

**Question 1:**

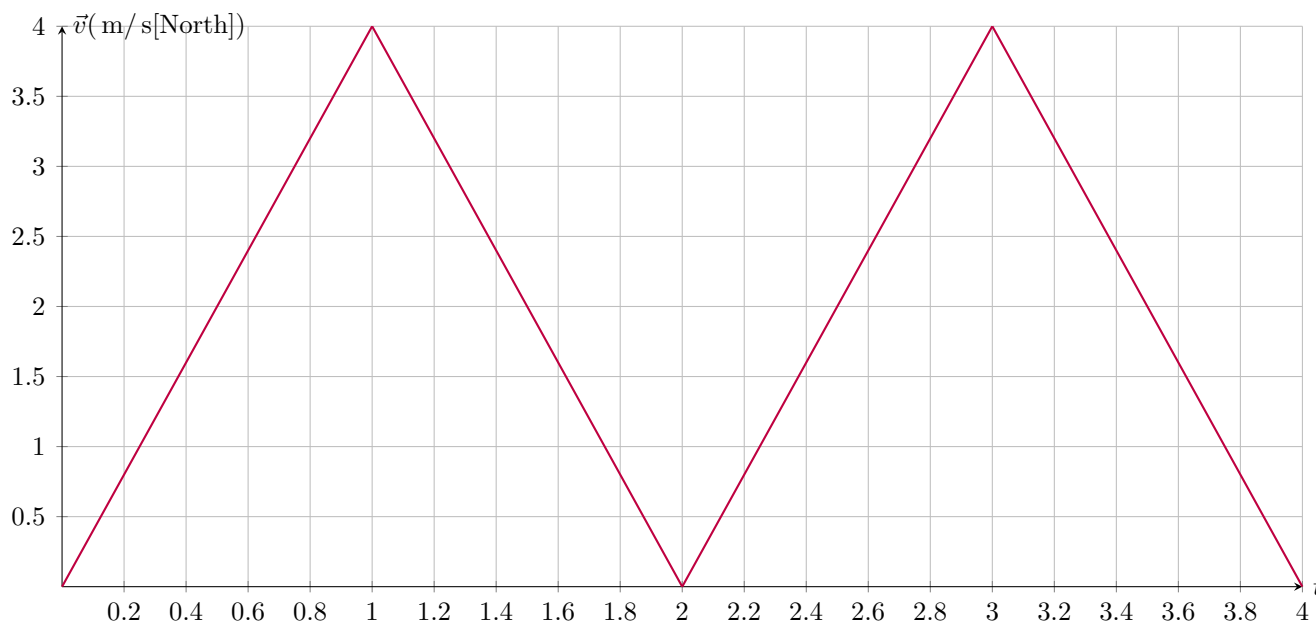
Answer the following True/False questions (**Assume [East] is positive**)

1. Consider an object under uniform motion in the negative direction.
  - (a) The object has a non-zero average acceleration in the negative direction. (T / F)
  - (b) At the end of the trip, the object may remain [East] relative to the reference point. (T / F)
2. De-acceleration is just acceleration in the same direction of motion (T / F)
3. Suppose that a bullet accelerates at  $\vec{a}_{av} = +1.068 \text{ km/s}^2$  from rest to a final velocity of  $\vec{v}_f = +356 \text{ m/s}$ . Then,
  - (a) The time elapsed was  $\Delta t = 3 \text{ s}$  (T / F)
  - (b) If I double the acceleration of the bullet, then  $\Delta t$  doubles as well. (T / F)
4. Suppose a Velocity V. Time plot is represented by  $y = 2x + 4$ ,
  - (a) The average acceleration is uniform (T / F)
  - (b) The initial velocity of the body at  $t = 0$  was  $\vec{v}_i = +4 \text{ m/s}$  (T / F)
  - (c) The displacement over the time interval  $[0, 2]$  was  $\Delta \vec{d} = +12 \text{ m}$  (T / F)
  - (d) The average acceleration is  $\vec{a}_{av} = +2 \text{ m/s}^2$  (T / F)
5. A secant line on a Velocity V. Time graph over the interval  $[t_1, t_2]$  gives me the instantaneous acceleration over the time interval  $[t_1, t_2]$ . (T / F)
6. Suppose a Position V. Time plot is represented by  $y = x^2 + 4$ . Then,
  - (a) The object is slowing down in the positive direction. (T / F)
  - (b) The object is experiencing uniform motion. (T / F)
  - (c) The object may be experiencing uniform acceleration (T / F).
  - (d) The initial position vector of the object at  $t = 0$  is  $\vec{d}_i = +2 \text{ m}$  (T / F)
7. Suppose that the tangent line to a Position V. Time plot at  $t = 4$  was represented by the equation  $y = -3x + 7$ . Then,
  - (a) The instantaneous velocity of the object at  $t = 4$  was  $\vec{v} = +3 \text{ m/s}$  (T / F)
  - (b) Suppose that the Position V. Time plot happened to be linear, then the average velocity of the object must have been  $\vec{v}_{av} = -3 \text{ m/s}$ . (T / F)
8. Suppose a Velocity V. Time plot is represented by  $y = -x + 3$ , then the displacement over the time interval  $[0, 6]$  is  $\Delta \vec{d} = +0 \text{ m}$ . (T / F)
9. Suppose that the average acceleration of an object in motion differs at two distinct points in time, then the Velocity V. Time plot must have been non-uniform. (T / F)

**Question 2:**

Answer the following multiple choice questions.

