Fall 2008 RED Barcode Here

Physics 105, sections 1 and 2

Final Exam Please write your CID_____

Colton 2-3669

4 hour time limit. No notes. No books. No calculators.

Constants:

$g = 9.8$ m/s^2 → **but you may use 10 m/s^2 in nearly all cases**

$G = 6.67 \times 10^{-11}$ N·m^2/kg^2

$k_B = 1.381 \times 10^{-23}$ J/K

$N_A = 6.022 \times 10^{23}$

$R = k_B \cdot N_A = 8.314$ J/mol·K

$\sigma = 5.67 \times 10^{-8}$ W/m^2·K^4

Mass of Sun = 1.991×10^{30} kg

Mass of Earth = 5.98×10^{24} kg

Radius of Earth = 6.38×10^6 m

Radius of Earth's orbit = 1.496×10^{11} m

Density of water: 1000 kg/m^3

Density of air: 1.29 kg/m^3

Young's modulus of steel: 20×10^{10} N/m^2

Linear exp. coeff. of copper: 17×10^{-6} /°C

Linear exp. coeff. of steel: 11×10^{-6} /°C

Specific heat of water: 4186 J/kg·°C

Specific heat of ice: 2090 J/kg·°C

Specific heat of steam: 2010 J/kg·°C

Specific heat of aluminum: 900 J/kg·°C

Latent heat of melting (water): 33×10^5 J/kg

Latent heat of boiling (water): 2.26×10^6 J/kg

Thermal conduct. of aluminum: 238 J/s·m·°C

sin(30°) = 0.5

cos(30°) ≈ 0.866

tan(30°) ≈ 0.577

π ≈ 3.14

Conversion factors

1 inch = 2.54 cm

1 m^3 = 1000 L

1 atm = 1.013×10^5 Pa = 14.7 psi

$T_F = \frac{9}{5}T_C + 32$

$T_K = T_C + 273.15$

Other equations

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Surface area of sphere = $4\pi r^2$

Volume of sphere = $(4/3)\pi r^3$

$v_{ave} = \frac{v_i + v_f}{2}$

$v = v_o + at$

$x = x_o + v_o t + \frac{1}{2}at^2$

$v_f^2 = v_o^2 + 2a\Delta x$

$w = mg$, $PE_g = mgy$

$F = -kx$, $PE_s = ½ kx^2$

$f = \mu_K N$ (or $f \le \mu_S N$)

$P = F_{//}v = Fv\cos\theta$

$F\Delta t = \Delta p$

Elastic: $(v_1 - v_2)_{bef} = (v_2 - v_1)_{after}$

arc length: $s = r\theta$

$v = r\omega$

$a_{tan} = r\alpha$

$a_c = v^2/r$

$F_g = \frac{GMm}{r^2}$, $PE_g = -\frac{GMm}{r}$

$I_{pt\ mass} = mR^2$

$I_{sphere} = (2/5)\ mR^2$

$I_{hoop} = mR^2$

$I_{disk} = (1/2)\ mR^2$

I_{rod} (center) = (1/12) mL^2

I_{rod} (end) = (1/3) mL^2

$L = r_\perp p = rp_\perp = rp\sin\theta$

stress = F/A; strain = $\Delta L/L$

Y = stress/strain

$P = P_0 + \rho g h$

$VFR = A_1 v_1 = A_2 v_2$

$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$\Delta L = \alpha L_0 \Delta T$

$\Delta V = \beta V_0 \Delta T$; $\beta = 3\alpha$

$KE_{ave} = \frac{1}{2}mv_{ave}^2 = \frac{3}{2}k_B T$

$Q = mc\Delta T$; $Q = mL$

$\frac{\Delta Q}{\Delta T} = kA\frac{T_2 - T_1}{L}$

$P = e\sigma AT^4$

$|W_{on\ gas}|$ = area under P-V curve = $P\Delta V$ (constant pressure)

$U = \frac{3}{2}Nk_B T = \frac{3}{2}nRT$ (monatomic ideal gas)

$Q_h = |W_{net}| + Q_c$

$e = \frac{|W_{net}|}{Q_{added}} = 1 - \frac{Q_c}{Q_h}$

$e_{max} = 1 - \frac{T_c}{T_h}$

$\omega = \sqrt{\frac{k}{m}}$, $T = 2\pi\sqrt{\frac{m}{k}}$

$\omega = \sqrt{\frac{g}{L}}$, $T = 2\pi\sqrt{\frac{L}{g}}$

$v = \sqrt{\frac{T}{\mu}}$, $\mu = m/L$

$v = \sqrt{\frac{Y}{\rho}}$, $v = \sqrt{\frac{B}{\rho}}$

v_{air} = 343 m/s at 20° C

$\beta = 10\log\left(\frac{I}{I_0}\right)$ $I_0 = 10^{-12}$ W/m^2

$f' = f\frac{v \pm v_0}{v \pm v_S}$

$f_n = n\frac{v}{2L}$ $n = 1,2,3,...$

$f_n = n\frac{v}{4L}$ $n = 1,3,5,...$

Write your work on the exam pages if you wish. Of course also **record your final answers on the bubble sheet**. You will not get this exam booklet back.