

# Simple Harmonic Motion

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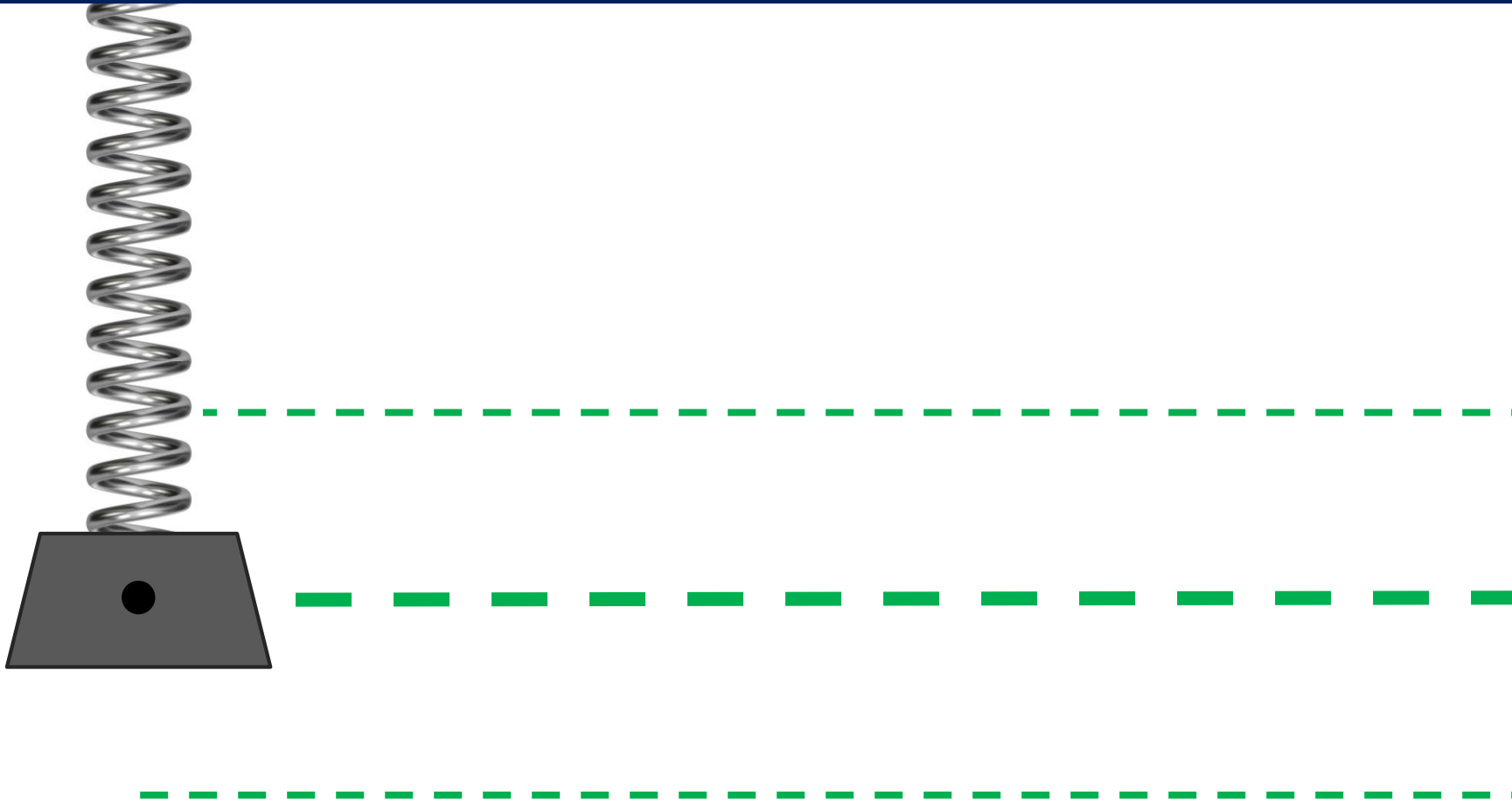
IB PHYSICS | WAVES - SOUND

# Warm up

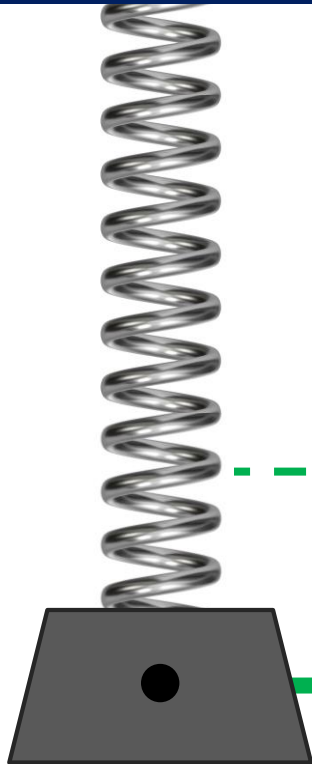


What words would you use to describe the motion of a bobble head doll?

