Physics 103 Exam 3, April 24th 2008

Version #1

Student: _____

Student Id Number _____ **ID Code A**

Section Number: _____

TA Name: _____

Fill in your name, student ID # (not your social security #), and section # (under ABC of special codes) on the Scantron sheet. Be sure to fill in the letter for the ID code on the upper right of this page for the first question. This determines which version of the test you took, and it is very important to get this correct. Make sure your exam has questions 2-21 and 6 total pages.

Ideal gas law: $k_B = 1.38 \times 10^{-23}$ J/K, R = 8.31 J/(mol K), R = 0.0821 (L atm)/(mol K)
Avogadro's Number: $N_A = 6.02 \times 10^{23}$ atoms/mole
Atmospheric Pressure: $P = 1.01 \times 10^5$ Pa
Freezing point of water in Kelvin: 273.15 K
density of: water 1000 kg/m^3 mercury 13600 kg/m^3

1. Please be very careful answering the first question.
ENTER THE ID CODE FOUND ABOVE IN THE UPPER RIGHT CORNER
A. ID CODE A
B. ID CODE B
C. ID CODE C

2. Water has a density of 1000 kg/m^3. The column of water that would produce a pressure of 1.0135×10^5 N/m^2 is:
A. 10.340 m.
B. 7.3300 m.
C. 15.720 m.
D. 9.8200 m.
E. 20.010 in.

3. A hydraulic lift has a small piston with a diameter 5.0 cm and the large piston with a diameter of 25 cm. What force must be applied on the small piston in order to lift a car on the large piston that weighs 13,000 N?
A. 2600 N
B. 5200 N
C. 260 N
D. 26 N
E. 520 N

4. The Young's modulus of a material, as a meaningful physical property, is applicable to which of the following?
A. only solids
B. solids, liquids and gases
C. only liquids
D. none of the other answers
E. only gases

5. A mercury manometer measures a pressure of 150 mmHg. What is this pressure in kPa?
A. 12
B. 15
C. 20
D. 24
E. 29

6. Water is flowing through a pipe with a constriction. The diameter of the narrow section is one-half the diameter of the wide section. If the velocity of the incompressible fluid is 3.20 m/s in the wide section, then what is the velocity of the fluid in the narrow section?
A. 10.5 m/s
B. 16.5 m/s
C. 19.8 m/s
D. 18.7 m/s
E. 12.8 m/s

7. A 40.0 liter gas tank is filled to the brim with gasoline when the temperature is 5.00°C. Gasoline has a coefficient of volume expansion of 950×10^{-6} / °C. If the gas tank is moved into the sun of a hot summer day, the temperature of the gas tank is increased to 60.0°C. What is the volume of gasoline that overflows the tank (ignore the expansion of the gas tank)?
A. 1.55 liters
B. 3.11 liters
C. 3.95 liters
D. 2.67 liters
E. 2.09 liters

8. A sample of water has a mass of 10.0 grams. What is the number of molecules of water in the 10.0 gram sample (H=1u, O=16u)?
A. 2.00×10^{23}
B. 4.25×10^{23}
C. 3.34×10^{23}
D. 2.56×10^{23}
E. 1.99×10^{23}

9. If the average kinetic energy of a fixed volume of ideal gas increases, what must be true?
A. The pressure increases while the temperature stays the same.
B. The temperature increases while the pressure stays the same.
C. Both the pressure and temperature increase.
D. None of the other answers
E. The density decreases.

10. A sample of an ideal gas has a volume of 0.0100 m^3, a pressure of 100×10^3 Pa and a temperature of 300 K. What is the number of moles in the sample of gas?
A. 0.401
B. 0.502
C. 0.330
D. 0.302
E. 0.375

11. What is the average kinetic energy per particle in 1.00 mole of an ideal gas at a pressure of 1.50 atmospheres and a temperature of 20°C?
A. 4.75×10^{-21} J
B. 6.65×10^{-21} J
C. 5.05×10^{-21} J
D. 6.07×10^{-21} J
E. 6.67×10^{-21} J

12. Which of the following is not included in the internal energy of a system?
A. The kinetic energy of the center of mass of the entire system
B. The rotational kinetic energy of individual particles
C. The kinetic energy of the individual particles
D. The spring potential energy of the individual particles
E. All of the other answers are included in the energy of the system

13. A 100 g glass container is at 10.0°C. 200 g of water at 90.0°C is added to the glass container. What is the final temperature of the water and the glass in °C (specific heat of water =1.00 cal/g °C, specific heat of glass =0.200 cal/gm °C)?
A. 46.9
B. 68.2
C. 82.7
D. 75.0
E. 50.2

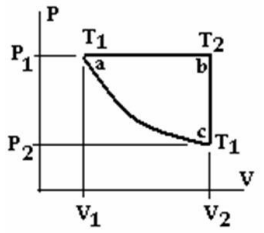
14. The latent heat of fusion to melt lead at 327.0°C is 22.9 kJ/kg and the specific heat of lead is 0.130 kJ/kg•°C. What is the energy needed to melt 100 grams of lead starting at 0°C?
A. 7.76 kJ
B. 4.23 kJ
C. 3.56 kJ
D. 7.02 kJ
E. 6.54 kJ

15. A brass rod is placed between two temperature sources so that heat can flow between them. One temperature is 80°C and the other temperature is 20°C. The length of the rod is 50.0 cm, and the cross sectional area is 15.0 cm^2. If the coefficient of thermal conduction for brass is 100 W/m °C, then what is the heat flow between the hot temperature and the cold temperature?
A. 8.2 W
B. 18 W
C. 9.4 W
D. 7.5 W
E. 12 W

16. The solar energy coming to the earth by radiation is 1,340 W/m^2 when the temperature of the Sun is 5800 K. If the temperature of the Sun decreased by 10.0%, then what would be the amount of solar radiation coming to the earth?
A. 879 W/m^2
B. 578 W/m^2
C. 752 W/m^2
D. 667 W/m^2
E. 610 W/m^2

17. If 50 kJ of heat flows into a system and 35 kJ of work is done by the system, then what is the change in internal energy?
A. 70 kJ
B. 85 kJ
C. 65 kJ
D. 15 kJ
E. 10 kJ

18. What are the units of the area under a curve on a PV diagram where pressure is in Pa and V is in m^3?
A. Watts
B. $Meter^2$
C. Joules
D. Time
E. Calories



19. See diagram above. One mole of an ideal gas undergoes an isobaric process from point a to point b in the figure. $P_1 = 3.00$ atms, $P_2 = 1.00$ atm, $V_1 = 7.00$ liters, and $V_2 = 21.0$ liters. What is the heat gained by the system along the path from point a to b?
A. 5,640 J
B. 10600 J
C. 4,260 J
D. 6,380 J
E. 3,750 J

20. See diagram above. One mole of an ideal gas undergoes an isothermal process from point c to point a in the figure. $P_1 = 3.00$ atms, $P_2 = 1.00$ atm, $V_1 = 7.00$ liters, and $V_2 = 21.0$ liters. What is the change in the internal energy of the gas from point c to point a?
A. 0 J
B. +5,780 J
C. -5,780 J
D. -2,340 J
E. +2,340 J

21. An engine goes through a cyclic process. During the cyclic process the engine does 600 J of work and has a heat output of 2400 J. What is the efficiency of the engine?
A. 62%
B. 20%
C. 10%
D. 55%
E. 35%