12.37. SOLVE: (a) The magnitude of $A \times B$ is $AB\sin\alpha = (6)(4)\sin 45^\circ = 21.21.$ The direction of $A \times B$ is given by the right-hand rule. To curl our fingers from A to $B,$ we have to point our thumb into the page. Thus, $A \times B =$ (21, into the page).

(b) $C \times D = ((6)(4)\sin 90^\circ,$ out of the page) = (24, out of the page).

12.45. MODEL: Model the turntable as a rigid disk rotating on frictionless bearings. As the blocks fall from above and stick on the turntable, the turntable slows down due to increased rotational inertia of the (turntable + blocks) system. Any torques between the turntable and the blocks are internal to the system, so angular momentum of the system is conserved.

VISUALIZE: The initial moment of inertia is I_1 and the final moment of inertia is I_2.

SOLVE: The initial moment of inertia is $I_1 = I_{\text{disk}} = \frac{1}{2}mR^2 = \frac{1}{2}(2.0\text{ kg})(0.10\text{ m})^2 = 0.010\text{ kg m}^2$ and the final moment of inertia is

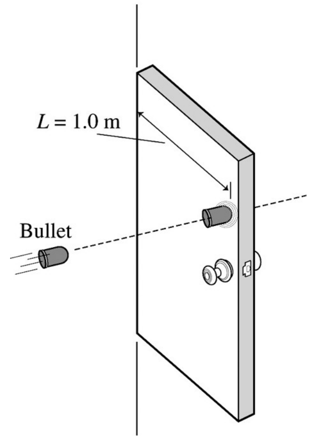
$$I_2 = I_1 + 2mR^2 = 0.010\text{ kg m}^2 + 2(0.500\text{ kg}) \times (0.10\text{ m})^2 = 0.010\text{ kg m}^2 + 0.010\text{ kg m}^2 = 0.020\text{ kg m}^2$$

Let ω_1 and ω_2 be the initial and final angular velocities. Then

$$L_{\text{f}} = L_{\text{i}} \Rightarrow \omega_2 I_2 = \omega_1 I_1 \Rightarrow \omega_2 = \frac{I_1\omega_1}{I_2} = \frac{(0.010\text{ kg m}^2)(100\text{ rpm})}{0.020\text{ kg m}^2} = 50\text{ rpm}$$

12.78. MODEL: For the (bullet + door) system, the angular momentum is conserved in the collision.

VISUALIZE:



SOLVE: As the bullet hits the door, its velocity v is perpendicular to r. Thus the initial angular momentum about the rotation axis, with $r = L$, is

$$L_i = m_B v_B L = (0.010\text{ kg})(400\text{ m/s})(1.0\text{ m}) = 4.0\text{ kg m}^2/\text{s}$$

After the collision, with the bullet in the door, the moment of inertia about the hinges is

$$I = I_{door} + I_{bullet} = \frac{1}{3}m_D L^2 + m_B L^2 = \frac{1}{3}(10.0\text{ kg})(1.0\text{ m})^2 + (0.010\text{ kg})(1.0\text{ m})^2 = 3.343\text{ kg m}^2$$

Therefore, $L_f = I\omega = (3.343\text{ kg m}^2)\omega$. Using the angular momentum conservation equation $L_f = L_i (3.343\text{ kg m}^2)\omega = 4.0\text{ kg m}^2/\text{s}$ and thus $\omega = 1.2\text{ rad/s}$.