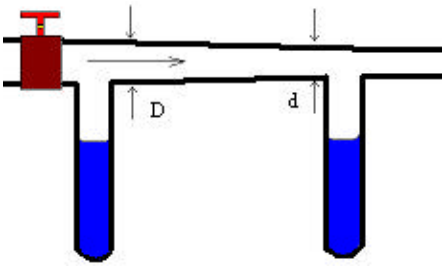
1. An ideal gas initially at pressure p_o undergoes a free expansion until its volume is 3.0 times its initial volume. What then is its pressure?

   A. $3.0\ p_o$
   B. $(p_o)^3$
   C. p_o
   D. $(p_o)^{1/3}$
   E. $p_o/3.0$

2. Does the temperature of an ideal gas increase, decrease or stay the same during (a) an isothermal expansion (b) an expansion at constant pressure (c) an adiabatic expansion (d) an increase in pressure at constant volume?

   A. stays same, decreases, decreases, increases
   B. stays same, increases, decreases, increases
   C. decreases, increases, increases, decreases
   D. increases, stays same, decreases, stays same
   E. stays same, stays same, increases, stays same

3. A sealed pipe of varying diameter (d < D) is connected over two identical test-tubes containing air above identical amounts of colored water. When air passes through the pipe, what can you say about the water levels in these tubes?

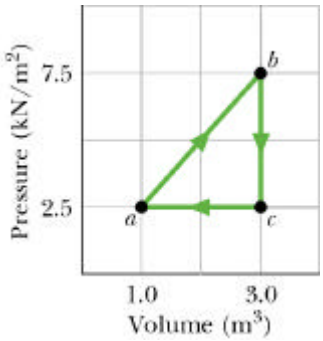


   A. The level is marginally lower where the tube is narrower because the air is moving more slowly there, so its pressure is higher.
   B. The level is marginally higher where the tube is narrower because the air is moving more slowly there, so its pressure is lower.
   C. The level is marginally higher where the tube is narrower because the air is moving more quickly there, so its pressure is lower.
   D. The level is marginally lower where the tube is narrower because the air is moving more quickly there, so its pressure is lower.
   E. The level is the same in both tubes because water seeks it own level.

4. Approximately how much net energy do you radiate away if it takes you 1 minute to hunt for clothes to wear after getting out of the shower? Assume the emissivity of your skin is 0.85 and make reasonable assumptions about the other parameters you need to make the calculation.

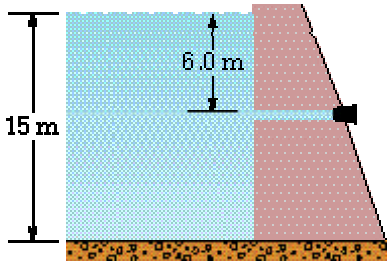
A. 2.5 J
B. 9,000 J
C. 150 J
D. 1,500 J
E. 3,000 J

5. A sample of ideal gas is taken through the cyclic process *abca* as shown in the figure. At point a, the temperature is T = 200K. What is the temperature at point *b*?



A. 203K
B. 1800K
C. 205K
D. 200K
E. cannot be determined from information given

6. Fresh water of density $\rho = 1000$ kg/m^3 is behind a reservoir dam that is 15 m deep. A horizontal pipe 4.0 cm in diameter passes through the dam 6.0 m below the water surface, as shown in the figure. After a plug securing the pipe opening is removed, how much water flows out in 3 hours?



A. 39 m^3
B. 49 m^3
C. 588 m^3
D. 147 m^3
E. 233 m^3

7. A steel rod is 3.000 cm in diameter at 25°C. A brass ring has an interior diameter of 2.992 cm at the same temperature. At what common temperature will the ring just slide onto the rod? For steel, $\alpha = 11 \times 10^{-6}$/°C. For brass, $\alpha = 19 \times 10^{-6}$/°C.

A. 357.0 °C
B. 335.0 °C
C. 25.008 °C
D. 332.0 °C
E. 360.0 °C

8. An air bubble of 10 cm^3 volume is at the bottom of a lake 20 m deep where the temperature is 4°C. The bubble rises to the surface, which is at a temperature of 20°C. Take the temperature of the bubble's air to be the same as that of the surrounding water, and assume no water molecules enter the air. Just as the bubble reaches the surface, what is its approximate volume? (You may treat the air in the bubble as an ideal gas.)

