Reminders 07-27-09:

- Exam 2 Average
- Read Chapter 8; (make sure you thoroughly read through the chapters we cover)
- 6th Webassign due Tonight 11:59PM
- Skip Chapter 13 Due to Time Constraints
- ***Exam 3 Chapters 6-8 Next Thursday***
- Standard assessment p.169 answers D, B, B, C, B, B, D, it goes past ring. **THESE ARE GREAT PRACTICE PROBLEMS**!!!!!!!!

Objectives:

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- Gravitation
- Rotational Kinematics

$$\frac{G M_E M_s}{r_{es}^2} = \frac{M_E V^2}{r_{es}}$$

$$V = \sqrt{\frac{G M_s}{r_{es}}} = \frac{2\pi r_{es}}{T}$$

Solve for T n r_{es}

$$\frac{G M_s}{r_{es}} = \frac{(2\pi)^2 r_{es}^2}{T^2}$$

$$T^2 = \frac{(2\pi)^2}{G M_s} r_{es}^3$$

Period squared is proportional to distance between two object cubed.

$$\frac{T^2}{r_{es}^3} = \frac{(2\pi)^2}{G M_s}$$

N is force of scale on you!

You're weightless

$N - mg = -ma$

$N - mg = -m\frac{v^2}{r}$

$N - mg = -mg$

$N = 0$

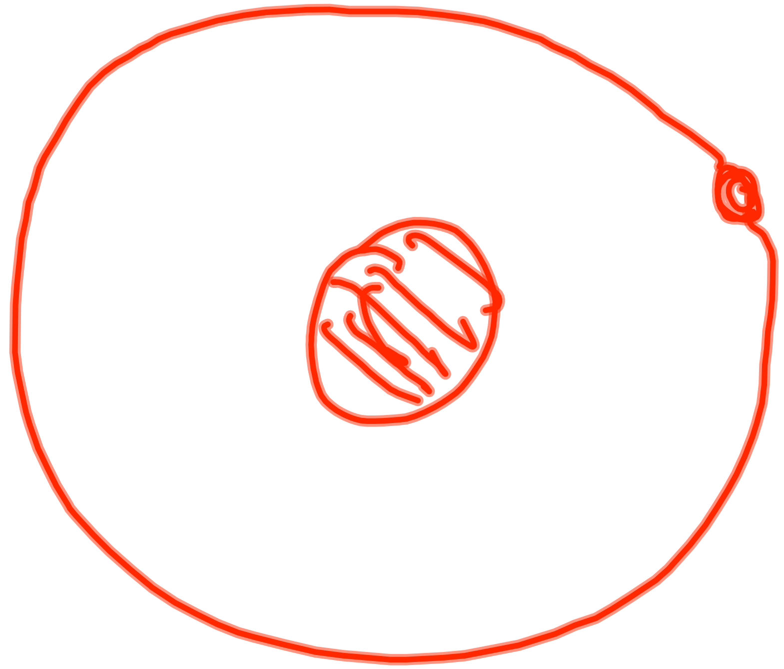
Kepler's 3rd Law

$$\frac{T^2}{R^3} = 1$$ only true for motion of planets around sun; where T is in years and R in A.U.

Better to remember as

$$\frac{T^2}{R^3} = \underline{\text{constant}}$$

Webassign 6 Ch 7 #4



$$\frac{G M_m m_s}{r^2} = m a$$

$$\frac{G M_m \cancel{m_s}}{r^2} = \frac{\cancel{m_s} V^2}{r}$$

$$V = \sqrt{\frac{G M_m}{r}} = \frac{2\pi r}{T} = \frac{\text{Circumference}}{\text{Period}}$$

solve for T

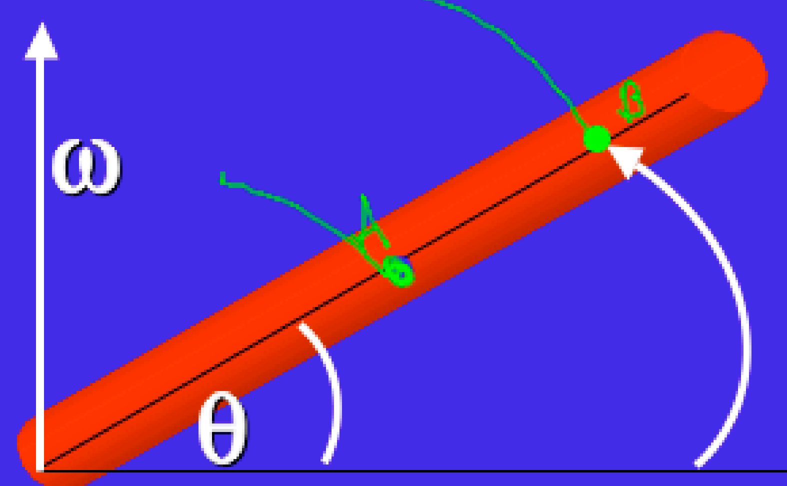
Rotational Kinematics

- **Average angular speed (cont'd)**
  - Note each point on rod or any rigid body rotates with the same ω, but the linear velocity of each point on it is different. Why?

$$\Delta S = r \Delta\theta$$

$$\Delta S_A = r_a \Delta\theta$$

$$\Delta S_B = r_B \Delta\theta$$



$$\frac{\Delta s}{\Delta t} = r\left(\frac{\Delta\theta}{\Delta t}\right) = r\omega$$

- **What is your apparent weight if you are orbiting the Earth 200km above the its surface? Can you think of problems that are similar to this one?**

Your weight is gravitational attraction between you and earth.

