

# REVIEW FOR FIRST EXAM

This review sheet is intended to be a broad guide to help you prepare for the examination. Some of the exam questions will test your basic knowledge of the material (i.e., knowing just the facts), but others will test your understanding of the implications of these facts. So, you will be tested on knowledge and application. Your prep should include study of your notes, the book, and the ppts.

## 1. *Historical*

- Greek Astronomy – names, accomplishments (Pythagoras, Aristotle, Aristarchus, Ptolemy, Eratosthenes, Hipparchus)
- Copernicus and the heliocentric model - know about retrograde loops; understand the difference between geocentric and heliocentric
- Tycho Brahe the observer and his contributions
- Kepler and his 3 Laws; his use of ellipses (know about semi-major axis and eccentricity)
- Galileo: his observations and experiments (particularly the importance of phases of Venus)
- Hooke and idea of central forces
- Newton and his laws of motion; know about forces, inertia, speed, velocity, acceleration, momentum, angular momentum
- Kirchoff's laws - know about Bohr atom and blackbodies, absorption, emission, and ionization

## 2. *Astro Tools*

- Gravity: know the formula for Newton's force of gravity; be familiar with circular motion under gravity, escape speed, orbital motion concepts
- Observing with telescopes - know about atmospheric seeing, atmospheric transparency, why astronomers put telescopes in space, the concept of "resolution" for image clarity (angular resolution) and spectral detail (spectral resolution); know that telescope sensitivity refers to faintness level - telescopes are basically "light buckets", and sensitivity depends on aperture size
- Electromagnetic spectrum – know the different bands of light; understand what wavelength and frequency mean, and the relation between wavelength and frequency and speed of light
- Flux (i.e., the inverse square law of light), luminosity,
- Planck and Einstein - know about photons and photon energy
- Blackbodies - Wien's law and Stefan-Boltzmann's Law; know that blackbodies are perfect absorbers
- Gases, Pressure, Temperature, Density and the Ideal Gas Law; concept of gas as particles in motion; understand that gas particles have a range of speeds and are randomly directed, that thermal speed is a kind of average, and that the average depends on both temperature and particle mass
- Doppler shift - motion toward or away produces wavelength shift; understand what redshift and blueshift refer to

### 3. *The Sky*

- Know about circles, angles (and radians), and angular size
- Order of the eight planets from the Sun; be familiar with configurations of the planets - conjunctions, opposition, greatest elongation, quadrature
- know what the ecliptic is and represents; know that the zodiac constellations lie along the ecliptic
- know that the tilt of the Earth causes the seasons
- Finding and using the North star (such as getting latitude on Earth); understanding what star trails are and represent
- know which way the Earth rotates
- understand the celestial sphere

EXPRESSIONS WE HAVE SEEN - Be familiar with what the equations represent

Angular size,  $\theta = D/d$

Wave properties of light,  $\lambda\nu = c$

Energy property of photons,  $E = h\nu$

Kepler's 3rd law for the Solar System, orbital period  $P^2 \propto a^3$

Force of gravity,  $F_G = GMm/d^2$

Escape speed,  $v_{\text{esc}} = \sqrt{2GM/R}$

Circular orbital speed,  $v_c = \sqrt{GM/R}$

Newton's version of Kepler's 3rd Law,  $a^3 = \frac{G(m_1+m_2)}{4\pi^2} P^2$

Newton's 2nd law, force  $F = ma$

Flux of light, flux  $F \propto L/d^2$

Wien's law,  $\lambda_{\text{max}} \propto 1/T$

Stefan-Boltzmann law, surface brightness  $F_{\text{BB}} \propto T^4$

Doppler shift  $\Delta\lambda/\lambda = v/c$

The average thermal speed of particles in a gas with temperature  $T$  and mass  $m$  is  $v_{\text{th}} = \sqrt{\frac{3kT}{m}}$