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Fall 2007 Barcode Here

Physics 105 Final Exam

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CID ____________________

NO TIME LIMIT.
CLOSED BOOK/NOTES

g=9.80 m/s^2

If $ax^2 + bx + c = 0$, $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

$v^2 = v_o^2 + 2a(x - x_o)$

$w = mg$, $PE_g = mgy$

$f = \mu N$ (or $f \le \mu N$, for static friction)

$F = -kx$, $PE_s = ½ kx^2$

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

arc length: $s = r\theta$

$v = r\omega$

$a_{tan} = r\alpha$

$a_c = v^2/r$

$F = \dfrac{GMm}{r^2}$, $PE_g = -\dfrac{GMm}{r}$

G = 6.67 × 10^{-11} N·m^2/kg^2

R_{earth} = 6.38 × 10^6 m

M_{earth} = 5.98 × 10^{24} kg

M_{sun} = 1.99 × 10^{30} kg

I_{sphere} = (2/5) MR^2

I_{hoop} = MR^2

I_{disk} = ½ MR^2

$I_{rod\ (center)}$ = (1/12) ML^2

$I_{rod\ (end)}$ = (1/3) ML^2

ρ_{water} = 1000 kg/m^3

k_B = 1.381 × 10^{-23} J/K

N_A = 6.022 × 10^{23}

$R = k_B \cdot N_A$ = 8.314 J/mol·K

R = 0.08206 liter·atm/mol·K

σ = 5.67 × 10^{-8} W/m^2·K^4

1 atm = 1.013 × 10^5 Pa = 14.7 psi

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

$T_K = T_C + 273.15$

1 cal = 4.186 J

1 m^3 = 1000 L

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

$P = P_0 + \rho gh$

$A_1 v_1 = A_2 v_2$

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

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

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

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

$\dfrac{\Delta Q}{\Delta t} = kA\dfrac{T_2 - T_1}{L}$

$P = e\sigma A T^4$

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

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

$e = \dfrac{|W_{net}|}{Q_h} = 1 - \dfrac{Q_c}{Q_h}$

$e_{max} = e_c = 1 - \dfrac{T_c}{T_h}$

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

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

$v = \sqrt{\dfrac{T}{\mu}}$, $\mu = m/L$ $\quad v = \sqrt{\dfrac{B}{\rho}}$ $\quad v = \sqrt{\dfrac{Y}{\rho}}$

v_{air} = 340 m/s, unless otherwise specified

$A_{sphere} = 4\pi r^2$

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

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

$f_n = n\dfrac{v}{2L}$ $\quad n = 1,2,3,\ldots$ $\qquad f_n = n\dfrac{v}{4L}$ $\quad n = 1,3,5,\ldots$

Keep four significant digits throughout your calculations; do not round up to less than four. When data is given, assume it has at least four significant digits. For example "15 meters" means 15.00 meters. You are **encouraged to write your work and full answers on the exam** (but record your final answers on the bubble sheet as explained above).

[?] with choices means simple multiple choice, **marked on the bubble sheet (scantron).**

Fall 2008 students: Last year we did numerical answers a different way on the bubble sheets. (Problems with numerical answers are marked with a [S].) As a result, I opted not to include answer ranges on this "practice exam", but don't worry—I will on your actual final exam. Since you're not allowed calculators, the problems on the final will either use easier numbers or no numbers at all. Also: your first page will be similar, but not identical to the first page of this exam. And I will list the problems with the problem numbers in front, and the answer choices going vertically down the page (the way I've done the last couple of midterms). --Dr Colton

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Make sure your calculator is in DEGREES, not radians.

On the surface of a pond, waves travel at a speed of 1.2 m/s. Kermit the Frog splashes the surface 7 times each second as he listens to music. The period of the water waves he makes is [1S]______ sec. The wavelength of the waves is [2S]______ m.

A 0.2 kg mass vibrates on a spring with spring constant 5 N/m. The frequency of the oscillation is [3S]_____ Hz (not rad/s).

If you shake the end of a rope up and down, the resulting wave will be [4?]____. 1) longitudinal 2) triangular 3) nodal 4) circular 5) transverse

A boy is listening to two speakers that oscillate identically. He is 10 m from the first, and 11.5 m from the second. The lowest frequency of sound that will give him an intensity minimum at this location because of interference is [5S]____ {74.7, 120} Hz . (Speed of sound is 340 m/s).

A car drives very fast at 112 m/s toward a hill and honks its horn with frequency of 480 Hz. (Speed of sound is 340 m/s). A man on the hill hears a frequency of [6S]__________ Hz.

A sound meter measures the noise intensity level of a machine to be 58 dB. The intensity arriving at the meter is [7S]_________ W/m^2. If there were *two* identical machines the same distance from the meter, the noise level would be [8S]_____ dB.

When a small part of an artery gets narrowed with plaque, the blood in this narrow portion of the artery has a blood pressure that is [9?]_____ 1) larger 2) smaller 3) the same compared to the blood pressure in the wide parts just outside it in the same artery tube.

