Chapter 10
Fluids and Kinetic Theory

10.1 Density — Homework # 75

Density of Substances

Substance	Density (ρ) (kg/m^3)	Substance	Density (ρ) (kg/m^3)
Solids		*Liquids*	
Aluminum	2.70×10^3	Water	1.00×10^3
Copper	8.92×10^3	Blood, plasma	1.03×10^3
Concrete	2.3×10^3	Blood, whole	1.05×10^3
Iron and Steel	7.85×10^3	Ethyl Alcohol	0.79×10^3
Gold	19.32×10^3	Gasoline	0.68×10^3
Ice	0.917×10^3	Mercury	13.6×10^3
Lead	11.30×10^3	Sea Water	1.025×10^3
Platinum	21.45×10^3	Vegetable Oil	0.93×10^3
Silver	10.49×10^3		
Tin	7.31×10^3	*Gases*	
Uranium	18.74×10^3	Air	1.29
Zinc	7.14×10^3	Carbon Dioxide	1.98
		Helium	0.179
		Steam (100°C)	0.598

I

01. What is the approximate mass of air in a classroom that is 12.50 m x 4.00 m x 5.10 m?

02. A wooden totem pole made of red cedar (SG = 0.380) has an approximate volume of 12.5 m^3. What is its approximate mass?

03. A penny made in the United States in 1938 has a mass of 3.10 g and a diameter of 1.90 cm. What is the thickness of the penny?

II

04. A bottle has a mass of 46.75 g when empty and a mass of 104.32 g when filled to the brim with water. The water is emptied and the bottle is filled with an unknown fluid giving the bottle a fluid-filled mass of 92.23 g.
a.) What is the specific gravity (SG) of this fluid? b.) What might this fluid be?

05. If 6.00 L of antifreeze (SG = 0.80) are added to 5.00 L of water, what is the SG of this 11.0-L mixture?

III

06. How much fresh water must be added to 12.5 L of sea water to produce a mixture with a SG of 1.018?

ANSWERS: **01.** 329 kg **02.** 4750 kg **03.** 1.23 mm **04.** a.) 0.79 b.) ethyl alcohol **05.** 0.89
06. 4.86 L (results anywhere from 4.22 L to 5.6 L depend on rounding techniques)

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Fluids and Kinetic Theory
10.2 Pressure and Pascal's Principle — Homework # 76

I

01. The arm of a record player exerts a force on a record. This force is equivalent to a 1.00 g mass sitting directly on the stylus. If the stylus has a diameter of 0.0013 cm, calculate the pressure on the record grove in _____.
    a.) Pa b.) atm

02. A healthy value for diastolic blood pressure is 80.0 mm Hg. What would be the reading if measured in _____. a.) Pa b.) atm c.) torr

03. A physics teacher stands 1.88 m tall. What is the difference in blood pressure between the top of his head and the bottom of his feet when he is standing upright?

04. A lab desk has dimensions of 1.629 m in length by 0.610 m in width with a mass of 38.6 kg.
    a.) What is the total force acting on the top of the table from the atmosphere on an average day?
    b.) Assuming the desk is not bolted to the floor, what is the total force need to lift this desk?
    c.) Why is the answer to b.) less than a.)?

II

05. A cylindrical swimming pool with a diameter of 5.486 m is filled to a height of 1.220 m.
    a.) What is the total pressure at the bottom?
    b.) What is the total force on the bottom?
    c.) What is the total pressure on the side of the pool at the bottom?
    d.) What is the total pressure on the side of the pool at the top?
    e.) Estimate the total force on the side of the pool? (SA_{cylinder} is $2\pi rh$) Hint: Use average pressure to get total force.

06. Each of the four tires of a 1450-kg car have a gauge pressure of 221 kPa (32.0 lb/in^2). How much area of each tire is in contact with the ground?

07. A rectangular-shaped bulkhead that is 72.0 m wide by 12.0 m high has water up to the top edge of the bulkhead.
    a.) What is the total force on the bulkhead if it is located in a fresh-water river?
    b.) What is the total force on the bulkhead if it is located in a seaport?

08. The maximum gauge pressure in a hydraulic lift used in a auto-repair shop is 16.0 atm. If the output line has a diameter of 20.0 cm, what is the largest mass that it can lift?

