 m/s^2
7. 8.2 s
8. (a) 3.50 m/s
   (b) -0.25 m/s^2
   (c) 24.5 m
   (d) $v = 3.5 \text{ m/s} - (0.25 \text{ m/s}^2)t$