Name: _____ Date: _____ Period: _____

ROTATION DAY 5: TORQUE & STATICS REVIEW

KEY EQUATIONS — UNIT 5

Angular Kinematics:

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$\omega = \omega_0 + \alpha t$

$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

Linear-Angular Bridge: $v = \omega r, \quad a_t = \alpha r$

Torque: $\tau = rF\sin\theta$

Equilibrium: $\sum F = 0, \quad \sum \tau = 0$

Note: The quiz covers Days 1–4. This review mixes all the skills. Work with a partner if you finish early.

SKILL **Quick Recall: Fill in the table**

Quantity	Linear	Rotational
Position	x (m)	θ (_____)
Velocity	v (m/s)	ω (_____)
Acceleration	a (m/s²)	α (_____)
Inertia	m (kg)	??? *(Day 7!)*
Net cause of change	$\sum F = ma$	$\sum \tau$ =??? *(Day 8!)*

1 **Kinematics Review**

A disk starts at $\omega_0 = 20$ rad/s and decelerates at $\alpha = -4.0$ rad/s².

(a) How long until it stops?

(b) How many revolutions does it make?

(c) If the disk has radius $r = 0.30$ m, what is the tangential speed of a rim point initially?

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ROTATION DAY 5 (CONTINUED)

2 Torque Calculation

A force of 40 N is applied at the end of a 0.50 m wrench, 55° from the wrench handle.

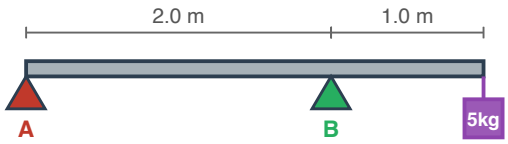
(a) Calculate the magnitude of the torque.

(b) At what angle would the torque be maximum?

(c) What would the torque be at that optimal angle?

3 Statics — Supported Beam

A 3.0 m uniform beam (mass 10 kg) is supported at the left end (point A) and at the 2.0 m mark (point B). A 5.0 kg mass hangs from the right end.



(a) Choose a smart pivot point. Which point (A or B) and why?

(b) Using $\sum \tau = 0$, find the support force at the other point.

(c) Use $\sum F_y = 0$ to find the remaining force.

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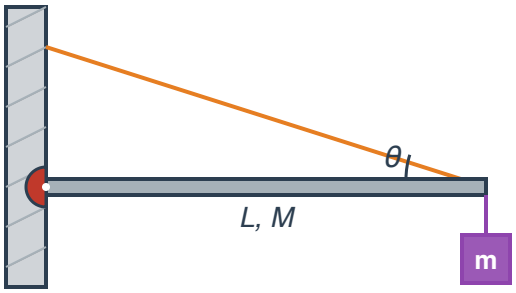
ROTATION DAY 5 (CONTINUED)

4 AP-Style FRQ Practice

Setup: A uniform horizontal beam of length L and mass M is attached to a wall by a hinge. A cable makes angle θ with the beam and connects the free end to the wall above the hinge. A block of mass m hangs from the free end.



(a) Draw a free-body diagram of the beam showing all forces. Label each force.

(b) Derive an expression for the tension T in the cable in terms of M, m, L, g, and θ.

(c) The cable is cut. Describe what happens to the beam immediately after. What is the initial angular acceleration? (Qualitative description + set up the equation; don't solve.)

On the quiz: You'll see a mix of torque calculations, statics problems, and kinematics. Expect at least one problem requiring a free-body diagram. The FRQ format above is exactly what AP will look like.

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ROTATION DAY 5 (CONTINUED)

COMMON MISTAKES CHECKLIST

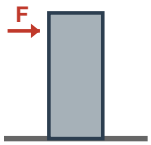
CHECK **Self-Assessment: Rate yourself on each skill**

Skill	Rating	If shaky, review...
Convert between rad, deg, rev	□ □ □	Day 1
Use rotational kinematics equations	□ □ □	Day 1
Use $v = \omega r$ and $a_t = \alpha r$	□ □ □	Day 2
Calculate torque with $\tau = rF\sin\theta$	□ □ □	Day 3
Assign correct sign to torques	□ □ □	Day 3
Choose a smart pivot point	□ □ □	Day 4
Solve $\sum F = 0$ and $\sum \tau = 0$ simultaneously	□ □ □	Day 4

5 **Final Practice — Tipping vs. Sliding**

A uniform rectangular block of mass $m = 50$ kg, height $H = 2.0$ m, and width $W = 0.80$ m rests on a flat floor. The coefficient of static friction is $\mu_s = 0.30$.

A person pushes horizontally at the top edge ($h = 2.0$ m). Will the block tip over or slide forward first? Justify your answer by calculating the minimum force required for each threshold.



Exam tip: For "tipping vs. sliding" problems, calculate the required force for each threshold independently. Whichever requires the *smallest* applied force will happen first! When calculating the tipping threshold, remember the normal force shifts entirely to the front corner.

EXIT **Reflection**

What topic are you least confident about? Write one specific question you want answered before the quiz.

Tomorrow: Mid-unit quiz on Days 1–4. Calculator allowed. One equation sheet (provided). Show all work for full credit.