# A Mass on a Spring

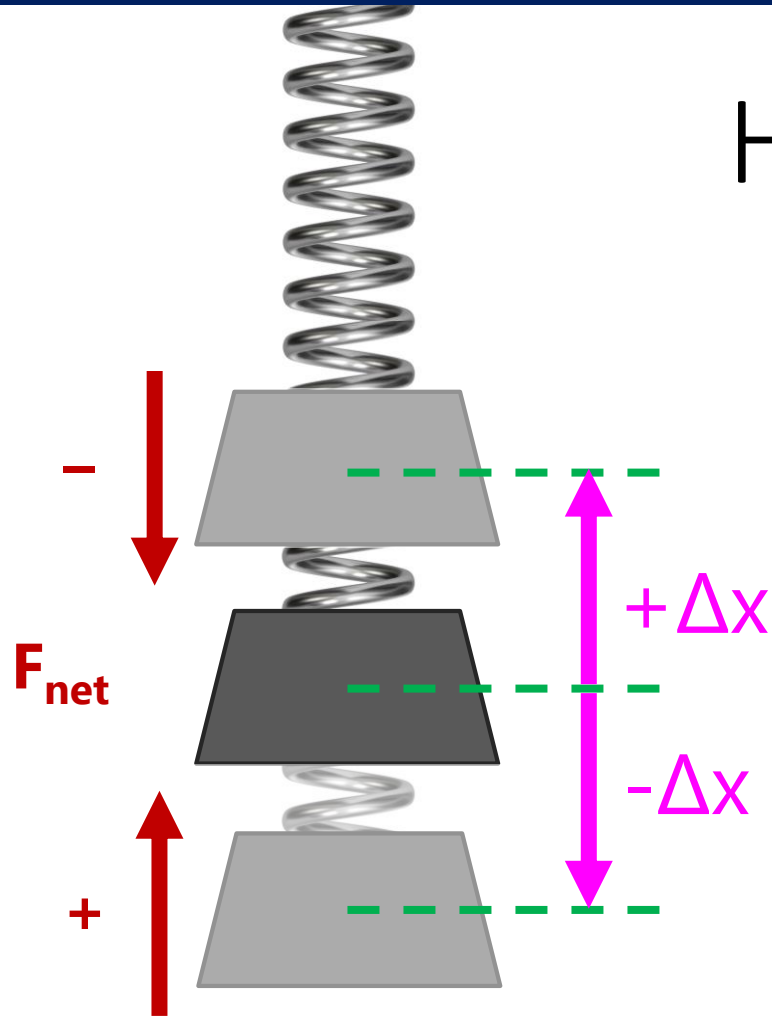


Let's look at the forces...

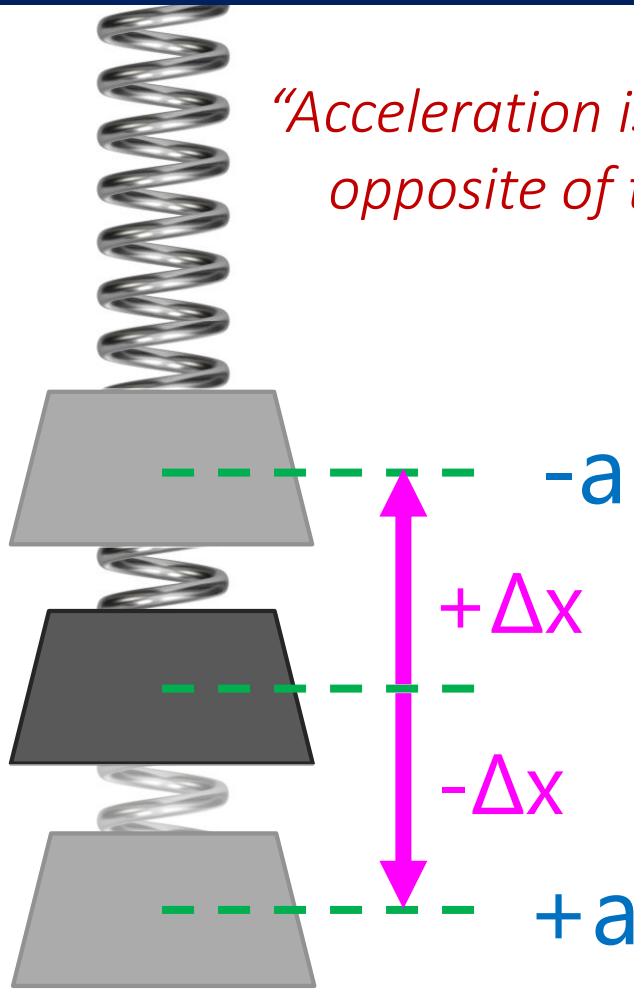


# Force and Displacement

Hooke's Law:  $F = -k\Delta x$



# Why the Negative Sign??



*“Acceleration is proportional to the opposite of the displacement”*

$$a \propto -x$$

# Let's look at this one more time...

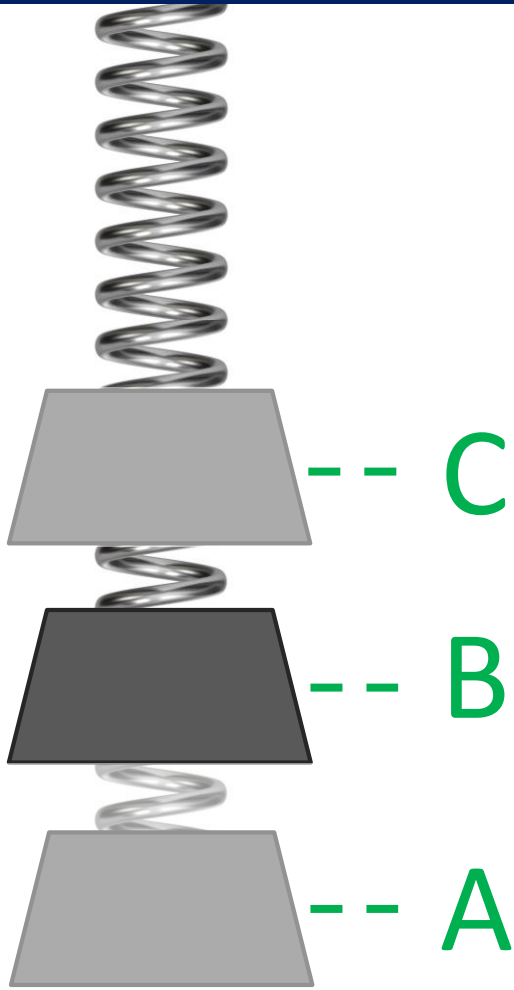


When is the **force** largest?

When is the **acceleration** largest?

When is the **velocity** largest?

