TUTORIAL CHAPTER 2 – KINEMATICS

1. If you are driving 110 km/h along a straight road and you look to the side for 2.0 s, how far do you travel during this inattentive period?

2. You are driving home from school steadily at 65 mph for 130 miles. It then begins to rain and you slow to 55 mph. You arrive home after driving 3 hours and 20 minutes.

   (a) How far is your hometown from school?

   (b) What was your average speed?

3. An airplane travels 2100 km at a speed of 800 km/h, and then encounters a tailwind that boosts its speed to 1000 km/h for the next 1800 km. What was the total time for the trip? What was the average speed of the plane for this trip?

4. A bowling ball travelling with constant speed hits the pins at the end of a bowling lane 16.5 m long. The bowler hears the sound of the ball hitting the pins 2.50 s after the ball is released from his hands. What is the speed of the ball? The speed of sound is 340 m/s.

5. At highway speeds, a particular automobile is capable of an acceleration of about 1.6 m/s^2. At this rate, how long does it take to accelerate from 80 km/h to 110 km/h?

6. A sports car is advertised to be able to stop in a distance of 50 m from a speed of 90 km/h. What is its acceleration in m/s^2? How many g's is this ($g = 9.80\ m/s^2$)?

7. A light plane must reach a speed of 30 m/s for takeoff. How long a runway is needed if the (constant) acceleration is 3.0 m/s^2?

8. A world-class sprinter can burst out of blocks to essentially top speed (of about 11.5 m/s) in the first 15.0 m of the race. What is the average acceleration of this sprinter and how long does it take her to reach that speed?

9. A car slows down from a speed of 25.0 m/s to rest in 5.00 s. How far did it travel in that time?

10. Show that the equation for the stopping distance of a car is $d_s = v_o t_R - v_o^2/(2a)$, where v_o is the initial speed of the car, t_R is the driver's reaction time, and a is the constant acceleration (and is negative).

11. Calculate

    (a) how long it took King Kong to fall straight down from the top of the Empire State Building (380 m) high, and

    (b) his velocity just before "landing"?

12. A ballplayer catches a ball 3.3 s after throwing it vertically upward. With what speed did he throw it, and what height is it reach?

13. Draw graphs of

    (a) the speed

    (b) the distance fallen,

    as a function of time, for an object falling under the influence of gravity from $t = 0$ to $t = 5.00$ s. Ignore air resistance and assume $v_o = 0$.

14. If air resistance is neglected, show (algebraically) that a ball thrown vertically upward with a speed v_o will have the same speed, v_o, when it comes back down to the starting point.

15. A stone is thrown vertically upward with a speed of 20.0 m/s.

    (a) How fast is it moving when it reaches a height of 12.0 m?

    (b) How long is required to reach this height?

    (c) Why are there two answers to (b)?

16. A stone is thrown vertically upward with a speed of 12.0 m/s from the edge of a cliff 75.0 m high.

    (a) How much later does it reach the bottom of the cliff?

    (b) What is its speed just before hitting?

    (c) What total distance did it travel?

17. A cyclist rides along a straight road from a point A to a point B. He starts from rest at A and accelerates uniformly to reach a speed of 12 m/s in 8 seconds. He maintains this speed for a further 20 seconds and then uniformly decelerates to rest at B. If the whole journey takes 34 seconds,

    a) Find his acceleration during the first 8 seconds.

    b) Calculate the total distance travelled.

    c) Obtain average velocity for the whole motion.

    d) Determine the acceleration when the cyclist uniformly decelerates to rest at B.

    e) Obtain instantaneous velocity experienced by the cyclist 2 second after he start decelerates uniformly.

    f) Find instantaneous acceleration experienced by the cyclist 3 second after he start decelerates uniformly.

18. An object is dropped from a bridge. A second object is thrown downwards 1.00 s later. They both reach the water 20.0 m below at the same instant.

    (a) How long did it take for the first object to reach the water?

    (b) How long did it take for the second object to reach the water?

    (c) What was the initial speed of the second object?

