Homework No. 02 (Fall 2021)

PHYS 203A: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale
Due date: Tuesday, 2021 Aug 31, 12.30pm, on D2L

Instructions

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.

- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assesments → Assignments).

1. (**10 points.**) Motion of an object moving with uniform velocity is described by the equation

$$x = vt, \tag{1}$$

   where x is the position of the object, v is the velocity of the object, and t is time.

   (a) Plot x versus t for $v = 3.0 \, \text{m/s}$.

   (b) Determine the position of the object at $t = 0 \, \text{s}$, and mark this point on the plot. Repeat this for $t = 1.0 \, \text{s}, 2.0 \, \text{s}, 3.0 \, \text{s}, 4.0 \, \text{s}$.

   (c) What is the acceleration of the object?

2. (**10 points.**) Motion of an object moving with uniform acceleration, after starting from rest, is described by the equation

$$x = \frac{1}{2}at^2, \tag{2}$$

   where x is the position of the object, a is the acceleration of the object, and t is time.

   (a) Plot x versus t for $a = 2.0 \, \text{m/s}^2$.

   (b) Determine the position of the object at $t = 0 \, \text{s}$, and mark this point on the plot. Repeat this for $t = 1.0 \, \text{s}, 2.0 \, \text{s}, 3.0 \, \text{s}, 4.0 \, \text{s}$.

   (c) The slope in a position-time plot represents velocity. Using this idea estimate the velocity of the object at $t = 2.0 \, \text{s}$ graphically.

3. (**10 points.**) A motorcycle has a constant acceleration of $2.0 \, \text{m/s}^2$. Both the velocity and acceleration of the motorcycle point in the same direction.

   (a) How much time is required for the motorcycle to change its speed from $10.0 \, \text{m/s}$ to $20.0 \, \text{m/s}$?

(b) How much time is required for the motorcycle to change its speed from $20.0\,\text{m/s}$ to $30.0\,\text{m/s}$?

(c) How much time is required for the motorcycle to change its speed from $30.0\,\text{m/s}$ to $40.0\,\text{m/s}$?

4. (**10 points.**) While standing on a $50.0\,\text{m}$ tall building you throw a stone straight upwards at a speed of $15\,\text{m/s}$.

(a) How long does the stone take to reach the ground?

(b) How high above the building does the stone reach?

5. (**10 points.**) A fish is dropped by a pelican that is rising steadily at a speed $4.0\,\text{m/s}$. Determine the time taken for the fish to reach the water $15.0\,\text{m}$ below. How high above the water is the pelican when the fish reaches the water?

6. (**10 points.**) A car is traveling at $10.0\,\text{m/s}$, and the driver sees a traffic light turn red. After $0.500\,\text{s}$ (the reaction time), the driver applies the brakes, and the car decelerates at $8.00\,\text{m/s}^2$. What is the stopping distance of the car, as measured from the point where the driver first sees the red light?

7. (**10 points.**) A speeding car is moving at a constant speed of $v = 80.0\,\text{miles/hour}$ ($35.8\,\text{m/s}$). A police car is initially at rest. As soon as the speeder crosses the police car the cop starts chasing the speeder at a constant acceleration of $a = 2.0\,\text{m/s}^2$. Determine the time it takes for the cop to catch up with the speeder. Determine the distance traveled by the cop in this time.

8. (**10 points.**) A key falls from a bridge that is $50.0\,\text{m}$ above the water. It falls directly into a boat that is moving with constant velocity, that was $10.0\,\text{m}$ from the point of impact when the key was released. What is the speed of the boat?