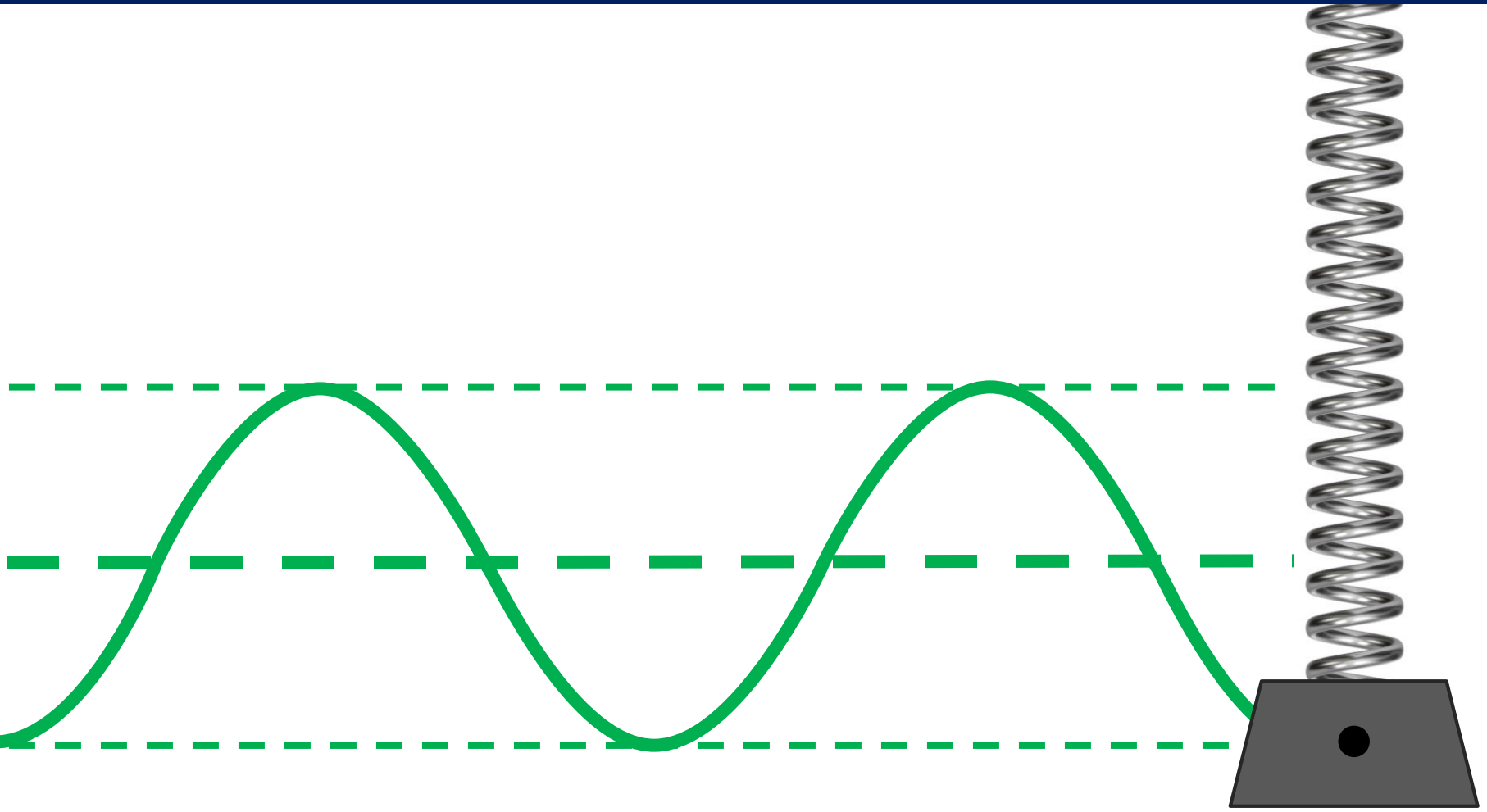
# Where is the Greatest...

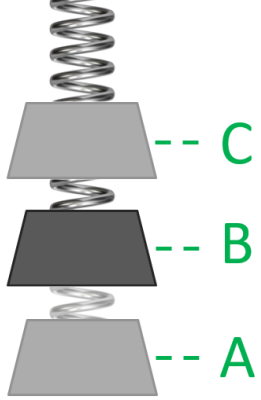
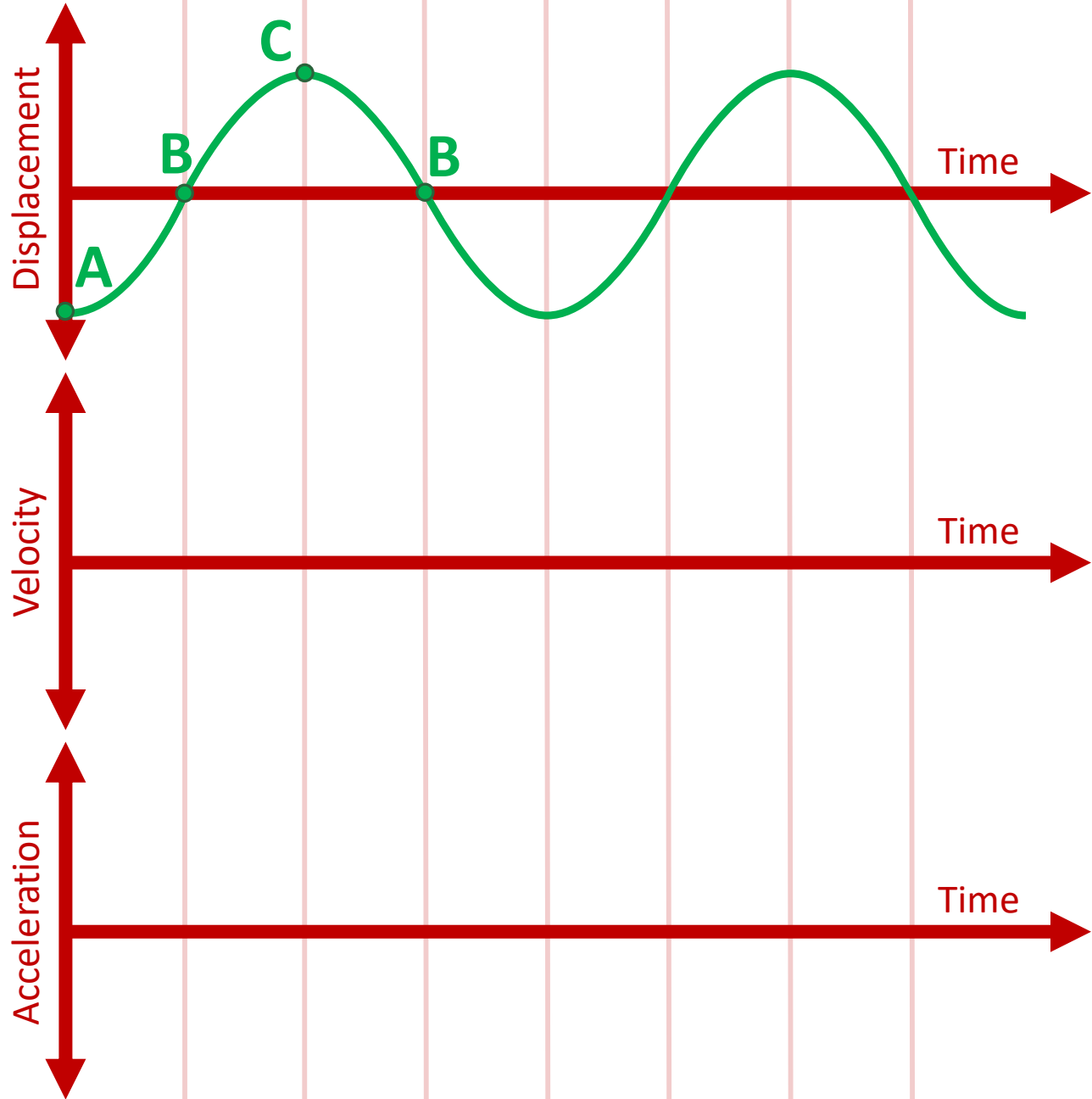


