OCR (A) A-Level Physics

5.3 Oscillations

Flashcards

Considering a spring oscillating, give the definitions of the following:

Displacement

Amplitude

Period

Frequency

Considering a spring oscillating, give the definitions of the following:

- Displacement - distance from the equilibrium position (vector)
- Amplitude - maximum displacement
- Period - time taken for a complete oscillation
- Frequency - number of oscillations per second

State the equation relating angular frequency and time period.

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$$\omega = 2\pi/T$$

Where ω = angular frequency, T = time period

What are the conditions for SHM?

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- Acceleration must be directly proportional to displacement and in the opposite direction:

$$(a \propto -x)$$

- It must act towards equilibrium.

What are the two main examples of systems which undergo SHM?

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1. A mass-spring system
2. A pendulum

What is the constant of proportionality linking acceleration and displacement?

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$$-\omega^2$$

What is x as a function of t and ω?

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$x = A\cos\omega t$ or $x = A\sin\omega t$

(where A is amplitude)

True or false: velocity is maximum when displacement is maximum.

True or false: velocity is maximum when displacement is maximum.

False.

The velocity is minimum at the amplitude of oscillation, as the object changes direction.

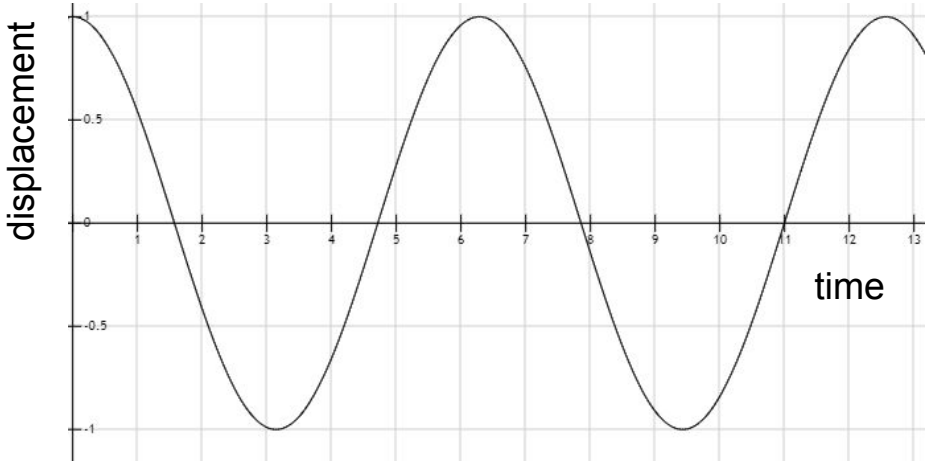
Velocity is maximum when the object passes through the equilibrium position.

How can you calculate the maximum speed using ω and A?

How can you calculate the maximum speed using ω and A?

$$v_{max} = \omega A$$

If the following graph shows displacement against time, what would the velocity-time graph look like?



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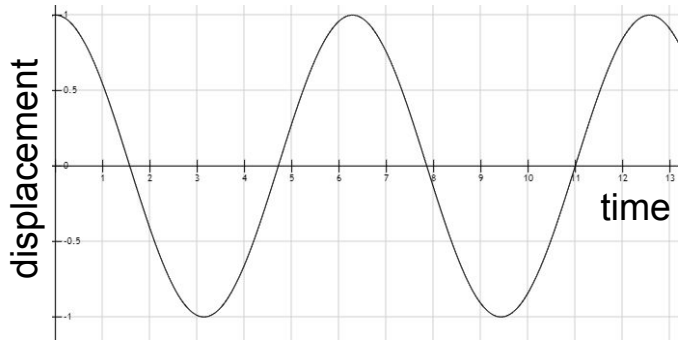
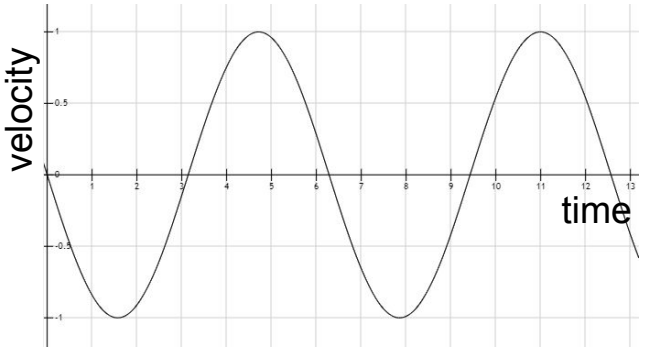
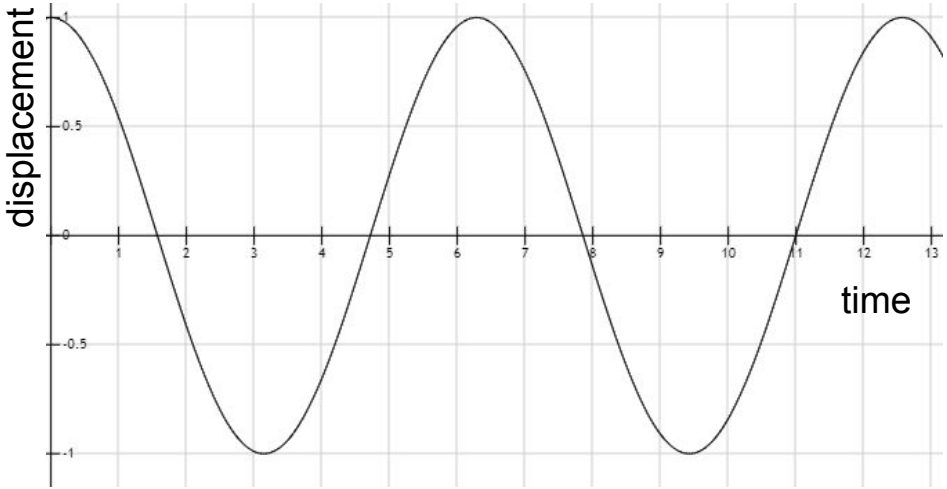




If the following graph shows displacement against time, what would the acceleration-time graph look like?