19. A student throws a set of keys vertically upward to her sorority sister, who is in a window 4.00 m above. The keys are caught 1.50 s later by the sister's outstretched hand.

a) With what initial velocity were the keys thrown?

b) What was the velocity of the keys just before they were caught?

20.

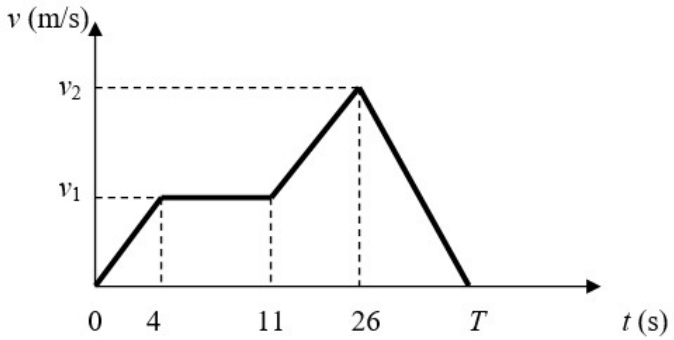


Figure 2 shows the velocity-time graph of a car moving in a straight line. The car accelerates from rest at 3.0 m/s^2 for 4 s, travels at a constant speed for 7 s, accelerates at 1.0 m/s^2 for 15 s, and then decelerates to rest at 2.5 m/s^2. Determine

(a) the velocity, v_1

(b) the velocity, v_2

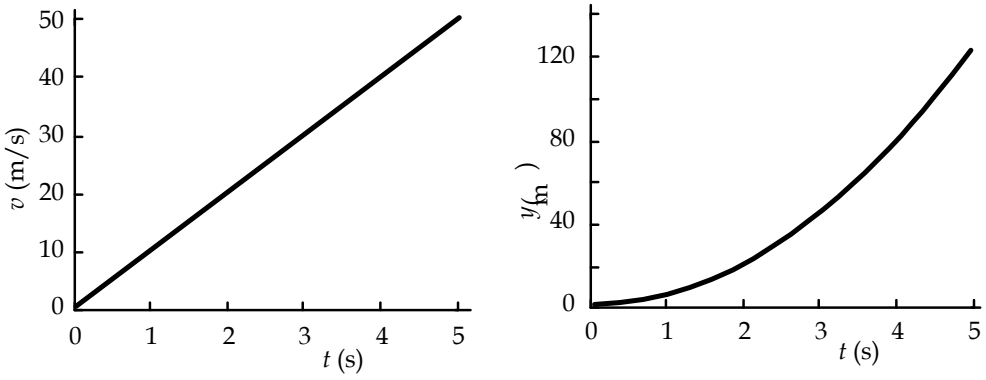
(c) the total time spent, T

Answers:

1. d = 61 m.
2. (a) D = 203 mi. (b) average speed = 61 mi/h.
3. T = 4.43 h. average speed = 881 km/h.
4. v = 6.73 m/s.
5. Δt = 5.2 s.
6. a = - 6.3 m/s^2. The number of g's is 0.64.
7. $L = 1.5 \times 10^2$ m.
8. a = 4.41 m/s^2. t = 2.61 s.
9. x = *62.5 m.*.
11. (a) t = 8.81 s. (b) v = 86.3 m/s (down).

12. v_0 = 16 m/s. h = 13 m.

13.



14. Proof.

15. (a) v = ± 12.8 m/s. (b) t = 0.735 s, 3.35 s.

(c) There are two answers because the stone reaches this height on the way up (t = 0.735 s) and on the way down (t = 3.35 s).

16. (a) t = 5.33 s. (b) v = - 40.2 m/s.

(c) The total distance travelled, d = 89.7 m.

17. (a) 1.5 m/s^2 (b) 324 m

(c) 9.53 m/s (d) -2 m/s^2

(e) 8 m/s (f) -2 m/s^2

18. (a) 2.02 s (b) 1.02 s

(c) 14.6 m/s

19. (a) 10.02 m/s (b) -4.69 m/s

20. (a) 12 m/s (b) 25 m/s

(c) 36.8 s