6. Energy and Momentum of Rotating Systems — Starter Quiz · 课前小测

AP Physics C: Mechanics Name: _____ Score: _____

1. A wheel with $I = 2\ \text{kg} \cdot \text{m}^2$ spins at $\omega = 3$ rad/s. Its rotational kinetic energy (in J)?

   _____ J

2. A constant torque of $6\ \text{N} \cdot \text{m}$ turns a wheel through $\theta = 4$ rad. The work done (in J)?

   _____ J

3. A flywheel with $I = 5\ \text{kg} \cdot \text{m}^2$ spins at $\omega = 4$ 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 $\omega = 10$ rad/s. Its forward speed (in m/s)?

   _____ m/s

6. A satellite moves to a lower circular orbit. Its orbital speed...

   ☐ increases

   ☐ decreases

   ☐ stays the same

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

   ☐ 3 times larger

   ☐ 6 times larger

   ☐ 9 times larger

   ☐ unchanged

8. Angular momentum is conserved exactly when...

   ☐ the net external torque is zero

   ☐ the object is at rest

   ☐ no forces act at all

9. For a wheel rolling without slipping, the point touching the ground is momentarily...

   ☐ at rest

   ☐ moving at v

   ☐ moving at $2v$

10. What provides the centripetal force that holds a satellite in a circular orbit?

    ☐ gravity

    ☐ air resistance

    ☐ the satellite's engine

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Answers · 答案

AP Physics C: Mechanics

1. **9 J**

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

2. **24 J**

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

3. **20 kg · m²/s**

   $L = I\omega = 5 \times 4 = 20$ kg · m²/s.

4. **4 rad/s**

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

5. **3 m/s**

   $v = \omega r = 10 \times 0.3 = 3$ 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. **the net external torque is zero**

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

9. **at rest**

   The contact point has zero velocity at that instant – that is the no-slip condition.

10. **gravity**

    $GMm/r^2 = mv^2/r$ – gravity is the centripetal force.