

Starter Quiz

AP Physics C: Mechanics Name: _____ Score: _____

1. A wheel with $I = 2\text{ kg} \cdot \text{m}^2$ spins at $\omega = 3\text{ rad/s}$. Its rotational kinetic energy (in J)?
_____ J
2. A constant torque of $6\text{ N} \cdot \text{m}$ turns a wheel through $\theta = 4\text{ rad}$. The work done (in J)?
_____ J
3. A flywheel with $I = 5\text{ kg} \cdot \text{m}^2$ spins at $\omega = 4\text{ rad/s}$. Its angular momentum (in $\text{kg} \cdot \text{m}^2/\text{s}$)?
_____ $\text{kg} \cdot \text{m}^2/\text{s}$
4. A skater with $I_i = 8\text{ kg} \cdot \text{m}^2$ spins at 2 rad/s , then pulls in to $I_f = 4\text{ kg} \cdot \text{m}^2$. Her new angular speed (in rad/s)?
_____ rad/s
5. A wheel of radius 0.3 m rolls without slipping at $\omega = 10\text{ rad/s}$. Its forward speed (in m/s)?
_____ m/s
6. A satellite moves to a lower circular orbit. Its orbital speed...

☐ stays the same

☐ increases

☐ decreases
7. If you triple a wheel's angular speed but keep its rotational inertia, its rotational kinetic energy becomes...

☐ 6 times larger

☐ 9 times larger

☐ 3 times larger

☐ unchanged
8. Positive net rotational work makes a spinning object speed up.

☐ True

☐ False
9. Angular momentum $L = I\omega$ is the rotational twin of which linear quantity?

☐ momentum $p = mv$

☐ force $F = ma$

☐ energy $\frac{1}{2}mv^2$

- ☐ the object is at rest
- ☐ no forces act at all
- ☐ the net external torque is zero

1. **9 J**

$K = \frac{1}{2}I\omega^2 = \frac{1}{2}(2)(3)^2 = 9 \text{ J}.$

2. **24 J**

$W = \tau\theta = 6 \times 4 = 24 \text{ J}.$

3. **20 kg · m²/s**

$L = I\omega = 5 \times 4 = 20 \text{ kg} \cdot \text{m}^2/\text{s}.$

4. **4 rad/s**

$I_i\omega_i = I_f\omega_f \Rightarrow 8 \times 2 = 4 \times \omega_f, \text{ so } \omega_f = 4 \text{ rad/s}.$

5. **3 m/s**

$v = \omega r = 10 \times 0.3 = 3 \text{ m/s}.$

6. **increases**

$v = \sqrt{GM/r},$ so a smaller r gives a larger v .

7. **9 times larger**

ω is squared, so $3^2 = 9$ times the energy.

8. **True**

$W_{net} = \Delta K_{rot};$ positive work raises the rotational kinetic energy, so ω rises.

9. **momentum $p = mv$**

I mirrors m and ω mirrors v , so $L = I\omega$ mirrors $p = mv$.

10. **the net external torque is zero**

Zero net external torque means $dL/dt = 0$, so L stays constant.