SOLUTIONS

1. (Ch08, Q05) **Yes.** Both children rotate through the same *angle* in a given amount of time.

2. (Ch08, Q06) **No.** The child sitting near the edge travels a greater *linear distance* in a given amount of time.

3. (Ch08, Q10) The force $F_2$ will produce a torque about the axis. Torque requires both a force and a perpendicular *lever arm*.

4. (Ch08, Q11) The force $F_1$ will produce the greater torque on the wheel. Part of $F_2$ is directed parallel to the radius, and hence will not contribute to the torque. Only $F_1$ is acting purely perpendicular to the radius.

5. (Ch08, Q22) **Yes.** By changing how your weight is distributed with respect to the axis of rotation, *e.g.* by moving your arms and legs.

6. (Ch08, Q32)
   (a) By the right hand rule, the direction is **away from the observer** who sees the pencil fall to the right.
   (b) **No,** angular momentum is not conserved. Gravity is exerting a torque on the pencil, causing it to undergo angular acceleration.

7. (Ch08, E04) Rotational acceleration $\alpha = \Delta \omega / \Delta t$.
   $$\alpha = \frac{\Delta \omega}{\Delta t} = \frac{1.8 - 0.6}{4} = 0.3 \text{ rad/s}^2$$

8. (Ch08, E06) Same equation as above,
   $$\alpha = \frac{\Delta \omega}{\Delta t} = \frac{3 - 6}{12} = -0.25 \text{ rad/s}^2$$

9. (Ch08, E08)
   (a) Torque equals force $\times$ lever arm, or
   $$\tau = Fl = 50 \times 0.24 = 12 \text{ N} \cdot \text{m}$$
   (b) The lever arm would be 12 cm instead of 24 cm, so
   $$\tau = Fl = 50 \times 0.12 = 6 \text{ N} \cdot \text{m}$$

10. (Ch08, E10) The torques must be equal and opposite for the system to be balanced.
    $$3N \times 0.1m = x \times 0.05m$$
    Solving for $x$, a weight of **6 Newtons** must be placed 5 cm from the fulcrum.
11. (Ch08, E12) Torque is related to rotational acceleration by $\tau = I\alpha$. Solving for $\alpha$,

$$\alpha = \frac{\tau}{I} = \frac{60}{12} = 5 \text{ rad/s}^2$$

12. (Ch08, E18) This is an *angular momentum conservation* problem. We set the initial angular momentum equal to the final angular momentum:

$$I_{\text{init}}\omega_{\text{init}} = I_{\text{final}}\omega_{\text{final}}$$

All quantities are known except for the final angular velocity. Solving,

$$\omega_{\text{final}} = \frac{I_{\text{init}}}{I_{\text{final}}} \times \omega_{\text{init}} = \frac{4.5}{1.5} \times 20 = 60 \text{ RPM}$$