

AP Physics C: Mechanics

Name: _____ Score: _____

1. A spring with $k = 20 \text{ N/m}$ is stretched $x = 0.15 \text{ m}$. The magnitude of the restoring force (in N)?
_____ N
2. An oscillator has a period of 0.25 s . Its frequency (in Hz)?
_____ Hz
3. An oscillator has $A = 0.2 \text{ m}$ and $\omega = 4 \text{ rad/s}$. Its maximum speed (in m/s)?
_____ m/s
4. A spring with $k = 100 \text{ N/m}$ oscillates with amplitude $A = 0.2 \text{ m}$. Its total energy (in J)?
_____ J
5. A simple pendulum has $L = 0.25 \text{ m}$ and $g = 9.8 \text{ m/s}^2$. Its period (in s, to 1 decimal)?
_____ s
6. A motion is simple harmonic when the restoring force is...
 - ☐ proportional to displacement and opposite in direction
 - ☐ constant in size and direction
 - ☐ proportional to speed
7. You replace a mass-spring oscillator's mass with a heavier one. The period...
 - ☐ stays the same
 - ☐ increases
 - ☐ decreases
8. Where in the motion is the speed greatest?
 - ☐ it is constant
 - ☐ at the equilibrium position
 - ☐ at the two extremes
9. At which point is the oscillator's energy entirely kinetic?
 - ☐ at the equilibrium position
 - ☐ nowhere – it is always shared
 - ☐ at the extremes

10. In the physical pendulum period $T = 2\pi\sqrt{I/(mgd)}$, what is d ?

- ☐ the radius of the pivot
- ☐ the distance from the pivot to the centre of mass
- ☐ the full length of the body

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1. **3 N**

$$|F| = kx = 20 \times 0.15 = 3 \text{ N.}$$

2. **4 Hz**

$$f = 1/T = 1/0.25 = 4 \text{ Hz.}$$

3. **0.8 m/s**

$$v_{max} = A\omega = 0.2 \times 4 = 0.8 \text{ m/s.}$$

4. **2 J**

$$E = \frac{1}{2}kA^2 = \frac{1}{2}(100)(0.2)^2 = 2 \text{ J.}$$

5. **1.0 s**

$$T = 2\pi\sqrt{L/g} = 2\pi\sqrt{0.25/9.8} \approx 1.0 \text{ s.}$$

6. **proportional to displacement and opposite in direction**

$F = -kx$ – proportional to x and pointing back toward equilibrium.

7. **increases**

$T = 2\pi\sqrt{m/k}$, so a bigger m gives a longer T .

8. **at the equilibrium position**

Speed peaks where $x = 0$ (the middle) and is zero at the ends.

9. **at the equilibrium position**

At equilibrium $x = 0$ so $U = 0$ and all the energy is kinetic.

10. **the distance from the pivot to the centre of mass**

d is the pivot-to-centre-of-mass distance – the lever arm of gravity.