Displacement	Velocity	Acceleration

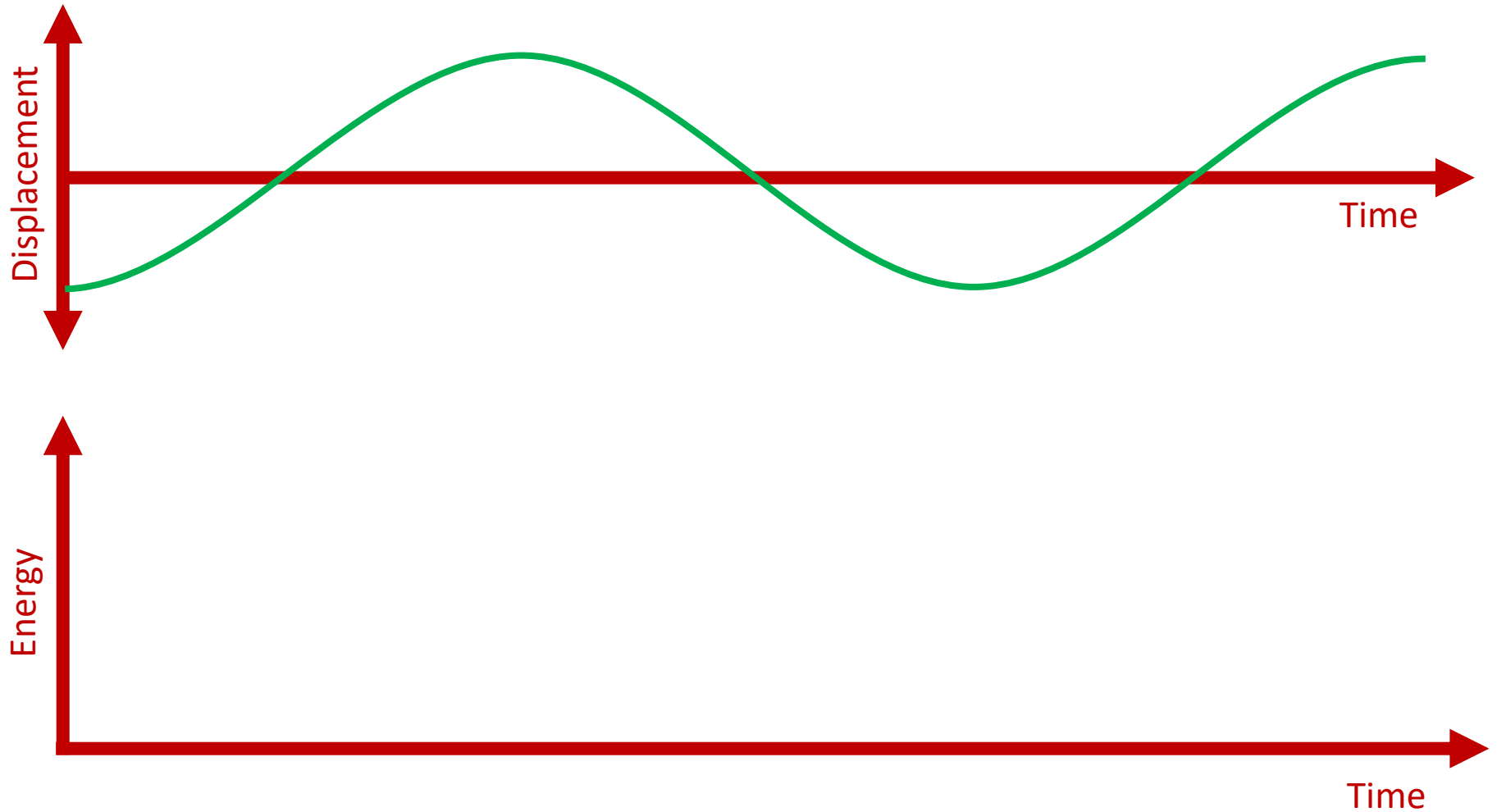


# Graphing Displacement vs Time

