Flywheel Angular Acceleration Problem — Worked Example

A flywheel is rotating with an initial angular velocity of **120 rad/s**. It experiences a **uniform angular acceleration of 6 rad/s²** for **10 seconds**.

Determine the **final angular velocity** of the flywheel:

1. In **radians per second (rad/s)**
2. In **revolutions per minute (rpm)**

Solution

We use the angular kinematics relation:

$$\omega = \omega_0 + \alpha t$$

where:

- Initial angular velocity: $\omega_0 = 120\,\text{rad/s}$
- Angular acceleration: $\alpha = 6\,\text{rad/s}^2$
- Time: $t = 10\,\text{s}$

Step 1: Final angular velocity in rad/s

$$\omega = 120 + 6(10)$$

$$\omega = 120 + 60 = 180\,\text{rad/s}$$

Step 2: Convert rad/s to revolutions per minute (rpm)

Use:

$$1\,\text{rev} = 2\pi\,\text{rad}, \qquad 1\,\text{min} = 60\,\text{s}$$

$$\omega_{\text{rpm}} = \omega \left(\frac{60}{2\pi} \right)$$

$$\omega_{\text{rpm}} = 180 \times \frac{60}{2\pi}$$

$$\omega_{\text{rpm}} = 1719\,\text{rpm}$$

Final Answers

- **Final angular velocity:**

$$\boxed{180\,\text{rad/s}}$$

- **Final angular velocity in rpm:**

$$\boxed{1719\,\text{rpm}}$$

Code

```
import math

# Given values
omega_0 = 120        # initial angular velocity (rad/s)
alpha = 6            # angular acceleration (rad/s^2)
t = 10               # time (s)

# Final angular velocity (rad/s)
omega_final = omega_0 + alpha * t

# Convert to revolutions per minute (rpm)
omega_rpm = omega_final * (60 / (2 * math.pi))

print(f"Final angular velocity: {omega_final:.2f} rad/s")
print(f"Final angular velocity: {omega_rpm:.2f} rpm")
```