

Information about the Midterm

The midterm is on the evening of Thursday, March 4, from 6-8 PM. If you cannot make this time, you should already have made arrangements with me. If you are ill or miss the test for any reason, contact me via email ecarlson@wfu.edu or by cell 336-407-6528.

To the midterm, you should bring:

- Pen or pencil
- Calculator
- Ruler with metric markings
- Paper

I'll supply paper if you prefer.

Outline of the Midterm

This test consists of three parts. For the first part, you may write your answers directly on the exam, if you wish. For the other parts, use separate sheets of paper. Useful equations can be found at the start of part 3. The total test is worth 200 points.

Part I: Multiple Choice [40 points]

For each question, choose the best answer (2 points each)

[questions 1-20]

Part II: Short essays [60 points]

Write approximately a paragraph or two explaining the following (15 points each).

[questions 21-24]

Part III: Calculation [100 points]

For each of the following problems, give the answer, explaining your work. The value of each portion appears in square brackets. Some possibly useful equations appear below. (20 points each)

[a bunch of formulas]

[questions 25-29]

Equations for the Midterm

The following should be memorized by you:

<p style="text-align: center;"><u>Units</u></p> $2\pi \text{ rad} = 360^\circ$ $1^\circ = 60'$ $1' = 60''$ $1'' = 1000 \text{ mas}$ $\frac{1 \text{ pc}}{1 \text{ rad}} = \frac{1 \text{ AU}}{1''}$	<p style="text-align: center;"><u>Metric</u></p> $k = 10^3$ $M = 10^6$ $G = 10^9$ $m = 10^{-3}$ $\mu = 10^{-6}$ $n = 10^{-9}$	<p style="text-align: center;"><u>Simple Orbits</u></p> $\mathbf{F} = -\frac{GMm\hat{\mathbf{r}}}{r^2}$ $E_p = -\frac{GMm}{r}$ $E_K = \frac{1}{2}mv^2$ $v^2 = \frac{GM}{R}$ $\mathbf{g} = \frac{\mathbf{F}}{m} = -\frac{GM\hat{\mathbf{r}}}{r^2}$	<p style="text-align: center;"><u>Gauss's Law</u></p> $\int \mathbf{g} \cdot \hat{\mathbf{n}} dA = -4\pi GM_{\text{in}}$ $\mathbf{g}(R) = -\frac{GM(R)\hat{\mathbf{r}}}{R^2}$	<p style="text-align: center;"><u>Parallax</u></p> $d = \frac{1}{p}$
<p style="text-align: center;"><u>EM waves</u></p> $c = 3 \times 10^8 \text{ m/s}$ $\omega = ck$ $k\lambda = 2\pi$ $f = 1/T$ $\omega = 2\pi f$ $c = \lambda f$	<p style="text-align: center;"><u>Flux</u></p> $\mathcal{F} = \sigma T^4$ $L = 4\pi R^2 \mathcal{F}$	<p style="text-align: center;"><u>Gravitational Potential</u></p> $\mathbf{g} = -\nabla\Phi$ $\Phi(\mathbf{r}) = -\sum_i \frac{Gm_i}{ \mathbf{r} - \mathbf{r}_i }$ $E_{pi} = m_i\Phi(\mathbf{r}_i)$ $2\langle E_K \rangle + \langle E_p \rangle = 0$	<p style="text-align: center;"><u>Proper Motion</u></p> $v_t = \mu d$	<p style="text-align: center;"><u>Distance/Size</u></p> $s = \theta d$
	<p style="text-align: center;"><u>Magnitude/Distance</u></p> $m - M = 5 \log d - 5$ $d = 10^{\frac{1+m-M}{5}} \text{ pc}$	<p style="text-align: center;"><u>Luminosity/Brightness</u></p> $L = 4\pi d^2 b$		

You should be able to use the following equations, but you are not expected to memorize them:

<p style="text-align: center;"><u>Units</u></p> $1 \text{ AU} = 1.496 \times 10^{11} \text{ m}$ $1 \text{ pc} = 3.086 \times 10^{16} \text{ m}$ $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$ $1 \text{ y} = 3.155 \times 10^7 \text{ s}$ $R_\odot = 6.955 \times 10^8 \text{ m}$ $M_\odot = 1.989 \times 10^{30} \text{ kg}$ $L_\odot = 3.839 \times 10^{26} \text{ W}$ $T_\odot = 5777 \text{ K}$	<p style="text-align: center;"><u>Physical Constant</u></p> $k_B = 1.381 \times 10^{-23} \text{ J/K}$ $k_B = 8.671 \times 10^{-5} \text{ eV/K}$ $\sigma = 5.670 \times 10^{-8} \text{ W/m}^2/\text{K}^4$ $\hbar = 1.055 \times 10^{-34} \text{ J}\cdot\text{s}$ $\hbar = 6.582 \times 10^{-16} \text{ eV}\cdot\text{s}$ $G = 6.673 \times 10^{-11} \text{ m}^3/\text{kg}\cdot\text{s}^2$	<p style="text-align: center;"><u>Gravitational Potential Energy</u></p> $E_p = -\frac{1}{2} \int d^3\mathbf{r} \int d^3\mathbf{r}' \frac{G\rho(\mathbf{r})\rho(\mathbf{r}')}{ \mathbf{r} - \mathbf{r}' }$ $E_p = \frac{1}{2} \int d^3\mathbf{r} \rho(\mathbf{r})\Phi(\mathbf{r})$	
	<p style="text-align: center;"><u>Black Body Radiation</u></p> $u = \frac{\pi^2 (k_B T)^4}{15 (\hbar c)^3}$ $\lambda_{\text{max}} T = 2.8978 \times 10^{-3} \text{ m}\cdot\text{K}$	<p style="text-align: center;"><u>Black Hole</u></p> $R_s = \frac{2GM}{c^2}$	<p style="text-align: center;"><u>Relative speed, Circular Orbits</u></p> $v_r = R_0 \sin i \left(\frac{V}{R} - \frac{V_0}{R_0} \right)$
<p style="text-align: center;"><u>Brightness/Magnitude</u></p> $b = 2.52 \times 10^{-8} \text{ W/m}^2 \left(10^{-\frac{2}{5}m} \right)$		<p style="text-align: center;"><u>Doppler Shift</u></p> $1+z = \frac{\lambda}{\lambda_0} = \frac{\sqrt{1+v_r/c}}{\sqrt{1-v_r/c}}$	
<p style="text-align: center;"><u>Moving Cluster</u></p> $d = \frac{v_r \tan \theta}{\mu}$	<p style="text-align: center;"><u>Planetary Nebula</u></p> $M^* = -4.47$	<p style="text-align: center;"><u>Type Ia SN</u></p> $M_{\text{max}} = -19.3$	<p style="text-align: center;"><u>Cepheid Period/Luminosity</u></p> $M = -2.81 \log(P) - 1.43$