AP PHYSICS 1 • EXERCISE SHEET

6.2 Torque and Work

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

Objective

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

You must be able to:

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

1 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]

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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]

4 Go further

- work through the **6.2 Torque and Work** lesson on the **Learn** page;
- read the **Energy and Momentum of Rotating Systems** section of the AP Physics 1 handout on the **Know** page.

Solutions

2.1 $W = \tau\,\Delta\theta = 5.0 \times 4.0 = 20$ J.

2.2 $P = \tau\omega = 20 \times 15 = 300$ W.

2.3 30 J (all the net work becomes rotational kinetic energy).

3.1 B.

3.2 B.

3.3 (a) $W = \tau\,\Delta\theta = 2.0 \times 10 = 20$ J. (b) $\frac{1}{2}I\omega^2 = 20 \Rightarrow \omega = \sqrt{\dfrac{2(20)}{0.40}} = 10$ rad s^{-1}.