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

AP Physics 1 Name: _____ Score: _____

1. A wheel with $I = 4\ \text{kg} \cdot \text{m}^2$ spins at $\omega = 3\ \frac{\text{rad}}{\text{s}}$. What is its rotational kinetic energy, in joules?

   _____ J

2. A constant torque of $5\ \text{N} \cdot \text{m}$ turns a wheel through 4 rad. How much work is done, in joules?

   _____ J

3. A disk with $I = 2\ \text{kg} \cdot \text{m}^2$ spins at $\omega = 5\ \frac{\text{rad}}{\text{s}}$. What is its angular momentum, in $\text{kg} \cdot \text{m}^2/\text{s}$?

   _____ $\text{kg} \cdot \text{m}^2/\text{s}$

4. A skater with $I_1 = 6\ \text{kg} \cdot \text{m}^2$ spins at $2\ \frac{\text{rad}}{\text{s}}$, then pulls in to $I_2 = 2\ \text{kg} \cdot \text{m}^2$. What is her new ω, in $\frac{\text{rad}}{\text{s}}$?

   _____ rad/s

5. The total kinetic energy of a rolling object is:

   ☐ $\frac{1}{2}mv^2$ only

   ☐ $\frac{1}{2}I\omega^2$ only

   ☐ $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

   ☐ $mv^2 + I\omega^2$

6. What provides the centripetal force that keeps a satellite in a circular orbit?

   ☐ the satellite's engines

   ☐ gravity

   ☐ air resistance

   ☐ an outward centrifugal force

7. Which is the formula for rotational kinetic energy?

   ☐ $\frac{1}{2}mv^2$

   ☐ $\frac{1}{2}I\omega^2$

   ☐ $I\omega$

   ☐ mgh

8. A torque of $5\ \text{N} \cdot \text{m}$ turns a shaft at $\omega = 2\ \frac{\text{rad}}{\text{s}}$. What is the power, in watts?

   _____ W

9. Angular momentum is the rotational twin of linear momentum $p = mv$. Which is its formula?

   ☐ $\frac{1}{2}I\omega^2$

   ☐ $I\omega$

   ☐ $\tau\theta$

   ☐ $I\alpha$

10. Angular momentum is conserved when there is no external:

    ☐ force

    ☐ torque

    ☐ friction of any kind

    ☐ motion

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Answers · 答案

AP Physics 1

1. **18 J**

   $E_k = \frac{1}{2}I\omega^2 = \frac{1}{2}(4)(9) = 18$ J.

2. **20 J**

   $W = \tau\theta = 5 \times 4 = 20$ J.

3. **10 kg · m²/s**

   $L = I\omega = 2 \times 5 = 10\ \text{kg} \cdot \text{m}^2/\text{s}$.

4. **6 rad/s**

   $I_1\omega_1 = I_2\omega_2 \Rightarrow 12 = 2\omega_2 \Rightarrow \omega_2 = 6\ \frac{\text{rad}}{\text{s}}$.

5. $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

   A rolling body moves and spins, so its KE is the sum $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$.

6. **gravity**

   Gravity is the centripetal force: $\dfrac{GMm}{r^2} = \dfrac{mv^2}{r}$.

7. $\frac{1}{2}I\omega^2$

   It is $\frac{1}{2}I\omega^2$ — the rotational twin of $\frac{1}{2}mv^2$.

8. **10 W**

   $P = \tau\omega = 5 \times 2 = 10$ W.

9. $I\omega$

   $L = I\omega$ — inertia times angular velocity, the twin of mv.

10. **torque**

    With no external **torque**, L cannot change: $I_1\omega_1 = I_2\omega_2$.