

5. Torque and Rotational Dynamics

Starter Quiz · 课前小测

AP Physics 1

Name: _____ Score: _____

1. A wheel goes from rest to $\omega = 12 \frac{\text{rad}}{\text{s}}$ in 4 s. What is its angular acceleration, in $\frac{\text{rad}}{\text{s}^2}$?
_____ rad/s^2
2. A point is 0.3 m from a wheel's axis, spinning at $\omega = 10 \frac{\text{rad}}{\text{s}}$. What is its linear speed, in $\frac{\text{m}}{\text{s}}$?
_____ m/s
3. A 20 N force acts at right angles, 0.4 m from a bolt. What is the torque, in $\text{N} \cdot \text{m}$?
_____ $\text{N} \cdot \text{m}$
4. Two 0.5 kg balls sit 2 m from the axis on a light rod. What is the rotational inertia, in $\text{kg} \cdot \text{m}^2$?
_____ $\text{kg} \cdot \text{m}^2$
5. A 300 N child sits 2 m from a seesaw pivot. How far from the pivot must a 400 N child sit to balance it, in metres?
_____ m
6. How many radians are there in one complete turn?
☐ 360
☐ π
☐ 2π
☐ 1
7. On a rigid spinning disk, how do a rim point and a point near the hub compare?
☐ same ω and same v
☐ same ω , but the rim has larger v
☐ same v , but the rim has larger ω
☐ the hub point does not move
8. A force is aimed straight through the pivot. What torque does it produce?
☐ the maximum
☐ half the maximum
☐ zero
☐ a negative torque
9. Rotational inertia depends on:

- ☐ the total mass only
- ☐ the mass and how it is distributed about the axis
- ☐ the colour of the object
- ☐ the speed of rotation

10. What is the condition for rotational equilibrium?

- ☐ the net force is zero
- ☐ the net torque is zero
- ☐ the object is at rest
- ☐ all forces are equal

AP Physics 1

1. **3 rad/s²**

$$\alpha = \Delta\omega / \Delta t = 12/4 = 3 \frac{\text{rad}}{\text{s}^2}.$$

2. **3 m/s**

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

3. **8 N · m**

$$\tau = rF \sin 90^\circ = 0.4 \times 20 \times 1 = 8 \text{ N} \cdot \text{m}.$$

4. **4 kg · m²**

$$I = \sum mr^2 = 2 \times (0.5 \times 2^2) = 4 \text{ kg} \cdot \text{m}^2.$$

5. **1.5 m**

$$300 \times 2 = 400 \times d_2 \Rightarrow d_2 = 600/400 = 1.5 \text{ m}.$$

6. **2π**

One full circle is 2π radians (≈ 6.28).

7. **same ω , but the rim has larger v**

All points share ω ; the rim has a larger radius, so $v = r\omega$ is larger there.

8. **zero**

$\theta = 0$ means $\sin \theta = 0$, so $\tau = 0$ — a force through the pivot cannot turn it.

9. **the mass and how it is distributed about the axis**

$I = \sum mr^2$ depends on both the mass and its distance from the axis (squared).

10. **the net torque is zero**

Rotational equilibrium means $\sum \tau = 0$ — the turning effects balance.