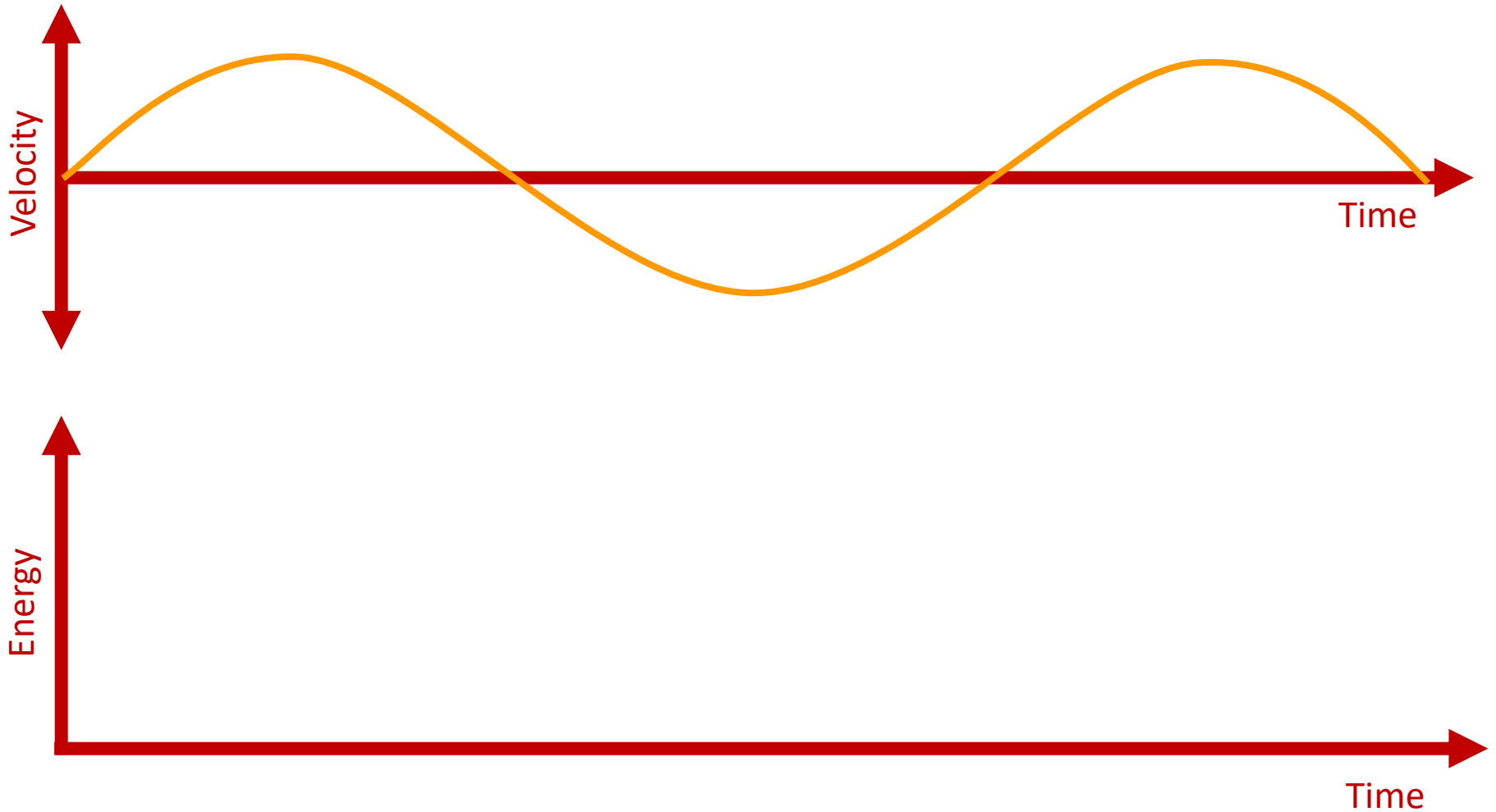




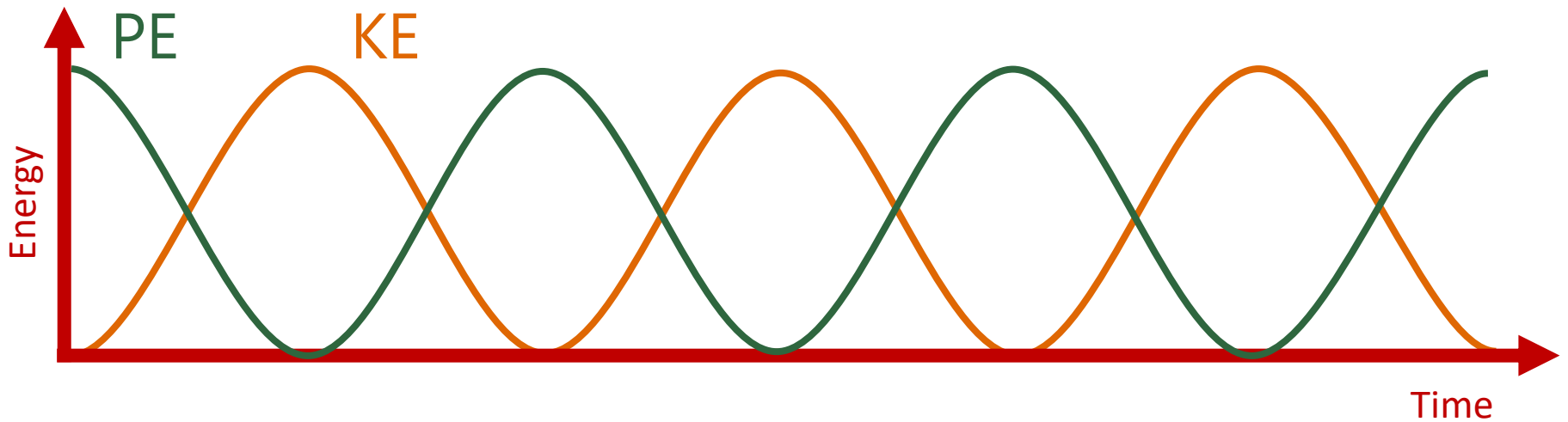
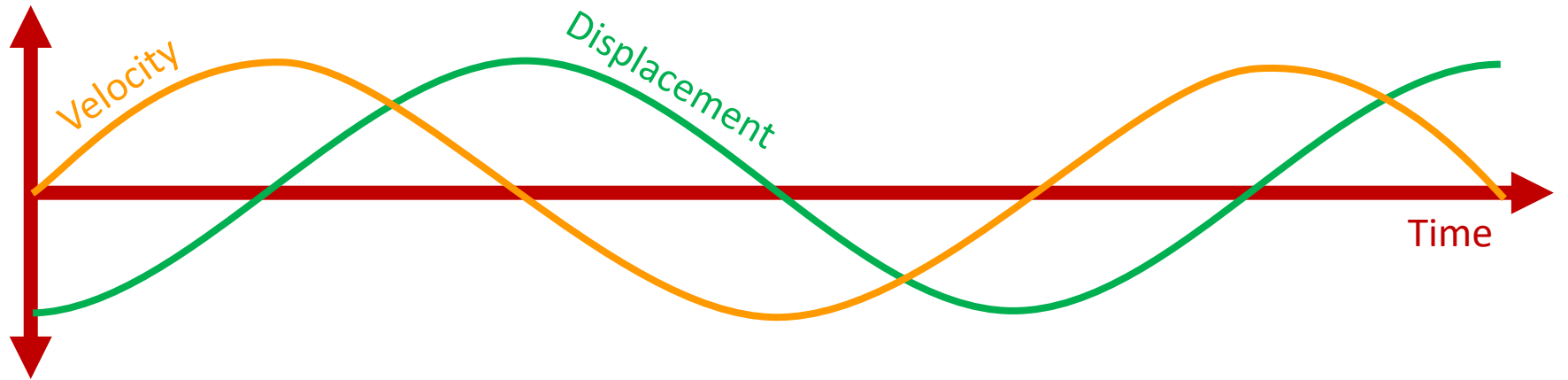
# Energy for SHM



