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Astronomy 350 **Fall 2012**

HOUR EXAM 2

November 2, 2012

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1. DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO.
2. Write you name above.
3. Show all of your work, and indicate clearly your final answer! A correct final answer may not receive credit if no work is shown.
4. Budget your time! Don't get stalled on any one question.
5. Short answer questions can be answered in 1-2 sentences, unless indicated otherwise. If you are writing paragraphs, you may have misread or misunderstood the question.
6. For your reference there are constants listed below.
7. The total number of points on the exam is 100.

Possibly Useful Information

Note that a symbol may take different meanings in different equations.

$\Delta x = v \times \Delta t$	$\Delta v = a \times \Delta t$
$P_{\rm yr}^2 = a_{\rm AU}^3$	$GMP^2 = 4\pi^2 a^3$
$F = ma$	$F = Gm_1m_2/R^2$
$a_{\rm circ} = v_{\rm circ}^2/r$	
$KE = \frac{1}{2}mv^2$	$PE = -Gm_1m_2/R$
$v_{\rm esc} = \sqrt{2GM/R}$	$M = v_{\rm circ}^2 R/G$
$F = L/4\pi R^2$	$d = 1\ {\rm pc}/p_{\rm arcsec}$
$L \propto M^4$	$\tau = 10^{10}\ {\rm yr}\ (M/M_\odot)^{-3}$
$\Delta t_{\rm obs} = \Delta t_{\rm rest}/\sqrt{1 - v^2/c^2}$	$L_{\rm obs} = L_{\rm rest}\sqrt{1 - v^2/c^2}$
$E = mc^2/\sqrt{1 - v^2/c^2}$	$KE = E - mc^2$
$R_{\rm Sch} = 2GM/c^2$	$R_{\rm Sch,\odot} = 2GM_\odot/c^2 = 3$ km
$\Delta t_{\rm obs}/\Delta t_{\rm em} = \lambda_{\rm obs}/\lambda_{\rm em} = \sqrt{\frac{1-R_{\rm Sch}/r_{\rm obs}}{1-R_{\rm Sch}/r_{\rm oem}}}$	
$z = (\lambda_{\rm obs} - \lambda_{\rm em})/\lambda_{\rm em}$	$v = cz$
$v = H_0 r$	$H = (da/dt)/a = (\text{rate of change in } a)/a$
$a = 1/(1+z)$	$z = (1-a)/a$
$G = 6.7 \times 10^{11}\ {\rm m^3/kg\ s^2}$	$c = 3.0 \times 10^8$ m/s
$1\ {\rm AU} = 1.5 \times 10^{11}$ m	$1\ {\rm pc} = 3.1 \times 10^{16}\ {\rm m} = 3.3$ lyr
$1\ {\rm kpc} = 10^3\ {\rm pc} = {\rm c} \times (3300\ {\rm yr})$	
$M_\odot = 2.0 \times 10^{30}$ kg	$M_{\rm Earth} = 6.0 \times 10^{24}$ kg
$L_\odot = 3.8 \times 10^{26}$ Watts	$\tau_\odot = 10^{10}\ {\rm yr} = 10$ billion yrs
$H_0 = 72\ {\rm km\ s^{-1}\ Mpc^{-1}}$	
$t_{\rm H} = 1/H_0 = 14$ billion years	$d_{\rm H} = c/H_0 = 4200$ Mpc