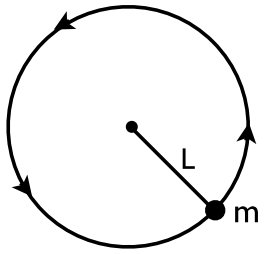
Solutions
Physics 116 - Second In-Class Practice Exam
Profs. Schnetzer and Kloet

1. A ball of mass m, at one end of a string of length L moves in a vertical circle just fast enough to prevent the string from going slack at the top of the circle. The speed of the ball at the bottom of the circle is:



a) $\sqrt{2gL}$
b) $\sqrt{3gL}$
c) $\sqrt{4gL}$
d) $\sqrt{5gL}$
e) $\sqrt{7gL}$

2. Each of the four corners of a square with edge a is occupied by a point mass m. There is a fifth mass, also m, at the center of the square. The work that must be done to remove the mass from the center to a point very far away is:

a) $4Gm^2/a$
b) $-4Gm^2/a$
c) $4\sqrt{2}Gm^2/a$
d) $-4\sqrt{2}Gm^2/a$
e) $4Gm^2/a^2$

3. Solid A with mass m is at its melting point T_A. It is placed in thermal contact with solid B also with mass m. Solid B is initially at temperature T_B ($T_B > T_A$). The combination is thermally isolated. A has latent heat of fusion L and when it is melted has specific heat capacity c_A. Solid B specific heat capacity c_B. If A completely melts, the final temperature of both A and B is:

   a) $(c_A T_A + c_B T_B - L)/(c_A + c_B)$
   b) $(c_A T_A - c_B T_B + L)/(c_A + c_B)$
   c) $(c_A T_A - c_B T_B - L)/(c_A + c_B)$
   d) $(c_A T_A + c_B T_B + L)/(c_A + c_B)$
   e) $(c_A T_A + c_B T_B + L)/(c_A - c_B)$

4. A 2 m^3 weather ballon is filled with helium at $P = 1$ atm and $T = 27^o$ C. At an elevation of 20,000 ft., the pressure is down by a factor of 2 and the temperature is down to $T = -48^o$ C. What is the volume of the balloon at this elevation?

   a) 3 m^3
   b) 4 m^3
   c) 2 m^3
   d) 2.5 m^3
   e) 5.3 m^3

5. An air bubble doubles in volume as it rises from the bottom of a lake to the top. Assuming that the lake is at uniform temperature, the depth of the lake is:

   a) 21 m
   b) 0.76 m
   c) 4.9 m
   d) 10 m
   e) 0.99 m

6. Two ideal monatomic gases are in thermal equilibrium with each other. Gas A is composed of molecules with mass m while gas B is composed of molecules with mass $4m$. The ratio of the root mean square velocity of gas A to the root mean square velocity of gas B is:

   a) 1/4
   b) 1/2
   c) 1
   d) 2
   e) 4

7. For constant-volume processes the heat capacity of gas A is greater than the heat capacity of gas B,. We conclude that when they absorb the same energy as heat at constant volume:

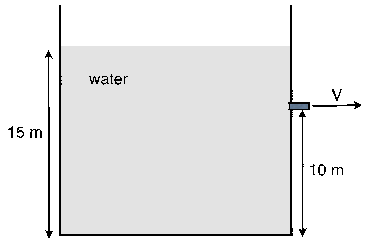
   a) the temperature of A increases more than the temperature of B
   b) the temperature of B increases more than the temperature of A
   c) the internal energy of A increases more than the internal energy of B
   d) the internal energy of B increases more than the internal energy of A
   e) A does more positive work than B

8. A balloon is released from a tall building. The total mass of the balloon including the enclosed gas is 2 kg. Its volume is 5.0 m^3. The density of air is 1.3 kg/m^3. Will the balloon rise, fall or remain stationary and why?

   a) The balloon will fall because its density is greater than that of air
   b) The balloon will remain stationary because its density is less than that of air
   c) The balloon will rise because the upward buoyant force is greater than the weight
   d) The balloon will fall because the upward buoyant force is less than its weight
   e) The question cannot be answered because the density of the gas inside the balloon is not given

9. A large tank is filled with water to a depth of 15 m. A spout located 10.0 m above the bottom of the tank is then opened as shown in the drawing. With what speed will water emerge from the spout?

a) 3.1 m/s
b) 9.9 m/s
c) 14 m/s
d) 17 m/s
e) 31 m/s

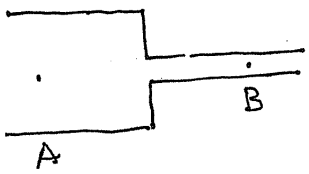


10. Alyssa went to her outside faucet to fill a 0.032 m^3 bucket with water to wash her car. Water exits with a speed of 0.64 m/s. The radius of the faucet is 0.0075 m. How long does it take to fill the bucket completely? (Assume that the water is non-viscous.)

a) 9.0 s
b) 17.0 s
c) 190 s
d) 280 s
e) 890 s

11. The density of the liquid flowing through the horizontal pipe in the drawing is 1500 kg/m^3. The speed of the fluid at point A is 5.5 m/s while at point B it is 8.0 m/s. What is the difference in pressure, $(P_B - P_A)$, between points B and A?

a) $+3.8 \times 10^3 Pa$
b) $-1.9 \times 10^3 Pa$
c) $+5.0 \times 10^4 Pa$
d) $-2.5 \times 10^4 Pa$
e) $-7.6 \times 10^5 Pa$



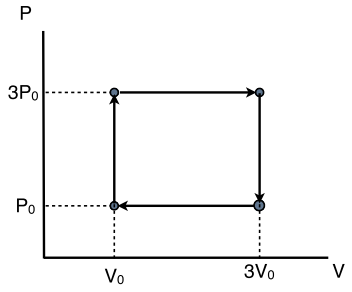
12. The pressure of an ideal gas is doubled during a process in which the energy lost as heat by the gas equals the work done on the gas. As a result, the volume is:

a) doubled
b) halved
c) unchanged
d) more information is needed to answer
e) the process is impossible

13. A monatomic ideal gas has molar specific heat C_p at constant pressure. When the temperature of n moles of the gas is increased by ΔT the increase in the internal energy of the gas is:

a) $nC_p\Delta T$
b) $n(C_p + R)\Delta T$
c) $n(C_p - R)\Delta T$
d) $n(2C_p + R)\Delta T$
e) $n(2C_p - R)\Delta T$

14. An ideal gas is taken through the cycle shown in the figure. What is the net amount of heat that flows into the gas in each cycle?



a) $8P_0V_0$
b) $-8P_0V_0$
c) $4P_0V_0$
d) $-4P_0V_0$
e) zero

15. An inventor claims to have a heat engine that has an efficiency of 40% when it operates between a high temperature reservoir of 150^o C and a low temperature reservoir of 30^o C. This engine:

a) violates more than one of the laws of thermodynamics
b) violates only the first law of thermodynamics
c) violates only the second law of thermodynamics
d) violates only the third law of thermodynamics
e) does not violate any of the laws of thermodynamics