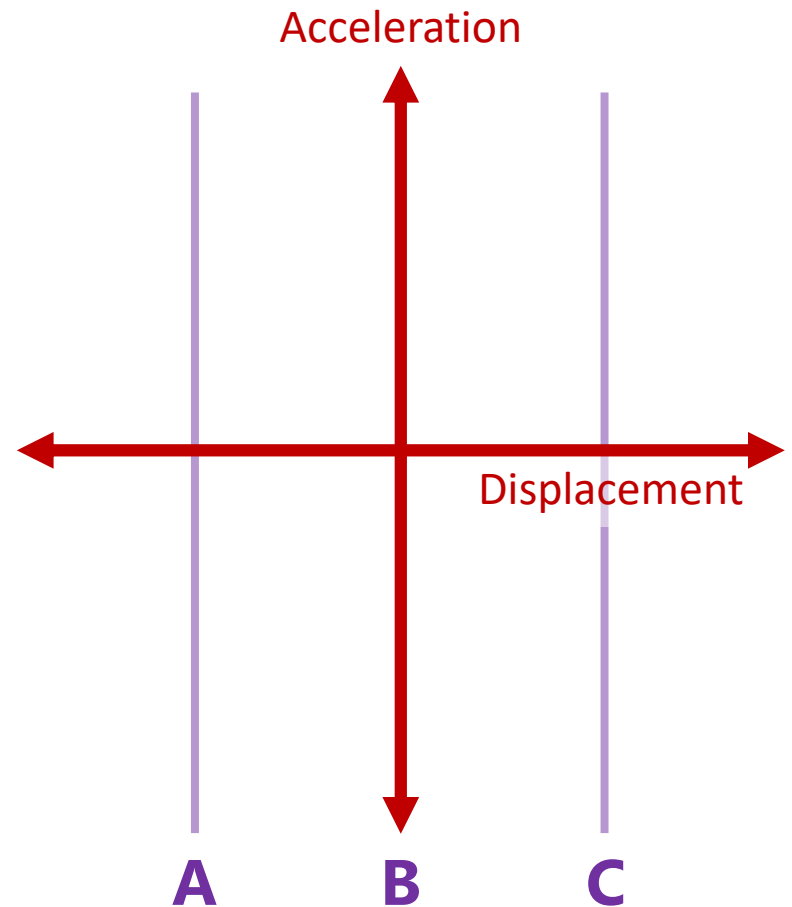
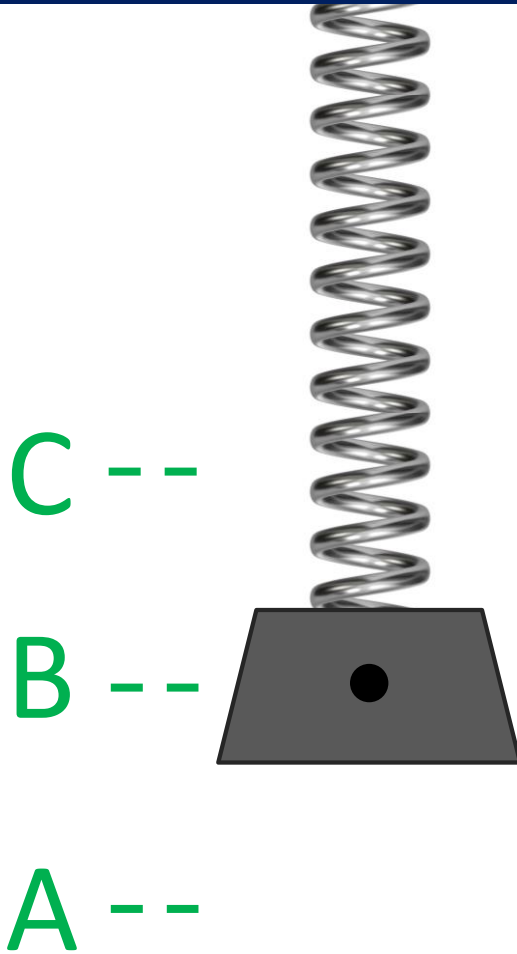
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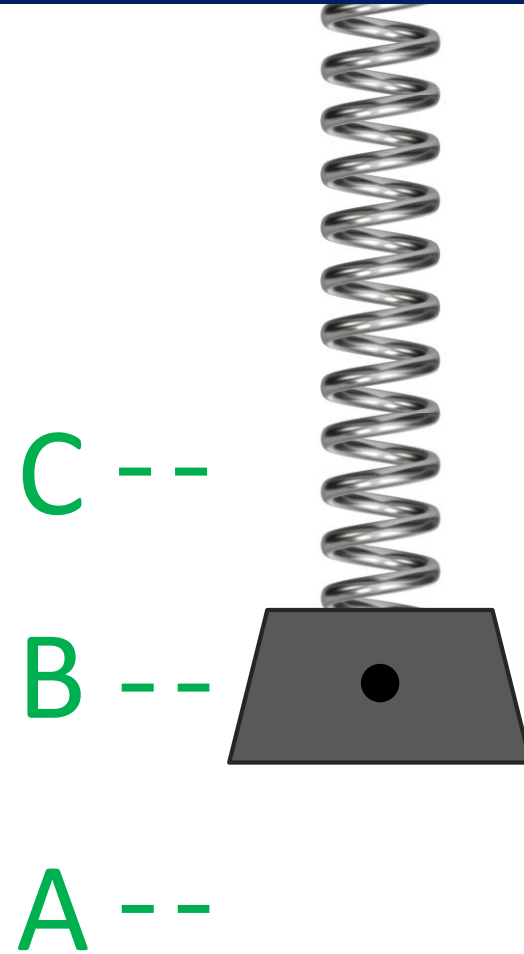
