PHYSICS DEPARTMENT

PHY 2004	Final Exam	December 15, 1997
D. Reitze, C. Stanton		
Name (print):	Signature:	

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

DIRECTIONS

- (1) Code your test number on your green answer sheet (use 76–80 for the 5-digit number). Code your name on your answer sheet. Darken circles completely (errors can occur if too light). Code your student number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout with scratch work most questions demand.
- (4) Work the questions in any order. Incorrect answers are not taken into account in any way; you may guess at answers you don't know if you feel that a correct answer is listed. Guessing on all questions will most likely result in failure.
- (5) If none of the answers is correct, please leave the answer sheet blank. It is not our intention to omit the right answer, but in case of a mistake, please leave the answer sheet blank.
- (6) Blacken the circle of your intended answer completely, using a number 2 pencil. Do not make any stray marks or the answer sheet may not read properly.
- (7) As an aid to the examiner (and yourself), in case of poorly marked answer sheets, please circle your selected answer on the examination sheet.
- (6) Good luck!!!

>>>>> WHEN YOU FINISH <

Hand in the green answer sheet separately.

Formulas

$\sigma = 5.67 \times 10^{-8} \frac{W}{(m^2 - K^4)}$	R = 8314 J/(kmol-K)				
density of water = $1000 \text{ kg/m}^3 = 1 \text{ g/cm}^3 = 62.4 \text{ lb/ft}^3$	Heat of Vaporization of Water $= 539 \text{ cal/g}$				
Heat of Fusion of Water $= 80 \text{ cal/g}$	Absolute Zero = -273° C	$g = 9.80 \text{ m/s}^2 = 32.2 \text{ ft/s}^2$			
$k(Boltzmann's constant) = 1.38 \times 10^{-23} J/K$	$1 \text{ MPa} = 10^6 \text{ Pa}$	$C_{\rm water} = 1 \text{ cal/g} - {}^{\circ}C$			
$C_{\mathrm{steam}} = 0.46 \; \mathrm{cal/g} - ^{\circ}\mathrm{C}$ $C_{\mathrm{ice}} = 0.5 \; \mathrm{cal/g} - ^{\circ}\mathrm{C}$	1 cal = 4.184 J	$1 \text{ GPa} = 1.0 \times 10^9 \text{ Pa}$			
$N_{A} = 6.02 \times 10^{26} / \mathrm{kmol} = 6.02 \times 10^{23} / \mathrm{mol}$	1 kcal = 1000 cal = 1 nutritionist's (food) Calorie				
$1 \text{ atm} = \text{Atmospheric Pressure} = 14.7 \text{ lb/in}^2 = 101 \text{ kPa} = 1.01 \times 10^5 \text{ Pa}$					

1.	A frictionless pulley	(see Figure $3)$ ha	as two masses,	$m_1 = 5 \text{ kg a}$	and mass m_2	$_2 = 1 \text{ kg},$	hanging f	rom it.	If the mass	ses are
	released from rest, w	hat is the tension	n (in N) in the	cord? (Assu	me the pull	ey is mass	sless.)			

- $(1)\ 16.3$
- (2) 3.3
- $(3)\ 10.8$
- (4) 4.7
- (5) 32.9
- 2. From atop the Century Tower (200 ft tall), you throw a ball downward with an initial velocity (downward) of 10 ft/s. How long does it take (in seconds) to reach the bottom?
 - $(1)\ 3.2$
- (2) 5.4
- (3) 7.5
- (4) 1.2
- $(5)\ 0.9$
- 3. If a pendulum has a speed of 24 cm/s as it passes through its lowest point, what angle (in degrees with respect to the vertical) was the pendulum released from? Assume friction is negligible and the length of the pendulum string is 80 cm.
 - (1) 4.9
- (2) 1.5
- (3) 3.2
- (4) 12.3
- (5) 53.2

