6.2 Torque and Work

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS rotational kinetic energy • rotational power

Objective

Build the skills to answer exam questions on **torque and work**.

You must be able to:

- calculate the **work done by a torque**, $W = \tau\,\Delta\theta$
- relate the work done by a net torque to the change in **rotational kinetic energy**
- define **rotational power** as $P = \tau\omega$
- find the work from the **area** under a torque-versus-angle graph

1 Key knowledge and worked examples

Study these first. Each one shows the method for a question type used later.

■ **Work by a torque**
$W = \tau\,\Delta\theta$, with $\Delta\theta$ in radians. This is the rotational partner of $W = Fd$.

■ **The rotational work-energy theorem**
$W_{net} = \Delta K_{rot} = \frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2$.

■ **Rotational power**
$P = \tau\omega$. A torque of 8.0 N m through $\Delta\theta = 2.0$ rad does $W = 16$ J.

2 Practice

2.1 A torque of 5.0 N m turns a wheel through 4.0 rad. Find the work done. [1]

2.2 A motor applies 20 N m at $\omega = 15$ rad s^{-1}. Find its power output. [2]

2.3 A net work of 30 J is done on a flywheel starting from rest. State its final rotational kinetic energy. [1]

3 Exam-style questions

3.1 The work done by a torque is [1]

☐
A $\tau\omega$
B $\tau\,\Delta\theta$
C $I\alpha$
D $\frac{1}{2}I\omega^2$

3.2 Rotational power is equal to [1]

☐
A τ/ω
B $\tau\omega$
C $\tau + \omega$
D $I\alpha$

3.3 A wheel of $I = 0.40$ kg m^2, initially at rest, has a 2.0 N m torque applied through 10 rad.

(a) Find the work done. [2]

(b) Find the final angular velocity. [2]