A. 148 cm^3
B. 21 cm^3
C. 104 cm^3
D. 5 cm^3
E. 31 cm^3

9. Calculate the change in entropy of a 1 kg block of ice that melts into water at 0° C. The latent heat of fusion of ice = 3.33×10^5 J/Kg.

A. 3.33×10^2 J/K
B. -3.33×10^3 J/K
C. -1.22×10^3 J/K
D. 1.22×10^3 J/K
E. 3.33×10^3 J/K

10. A thermally insulated box contains two compartments separated by a wall. One compartment contains a gas. The other contains a vacuum. The wall suddenly breaks and the gas expands to occupy the entire box. Which of the following statements is true?

A. The temperature of the gas decreases.
B. The entropy of the gas increases.
C. The gas absorbs heat during the expansion.
D. The gas does work during the expansion.
E. The internal energy of the gas increases.

11. A block of wood weighs 160 N and has a density that equals 0.60 that of seawater. To sink it in seawater requires an additional downward force of:

A. 107 N
B. 240 N
C. 54 N
D. 96 N
E. We need to know the density of seawater to answer this.

12. An aluminum cup of 100 cm^3 is filled with glycerin at 23°C. How much glycerin, if any, will spill out of the cup if the temperatures of the cup and glycerin are increased to 27°C? For glycerin, $\beta = 5 \times 10^{-4}$/°C; for aluminum, $\alpha = 23 \times 10^{-6}$/°C.

A. none will spill
B. $0.59 cm^3$ spills
C. $0.17 cm^3$ spills
D. $0.23 cm^3$ spills
E. $0.76 cm^3$ spills

13. A mixture of three nonreacting gases is held in a container. There are n_1 moles of gas one, n_2 moles of gas two, and n_3 moles of gas three in the container. The gases have constant-volume molar specific heats of C_1, C_2, and C_3, respectively. The effective constant-volume molar specific heat of the three-gas mixture is given by:

A. $(C_1 + C_2 + C_3)/3$
B. $(n_1C_1 + n_2C_2 + n_3C_3)/(n_1 + n_2 + n_3)$
C. $C_1 + C_2 + C_3$
D. $(n_1 + n_2 + n_3)/(n_1C_1 + n_2C_2 + n_3C_3)$
E. $(n_1 + n_2 + n_3)(C_1 + C_2 + C_3)/3$

14. Increasing values of the specific heat at constant volume, C_V, for small densities of gases are measured, with C_V(monatomic) < C_V(diatomic) < C_V(polyatomic). This is explained by:

A. the increasing molecular mass as one progresses from monatomic to diatomic to polyatomic gases.
B. the increasing numbers of degrees of freedom available as one progresses from monatomic to diatomic to polyatomic gases.
C. conservation of momentum
D. the extra rotational degree of freedom in monatomic gases.
E. the decreasing chemical stability as one progresses from monatomic to diatomic to polyatomic gases.

15. The ratio of the fundamental frequency of a 7.5 cm long pipe open at both ends to the fundamental frequency of a 15 cm long pipe open only at one end is:

A. 0.25
B. 2.0
C. 4.0
D. 1.0
E. 0.5

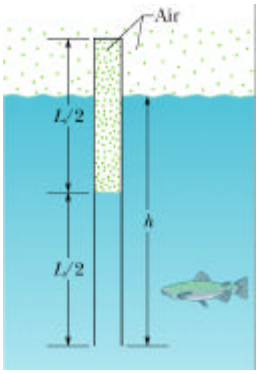
16. Helium gas, which is a byproduct of radioactive decays, escapes from the Earth:

A. due to the size of the low velocity tail of its distribution function.
B. due to the high ejection velocity from the radioactive nucleus.
C. due to the size of the high velocity tail of its distribution function.
D. helium cannot escape the Earth.
E. due to the narrowness of its velocity distribution function.

17. An isothermal free expansion of an ideal gas occurs for a gas having initial values of the variables p and V. The expansion ends at volume 2 V. Which of the following statements is true?

A. The internal energy decreases.
B. The entropy decreases.
C. The entropy does not change.
D. The pressure remains constant.
E. No work is done.

18. A pipe of length L = 25.0 m that is open at one end contains air at atmospheric pressure. It is thrust vertically into a freshwater lake until the water rises halfway up into the pipe, as shown in the figure. What is the depth "h" of the lower end of the pipe? Assume constant temperature everywhere.



A. 10.4 m
B. 22.8 m
C. 25.0 m
D. 50.0 m
E. 47.8 m

19. A train at rest has a whistle that blows a note at 500 Hz. If the train is moving away from a stationary observer at a speed of 50 m/s, what is the frequency heard by the observer? Assume that the speed of sound in air is 340 m/s.