- Which of the following statements are correct about the plot below? (Assume that the motion lasted for 4 seconds)



- The body experienced uniform acceleration throughout the entire trip.
  - Within the time interval  $[0, 2]$  the average acceleration was  $\vec{a}_{av} = +0 \text{ m/s}^2$
  - Within the time interval  $[3, 4]$  the average acceleration was  $\vec{a}_{av} = -4 \text{ m/s}^2$
  - Within the time interval  $[1, 4]$  the average acceleration was  $\vec{a}_{av} = -1.333 \text{ m/s}^2$
  - At  $t = 2 \text{ s}$ , the instantaneous acceleration was  $\vec{a}_{av} = +4 \text{ m/s}^2$
  - At  $t = 3.4 \text{ s}$ , the instantaneous acceleration was  $\vec{a}_{av} = -4 \text{ m/s}^2$
  - The average acceleration is not the same as the instantaneous acceleration for each point in time.
- The Velocity  $V$ . Time plot for a body in motion is similar to  $y = 4x + 7$ .
    - The displacement over the first  $t = 4 \text{ s}$  was  $\Delta \vec{d} = +23 \text{ m}$ .
    - The object experienced uniform motion.
    - The object experienced uniform acceleration.
    - The object was speeding up in the positive direction

**Question 3:**

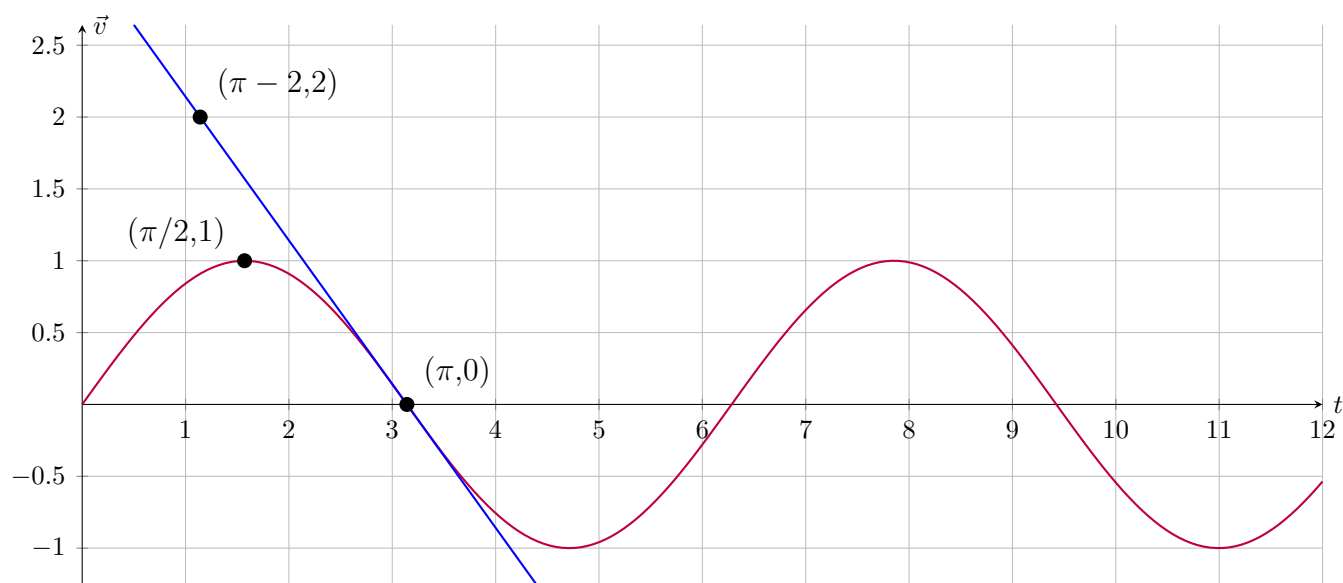
Answer the following inquires about the plot below,



- (a) The displacement over the time interval  $[1, 3]$ .
- (b) The displacement over the time interval  $[3, 8]$ .
- (c) The displacement by the end of the trip ( $\Delta t = 12 \text{ s}$ )

