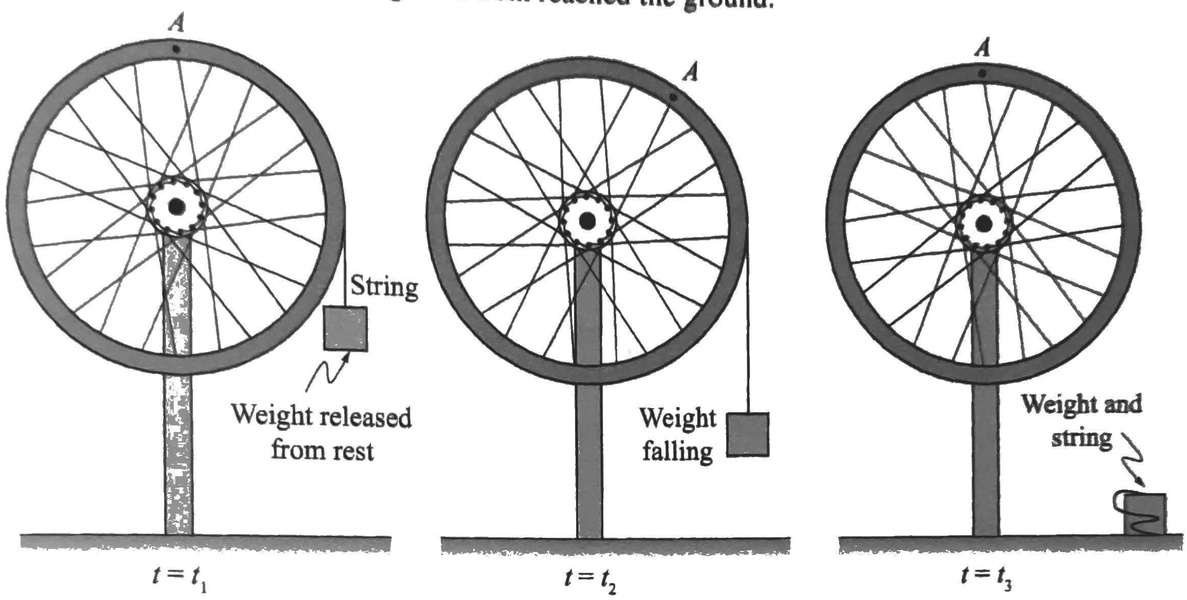
Name ______________________

1. A bicycle wheel is mounted on a fixed, *frictionless* axle. A light string is wound around the wheel's rim, and a weight is attached to the string at its free end. The diagrams below depict the situation at three different instants:

- At $t = t_1$, the weight is released from rest.
- At $t = t_2$, the weight is falling and the string is still partially wound around the wheel.
- At $t = t_3$, the weight and string have both reached the ground.



Note: The above diagrams do not represent stroboscopic photographs of the wheel.

a. What is the direction of the angular velocity $\vec{\omega}$ of the wheel at each time shown? If $|\vec{\omega}| = 0$ at any time, state so explicitly. Explain.

b. What is the direction of the wheel's angular acceleration $\vec{\alpha}$ at each time shown? If $|\vec{\alpha}| = 0$ at any time, state so explicitly. Explain.

c. Rank the magnitudes of the centripetal acceleration of point *A* at the three times shown (a_{A1}, a_{A2}, a_{A3}). If any of these is zero, state so explicitly. Explain your reasoning.

2. A small piece of clay is stuck near the edge of a phonograph turntable. Let $\vec{\alpha}$ represent the angular acceleration of the clay and $\vec{a}_r$ represent the centripetal acceleration of the clay.

   a. For each situation described below, describe a possible motion of the turntable. (Some parts have more than one correct answer.) Explain your reasoning in each case.

      i. $|\vec{\alpha}| = 0$ and $|\vec{a}_r| = 0$

      ii. $|\vec{\alpha}| = 0$ and $|\vec{a}_r| \neq 0$

      iii. $|\vec{\alpha}| \neq 0$ and $|\vec{a}_r| \neq 0$

   b. The equation "$\vec{\alpha} = \vec{a}_r / r$" is *not* a correct vector equation.

      i. Explain how you can tell that the vector equation above is not correct.

      ii. Is "$\alpha = a_r / r$" a correct *scalar* equation? Explain why or why not.