

A-Level Physics

Name: _____ Score: _____

1. In simple harmonic motion, the acceleration is:
 - ☐ proportional to the speed
 - ☐ proportional to displacement and directed back toward equilibrium
 - ☐ always zero
 - ☐ constant in size and direction
2. The kinetic energy of an oscillator is greatest:
 - ☐ never
 - ☐ at the extreme positions
 - ☐ at the equilibrium position
 - ☐ everywhere equally
3. Damping of an oscillation is caused by:
 - ☐ increasing the mass
 - ☐ a driving force adding energy
 - ☐ a resistive force removing energy
 - ☐ resonance
4. A full definition of simple harmonic motion needs which statements? Select **all** that apply.
 - ☐ the acceleration is always directed towards that fixed point
 - ☐ the acceleration is proportional to the displacement from a fixed point
 - ☐ the speed is constant
 - ☐ the motion repeats with a constant period

Tick every correct option.
5. At the extreme positions of the motion, all the energy is potential.
 - ☐ True ☐ False
6. Damping reduces the frequency of an oscillation rather than its amplitude.
 - ☐ True ☐ False
7. An oscillation has a period of 2.0 s. What is its angular frequency ω ?
_____ rad/s

8. With no damping, the total energy of an oscillator stays constant.

☐ True ☐ False

9. A car suspension returns the car to its normal height quickly without bouncing. Which damping is this, and why?

☐ light damping: it oscillates only a little

☐ critical damping: it returns to equilibrium in the shortest time without oscillating

☐ no damping is needed

☐ heavy damping: it does not oscillate

10. In SHM the speed is greatest at the _____ position.

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1. proportional to displacement and directed back toward equilibrium

That is exactly $a = -\omega^2 x$ – bigger displacement, bigger pull back; always toward the middle.

2. at the equilibrium position

Speed is greatest at the middle, so KE peaks there while PE is at its lowest.

3. a resistive force removing energy

Friction or drag carries energy away as heat, so each swing is smaller than the last.

4. the acceleration is always directed towards that fixed point; the acceleration is proportional to the displacement from a fixed point

Those two statements are the definition and carry both marks. The constant period is a consequence of them, and the speed is certainly not constant.

5. True

The oscillator is momentarily at rest there, so KE = 0 and all the energy is potential.

6. False

The amplitude falls as energy becomes thermal. For light damping the frequency is essentially unchanged, which is why a bell keeps its note as it fades.

7. 3.14 rad/s

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{2.0} = \pi \approx 3.14 \frac{\text{rad}}{\text{s}}.$$

8. True

Energy just swaps between KE and PE; their sum is conserved.

9. critical damping: it returns to equilibrium in the shortest time without oscillating

Heavy damping also avoids oscillating but takes longer, so the car would sag back slowly. Give both properties: shortest time and no oscillation.

10. equilibrium

At the middle all the energy is kinetic, so the speed is maximum ($v = \omega x_0$).