09. How high would the level be in an ethyl alcohol barometer at normal atmospheric pressure?

10. Determine the minimum gauge pressure need in the water pipe leading into a building if it is to feed a faucet on the twelfth floor 30.0 m above.

III

11. A very long tube with a radius of 0.300 cm is placed in a tightly-fitting hole in the top of wine barrel with a radius of 20.0 cm and filled to the lid with water. If water is filled in the tube to a height of 12.0 m the barrel bursts.
    a.) What is the mass of the water column in the tube? b.) What is the net force on the lid of the barrel?

ANSWERS: **01.** a.) 7.38×10^7 Pa b.) 731 atm **02.** a.) 10.6 kPa b.) 0.105 atm c.) 80.0 torr **03.** 19.3 kPa **04.** a.) 100,363 N b.) 378 N c.) Same pressure on bottom **05.** a.) 113 kPa b.) 2.67×10^6 N c.) 113 kPa **05.** d.) 101 kPa e.) 2.25×10^6 N **06.** 0.0110 m^2 **07.** a.) 1.38×10^8 N b.) 1.39×10^8 N **08.** 5180 kg **09.** 13.0 m **10.** 2.94×10^5 Pa **11.** a.) 0.339 kg b.) 1.48×10^4 N

Chapter 10
Fluids and Kinetic Theory
10.3 Buoyancy and Archimedes' Principle — Homework # 77

Refer to the table of "Density of Substances" on Homework #75 in this chapter.

I

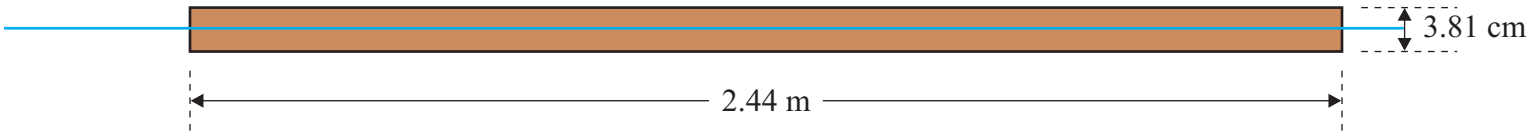
01. A geologist finds a rock sample that has magnetic properties. He suspects that this sample is magnetite iron ore which has a density of 5046 kg/m^3. He determines the mass of the rock to be 3.28 kg while its apparent mass is 2.63 kg when placed in water. What is the density of this rock? (Is it magnetite iron ore?)

02. What fraction of a piece of lead will be submerged when it floats in mercury?

II

03. A hydrometer is 32.0 cm in length and has a cross sectional area of 2.75 cm^2 and has a mass of 79.2 g.
    a.) How far from the end should this hydrometer have a marking 1.00 (the level to which it would sink in water)?
    b.) This hydrometer is placed in a sample of beer taken from a fermenting vat and sinks to a level of 29.2 cm. What is the density of the beer?

Problem 04



Side View

04. A 8 foot piece of 2" x 4" (actual dimensions are 1½" x 3½") lumber has metric dimensions of 2.44 m x 3.81 cm x 8.89 cm. When this 2-by-4 floats in water it naturally orients itself so that its center of mass is at its lowest possible level which is accomplished by having its biggest dimensions (2.44 m x 8.89 cm) floating parallel to the surface of the water. If 1.79 cm of the remaining dimension is above water, what is the density of the lumber?

05. An 86.20-kg man has an effective mass of 3.99 kg when standing in sea water up to his neck. The SG of the human body is approximately 1.00.
    a.) What is the mass of the portion of the body submerged?
    b.) What percentage of this man's total body weight is in his head?
    c.) Is this typical for a human male? See Homework #48 in "Chapter 6-Linear Momentum" for the table of "Center of Mass of Parts of Typical Male Human Body."

06. An animal is placed in a vat of water to determine its density. Ethyl alcohol is slowly added until the animal is freely suspended. This occurs when there is 15.5 percent alcohol by volume and 84.5 percent water. What is the density of the animal?

07. A 0.925-kg piece of African mohagony floats in water but has an apparent mass of 0.039 kg when placed in ethyl alcohol. What is the SG of this piece of African mahogony?

