What's Up In The Sky This Week?

- Comet Holmes
  - To the north east
  - Naked eye or binocular
    - Not sure how long it will be bright
- **Sunrise:** 7:56 am
- **Sunset:** 7:24 pm
- **Moonrise:** 10:14 pm
- LQ 11/1 5:18 pm EDT

- ISS over Cleveland
  - Nov 6, 6:11 AM

SATELLITE	LOCAL DATE/TIME	DURATION (MIN)	MAX ELEV (DEG)	APPROACH (DEG-DIR)	DEPARTURE (DEG-DIR)
ISS	Tue Nov 06/06:11 AM	5	72	10 above SW	12 above EN

Eggsploration - Energy

Conservation of Energy

- Energy Analysis gives a framework to help understand motion
- Energy = Potential Energy + Kinetic Energy
  [+ Chemical Energy + Nuclear Energy + ...]
- PE (Potential Energy) is stored energy
  - Could be Battery, Charged Capacitor, compressed spring
  - We will be concerned with Gravitational Potential Energy
    - Stored by raising an object.
    - Orbital PE = 0 at $h=\infty$, $PE_g = -GM_e m/(R_e+h)$
    - Earth Surface PE = 0 at h=0, $PE_g = mgh$
      - $PE = -GM_e m/(R_e+h) + GM_e m/R_e$, $g = GM_e/R_e^2$
- KE (Kinetic Energy) due to motion, $\frac{1}{2} mv^2$

Eggsploration – Energy (2)

Conservation of Energy

- How High will a rocket go? Convert KE to PE.
- Initial Energy PE = 0, KE = ½ mv_0^2
- At Peek Altitude Final Energy , KE(v=0 = 0, PE = mgh.
- Initial Energy = Final Energy (conservation)
  - ½ mv_0^2 = mgh
  - h = ½ v_0^2/g
- Hang on to this thought: **h = ½ v_0^2/g**
  - This ignores energy lost to air resistance!

Eggsploration - Impulse

- Rocket Motors are rated by ***Impulse***
- Impulse (I) = change in momentum (p), $\Delta p = \Delta mv$
  - Rocket Motors eject ***Mass*** at some ***velocity***.

$$\Delta p = mv = \int f\,dt = f\,\Delta t$$

$$v = \Delta p / m$$

- Use Impulse to estimate initial velocity, v_0
  - Quest C6 motor, I = 8.5 N-s
  - Rocket Mass 122 g
    - 55 g egg
    - 57 g Quest Courier
    - 10 g C6-3 after firing
  - $\mathbf{V_0}$ = 8.5 N-s / 0.122 Kg = **69.7 m/s** = 155.9 MPH
  - $V_1 = (I - mg\Delta t)/m = (8.5 - 0.122*9.8*1.7)/0.122$ = **53 m/s** = 118.5 MPH

Eggsploration - Height

Estimate peak height from **Conservation of Energy**

- $PE_{final} = KE_{initial}$
- $g\ h = ½\ v_0^2$
- $h = ½\ (69.7\ m/s)^2/9.8\ m/s^2$
- h (69.7 m/s) = **248 m** = 813 ft
- h_1 (53 m/s) = 143 m = 470 ft
  - Note: does ***not*** include energy lost to air resistance which will significantly reduce altitude.
  - Documentation indicates 137m / 450 ft with egg

- Next week we look at orbital examples