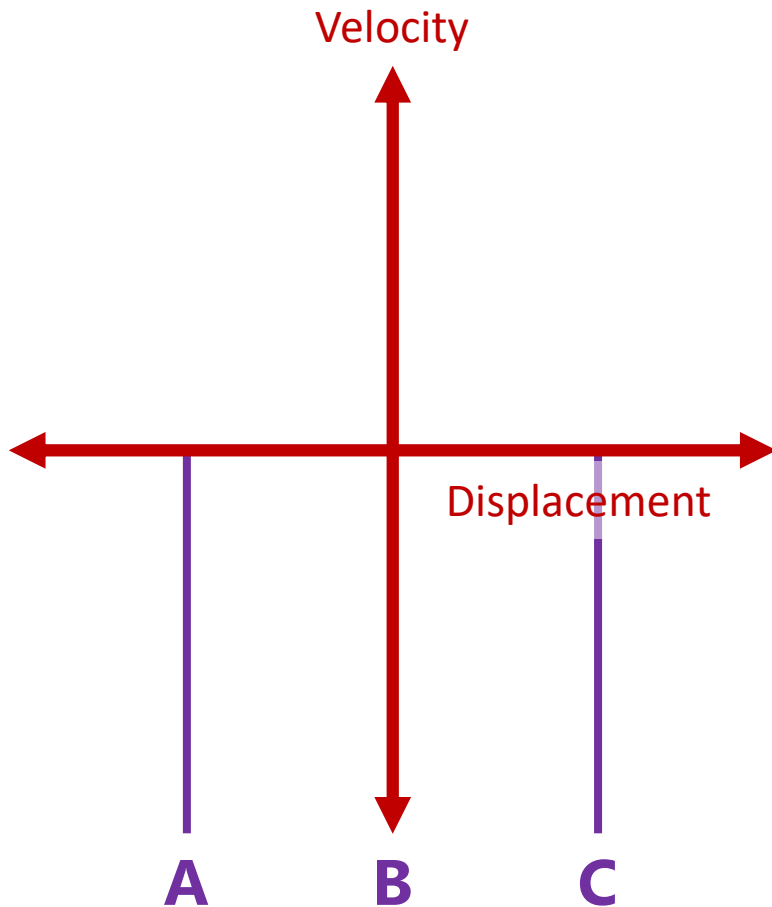
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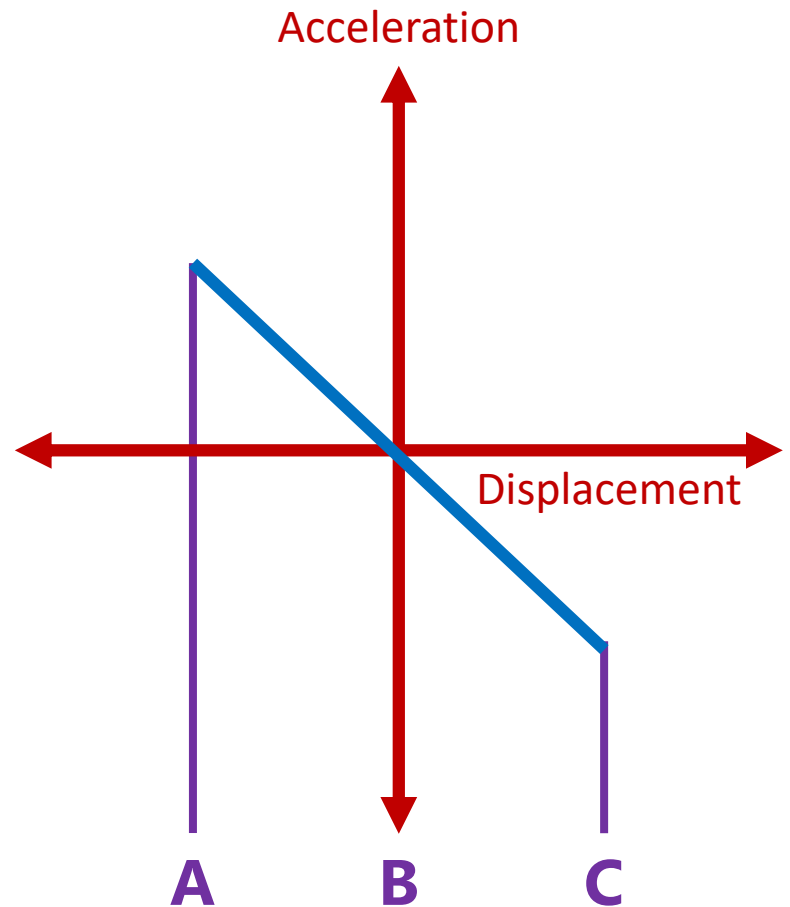
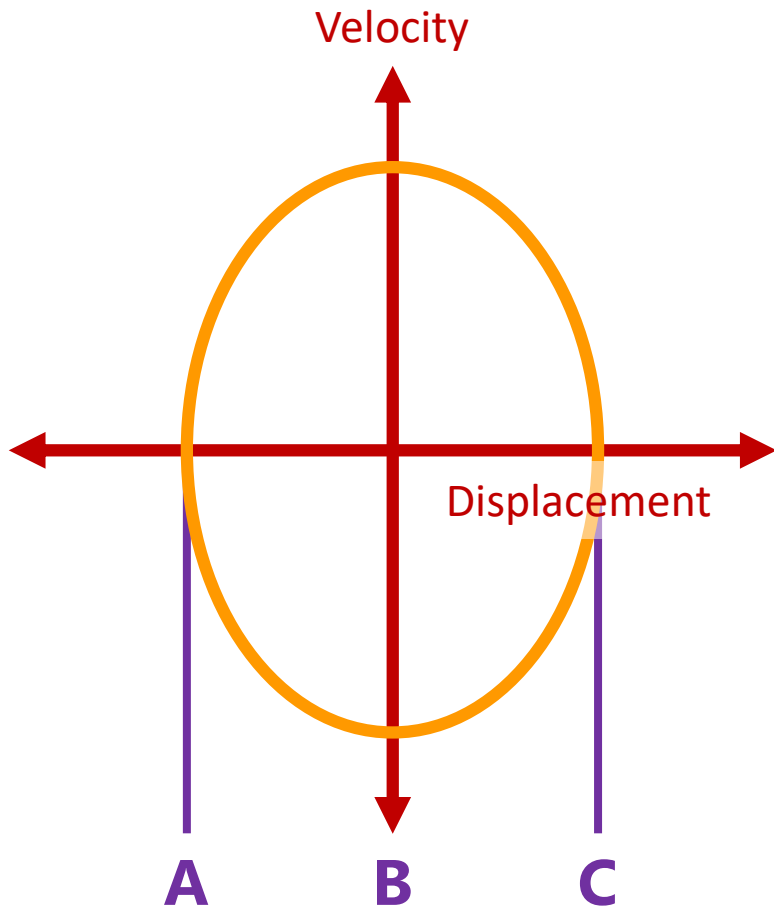
# Acceleration vs Displacement



