*MECH-420 with Dr. Berry has pushed me to limits I did not know I had. But I can say with 100% certainty I am a better student and will be a better engineer as a direct result of it. Taking this course with Dr. Berry was a blessing. You will work hard in this course, but you will MASTER the concept as they apply to the real world.*

# MECH-420
# Heat Transfer

## UNIT STUDY AIDS

KNOWLEDGE, YOU SEEK, DO YOU?
DO OR DO NOT. THERE IS NO TRY

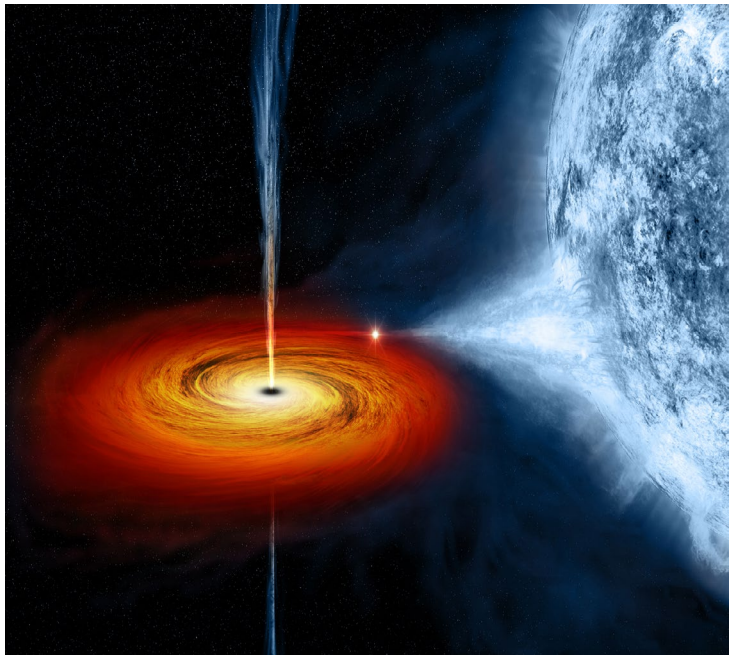
# HOMEWORK

## FOLLOW THE PATH

1.The comet Centaur is headed straight for a BLACK HOLE emitting thermal radiation causing the temperature of comet to be measured as:

$$T(x,y,z,t) = (2xt + 12y^2x^2zt^{-1/2} - 34y^3xzt^3)\ K$$

Where “x,y,”z are in meters, and “t” is in seconds.



a. What are the units on the constants “2”, “12”, and “34”.
b. Determine the expression/relationship for the *Time Rate of Change of Temperature* $\frac{DT}{Dt}(K/s)$ for the doomed comet Centaur and **VERIFY** the units on each term.

# UNIT ANALYSIS

$$T(x,y,z,t) = (2xt + 12y^2x^2zt^{-1/2} - 34y^3xzt^3)[K]$$

$$[K] = 2[][m][s]$$

$$2[] = \frac{[K]}{[m][s]} = \frac{K}{m-s}$$

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$$[K] = 12[][m^5][s]^{-1/2}$$

$$12[] = \frac{[K]}{[m^5][s]^{-1/2}} = \frac{K}{m^5 - s^{-1/2}}$$

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$$[K] = 34[][m^5][s^3]$$

$$34[] = \frac{[K]}{[m^5][s^3]} = \frac{K}{m^5 - s^3}$$

# TIME RATE OF CHANGE

$$T(x,y,z,t) = (2xt + 12y^2x^2zt^{-1/2} - 34y^3xzt^3)[K]$$

$$\frac{DT}{Dt}\left[\frac{K}{s}\right] = 2x - 1/2 * 12 * y^2x^2zt^{-3/2} - 3 * 34 * y^3xzt^2$$

$$= \left[2x - 6y^2x^2t^{-3/2} - 102y^3xzt^2\right][?]$$

ENTER UNITS

$$= 2\left[\frac{K}{\cancel{m} - s}\right]x[\cancel{m}] - 6\left[\frac{K}{\cancel{m}^5 - s^{-1/2}}\right]y^2x^2z[\cancel{m}^5]t^{-3/2}[s^{-3/2}]$$

$$-102\left[\frac{K}{\cancel{m}^5 - s^3}\right]y^3xz[\cancel{m}^5]t^2[s^2]$$

As staff scientist for Cosmic Physics Inc. on the deep space research vessel **PROTIUS ONE**, your team after months of analysis has measured data and have determined the following equation for the Neutron Power Flux $(\Psi)$ emitted within a Black Hole where "c" is the speed of light (m/s), "t" is time, and "J" is Joules:

$$\Psi(t)\left[\frac{J}{s}\right] = A[]^{3/2}\, t^{1/2} + B[]^{-1/3}\, t^{3} + C[]^{-2/3}\, t^{5/6} + D[]c[m/s]^{2}\, t^{-12}$$

a. Determine the units of time varying constants A[], B[], C[], and D[].

b. The time rate of change of the neutron power flux $(\frac{d\Psi}{dt})$ provides the power absorption rate of radiant energy. Determine $(\frac{d\Psi}{dt}\left[\frac{J/s}{s}\right])$ and show that units are **<u>CORRECT</u>**.