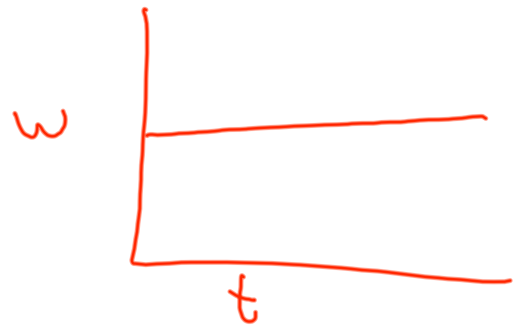
$$\frac{G M_e m}{(6.37\times10^6 + 2.00\times10^5)^2} = m\left(9.2\,\frac{m}{s^2}\right)$$

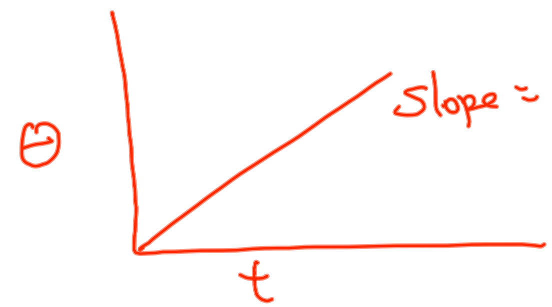
$M_e = 5.98\times10^{24}\ kg$

$G = 6.67\times10^{-11}\ \frac{N\,m^2}{kg^2}$

Questions

- How does the angular position of a point on an object change if does it rotates at a constant ω? Sketch a graph of θ vs. t.
- What is the angular speed of the second hand of a clock? Repeat calculation for minute hand of clock.





Slope $= \frac{\Delta\theta}{\Delta t} = \omega$

$\Delta\theta = \omega\Delta t$ if ω constant

$\omega = \frac{\Delta\theta}{\Delta t}$ → second hand of clock

$= \frac{2\pi}{60s} = \frac{\pi}{30s} = 0.10/s$

minute hand

$\omega = \frac{2\pi}{3600s} = \frac{\pi}{1800s} = 0.0017/s$

- A motorcycle wheel accelerates (cw) from rest to 60rev/s in 3.8s.
  - What is the magnitude of the average acceleration of the motorcycle?

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{60\,rev/s - 0}{3.8s}$$

$$\alpha = \frac{60\,\cancel{rev}/s}{3.8s} \cdot \frac{2\pi\,rad}{\cancel{rev}}$$

$$= 99.2\,rad/s^2$$

$$= 99.2/s^2$$

- The angular position of a rotating object is given by $\theta = 1.0 - 2.0t + 5.0t^2$ rad.
  - How many revolutions does it make between 0 and 2.0s.
  - What is the angular acceleration?
  - What is the average angular speed between 1.0s and 2.0s?
  - What is the angular velocity at t=2.0s? How many more revolutions are needed to double its angular velocity?

1.0 represents θ when t=0
It θ_i.

-2.0 represents ω at t=0. It is θ_i.

Want number of revs. bet. 0 at 2.0s.

Need to know $\Delta\theta$ between 0 and 2.0s

$\Delta\theta = \theta(t=2.0s) - \theta(t=0s)$

$\theta(t=0s) = 1.0\,rad$

$\theta(t=2.0s) = 1.0 - 2.0(2.0s) + 5.0(2.0s)^2$
$= 17$ radians

$\Delta\theta = 17\,radians - 1.0\,rad = 16.0\,rad$

$\#\,rev = \frac{16.0\,rad}{2\pi\,rad/rev} = 2.55\,rev$

What is α?

$5.0 = \frac{\alpha}{2}$

$\alpha = 10.0\,rad/s^2$

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need $\frac{\Delta\theta}{\Delta t} = \omega_{avg}$ $\quad\theta(t=2.0) = 17\,rad$

$\theta(t=1.0s) = 1.0 - 2.0(1.0) + 5.0(1.0)^2$
$= 4.0\,rad$

$\omega_{avg} = \frac{17.0\,rad - 4.0\,rad}{1.0s} = 13\,rad/s$

Want ω at $t = 2.0s$?

$$\omega_f = \omega_i + \alpha t$$

$$= -2.0/s + (10.0)(2.0)$$

$$= 18 \text{ rad/s}$$

How many more revolutions needed to double velocity?

$\omega_f = 36 \text{ rad/s}$ $\quad \alpha = 10 \text{ rad/s}^2$

$\omega_i = 18 \text{ rad/s}$

$$\omega_f^2 - \omega_i^2 = 2\alpha\Delta\theta$$

$$\Delta\theta = \frac{\omega_f^2 - \omega_i^2}{2\alpha}$$

rev $= \dfrac{\dfrac{(36/s)^2 - (18/s)^2}{2(10/s^2)}}{2\pi}$

$= \sout{20.5 \text{ rev.}}$

$= 7.73 \text{ rev}$