

PHYSICS 1030

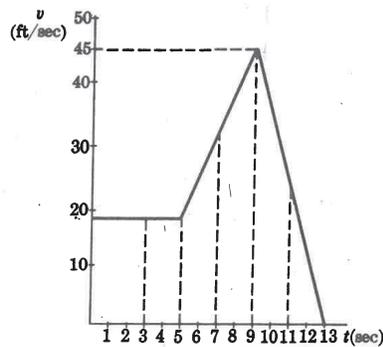
Homework #2

(Due Sept. 11, 2023, 6:00 pm)

1. The two-mile running record on an indoor track is 8 min 3.40 sec, set by Mo Farah of the United Kingdom in 2015. To what average velocity does this correspond in (a) mi/sec? (b) mi/hr? (c) cm/sec? (d) ft/sec?

2. A body moves along a straight line, its distance from the origin at any instant being given by the equation $x = 8t - 3t^2$, where x is in centimeters and t is in seconds. (a) Find the average velocity of the body in the interval from $t = 0$ to $t = 1$ sec, and in the interval from $t = 0$ to $t = 4$ sec. (b) Find the expression for the average velocity in the interval from t to $t + \Delta t$. (c) What is the limiting value of this expression as Δt approaches zero? (d) Find the time or times at which the body is at rest. (e) Find the expression for the acceleration at any time.

3. The graph below shows the velocity of a body plotted as a function of time.



- What is the instantaneous acceleration at $t = 3$ sec?
- What is the instantaneous acceleration at $t = 7$ sec?
- What is the instantaneous acceleration at $t = 11$ sec?
- How far does the body go in the first 5 sec?
- How far does the body go in the first 9 sec?
- How far does the body go in the first 13 sec?

4. An object is thrown vertically upward. It has a speed of 32 ft/sec when it has reached one-half its maximum height. (a) How high does it rise? (b) What is its velocity and acceleration 1 sec after it is thrown? (c) 3 sec after? (d) What is the average velocity during the first half-second?

5. A student determined to test the law of gravity for himself walks off a skyscraper 900 ft high, stopwatch in hand, and starts his free fall (zero initial velocity). Five seconds later, Superman arrives at the scene and dives off the roof to save the student. (a) What must Superman's initial velocity be in order that he catch the student just before the ground is reached? (b) What must be the height of the skyscraper so that even Superman can't save him? (Assume that Superman's acceleration is that of any freely falling body.)

6. A ball is thrown nearly vertically upward from a point near the cornice of a tall building. It just misses the cornice on the way down, and passes a point 160 ft below its starting point 5 sec after it leaves the thrower's hand. (a) What was the initial velocity of the ball? (b) How high did it rise above its starting point? (c) What was the magnitude of its velocity as it passed a point 64 ft below the starting point?

7. A ball is shot straight up from the ground. After 6 seconds, the ball is at the same height as it was after 4 seconds. What was the initial velocity?

Extra credit. Alice travels twice the speed of Bob and three times the speed of Carly. How many minutes will it take Carly to cover the distance Bob covers in 36 minutes?