1. In simple harmonic motion, the acceleration is:

   ☐ proportional to the speed and in the direction of motion

   ☐ proportional to displacement and directed back toward equilibrium

   ☐ always zero at every point in the motion

   ☐ constant in size and always in the same 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

exercises.lol exercises.com.cn

☐ 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 a little, then settles quickly

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

   ☐ no damping: the springs alone stop the bouncing

   ☐ heavy damping: it settles without oscillating, but slowly

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

    _____

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**

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

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 ($v = \omega x_0$).

exercises.lol exercises.com.cn