Rotation Homework Problems:
p. 158: #39, 41, 44, 47, 53

Problems taken from the school's old textbook:
Giancoli, D. (1980). *Physics*, 2nd Ed. Englewood Cliffs, NJ: Prentice Hall.

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39. A centrifuge rotor has a moment of inertia of 4.00×10^{-2} kg·m^2. How much energy is required to bring it from rest to 10,000 rpm?

41. When an object has symmetry, its moment of inertia often can be expressed as a simple formula. For instance, the moment of inertia for a hoop rotated about its center is mr^2. For a uniform disk rotating about its center, the moment of inertia is $1/2mr^2$. A uniform sphere rotated about its center is $2/5mr^2$. However as you know, most objects do not enjoy the benefit of symmetry. As a result, if we can even come up with a formula for their moments of inertia, the formulas might not be all that simple. Often, the moments of inertia for these objects are determined experimentally by applying a known torque to the object, measuring the angular acceleration it experiences, and calculating its moment of inertia using $\sum\tau = I\alpha$. If this calculated moment of inertia is set equal to mr^2 (the basic formula for the simplest of objects – a point mass), the r that satisfies this equation is called the object's *radius of gyration*. With all of that explanation behind us now, we are finally ready for this problem. A merry-go-round has a mass of 1560 kg and a *radius of gyration* of 18.5 m. How much work is required to accelerate it from rest to a rotation rate of one revolution in 7.10 seconds? (Hint: Think about CLEE and how a change in KE relates to work).

44. A hollow cylinder (hoop) is rolling on a horizontal surface at a speed of 3.4 m/s when it reaches a 20^o incline.
   a) How far up the surface of the incline will it go?
   b) How long will it be on the incline before it arrives back at the bottom?

47. What is the angular momentum of a 200-g ball rotating on the end of a string in a circle of radius 1.00 m at an angular speed of 9.45 rad/s?

53. A 4.5-m-diameter merry-go-round is rotating freely with an angular velocity of 0.70 rad/s; its total moment of inertia is 1750 kg·m^2.
   a) Four people standing on the ground, each of 65-kg mass, suddenly step onto the edge of the merry-go-round. What will be the angular velocity of the merry-go-round now?
   b) What will be the angular velocity of the merry-go-round if the people were on it initially, and then jump off?

ANSWERS:

39. 2.19×10^4 J
41. 2.09×10^5 J
44a. 3.45 m
44b. 4.06 seconds
47. 1.89 (kg·m^2)/s
53a. 0.400 rad/sec
53b. The angular velocity of the merry-go-round DOES NOT CHANGE when the passengers jump off. See the solutions book in the classroom for an expanded explanation.