Homework 7 Solutions
Physics 1000
Preparatory Physics
Due: Friday March 7, 1997

Reading Assignment

Basic Technical Physics, by Tippens. Chapter 6.

Written Assignment

Conceptual and Historical Questions

1. The slope of a curve on a position versus time graph is:

   a. position,

   b. velocity,

   c. speed,

   d. acceleration,

   e. indeterminate from the information given.

2. The slope of a curve on a velocity versus time graph is:

   a. position,

   b. velocity,

   c. speed,

   d. acceleration,

   e. indeterminate from the information given.

3. A 'kink' (a discontinuity in slope) in a position versus time graph:

   a. simply represents a quirk of nature,

   b. is physically unrealistic since it means that the object has undergone an infinite acceleration,

   c. is not representable mathematically since the slope is indeterminate and all graphs must have a slope everywhere,

   d. is a common occurrence in nature,

   e. was first explained by Galileo.

4. How many concentric spheres form the universe in Aristotle's cosmology? <u>59</u>

5. List the stratification of the four elements that form the Earth in order from innermost (nearest the Earth's center) to outermost (nearest the heavens). <u>Earth, Water, Air, Fire</u>

6. According to Aristole, the 'natural' place in the universe for a hunk of iron is in which stratum? <u>Earth</u>

7. Of the following theories and principles, circle those that Aristotle would have held: geocentrism, heliocentrism, noninertial theory of motion, inertial theory of motion, Law of Falling Bodies as stated by Galileo.

8. Same as 7, but circle those that Galileo would have held: geocentrism, heliocentrism, noninertial theory of motion, inertial theory of motion, Law of Falling Bodies as stated by Galileo.

9. This great thinker lived and worked about 100 years before Galileo. Among many other things, he studied falling bodies and developed a theory called 'The Law of Integers'. Da Vinci

Falling Bodies (Neglect air resistance.)

10. A cannon projects a cannon ball straight up in the air. If the cannon ball is observed to fall back to earth in 100 s, what was the initial speed of the cannon ball as it left the cannon's breach?

    $x = 0, x_0 = 0, t = 100$ s. Using Galileo's 2nd kinematical equation we get: $0 = v_0 t - gt^2/2 \rightarrow v_0 = gt^2/2 = (4.9)(100) = 490$m/s. Note that there might be some confusion in the wording of the problem. The student might have thought that 100 s referred not to the total time of flight but only to the downward time of flight, so that the total time of flight would be 200 s. In this case, $v_0 = 980$ m/s which we will also accept here.

11. What is the maximum height above the ground that the cannon ball attains?

    Using the up-down symmetry of the cannon ball's motion, the time at the top of the cannon ball's flight will be $t = 50s$. Thus, using Galileo's 4th kinematical equation we get: $x = v_0 t - gt^2/2 = (490)(50) - 4.9(50)^2 = 12,250$m. Again, if the student thought the total time of flight was 200s, then the time to the top of the cannon ball's flight would be 100 s and the maximum height would be 36,750 m.

Graphs of Position, Velocity, and Acceleration versus Time

12. The graph labeled '#12 (from me)' at upper left on the final page of this homework shows distance (x) versus time (t) for an elevator as it moves up and down in a building. Making sure you specify both the sign and the unit correctly, compute the elevator's velocity at each of the following points. Ignore the kinks in the graph. The grid is labeled with position in meters (x (m)) on the vertical axis and time in seconds (t (s)) on the horizontal axis.

    a. Point A. 0 m/s.

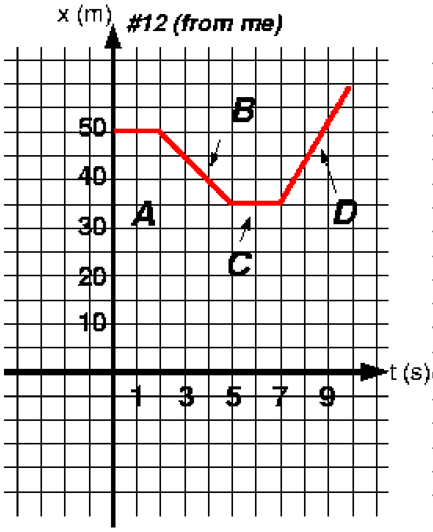
    b. Point B. v = -15m/3s = -5 m/s.

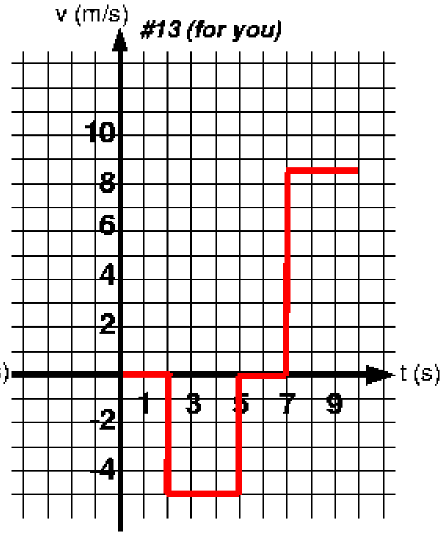
    c. Point C. 0 m/s.

    c. Point D. v = 25m/3s = 8.33 m/s.

13. Using the information on the graph from problem #12, on the upper right grid labeled '#13 (for you)' on the last page of this homework draw an accurate graph of velocity versus time

of the elevator. Make sure you indicate units on the graph axes. The grid is labeled with velocity in meters per second (v (m)) on the vertical axis and time in seconds (t (s)) on the horizontal axis.





Challenge Problem (Extra Credit)

A marathon runner runs at a steady 15 km/h, when the runner is 7.5 km from the finish, a bird begins flying from the runner to the finish at 30 km/h. When the bird reaches the finish line, it turns around and flies back to the runner, and then turns around again, repeating the back-and-forth trips until the runner reaches the finish line. How many km does the bird fly?

This is a very simple problem. The challenge is reading it carefully. The bird flies twice as fast as the runner runs. So while the runner runs 7.5 km to the finish line the bird will fly twice as far or 15 km. That's all there is to it!