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Lab 1: Motion in One Dimension - Part 1

PHYS 2305

Pre-lab Assignment

Question Pre-1: Explain the difference between average and instantaneous velocity.

* average velocity is the change in position over the time of travel while instantaneous velocity is the velocity of an object at a single point in time and space.

Question Pre-2: An object is initially at rest and then accelerates for a time interval Δt. After Δt, the object has displaced 1.5 m in the +x-direction and has an instantaneous velocity of 3.5 m/s in the +x-direction. Using relevant expressions from the reading, determine the following:

(a) The average acceleration of the object.

$v_i = 0$ m/s

$v_f = 3.5$ m/s

$\Delta x = 1.5$ m

$$v_f^2 - v_i^2 = 2a\Delta x$$

$$a = \frac{v_f^2 - v_i^2}{2\Delta x}$$

$$a = \frac{3.5^2}{2(1.5)}$$

$a = 4.08$ m/s^2 in the positive x-direction

(b) The time it took the object to travel 1.5 meters.

$$\Delta x = v_i t + \frac{1}{2}at^2$$

$$1.5\text{m} = 0(1) + \frac{1}{2}(4.08)t^2$$

$$1.5\text{m} = \frac{1}{2}(4.08)t^2$$

$$1.5\text{m} = 2.04t^2$$

$t^2 = 0.735$ s

$t = 0.86$ seconds

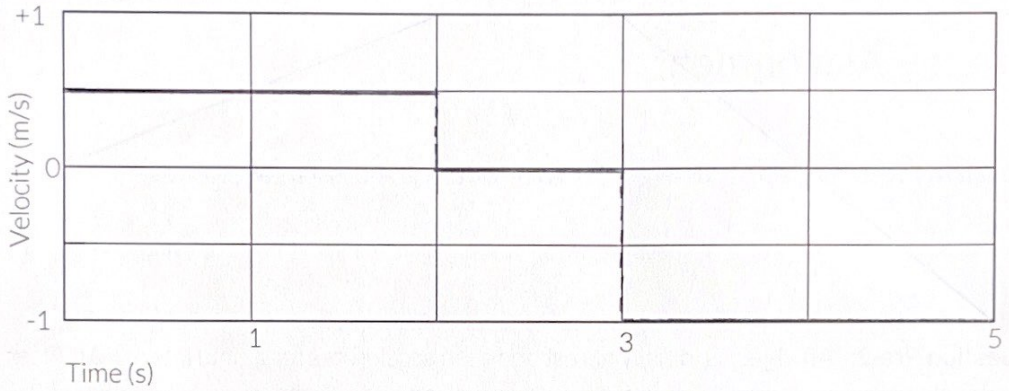
(c) The object's average velocity during this period of motion.

$$v_{avg} = \frac{1.5\text{m}}{0.86\text{s}}$$

$v_{avg} = 1.75$ m/s

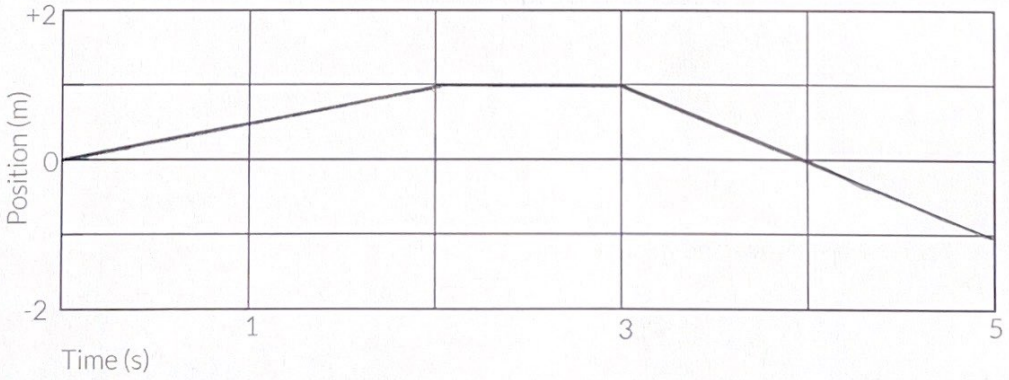
Question Pre-3: On Graph 1. 1, draw a solid line representing someone walking forward at a speed of 0.5 m/s for 2 seconds, resting for one second, then walking backward at a speed of 1.0 m/s for 2 seconds.

Graph 1. 1



Question Pre-4: On Graph 1. 2, draw a solid line representing someone starting at the origin and walking forward with a constant speed of 0.5 m/s for 2 seconds, standing still for one second, and then moving backward with a constant speed of 1.0 m/s for 2 seconds.

Graph 1. 2



Question Pre-5: Refer to Section 2. Constant-Acceleration Motion – Free-Fall. You tape a small washer to a ball and hang the ball from an electromagnet. When you press down on a trigger, the electromagnet will shut off, the ball will fall through a height of 75 cm, and land on a time-of-flight pad.
Determine the amount of time the ball will take to impact the time-of-flight pad once the trigger is activated. Show your calculations and ignore air resistance.

Given:

* height (h) = 75 cm = 0.75 m
* Inital speed (v) = 0 m/s

$$h = vt + \frac{1}{2}gt^2$$

- h is height
- v is initial velocity
- g is gravity ($9.8\ m/s^2$)
- t is time

Substitute values and solve:

$$0.75\ m = 0(t) + \frac{1}{2}(9.8)(t^2)$$

$$0.75\ m = 0 + 4.9t^2$$

$$t = \sqrt{\frac{0.75}{4.9}}$$

$$t = 0.391 \text{ seconds}$$