

Prelab No. 1

H. Ryott Glayzer

13th September 2024

1 Particle Motion given by $x(t) = 7.8 + 9.2t - 2.1t^3$

1.1 Instantaneous velocity

The instantaneous velocity of the particle can be determined by the first derivative of the equation of motion. The motion of the particle is defined as the relation

$$x(t) = 7.8 + 9.2t - 2.1t^3, \quad (1)$$

the derivative of which can be found via the power rule:

$$\dot{x}(t) = 9.2 - 6.3t^2. \quad (2)$$

The instantaneous velocity given by $\dot{x}(t)$ is time-dependent, as the velocity is not constant over time.

1.2 Zero Velocity

The velocity of the particle can be found via

$$\dot{x}(t) = 9.2 - 6.3t^2. \quad (3)$$

The zero of this function that lies in the positive-time domain represents a velocity of zero. Thus, the time where $\dot{x}(t) = 0$ can be found by setting the function equal to zero and solving for t :

$$\begin{aligned} 0 &= 9.2 - 6.3t^2 \\ 9.2 &= 6.3t^2 \\ \frac{92}{63} &= t^2 \\ t &= \frac{2}{3}\sqrt{\frac{23}{7}} \\ t &\approx 1.2 \end{aligned} \quad (4)$$

1.3 Instantaneous Acceleration

The instantaneous acceleration of the particle can be found via the second derivative of the equation of motion, or

$$\ddot{x} = -12.6t. \quad (5)$$

This acceleration is time dependent, and takes jerk into account.

1.4 Zero acceleration

The particle has zero acceleration at the time $t = 0$.

2 Particle Motion given by displacement.