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PHYSICS DEPARTMENT

PHY 2004 Exam 3 April 7, 2003

Name (print, last first): _____ 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.

(1) **Code your test number on your answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. 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) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or the answer sheet may not read properly.
(5) The answers are rounded off. Choose the closest to exact.
There is no penalty for guessing.

>>>>>>>>**WHEN YOU FINISH** <<<<<<<<
Hand in the answer sheet separately.

$\rho_{\text{water}} = 1000$ kg/m^3	$\alpha_{\text{steel}} = 12 \times 10^{-6}/°$C
$c_{\text{water}} = 4184$J/kg/°C	$N_a = 6.022 \times 10^{26}$ particles/kmol
$k = 1.3806 \times 10^{-23}$J/K	H_V(steam) = 539 cal/g
$\sigma = 5.67 \times 10^{-8}$ W/m^2/K^4	

1. A 3.0-cm radius water main in the basement has 500 kPa gauge pressure when a 1.0-cm radius pipe in the second floor 5 meters above the main breaks. How much water leaks out per minute? (in m^3 per minute)

(1) 0.57 (2) 1.25 (3) 25.6 (4) 0.06 (5) 2.8

2. It is estimated that the temperature of the sun's interios is 10×10^6K. What is the average speed of a hydrogen atom ($m = 1$kg/kmol) in a gas at this temperature (in m/s)?

(1) 5.0×10^5 (2) 60 (3) 0.20 (4) 3×10^9 (5) 7000.0

3. How many grams of hot steam at 130°C are needed to heat 1000 g of water at 50°C to 90°C? ($C_{\text{water}} = 1$ cal/g/°C, $C_{\text{steam}} = 0.46$ cal/g/°C)

(1) 71.1 (2) 36.2 (3) 326.3 (4) 0.5 (5) 13.8

4. Which of the following statements is incorrect?

(1) Net heat can flow even between two reservoirs at the same temperature.
(2) Heat flows spontaneously from a hot object to a cold one.
(3) Heat energy can be converted to mechanical energy.
(4) Absolute zero temperature T=0°K cannot be reached.
(5) If two objects are in equilibrium, they must share the same temperature.

5. The temperature of the sun's surface is 5500 K. How much heat does it radiate in a day assuming the sun is a blackbody (in J)? ($R_{\text{sun}} = 7 \times 10^8$m)

(1) 2.8×10^{31} J (2) 3.6×10^{20} (3) 560.2 (4) 4.3×10^{50} (5) 3.9×10^6

6. On a day when atmospheric pressure is exactly 100 kPa, what is the total pressure 5 m deep in a freshwater lake?

(1) 149 kPa (2) 101 kPa (3) 595 kPa (4) 52 kPa (5) 106 kPa

7. A steel measuring tape is 10.000 m long at 20°C. How much longer will it be at 30°C?

(1) 1.2 mm (2) .012 mm (3) 12.0 mm (4) 120 mm (5) 0.12 m

8. A 75-W light bulb is painted black so that it emits no light. Its total power is then released as heat. How long would the bulb take to heat 1500 g of water by 40°C if the bulb is completely submerged?

(1) 55.8 min (2) 25.0 min (3) 1.5 min (4) 4200 min (5) 0.5 min

9. If a Carnot engine has its cold reservoir at 10°C, what must be the temperature of its hot reservoir if its efficiency is to be 80 percent?

(1) 1142°C (2) 1420°C (3) 52°C (4) 1690°C (5) 325°C

10. In order to determine the thermal conductivity of a meterial, one measures the heat flow through it. It is found that 500 cal flows in 1 min through a 3-cm^2 area that is 2 mm thick. The temperature difference is maintained at 30°C. What is k for this material, in J/(m)(s)(°C)?

(1) 7.75 (2) 1.84 (3) 6.98×10^3 (4) 466 (5) 0.47