08. What fraction of an iceberg is above the level of the sea water in which it is floating?

ANSWERS: **01.** 5046 kg/m^3 (yes) **02.** 0.831 **03.** a.) 28.8 cm b.) 986 kg/m^3 **04.** 530 kg/m^3
05. a.) 80.2 kg b.) 6.95 % c.) yes **06.** 967 kg/m^3 **07.** 0.825 **08.** 0.105

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Fluids and Kinetic Theory
10.4 Fluids in Motion: Flow Rate and Bernoulli's Principle — Homework # 78

Refer to the table of "Density of Substances" on Homework #75 in this chapter.

I

01. A flexible air duct (with a circular cross section) with a diameter of 30.48 cm is used to refresh the air every 8.00 minutes in a room with dimensions of 8.45 m x 4.68 m x 2.92 m. How fast does the air flow through the duct?

02. If wind blows at 24.5 m/s over the roof of a house, what is the **NET** force on the roof if it has an area of 335 m^2?

II

03. A firehouse is supposed to spray water to a height of 21.34 m (70.0 feet). What gauge pressure is necessary in the water mains to accomplish this?

04. What is the volume rate of flow of water from a 1.95-cm-diameter faucet if the pressure head is 9.15 m (30.0 feet)? Note: A pressure head is the highest point that a fluid can travel (because of the limiting force of gravity) either through a conduit (such as a pipe) or in the air (ignoring air resistance) based on the pressure of the fluid in the conduit at ground level. Pressure head is an industry term used to describe the capabilities of a pump.

05. What is the lift (force) due to Bernoulli's principle on a wing with an area of 75.0 m^2 if air passes over the top and bottom surfaces of the wing at speeds of 340 m/s and 305 m/s, respectively?

06. Water at a gauge pressure of 3.65 atm at street level enters an office building at a speed of 0.650 m/s through a pipe with a diameter of 5.08 cm and proceeds up to the top floor 27.5 m above via a pipe that tapers down to 2.54 cm in diameter as it reaches the top floor. Ignoring viscosity, what is the _____ in the pipe on the top floor?
a.) flow velocity b.) gauge pressure

07. A garden hose is used as a siphon to empty an above-ground swimming pool that is filled to a height of 1.22 m (4.00 feet). At what speed will water leave the end of the hose that is sitting on the ground beside the pool?

08. If air flows through an intake venturi tube past the gas bowl of a carbeurator at 20.0 m/s. Assume a normal day
a.) Calculate the pressure difference between the intake tube and the gas bowl.
b.) How high can gasoline be pushed up a tube from the gas bowl as a result of this carbeurator system?

09. Show that the power needed to drive a fluid through a horizontal pipe is equal to the volume rate of flow, Q, times the pressure difference, $P_1 - P_2$.

III

10. A venturi tube is a pipe with a narrow constriction (called the throat) at one end. A venturi meter is used to measure the flow speed of fluids by inserting two pressure gauges in the venturi tube, one in the main (wide) area of the tube and the other in the throat.

a.) Show that the flow velocity measured by the venturi meter is given by the relation $v_1 = A_2\sqrt{\dfrac{2(P_1 - P_2)}{\rho(A_1^2 - A_2^2)}}$.

b.) A venturi meter with a main diameter is 3.00 cm and a throat diameter is 1.00 cm measures a pressure difference of 18.0 mm Hg when water flows through it. What is the velocity of water in the main area of the meter?

ANSWERS: **01.** 3.30 m/s **02.** 1.30 x 10^5 N **03.** 2.09 x 10^5 Pa **04.** 4.00 x 10^{-3} m^3/s **05.** 1.09 x 10^6 N
06. a.) 2.60 m/s b.) 0.950 atm **07.** 4.89 m/s **08.** a.) 258 Pa b.) 3.87 cm **10.** b.) 0.245 m/s

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10.5 Thermal Expansion — Homework # 79