4.	*A heavy solid cylinder is released from rest at the top of an inclined plane. When it reaches the bottom of the inclined plane, it is traveling at a (linear) speed of 2.1 m/s. How high (in m) is the inclined plane? Neglect the loss of energy due to friction. (NOTE: for a solid cylinder of mass m and radius b, the moment of inertia $I = (1/2)mb^2$.)							
	(1) 0.34	(2) 0.73	(3) 0.52	(4) 1.56	(5) 2.64			
5.	5. A volume of gas is decreased from $1500~\rm{cm^3}$ to $200~\rm{cm^3}$ under a constant pressure of 2.2 MPa. How much work (in J) was done on the gas?							
	(1) 2860 (2	2) -2860 (3) 2.86×10^9	$(4) -2.86 \times 10^9$	(5) 2.86			
6.	5. 50 g of water at 60° C is completely converted to steam after adding 42000 cal. What is the final temperature (in °C) of the steam? The heat capacity of steam is $0.46 \text{ cal/(g - °C)}$							
	(1) 667	(2) 567	(3) 767	(4) 212	(5) 1003			
7.	7. How much heat (in J) will radiate each second from a star with a surface temperature of 15000° K, a surface area of 5×10^{29} m ² , and an emissivity of 0.9?							
	$(1) 1.3 \times 10^{39}$	(2) 7.6×10^{31}	$(3) 6.8 \times 10^{37}$	(4) 1.5×10^{46}	$(5)~4.3 \times 10^{51}$			
8.	8. A piece of aluminum rod is 10 cm long and has a radius of 2 cm. If one end of the rod is held in boiling water (100°C) and the other end of the rod is held in ice water (0°C), how much heat (in cal) will flow through the rod in 10 s? The thermal conductivity of aluminum is 0.5 cal / (cm s °C).							
	(1) 628	(2) 63	(3) 100	(4) 49	(5) 366			
9.	9. * A mass is attached to a spring. If the mass undergoes simple harmonic motion with a period of 2.5 s and a TOTAL DISPLACEMENT of 15 cm, what is the maximum speed of the mass (in m/sec)?							
	(1) 0.19	(2) 0.38	(3) 1.14	(4) 0.62	(5) 2.29			
10.	0. A tube 4 m in length is open at one end and closed at the other end. What is the frequency of the first overtone? Assume the velocity of sound to be 340 m/sec.							
	(1) 64 Hz	(2) 21 Hz	(3) 141.67 Hz	(4) 113.3	(5) 56.67			
11.	. Vector A has magnitude 20 and makes an angle of 45° with respect to the x-axis. Vector B has magnitude 28 and makes an angle of 90° with respect to the x-axis. What angle does the vector $C = A - B$ make with respect to the x-axis?							
	(1) -44.4	(2) 71.5	(3) -71.5	(4) 44.4	(5) -45.6			
12.	2. The mass of Planet Y is nine times the mass of the Earth and its radius is two times the radius of earth. How many pounds will a man who weighs 160 lbs on Earth weigh on Planet Y?							

(1) 360

(2) 71

(3) 36

(4) 720

(5) 800

13.	* A Carbon atom ($m_C = 12$ atomic units) with initial velocity of 300 m/s collides head on with a stationary Ox atom ($m_O = 16$ atomic units). If the collision is perfectly elastic, then what is the velocity of the Oxygen atom after collision in m/s?							
	(1) 257	(2) 300	(3) 350	(4) 250	(5) 360			
14.	4. A 7 kg bowling ball is rolling along the floor at 10 m/s. The ball has a radius of 12 cm. What is the rotational energy (in J) of the ball? (NOTE: for a solid sphere of mass m and radius b , the moment of interia $I = \left(\frac{2}{5}\right) m \ b^2$.)							
	(1) 140	(2) 350	(3) 175	(4) 875	(5) 280			
15.	5. * A balloon vendor's tank has a volume of 0.5 m ³ and contains 5 kg of He ₂ (the molar weight of He ₂ is 8 kg/kmole). The temperature of the tank is 20°C. What is the GAUGE pressure (in atm) in the tank?							
	(1) 29.1	(2) 30.1	(3) 120	(4) 119	(5) 28.1			
16.	6. An ideal Carnot engine operates between two reservoirs which are at the temperatures 30°C and 300°C respectively. For each 150 J of heat energy taken in, how much heat (in J) is exhausted?							
	(1) 79	(2) 71	(3) 15	(4) 135	(5) 75			
17.	7. Refer to Table 1 for this question. If the RELATIVE humidity is 95% in the morning when the temperature is 20°C, then what is the RELATIVE humidity in the afternoon when the temperature is 32°C? Assume that the absolute humidity of the air does not change from the morning to the afternoon.							
	(1) 49	(2) 51	(3) 63	(4) 59	(5) 91			
18.	3. A 2.0 kg block strikes the end of a spring head and sticks as shown in figure 1. The velocity of the block before it hit the spring is 2.3 m/s and the spring constant is 5 N/m. How far in m, does the spring compress?							
	(1) 1.45	(2) 2.12	(3) 0.92	(4) 5.75	(5) 3.64			
19.	9. The acceleration due to gravity on Planet Z is: 21 m/s^2 . On Earth, a pendulum has a PERIOD of 5 s. What is the PERIOD (in s) of the same pendulum on Planet Z?							
	(1) 3.4	$(2) \ 2.3$	(3) 10.7	(4) 7.3	(5) 22.9			
20.	0. A 0.5 m string vibrates with a frequency of 1000 Hz. If the string has five nodes and four antinodes as shown in figure 2, then what is the speed (in m/s) of the waves on the string?							
	(1) 250	(2) 125	(3) 500	(4) 100	(5) 300			