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Homework 8 hints

A few reminders:

Kinematical linear quantities are often related to their rotational counterparts through multiplication by the radius:

Displacement:	$d = r\theta$
Speed/velocity:	$v = r\omega$
Acceleration:	$a_T = r\alpha$

In each case the same word is used in the rotational world with a "rotational" tagged onto the linear word. If a new word is needed, it is explicitly written down below.

The relationship of dynamical linear quantities to their rotational counterparts is not always so simple, but here's a list of the two sets:

Inertia:	m, I
Force/torque:	F, τ
Momentum:	p, L

Within the rotational world the interrelationship of rotational quantities parallels that of linear quantities:

$p = mv$:	$L = I\omega$
$F = ma$:	$\tau = I\alpha$
$F = \Delta p/\Delta t$:	$\tau = \Delta L/\Delta t$
$KE = \frac{1}{2}mv^2$:	$KE_{\text{rot}} = \frac{1}{2}I\omega^2$
$W = Fd$:	$W = \tau\theta$

Keeping these in mind allows you to answer the questions and misconceptuals.

Hints for problems (pages 222–225):

2. Use $d = r\theta$, converting θ to radians; r is the given earth-sun distance, and d will be the diameter of the sun.

3. Use $d = r\theta$ where θ is the given angle and r the given earth-moon distance.

11. The earth spins through 2π radians in 24 hours. Calculate the angular speed, ω, in radians/second. Using $R_E = 6.4\times10^6$m, and $v = r\omega$ you can directly get the linear speed at the equator. For another latitude, Θ, the effective radius you use is $R_E \cos\Theta$.

14. Do this in steps: (i) convert rpm to radians per second to get ω_i and ω_f. (ii) Given these two and the time, use the appropriate equation to get α. (iii) α allows you to get a_T, after you convert the given r to m. (iv) Use your new knowledge of α to get ω at the 2 sec mark, and use that ω and r to get v. (v) Use v and r and the formula for centripetal acceleration to get a_R.

17. Do this in steps: (i) convert rpm to radians per second to get ω_i and ω_f. (ii) Given these two and the time, use the appropriate equation to get α. (iii) Get the total angle by using any equation that has *theta* in it, then get number of revolutions from it.

18. Similar steps to previous.

24. Force exerted by cyclist is mg. Get torque from the force and the radius.

26. Use equation giving torque from force, r and θ.

50. Use formula for rotational KE.

60. Calculate I, the moment of inertia, from m and r. Once you have it, calculate L, the angular momentum.

61. Page 210 lists the moments of inertia for different objects. Use that and ω (from rpm information) to get L. Use change in L and t to get the torque.