**Question 4:**

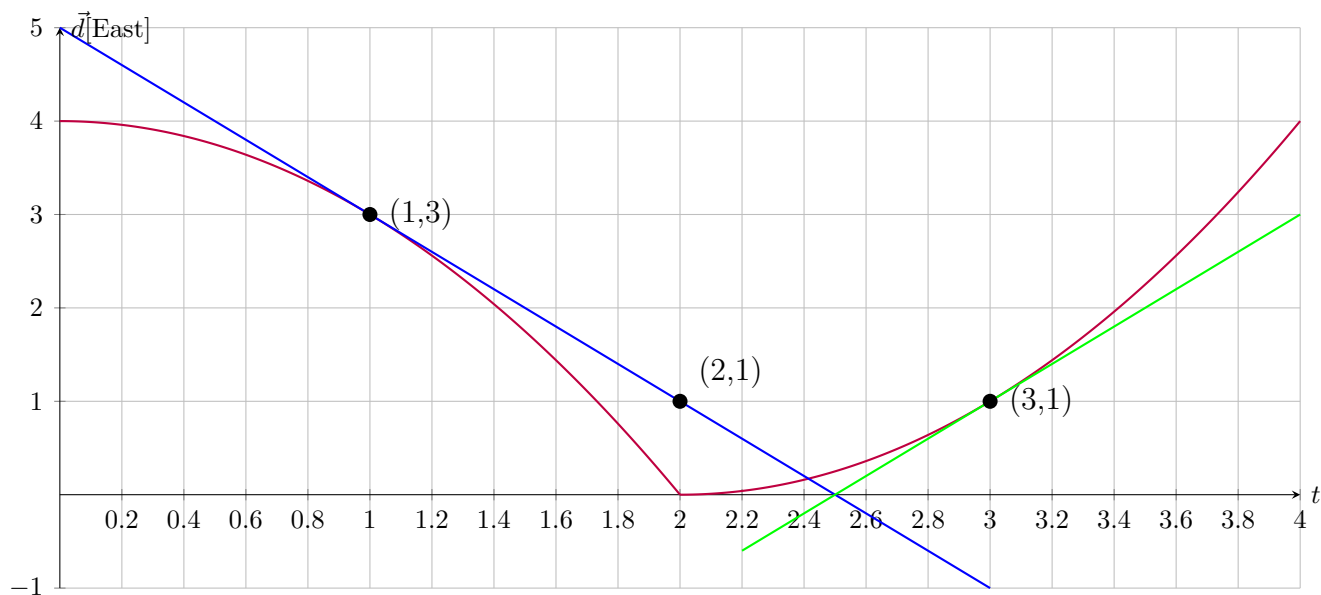
Answer the following inquires about the Velocity  $V$ . Time plot below,



- Determine the average acceleration within the time interval  $[\pi/2, \pi]$ .
- Determine the instantaneous acceleration at time  $t = \pi$ .  
(**Hint:** The line in blue is a tangent line to the plot at  $t = \pi$ )
- Prove that  $\vec{a}_{av} = +0 \text{ m/s}^2$  over the interval  $[0, \pi]$ .

**Question 5:**

Given the Position V. Time plot below, answer the following inquiries.



- Determine the average velocity over the time interval  $[0, 2]$ .
- Describe the motion over the time interval  $[0, 2]$
- Determine the instantaneous velocity at  $t = 1$ .  
(**Hint:** The line in blue is a tangent line to the plot at  $t = 2$ )
- Describe the motion of the plot after  $t = 2$  seconds.
- Determine the equation of the **tangent line** at  $t = 3$  ( $y = mx + b$ ).

**Question 6:**

A ball is kicked with an initial velocity of  $\vec{v}_i = 80 \text{ m/s}[\text{South}]$ . It experiences a drag force and de-accelerates at  $\vec{a}_{av} = 5 \text{ m/s}^2[\text{North}]$ .

- (a) Determine the final velocity of the ball after  $\Delta t = 40 \text{ s}$
- (b) At what time  $t$  did ball start to travel in the Northward direction.

**Question 7:**

Patrick has decided to embark on a journey throughout the sea on a boat. The boat has a relative velocity of  $\vec{v}_{BG} = 400 \text{ m/s [East]}$  relative to the ground (G). On the boat, Patrick is walking with a relative velocity of  $\vec{v}_{PB} = 50 \text{ m/s [East]}$  relative to the boat. Determine,

- (a) The velocity of patrick relative to the ground ( $\vec{v}_{PG}$ )

(**Hint:** Use the exact same technique from when we were working with position vectors, i.e  $\vec{v}_{AC} = \vec{v}_{AB} + \vec{v}_{BC}$ )

- (b) The average acceleration of Patrick relative to the ground over a time period of  $\Delta t = 40 \text{ s}$  if everything was initially at rest.

**Question 8:**

A car is initially traveling at an initial velocity  $\vec{v}_i = 412 \text{ m/s [East]}$ . The car then de-accelerates at an average acceleration of  $\vec{a}_{av}$  to come to a rest at a red light over a duration of  $\Delta t$ . When the light turns green, the car accelerates at an average acceleration  $-\vec{a}_{av}$  over a time period  $2\Delta t$ , to reach a final velocity of  $\vec{v}_f = 240 \text{ m/s [East]}$ . Determine the average acceleration  $\vec{a}_{av}$ .

(**Hint :** Setup the correct equations to get rid of  $\Delta t$ )