Monday Reading Assessment: Unit 4, Circular Motion

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1 Memory Bank

- $\Delta s = r\Delta\theta$
- $\omega = \frac{\Delta\theta}{\Delta t}$ ... Definition of angular velocity
- $v = r\omega$ ... Relationship between tangential velocity and angular velocity a distance r from the center
- $a_C = v^2/r = r\omega^2$ ... Centripetal acceleration
- $\omega = (2\pi)/T$ ... The orbital period, T, if ω is constant.
- **Force of Gravity:** The force of gravity between two objects of masses m_1 and m_2 separated by a distance r is

$$F_G = G\frac{m_1 m_2}{r^2} \tag{1}$$

In Eq. 1, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}.

2 Circular Motion

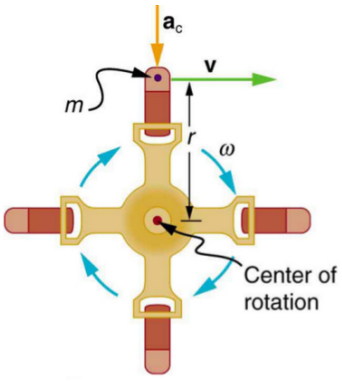

Figure 1: A blood centrifuge spinning counter-clockwise.

1. A diagram of a blood centrifuge is depicted in Fig. 1. It is spinning at an angular velocity of ω and tangential velocity v. In order to separate the contents in the vials (indicated with the mass m), the *centripetal acceleration* needs to be increased by a factor of 100. Which of the following actions will achieve this?
   - A: Doubling the angular velocity: $\omega \to 2\omega$.
   - B: Tripling the angular velocity: $\omega \to 3\omega$.
   - C: Quadrupling the angular velocity: $\omega \to 4\omega$.
   - D: Increasing the angular velocity by a factor of 10: $\omega \to 10\omega$.
2. Suppose the radius is 8 cm, and we measure $v = 15$ m/s. (a) What is ω? (b) What is a_C? If solid contents of the vial have a mass $m = 10$ grams, what is F_C?
3. What is the rotational *period* of the motion? That is, how long does it take for m to go around the circle?
4. The mass of the Moon is estimated to be 7.35×10^{22} kg, and orbits the Earth at a distance of 384,000 km. Assuming that the centripetal force is provided by Eq. 1, solve for the orbital period of the moon.