A. 444 Hz
B. 576 Hz
C. 436 Hz
D. 400 Hz
E. 589 Hz

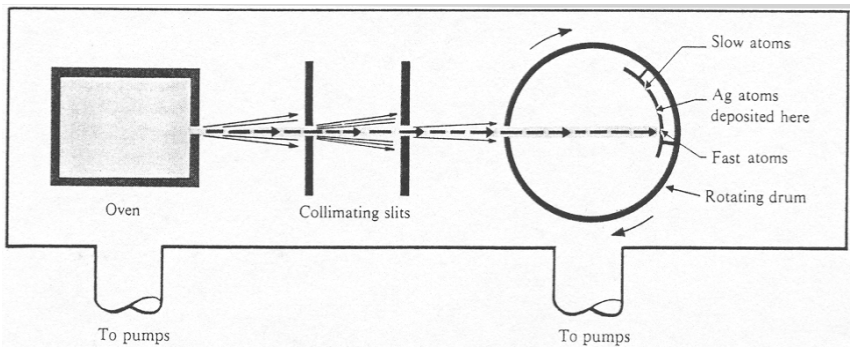
20. A tub of water is placed in a garage to keep the garage from getting too cold when the weather forecast calls for subfreezing temperatures. The tub contains 125kg of water, initially at 20°C. How long must a standard 1.5 kW heater run to put as much heat into the garage as the water would transfer if it froze completely at 0°C in that same length of time?

A. 9629 hours
B. 5.8 hours
C. 7.7 hours
D. 9.6 hours
E. 1.9 hours

21. A cook observes that the oil and vinegar mixture in some salad dressing separates into a layer of vinegar (density 1,100 kg/m^3) below a layer of oil (density 700 kg/m^3). An herb particle is observed to find its equilibrium position at the interface, half within each liquid. What is the density of this herb particle?

A. 500 kg/m^3
B. 1,100 kg/m^3
C. 700 kg/m^3
D. 900 kg/m^3
E. none of the above

22. One way to measure the Maxwell molecular velocity distribution is with the molecular apparatus shown in the figure. The actual measurement involves:



A. accelerating ionized molecules through the collimating slits and then measuring their velocities.
B. correlating the variations in thickness of the deposition layer with the molecular velocities after the rotating drum has rotated many times .
C. rotating the collimating slits to select out small velocity ranges.
D. measuring the velocity of each atom as it enters the drum with a time-of-flight apparatus.
E. correlating the variations in thickness of the deposition layer with the molecular velocities after holding the rotating drum in one of several fixed positions .

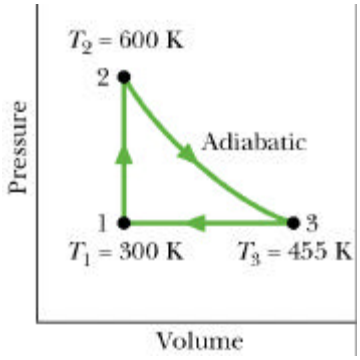
23. When you are 4.10 m from a point sound source, the sound level is 60.0 dB. How far away from the same source must you be for the sound level to be 50.0 dB?

A. 1.29 m
B. 6.76 m
C. 13.0 m
D. 41.0 m
E. 410 m

24. An engineer invents a new heat engine that operates between two reservoirs at T = 600 K and T = 300 K. What is the best efficiency that her new engine could achieve?

A. 100%
B. 75%
C. 25%
D. 10%
E. 50%

25. One mole of a monatomic ideal gas traverses the cycle shown in the figure. Compute the approximate change in internal energy on the adiabat 2 → 3.



A. 0 J
B. 1.8 x 10^3 J
C. -3.0 x 10^3 J
D. -1.8 x 10^3 J
E. 3.0 x 10^3 J

Answer Key for Test "P213FinalFa03.tst", 10/20/2003

No. in Q-Bank		No. on Test	Correct Answer
20	39	1	E
20	31	2	B
15	5	3	C
19	27	4	B
20	30	5	B
15	28	6	D
19	25	7	E
20	35	8	E
21	11	9	D
21	12	10	B
15	22	11	A
19	24	12	C
20	36	13	B
20	34	14	B
17	9	15	C
20	33	16	C
21	2	17	E
20	29	18	B
18	18	19	C
19	23	20	D
15	6	21	D
20	32	22	B
18	13	23	C
21	14	24	E
20	37	25	D