Coefficients of Thermal Expansion at 20°C

Material	Coefficient of Linear Expansion, α $[(C°)^{-1}]$	Coefficient of Volume Expansion, β $[(C°)^{-1}]$
Solids		
Aluminum	25 x 10^{-6}	75 x 10^{-6}
Brass	19 x 10^{-6}	56 x 10^{-6}
Concrete/Brick	≈12 x 10^{-6}	≈36 x 10^{-6}
Iron and Steel	12 x 10^{-6}	35 x 10^{-6}
Lead	29 x 10^{-6}	87 x 10^{-6}
Glass (Pyrex)	3 x 10^{-6}	9 x 10^{-6}
Glass (ordinary)	9 x 10^{-6}	27 x 10^{-6}
Quartz	0.4 x 10^{-6}	1 x 10^{-6}
Liquids		
Ethyl Alcohol		1100 x 10^{-6}
Gasoline		950 x 10^{-6}
Glycerin		500 x 10^{-6}
Mercury		180 x 10^{-6}
Water		210 x 10^{-6}
Gases		
Air (and most other gases at atmospheric pressure)		3400 x 10^{-6}

I

01. A concrete highway is built of slabs 15.0 m long. How wide should the expansion cracks between the slabs be to prevent buckling if the range of temperatures to which the highway may be exposed is -30.0°C to +50.0°C?

II

02. To make a secure fit, rivets that are larger than the rivet hole are often used by cooling the rivet (usually in dry ice) before it is placed in the hole. A steel rivet 2.385 cm in diameter is to be placed in a hole 2.382 cm in diameter. To what temperature must the rivet be cooled if it is to fit in the hole (at 20.0°C)?

03. If the density of mercury is 13,570 kg/m^3 at 20.0°C, what will be its density at 85.0°C?

04. An ordinary glass is filled to the brim with 275.0 mL of water at 25.0°C. Approximately how much water will spill out if the temperature is increased by 40.0°C?

05. What will be the ΔV for an iron sphere with a diameter of 28.6 cm at 25.0°C if it is heated to 200.0°C?

III

06. Show that for an isotropic solid $\beta = 3\alpha$. Hint: Show that the volume change for a rectangular solid of dimensions l_o x w_o x h_o is given by $\Delta V = 3\alpha \cdot l_o w_o h_o \cdot \Delta T$ not $\Delta V = \alpha^3 \cdot l_o w_o h_o \cdot \Delta T$.

ANSWERS: **01.** 1.44 cm **02.** -84.8°C **03.** 13,410 kg/m^3 **04.** 2.31 mL **05.** 7.50 x 10^{-5} m^3 (75.0 cm^3)

Chapter 10
Fluids and Kinetic Theory
10.6 The Gas Laws (Boyle's, Charles', Gay-Lussac's, Ideal) Homework # 80

Refer to the table of "Density of Substances" on Homework #75 in this chapter and Periodic Table in Documents.

I

01. A beaker of water contains 2.500 L of water.
    a.) How many moles of water are present? b.) How many molecules of water are present?

02. When 12.5 m^3 of an ideal gas initially at STP is placed under a pressure of 3.75 atm the temperature of the gas rises to 28.6°C. What is its volume under these conditions?

03. What is the number of molecules/m^3 of any ideal gas at STP?

II

04. Using the ideal gas law, calculate the density of nitrogen at STP.

05. What is the pressure inside a 26.5-L container holding 62.3 g of Neon gas at 25.0°C?

06. What is the volume of storage tank if the gauge pressure of 83.3 kg of argon is measured to be 3.68 atm at 25.0°C?

07. What is the temperature of a sample of sulfur dioxide having a mass of 0.0108 kg and a gauge pressure reading of 0.550 atm in a steel container with a volume of 2485 mL?

08. A storage tank contains 28.4 kg of chlorine gas at an absolute pressure of 2.85 atm. What will be the pressure in the tank if the chlorine is replaced by an equal mass of carbon dioxide gas at a constant temperature?

09. A tank contains 24.3 kg of fluorine gas at a gauge pressure of 5.25 atm. What mass of helium gas would be required to replace the fluorine at the same temperature and produce a gauge pressure of 6.45 atm?

10. There is 12.45 mol of oxygen gas contained in a balloon at 34.6°C. The balloon is in an air-tight room in which the gauge pressure is adjusted to 0.400 atm.
    a.) What is the volume of the gas?
    b.) If the volume of the gas is cut in half while the gauge pressure is adjusted to 1.55 atm, what is the temperature?

