# Prelab No. 1

H. Ryott Glayzer

11th October 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

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

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

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

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

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

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 $t$:

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

### 1.3 Instantaneous Acceleration

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

$$\ddot{x} = -12.6t. \tag{5}$$

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.

### 2.1 Constant Velocity by Kinematics

Given $\Delta x_{1s} = 14$ and $\Delta x_{2s} = 42$, as well as the assumption of a constant velocity, we can take

$$\vec{v} = \frac{\overrightarrow{\Delta x}}{\Delta t} \tag{6}$$

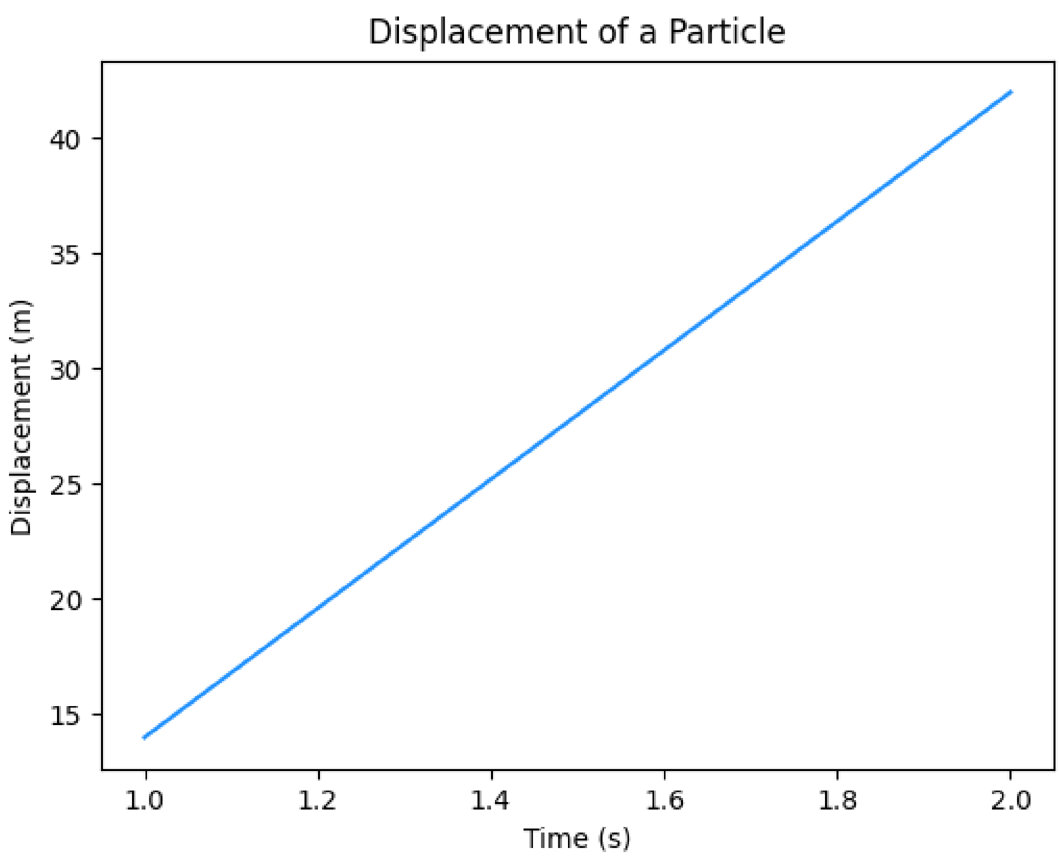
and input the values

$$\vec{v} = \frac{42 - 14\ m}{2 - 1\ s} \tag{7}$$

to find

$$\vec{v} = 28\ m/s \tag{8}$$

### 2.2 Plotting the data




This plot does reflect my earlier predictions.