

Exercise walk-through

6.3

Angular Momentum and Angular Impulse

AP Physics 1

Angular momentum and impulse

Angular momentum is the rotational twin of momentum:

Spin that resists change

$$L = I\omega$$

$$\Delta L = \tau \Delta t$$

Angular impulse = net torque $\times$ time.

Worked example

$L_i = 30$; a torque $\tau = 5 \text{ N m}$ acts for 4 s:

$$\Delta L = 5 \times 4 = 20$$

$$L_f = 30 + 20 = 50 \text{ kg m}^2/\text{s}$$

Exercises 2.1-2.3

2.1 A disc of $I = 0.50 \text{ kg m}^2$ spins at $\omega = 8.0 \text{ rad s}^{-1}$. Find its angular momentum. [1]

2.2 A torque of 4.0 N m acts for 3.0 s . Find the angular impulse. [1]

2.3 A wheel's angular momentum changes by $12 \text{ kg m}^2 \text{ s}^{-1}$ in 2.0 s . Find the net torque. [2]

Exercises 2.1-2.3

2.1 A disc of $I = 0.50 \text{ kg m}^2$ spins at $\omega = 8.0 \text{ rad s}^{-1}$. Find its angular momentum. [1]

2.1

- $L = I\omega = 0.50 \times 8.0 = 4.0 \text{ kg m}^2 \text{ s}^{-1}$

2.2 A torque of 4.0 N m acts for 3.0 s . Find the angular impulse. [1]

2.2

- $\Delta L = \tau \Delta t = 4.0 \times 3.0 = 12 \text{ kg m}^2 \text{ s}^{-1}$

2.3 A wheel's angular momentum changes by $12 \text{ kg m}^2 \text{ s}^{-1}$ in 2.0 s . Find the net torque.[2]

2.3

- $\tau = \frac{\Delta L}{\Delta t} = \frac{12}{2.0} = 6.0 \text{ N m}$

Exercises 3.1·3.2

3.1 The angular momentum of a rotating rigid body is

[1]

☐

A $I\alpha$

B $I\omega$

C $\frac{1}{2}I\omega^2$

D $\tau\omega$

3.2 Angular impulse is equal to

[1]

☐

A $\tau \Delta t$

B $I\alpha$

C Fd

D $\frac{1}{2}I\omega^2$

Exercises 3.1-3.2

3.1 The angular momentum of a rotating rigid body is

[1]

☐

A $I\alpha$

B $I\omega$

C $\frac{1}{2}I\omega^2$

D $\tau\omega$

3.1 B

- $I\omega$.

3.2 Angular impulse is equal to

[1]

☐

A $\tau \Delta t$

B $I\alpha$

C Fd

D $\frac{1}{2}I\omega^2$

3.2 A

- $\tau \Delta t$.

Exercise 3.3 (a)

3.3 A flywheel of $I = 0.20 \text{ kg m}^2$ spins at 30 rad s^{-1} . A constant friction torque of 0.60 N m acts on it.

(a) Find its initial angular momentum.

[1]

Exercise 3.3 (a)

3.3 A flywheel of $I = 0.20 \text{ kg m}^2$ spins at 30 rad s^{-1} . A constant friction torque of 0.60 N m acts on it.

(a) Find its initial angular momentum.

[1]

(a)

- $L = I\omega = 0.20 \times 30 = 6.0 \text{ kg m}^2 \text{ s}^{-1}$

Exercise 3.3 (b)

3.3 A flywheel of $I = 0.20 \text{ kg m}^2$ spins at 30 rad s^{-1} . A constant friction torque of 0.60 N m acts on it.

(b) Find the time for friction to bring it to rest.

[2]

Exercise 3.3 (b)

3.3 A flywheel of $I = 0.20 \text{ kg m}^2$ spins at 30 rad s^{-1} . A constant friction torque of 0.60 N m acts on it.

(b) Find the time for friction to bring it to rest.

[2]

(b)

- $$\Delta t = \frac{L}{\tau} = \frac{6.0}{0.60} = 10 \text{ s}$$