11. A flexible-walled container filled with 27.5 L of oxygen gas at 20.0°C has an absolute pressure of 1.64 atm. What will the pressure of the gas be if it is compressed to 17.6 L and heated until its temperature reaches 56.2°C?

12. A cubic box with a volume of 8.40×10^{-3} m^3 is filled with air at atmospheric pressure and a temperature of 25.0°C. The box is sealed and heated to 185.0°C. What is the **NET** force on **EACH** side of the box?

III

13. A tire is filled with air at 20.0°C to a gauge pressure of 175 kPa. From heat produced by friction between the road surface and the tire during driving the temperature of the air in the tire is raised to 42.5°C. What fraction of the original air must be removed if the original gauge pressure of the tire (175 kPa) is to be restored?

14. An air bubble at the bottom of a lake 21.7 m deep has a volume of 1.46 cm^3. If the temperature of the water at the bottom is 7.25°C and at the top is 17.08°C, what is the volume of the bubble as it reaches the surface?

ANSWERS: **01.** a.) 138.9 moles b.) 8.36×10^{25} molecules **02.** 3.68 m^3 **03.** 2.69×10^{25} molecules/m^3
04. 1.25 kg/m^3 **05.** 289 kPa (2.85 atm) **06.** 10.9 m^3 **07.** 278 K (5°C) **08.** 4.60 atm **09.** 3.05 kg
10. a.) 0.225 m^3 b.) 280 K (7°C) **11.** 2.88 atm **12.** 2250 N **13.** 0.0713 **14.** 4.68 cm^3

Chapter 10
Fluids and Kinetic Theory

10.7 Kinetic Theory — Homework # 81

Refer to the Periodic Table in Documents.

I

01. Calculate the rms speed of helium atoms near the surface of the sun at a temperature of about 6000 K.

02. A tank contains 3.75 L of nitrogen molecules at STP.
    a.) What is the average kinetic energy of these nitrogen molecules?
    b.) What is the total translational kinetic energy of these molecules?

03. A collection of twelve molecules have the following speeds given in arbitrary units at a certain moment in time: 3, 5, 2, 0, 8, 3, 10, 4, 2, 1, 7, and 3.
    a.) What is the most probable speed?
    b.) Calculate mean speed of the group.
    c.) Calculate the rms speed of the group.
    d.) Construct a graph of the relative number of molecules vs. speed for this collection and label the locations of the most probable speed, the mean speed, and the rms speed.

04. A gas in a container is at 25.0 °C.
    a.) To what temperature must it be raised to double the v_{rms} of its molecules?
    b.) what would happen to the v_{rms} if the absolute temperature were to double?

II

05. If the pressure of a gas were doubled while its volume held constant, by what factor would the rms speed change?

06. One storage tanks contains helium gas at STP. A second identical storage tank contains carbon dioxide at STP.
    a.) What is the average kinetic energy of the helium gas?
    b.) What is the average kinetic energy of the carbon dioxide gas?
    c.) What is the v_{rms} of the helium gas?
    d.) What is the v_{rms} of the carbon dioxide gas?

07. Algebraically demonstrate that for a mixture of two gases at the same temperature, the ratio of the rms speeds of the molecules is equal to the square root of the inverse ratio of their molecular masses.

08. Consider a container of a nitrogen at 0 °C.
    a.) Calculate the v_{rms} of a nitrogen molecule in this container.
    b.) Assuming essentially no collisions with other molecules, determine the maximum number of times per second a nitrogen molecule would traverse back and forth across an 8.21-m long room.

09. Show that the Pressure P of a gas can be written as $P = \frac{1}{3}\rho v^2$, where ρ is the density of the gas and v is the rms speed of the molecules.

