Fall 2009 RED barcode here
Physics 105, sections 1 and 2
Final Exam
Colton 2-3669 **Please write your CID here _____**

No time limit. No notes. No books. Testing Center calculators only.

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
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): 3.33×10^5 J/kg
Latent heat of boiling (water): 2.26×10^6 J/kg
Thermal conduct. of aluminum: 238 J/s·m·°C
$v_{air} = 343$ m/s at 20° C
$\sin(30°) = 0.5$
$\cos(30°) \approx 0.866$
$\tan(30°) \approx 0.577$
$\pi \approx 3.14$

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 = $(4/3)\pi r^3$

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

$$v = v_o + at$$

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

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

$w = mg$, $PE_g = mgy$
$F = -kx$, $PE_s = ½\, kx^2$

$$f = \mu_k N \quad (\text{or } f \le \mu_s N)$$

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

$$\vec{F}\Delta t = \Delta \vec{p}$$

Elastic: $(v_1 - v_2)_{bef} = (v_2 - v_1)_{after}$
arc length: $s = r\theta$

$$v = r\omega$$

$$a_{tan} = r\alpha$$

$$a_c = v^2/r$$

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

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

$I_{hoop} = mR^2$
$I_{disk} = (1/2)\, mR^2$
$I_{rod\ (center)} = (1/12)\, mL^2$
$I_{rod\ (end)} = (1/3)\, mL^2$

$$L = r_\perp p = r p_\perp = rp\sin\theta$$

$$P = P_0 + \rho g h$$

$$VFR = A_1 v_1 = A_2 v_2$$

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

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

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

$$\text{transl. } KE_{ave} = \frac{1}{2} m v_{ave}^2 = \frac{3}{2} k_B T$$

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

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

$$P = e\sigma A T^4$$

$|W_{on\ gas}|$ = area under P-V curve
$= |P\Delta V|$ (constant pressure)
$= |nRT\ln(V_2/V_1)|$ (isothermal)
$= |\Delta U|$ (adiabatic)

$$U = \frac{3}{2} N k_B T = \frac{3}{2} nRT \quad \text{(monatomic)}$$

$$U = \frac{5}{2} N k_B T = \frac{5}{2} nRT \quad \text{(diatomic, 300K)}$$

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

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

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

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

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

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

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

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

o-o/c-c: $f_n = nf_1; \; n = 1, 2, 3, ...$
o-c: $f_n = nf_1; \; n = 1, 3, 5, ...$

Did you write down your CID at the top of the page? _____ If not, your score might not be recorded correctly.

Instructions:

- **Record your answers on the bubble sheet.**
- The Testing Center no longer allows students to see which problems they got right & wrong, so I strongly encourage you to **mark your answers in this test booklet**. You will get this test booklet back (but only if you **write your CID at the top of the first page**).
- You may write on this exam booklet, and are strongly encouraged to do so.
- In all problems, **ignore friction, air resistance, and the mass of all springs, pulleys, ropes, cables, strings** etc., unless specifically stated otherwise.
- Use $g = 9.8\ m/s^2$ only if there are "9.8" numbers in the answer choices; **otherwise use $g = 10\ m/s^2$.**