In a toy gun, a compressed spring with spring constant 300 N/m pushes on a ball, speeding it up. If the ball has mass 0.020 kg and leaves the gun with speed 4 m/s, the spring must initially have been compressed [10S]_____ m. If the boy shoots the ball into the air with initial velocity 4 m/s, it will rise a distance of [11S]______m before it stops. It will take [12S]______ sec to come to a stop at the top.

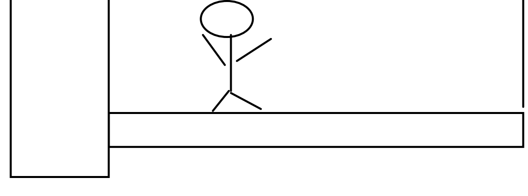
A car is slowing down while traveling in the negative-x direction. The direction of the acceleration of the car
[13?]_____ 1) is negative 2) is positive 3) is zero 4) depends on speed.

Two steamboats use ideal Carnot engines. The steam in one is hotter than the other, and the temperature of the outside air is the same for both. The efficiency of the engine will be greatest [14?]_____ 1) in the cooler engine 2) in the hotter engine 3) in neither engine.

A cyclist is traveling at 15 m/s and is 83 m from the finish line of a straight track. To complete the race in the next 5 seconds, his constant acceleration must be [15S]_____ m/s^2.

A 100 kg defensive end running north at 4 m/s tackles a 75 kg quarterback running south at 9 m/s. Their velocity right after the tackle is [16S] _______m/s to the [17] _____1) north 2) south. If instead the defensive end is running east before the tackle, their velocity right after the tackle is [18S] _______{3.15, 4.94} m/s

A man weighing 480 N stands 2 m from the left end of a plank weighing 350 N that is 6 m long. It pivots on its left end, where it is anchored to the wall. On the right it is supported by a vertical cable. The torque on the plank about the left end applied by the man's weight is [19S]____ Nm. The tension in the cable at the right end is [20S]_____ {249, 349} N.



A brass rod of radius 1.5016 cm is too big to fit in the 1.5000 cm radius hole that is drilled for it in a plate. To fit the rod in the hole, you must lower its temperature by a minimum number of degrees: [21S]____ °C. The thermal expansion coefficient of brass is 1.9×10^{-5}/°C. Assume that the plate temperature does not change.

A 2500 kg satellite orbiting the earth has an altitude of 5.00×10^{6} m above the <u>surface</u> of the earth. The potential energy of the satellite is [22S]_______J lower than if it were infinitely far from the earth.

Satellites in higher orbits have a speed that is [23?]______ 1) slower 2) faster 3) same speed compared to a satellite in lower orbit.

A bar has length 3 m and has a 2 cm × 2 cm square cross section. If one end is placed in ice at -10 C, and the other in water at 90 C, the heat flow is measured to be 500 W. The thermal conductivity of the bar material is [24S]______ J/s m °C.

A cannon is being carried by a boat in a lake. The boat displaces a volume of water that has the same weight as the [25?]________1) boat alone 2) cannon and boat 3) cannon alone. The boat tips and the cannon falls into the water. The cannon is lifted slowly from the water by a cable. The tension in the cable is [26?]____ 1) equal to the weight of the water displaced by the cannon 2) equal to the weight of the cannon 3) equal to the sum of #1 and #2 4) equal to the difference of #1 and #2.

A gas is contained in a metal cylinder of volume 1 m^3, at a pressure of 4 atmospheres at room temperature, 20 °C. The number of moles contained in the tank is [27S]_____ moles. If the gas in the cylinder is cooled and compressed at constant pressure to a volume of 0.3 m^3, the work done was [28S] ___________J.

A boy pulls horizontally a 15 kg sled with force 50 N along a horizontal path where the coefficient of friction is 0.25. The frictional force between the sled and the path is [29S]_____ N. The acceleration of the sled is [30S]_____ m/s^2. If the boy pulls with the same force at an angle of 30° above the horizontal the frictional force will be [31?]_________ 1) less 2) same 3) more

A cannonball is shot horizontally off a cliff that is 30 m high. The cannonball hits the ground 80 m from the base of the cliff. The cannonball was shot with initial speed [32S]______ {22.9, 32.6} m/s. When a cannonball shot at an angle above the horizontal is at its highest part of its arc, the acceleration of the cannonball is in the direction [33?]_______ Neglect any friction. 1) forward 2) backward 3) up 4) down 5) forward and up 6) forward and down 7) backward and up 8) backward and down

A piano of mass 300 kg is pulled at constant speed up a ramp inclined at 30° to the horizontal, by a rope parallel to the ramp. The acceleration of the piano is [34S]____ m/s^2. There is no friction. The tension in the rope is [35]______ {1420, 2000} N.

A 300 kg horse is tied to a 525 kg wagon with a rope. It pulls so the tension in the rope is 200 N, and they both accelerate. Assume no friction on the wagon. The acceleration of the wagon and the horse together is [36]______ m/s^2. The horizontal force that the horse exerts on the ground to accelerate them both is (and the ground pushes back the same) is [37S]___________ {295, 390} N.