ANSWERS: **01.** 6114 m/s **02.** a.) 5.65×10^{-21} J b.) 568 J **03.** a.) 3 b.) 4 c.) 4.92
04. a.) 919 °C (1192 K) b.) increase by $\sqrt{2}$ **05.** $\sqrt{2}$
06. a.) 5.65×10^{-21} J b.) 5.65×10^{-21} J c.) 1304 m/s d.) 393 m/s **08.** a.) 493 m/s b.) 30 x each way

Chapter 10
Fluids and Kinetic Theory
10.8 Real Gases and Phase Diagrams — Homework # 82

Diagram 1
Phase Diagram for Water (H_2O)
[Note: Scales are not linear]

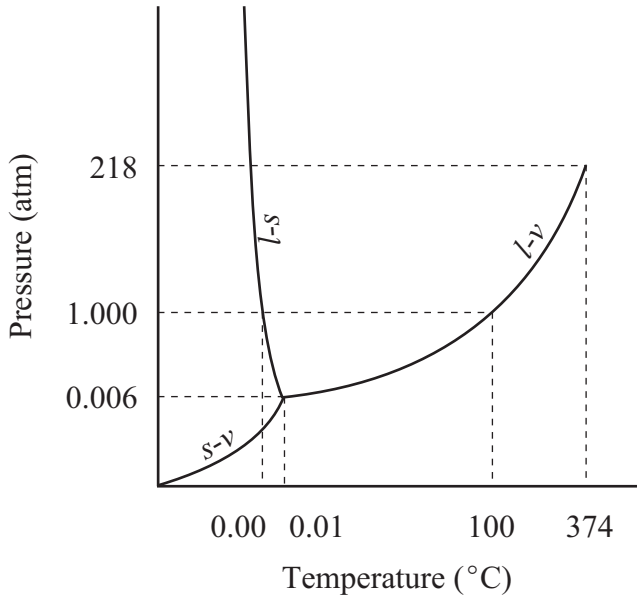
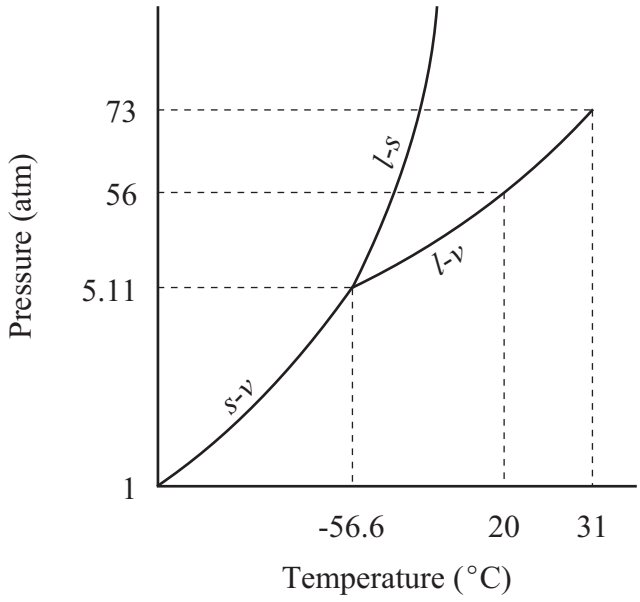


Diagram 2
Phase Diagram for Carbon Dioxide (CO_2)
[Note: Scales are not linear]



I

01. At normal atmospheric pressure, what phases can CO_2 exist?

02. For what range of temperatures can CO_2 be a liquid?

03. For what range of pressures can CO_2 be a liquid?

04. Which line represents the freezing point as a function of pressure in the CO_2 phase diagram?

05. Which line represents the boiling point as a function of pressure in the CO_2 phase diagram?

06. Which line represents the sublimation point as a function of pressure in the CO_2 phase diagram?

07. What is the triple point of CO_2?

08. What is the critical temperature of CO_2?

09. What is the critical pressure of CO_2?

10. What is the normal boiling point of H_2O?

11. What is the normal freezing point of H_2O?

ANSWERS: **01.** solid, vapor **02.** -56.6°C to 31°C **03.** 5.11 atm to 73 atm **04.** *l-s* **05.** *l-v* **06.** *s-v*
07. -56.6°C, 5.11 atm **08.** 31°C **09.** 73 atm **10.** 100°C **11.** 0.0°C

Chapter 10
Fluids and Kinetic Theory
10.9 Vapor Pressure and Humidity — Homework # 83

