

# Homework No. 02 (Fall 2020)

## PHYS 203A: COLLEGE PHYSICS

*Department of Physics, Southern Illinois University–Carbondale*

Due date: Tuesday, 2020 Sep 1, 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 (Assessments → Assignments).

### Questions

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 m/s to 20.0 m/s?
  - (b) How much time is required for the motorcycle to change its speed from 20.0 m/s to 30.0 m/s?
  - (c) How much time is required for the motorcycle to change its speed from 30.0 m/s to 40.0 m/s?
4. **(10 points.)** While standing on a 50.0 m tall building you throw a stone straight upwards at a speed of 15 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 m/s. Determine the time taken for the fish to reach the water 15.0 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 m/s, and the driver sees a traffic light turn red. After 0.500 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  $v = 80.0$  miles/hour (35.8 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 m above the water. It falls directly into a boat that is moving with constant velocity, that was 10.0 m from the point of impact when the key was released. What is the speed of the boat?