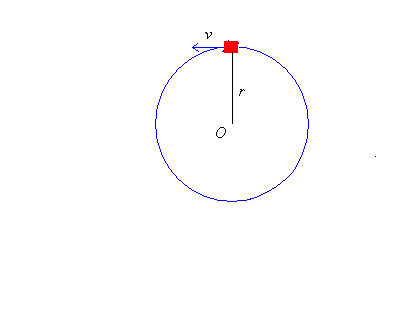
**Assignment 3 Due 1/29**

**(Circular Kinematics)**

**Problem 1.** (a) What is the centripetal acceleration of an Earthling around the equator? Note that the circumerance of the Earth is about 24000 miles.

(b) What is the centripetal acceleration of the Earth around the Sun? The distance between Earth and Sun is about 1.5×1011m.

**Problem 2.** Consider a fighter pilot undergoing flight simulation training. Suppose she starts from rest at the top of the circle (R = 5m) with a tangential acceleration of 2m/s2.



(a) when will she have traveled a quarter circle?

(b) what will be her tangential speed at that time?

(c) what will be the magnitude and direction of her acceleration at that time?

**Problem 3**. Two runners, Martha and George are racing around a circular track, whose radius is 60m. Suppose Martha runs counterclockwise, starting from rest with an acceleration of 0.2m/s2, and George runs clockwise at a constant speed of 6m/s.

(a) write an expression for Martha’s arc velocity vs, and arc position s, as a function of time.

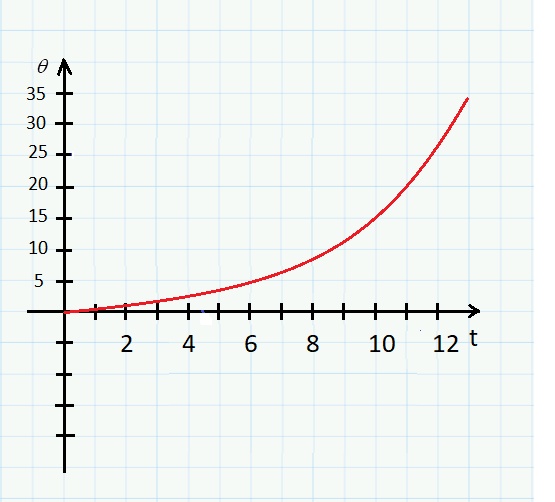
(b) write an expression for George’s arc velocity vs, and arc position s, as a function of time.

(c) When will they meet the first time? At what angle (express as a positive angle)?

(d) When will they meet the second time? At what angle (express as a positive angle)?

**(Angular Kinematics)**

**Problem 4.** You’re a rather slow figure skater learning to spin. The angle you’ve rotated through as a function of time is plotted below (θ is measured in radians):

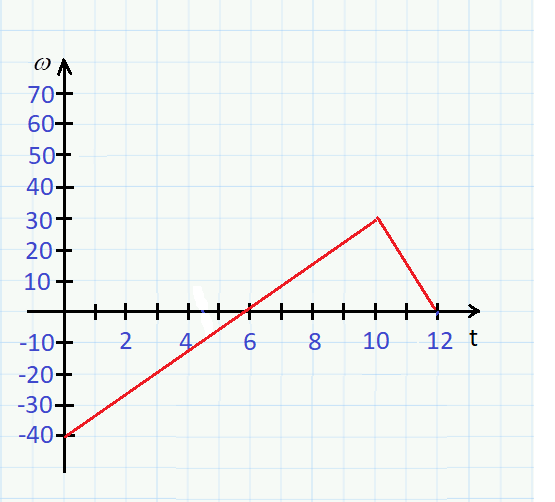


(a) Approximately when have you spun through 2 revolution?

(b) What is your average angular velocity between 0 and 10s?

(c) Estimate your angular velocity at t = 10s.

**Problem 5.** A yo-yo’s angular velocity (in rad/s) is shown below.

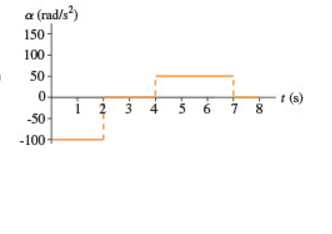


(a) When is it speeding up? Slowing down?

(b) What is its average angular acceleration between t = 3s and 12s?

(c) What is its maximum instantaneous angular acceleration?

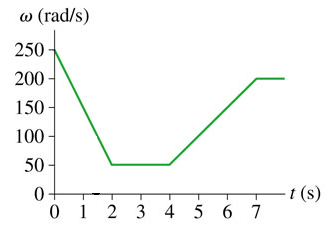
**Problem 6.** A blender’s angular acceleration is given by the following graph. Assuming it starts from rest…



(a) when is the blender speeding up? and when is it slowing down?

(b) what maximum angular speed does the blender attain during the 8s time interval? Which direction is it turning in?

**Question 7**. The angular velocity of a flywheel is illustrated below. When did the wheel complete 60 revolutions?



**Problem 8.** When you turn on your fan, it goes from an angular speed of 0 rev/s, to an angular speed of 5 rev/s in a time span of 4s.

(a) What is the angular acceleration of the fan in rad/s2?

(b) What was the fan’s angular velocity at t = 3s in rad/s? (in rpm)?

(c) What is the angular displacement of the fan in these first 3s in rad? (in rev)?

(d) The fan blade has a length of 45cm; what distance has the tip of the fan blade rotated through by 3s in m?

(e) How fast is the tip of the blade moving after 3s in m/s?

(f) What is the magnitude of the total acceleration of the tip at that time in m/s2? (in g’s)?