Saturated Vapor Pressure of Water

Temperature (◦C)	Saturated Vapor Pressure torr	Pa
-50	0.030	4.0
-10	1.95	2.60 x 10^2
0	4.58	6.11 x 10^2
5	6.54	8.72 x 10^2
10	9.21	1.23 x 10^3
15	12.8	1.71 x 10^3
20	17.5	2.33 x 10^3
25	23.8	3.17 x 10^3
30	31.8	4.24 x 10^3
40	55.3	7.37 x 10^3
50	92.5	1.23 x 10^4
60	149	1.99 x 10^4
70	234	3.12 x 10^4
80	355	4.73 x 10^4
90	526	7.01 x 10^4
100	760	1.01 x 10^5
120	1489	1.99 x 10^5
150	3570	4.76 x 10^5

I

01. What is the partial pressure of water in the air on a day when the temperature is 25.0 °C and the relative humidity is 85.0%

02. Approximately what is the dew point on a day with 60.0% humidity and a temperature of 25.0 °C?

03. At what approximate temperature does water boil at one location in the Andes where the air pressure is 0.692 atm?

04. What is the air pressure at a place in the Rockies where water boils at 80.0 °C?

II

05. A pressure cooker is half-filled with water before the lid is locked into place trapping some air above the water on a 25.0 °C day. The pressure cooker is placed on a stove and heated until the water begins to boil. Assuming no escape of air, what is the approximate pressure inside the pressure cooker if the water is boiling at 120 °C?

06. If the humidity of a 520 m^3 room at 25.0 °C is 80.0%, what mass of water must be removed by an air conditioner to reduce the humidity to 50.0%?

07. If the relative humidity in a room with dimensions 4.65 m x 7.28 m x 9.45 m is 70.0% on a 20.0 °C day, what mass of water can still evaporate from an open pan of water? Assume no loss of water out of this room.

ANSWERS: **01.** 2.69 x 10^3 Pa (20.2 torr) **02.** 17 °C **03.** 90 °C **04.** 4.73 x 10^4 Pa (355 torr)
05. 1.99 x 10^5 Pa (1489 torr) **06.** 3.59 kg **07.** 1.65 kg

Chapter 10
Fluids and Kinetic Theory
Fluids and Kinetic Theory Review — Homework # 84

Refer to the table of "Density of Substances" on Homework #75 and "Saturated Vapor Pressure of Water" on Homework #83 in this chapter and the Periodic Table in Documents.

II

01. A **CUBICLE** storage tank located outside a gas supply establishment in the open air (protected from human tampering by a chain link fence enclosure) contains 78.3 kg of carbon dioxide with a gauge pressure of 4.79 atm.
    a.) What mass of sulfur dioxide would be needed to replace the carbon dioxide so as to increase the gauge pressure to 7.43 atm?
    b.) Assuming the storage tank has a volume of 7.53×10^6 cm^3, what is the net force on each side of the container?
    c.) What is the v_{rms} of a carbon dioxide molecule in that tank if the temperature is 25.0 °C?
    d.) What is the total translational kinetic energy of the carbon dioxide sample in the tank (Assume 25.0 °C)?

02. A 32.70-kg object has an effective mass of 29.02 kg when placed in water.
    a.) What is the specific gravity of this object?
    b.) Of what material is the object made?

03. Each tire on an 18-wheel, 14,000-kg tractor trailer truck is inflated to a gauge pressure of 300 kPa. How much area of each tire is in contact with the ground?

04. What is the relative humidity on a 30.0 °C day if the dew point is 20.0 °C?

05. If 34.3 L of ammonia gas at a temperature of 23.6 °C and a gauge pressure of 4.37 atm is heated until the gauge pressure reads 7.48 atm while the volume is allowed to increase to 42.7 L, what is the new temperature of this gas?

06. Water at a gauge pressure of 2.45 atm at street level enters a school at a speed of 0.775 m/s through a pipe with a diameter of 3.81 cm and proceeds up to the top floor 15.7 m above via a pipe that tapers down to 2.54 cm in diameter as it reaches the top floor. Ignoring viscosity, what is the _____ in the pipe on the top floor?
    a.) flow velocity b.) gauge pressure

ANSWERS: **01.** a.) 166.1 kg b.) 1.86×10^6 N c.) 411 m/s d.) 6614 kJ (6.614×10^6 J)
02. a.) 8.9 b.) copper **03.** 0.019 m^2 (190 cm^2) **04.** 55.0% **05.** 310.0 °C (583 K)
06. a.) 1.74 m/s b.) 0.915 atm