# Velocity vs Displacement

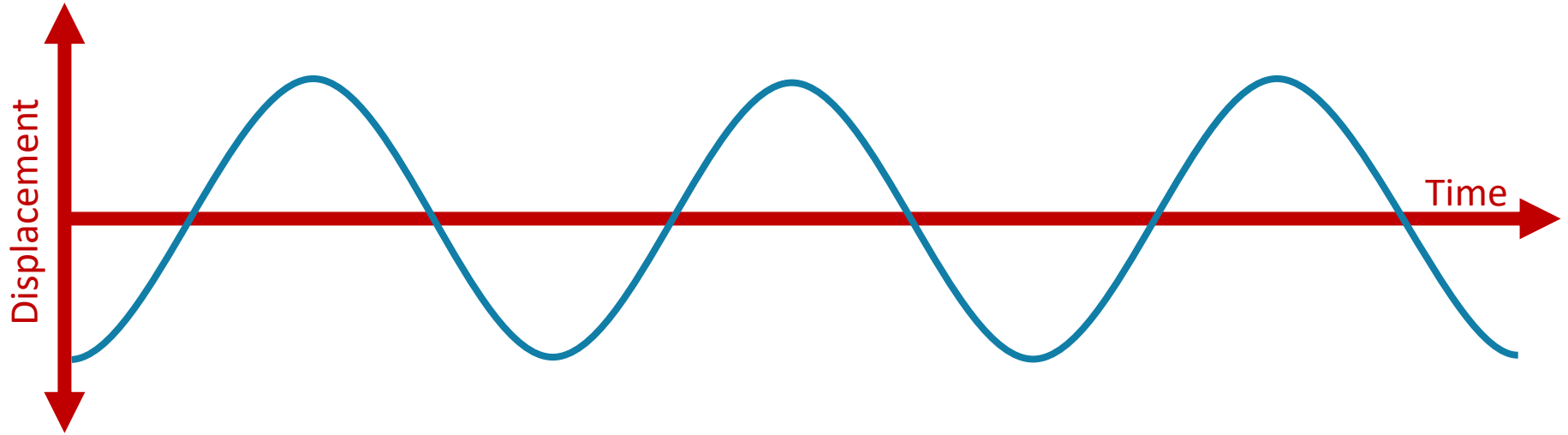


# \_\_\_\_\_ vs Displacement





# Properties of SHM



Property	What is it?	Symbol	Unit
Period			
Frequency			

# Period is related to Frequency

$$\text{Period} = 1 / \text{Frequency}$$

## Sub-topic 4.1 – Oscillations

$$T = \frac{1}{f}$$

## Sub-topic 4.2 – Travelling waves

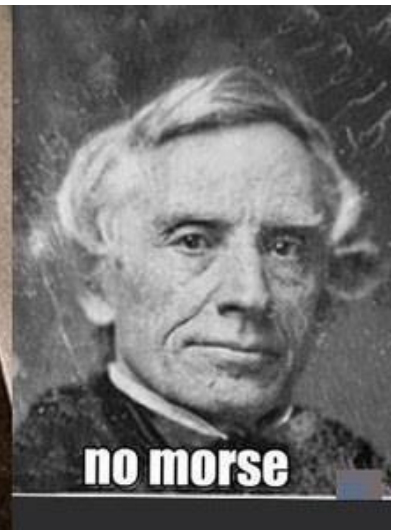
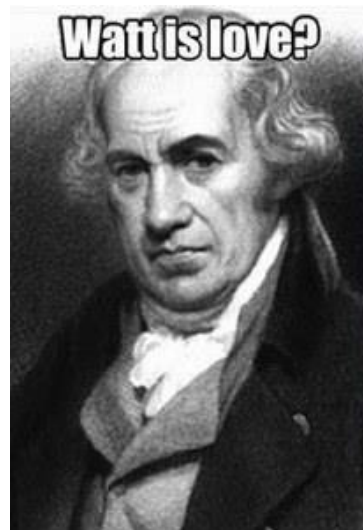
$$c = f\lambda$$

## Sub-topic 4.3 – Wave characteristics

$$I \propto A^2$$

$$I \propto x^{-2}$$

$$I = I_0 \cos^2 \theta$$



# Period is related to Frequency

$$\text{Period} = 1 / \text{Frequency}$$

$$f = \frac{1}{T}$$

Try this...

$$T = \frac{1}{f}$$

Taylor Swift's song Shake it Off has a tempo of 160 beats per minute (2.67 Hz) how many seconds are in between each beat (the **period**)



$$f = \frac{1}{T}$$

Try this...

$$T = \frac{1}{f}$$



You are standing on the beach with your feet in the water and notice that a new wave comes crashing in every 4 seconds, what is the **frequency** of these waves?

# A little harder...

You are pushing your younger brother on a swing and you end up pushing 12 times in one minute. What is the period and frequency of the swing?

# Lesson Takeaways

- I can relate the acceleration of an object in simple harmonic motion to its position
- I can graph the displacement, velocity, and acceleration vs time for simple harmonic motion
- I can describe and relate the properties of period and frequency
- I can calculate period and frequency from a scenario