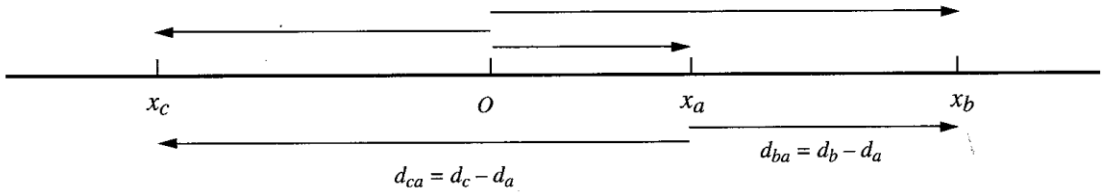
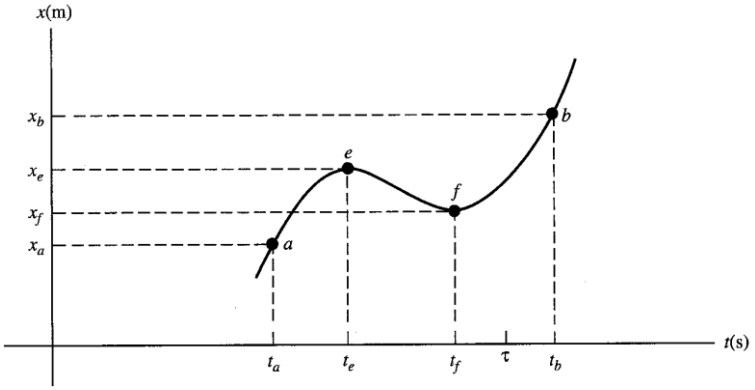
Assignment 1: PHY101 (Summer '23)

1. A vector **A** has a magnitude 7 and makes an angle 40° with the x-axis and a vector **B** has a magnitude 8 and makes an angle of 30° with the x-axis. Find the magnitude and direction of the vectors **C** = **A** + **B**, and **D** = **A** – **B**.
2. Given the two vectors $\vec{A} = -2\hat{\imath} + 3\hat{\jmath} + 5\hat{k}$ and $\vec{B} = 5\hat{\imath} + \hat{\jmath} + 2\hat{k}$, find (i) $\vec{A} + \vec{B}$, (ii) $\vec{A} - \vec{B}$, (iii) $\vec{A}.\vec{B}$, and (iv) $\vec{A} \times \vec{B}$.
3. In the figure below, let x_a = 3m, x_b = 7m, and x_c = -5m. Find the magnitudes and signs of the displacements d_{ca}, d_{ba}, d_{ac}, and d_{bc}.

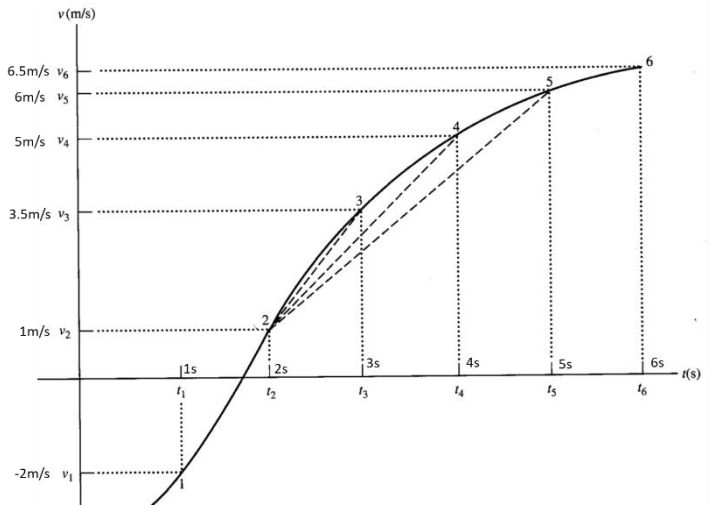


4. In the figure above, a particle passes point a at t_a = 4s, point b at t_b = 6s, and point c at t_c = 9s. Find the magnitude and direction of the average velocity of the particle between time intervals (i) t_a and t_b, (ii) t_b to t_c, and (iii) t_a to t_c.

5. In the figure below x_a = 3m at t_a = 4s, x_e = 5m at t_e = 4.5s, x_f = 4m at t_f = 5.3s, and x_b = 7m at t_b = 6s. In which direction is the particle moving in the interval (i) t_a to t_e, (ii) t_e to t_f, and (iii) t_f to t_b? What is the average velocity in the interval (i) t_a to t_e, (ii) t_e to t_f, (iii) t_f to t_b and (iii) t_a to t_b?



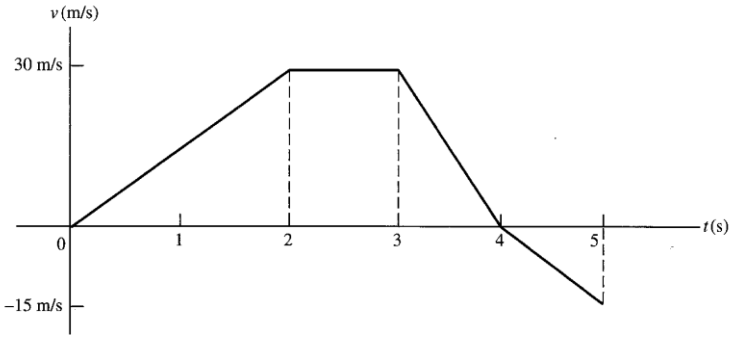
6.



From the figure, find the average acceleration between times (i) t_1 and t_5, (ii) t_2 and t_5, (iii) t_2 and t_4. From the plot show that even though the instantaneous velocity is zero, the instantaneous acceleration need not be zero.

7. A vehicle moving with initial velocity 30m/s accelerates at a rate of 15m/s^2. How fast will it be moving after 4s? The driver then slows down at a rate of -30m/s^2. How long does it take to come to a stop? How far did the vehicle travel in the first 3s and in the next 2s?

8. From the figure below find the displacement between the interval (i) 0 to 2s, 2 to 3s, 3 to 4s, and 4 to 5s. What is the total displacement from 0 to 5s? What is the total distance covered from 0 to 5s?



9. A stone is thrown straight up with a speed 50m/s. At what height will it be when its speed becomes 25m/5?

10. A projectile is fired at an initial speed of 40m/s at an angle of 30^o from the horizontal. At t = 1.5s, what is the total speed and what angle does it make with the horizontal? What is its height and distance along x-axis at t = 1.5s.

11. For the projectile in the problem above, find the equation of the orbit (y,x).

12. A particle is doing uniform (constant speed) circular motion. If *T* is the period of the orbit or the time after which the motion repeats, show that the magnitude of the centripetal acceleration can be given by $a = \frac{4\pi^2 R}{T^2}$, where R is the radius of the circle.