Astronomy 2 Winter 2017 Midterm
Useful formulae, unit conversion, and constants

Relevant Formulae

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\frac{\text{angular size}}{360°} = \frac{\text{physical size}}{2\pi \times \text{distance}}$$

$A^3 = P^2$ Kepler's third law for our Solar System, orbit periond P in years and radius (semi-major axis, average distance from the sun) of the orbit A in years

$C = 2\pi d$ Circumfrence C of a circle with radius d

$F = ma$ Newton's law relating force F, mass m and acceleration a

$F_g = \frac{GMm}{r^2}$ gravitational force F_g between masses M, m at distance r from each other

$a = \frac{GM}{R^2}$ surface gravity; acceleration a due to the gravitational force from mass M at distance R from the center

$P^2 = \frac{4\pi^2}{GM} A^3$ Newton's version of Kepler's 3rd law for a small object in orbit around an object of mass M. Orbit period P in seconds and average radius A in meters for the units of G given on the formula sheet. You can ignore the mass of the small object.

$\text{momentum} = mv$

$v_{\text{escape}} = \sqrt{\frac{2GM}{R}}$ Escape velocity at distance d from object of mass M

$v_{\text{circ}} = \sqrt{\frac{GM}{R}}$ velocity of an object in a circular orbit around an object of mass M at distance distance d

$\lambda_{\text{peak}} = \frac{2.9 \times 10^6 \,\text{nm}\,\text{K}}{\text{T}}$ thermal radiation: Wien's law, relationship between peak wavelength λ_{peak} in nm and temperature T in Kelvin

$E = hf$ photon energy E for frequency f

$E = \frac{hc}{\lambda}$ photon energy E for for wavelenth λ

$\frac{v}{c} = \frac{\lambda_{shift} - \lambda_{rest}}{\lambda_{rest}}$ Doppler shift

Units and Constants

1 km = 1000 m

1 AU $= 1.5 \times 10^{11}$ m

$c = 3 \times 10^{5}\,\frac{\mathrm{km}}{\mathrm{s}}$

$M_{\mathrm{Sun}} = 2 \times 10^{30}\,\mathrm{kg}$

$M_{\mathrm{Earth}} = 6 \times 10^{24}\,\mathrm{kg}$

$R_{\mathrm{Earth}} = 6,400\,\mathrm{km}$

$M_{\mathrm{Moon}} = 7 \times 10^{22}\,\mathrm{kg}$

Distance from the moon to the Earth: 384,000 km

$g = 9.8\frac{\mathrm{m}}{\mathrm{s}^2}$ (acceleration due to gravity on Earth)

$G = 6.67 \times 10^{-11}\,\frac{\mathrm{m}^3}{\mathrm{kg\,s}^2}$ (Gravitational constant)

3.14×10^{7} seconds per year

1 light year $= 9.46 \times 10^{12}\,\mathrm{km}$

$h = 6.626 \times 10^{-34}\,\mathrm{Js}$