CH2 Exercises

DISPLACEMENT, TIME and AVERAGE VELOCITY

1. (2.3) You normally drive at an average speed of 105 km/h, which takes 1 h and 50 min to reach your destination. However, traffic has slows you down to average speed of 70 km/h. How much longer will your trip take to cover the same distance?

AVERAGE AND INSTANEOUS ACCELERATION

2. (2.13) The fastest street car (Bugatti Veyron Super Sport) has the following test data:

Time	0	2.1	20.0	53
Speed (mi/hr)	0	60	200	253

   (a) Sketch a v_x-t graph of this car's velocity (mi/hr) as a function of time. Is its acceleration constant?
   (b) Calculate the car's average acceleration in (m/s^2) between:
      a. 0 and 2.1 s
      b. 2.1 and 20 s
      c. 20 and 53 s

MOTION WITH CONSTANT ACCELERATION:

3. (2.19) An antelope moving with constant acceleration covers the distance between two points 70 m apart in 6 s. Its speed as it passes the second point is 15 m/s. What are:
      a. its speed at the first at the first point?
      b. its acceleration?

4. (2.21) The fastest measured pitch in baseball left the pitchers hand at a speed of 45 m/s. If the pitcher was in contact with the ball over a distance of 1.5 m and produced constant acceleration,
      a. What acceleration did he give the ball?
      b. How much time did it take him to pitch it?

5. (2.33) A small block has constant acceleration as it slides down a frictionless incline. The block is released from rest at the top of the inline, and its speed after it has traveled 6.80 m to the bottom of the incline is 3.80 m/s. What is the speed of the block when it is 3.40 m from the top of the incline?

FREE FALLING BODIES

6. (2.35) If a flea can jump straight up to a height of 0.44 m, what is its initial speed as it leaves the ground? How long is it airborne?
7. (2.39) A tennis ball on Mars (where $g_M = 0.379g = 3.72\ m/s^2$ and air resistance is negligible) is hit directly upwards and returns to the same level 8.5 s later.
      a. How high above it original point did it travel?
      b. How fast was it moving just after it was hit?

8. (2.43) A 7500 kg rocket blasts off vertically from launch pad with constant upwards acceleration of 2.25 m/s^2, feeling no appreciable air resistance. With is has reached a height of 525 m, its engines suddenly fail, for which the only force acting on it now is gravity.
    a. What is the maximum height this rocket will reach above the launch pad?
    b. How much time will elapse after engine failure before the rocket crashes?
    c. What is the rockets velocity when it crashes into the launch pad?

9. (2.47) A 15 kg rock is dropped from rest on Earth and reaches ground in 1.75 s. When it is dropped from the same height on Enceladus (a moon of Saturn), it takes 18.6 s to reach the ground. What is the acceleration due to gravity on Enceladus?

10. (2.58) A brick is dropped from the roof of a tall building. After it has been falling for a few seconds, it falls 40.0 in a 1.00 s time interval. What distance will fall during the next 1.00 s interval? (Ignore air resistance)

CALCULUS BASED PROBLEMS

11. (2.56 **CALC**) A lunar lander is descending toward the moon's surface. Until the lander reaches the surface, it's height above the moon is given by $y(t) = y_o - v_o t + a_m t^2$, where y_o = 800 m is the initial height of the lander above the surface, v_o = 60 m/s, and a_m = 1.05 m/s^2.
    a. What is the initial velocity of the lander at t = 0?
    b. What is the velocity of the lander just before it reaches the lunar surface?

12. (2.69 **CALC**) The acceleration of a particle is given by $a_x(t) = -2\ m/s + (3.00\ m/s^3)t$.
    a. Find the initial velocity v_o such that the particle will have the same x-coordinate at t = 4.00 s at it had at t = 0.
    b. What is its velocity at t = 4.00 s?

13. (2.81 **CALC**) An object is moving along the x-axis. At t=0 it has velocity v_x = 20.0 m/s. Starting at time t = 0 it has acceleration ax = -Ct, where has units m/s^3.
    a. What is the value of C if the object stops in 8.00 s after t = 0?
    b. For the value of C calculated, how far does the object travel in 8.00 s?

14. (2.83 **CALC**) Cars A and B travel in straight line. The displacement of A from the starting point is given by the function $x_A(t) = \alpha t + \beta t^2$, where α = 2.60 m/s and β = 1.20 m/s2. The displacement B from the starting point is $x_B(t) = \gamma t^2 - \delta t^3$, where γ = 2.80 m/s^2 and δ = 0.20 m/s^3.
    a. Which car is ahead just after they leave the starting point?
    b. At that time(s) are the cars at the same point?
    c. At what time(s) is the distance from A to B neither increasing nor decreasing?
    d. At what time(s) do A and B have the same acceleration?