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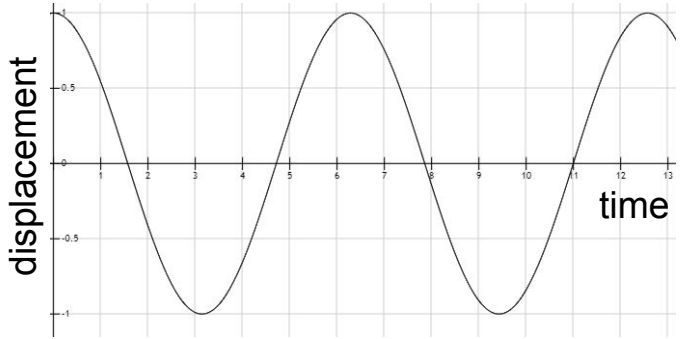

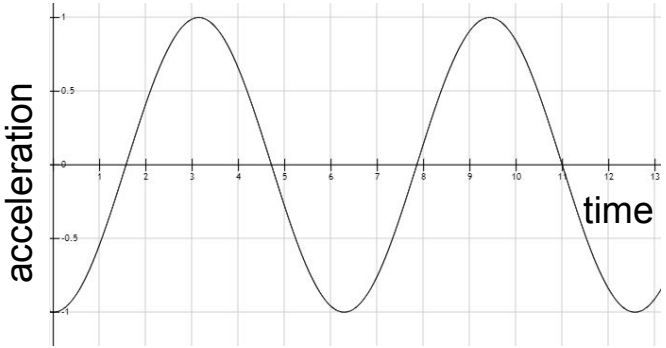

Draw the graph for potential energy and kinetic energy against displacement for a SHM system.

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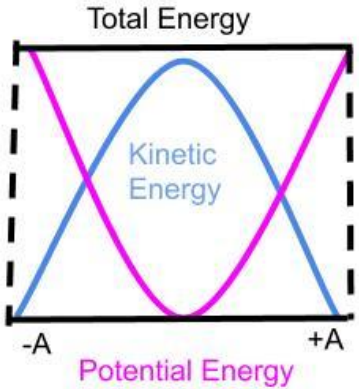

What is damping?

What is damping?

Damping is the process by which the amplitude of the oscillations decreases over time. This is due to energy loss to resistive forces such as drag or friction.

With a diagram to help, explain the difference between light damping, heavy damping and critical damping.

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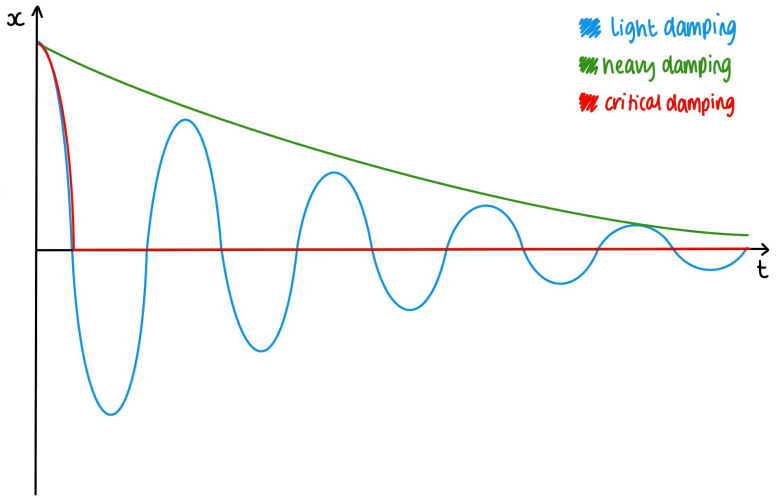
Light damping occurs naturally (e.g. pendulum oscillating in air), and the amplitude decreases exponentially (but time period remains constant as A and T are independent). When heavy damping occurs (e.g. pendulum oscillating in water) the amplitude decreases dramatically. In critical damping (e.g. pendulum oscillating in treacle) the object is stopped in as short a time as possible without overshooting equilibrium.



What is the difference between free and forced oscillations?

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When an object oscillates without any external forces being applied, it oscillates at its natural frequency. This is known as free oscillation. Forced oscillation occurs when a periodic driving force is applied to an object, which causes it to oscillate at a particular frequency.

What is resonance?

What is resonance?

When the driving frequency of the external force applied to an object is the same as the natural frequency of the object, resonance occurs. This is when the amplitude of oscillation rapidly increases, and if there is no damping, the amplitude will continue to increase until the system fails. As damping is increased, the amplitude will decrease at all frequencies, and the maximum amplitude occurs at a lower frequency.

Describe an experimental technique to investigate the resonance of an object

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- Suspend a mass between two springs attached to an oscillation generator and use a ruler parallel with the spring-mass system to record the amplitude.
- Increase the frequency of the generator slowly so that the amplitude increases, reaching maximum amplitude when the driver frequency is the same as the natural frequency of the system (after which, increasing the frequency will decrease the amplitude).
- Since drag force due to the air damps the system, the amplitude should not continue to increase until the point of system failure.
- To increase accuracy, the system can be filmed and the amplitude value recorded from video stills, as it can be difficult to determine this whilst the mass is oscillating.