Conceptual Physics Review (Chapters 18, 20, and 21)

Chapter 18 (Sections 1 & 2)

- Define mass density.
- Define weight density.
- Explain why density is the same for different amounts of the same material.
- Define specific gravity, and explain why it has no units.

Chapter 20 (Sections 1, 2, 3, 5, & 6)

- Explain why molecules in Earth's atmosphere neither escape nor settle to the ground.
- Describe the source of atmospheric pressure.
- Explain how a liquid gets sucked up through a straw.
- Describe the relationship between pressure and density for a given amount of a gas at a constant temperature.
- Describe the relationship between pressure and volume for a given amount of gas at a constant temperature. (Boyle's Law)
- Describe the relationship between temperature and volume for a given amount of gas at a constant pressure. (Charles's Law)
- Explain what determines whether an object will sink or float in air.
- Describe the fundamental differences between gases, liquids, and solids in terms of spacing between atoms or molecules of the substance, density of the substance, and compressibility.

Chapter 21 (Sections 1-7 & 9)

- Define temperature in terms of kinetic energy.
- Describe the common temperature scales.
- Define heat.
- Define thermal equilibrium.
- Distinguish between internal energy and heat.
- Describe how the quantity of heat that enters or leaves a substance is measured.
- Compare the specific heat capacities of different substances.
- Describe how water's high specific heat capacity affects climate.
- Describe the behavior of water as it is heated from 0°C to 15°C.

Homeworks, Worksheets, & Labs

Review all worksheets regarding the metric system, unit conversions, density, gases, heat, temperature, and specific heat capacity.
Review the Great Balloon Lab, which covers density and Charles's Law.
Review ALL homework problems you have been assigned from the textbook.

Sample Calculations

For problems 1-10, refer to Table 18.1 on p. 261 of your textbook as necessary. For each problem, either show you work with a calculation or explain conceptually.

1. Which has greater density – one kilogram of ice or one kilogram of water (at 4°C)?

2. Which has greater volume – one kilogram of lead or one kilogram of platinum?

3. Which has greater mass – one cubic meter of iron or one cubic meter of gold?

4. Which has greater density – one kilogram of lead or two kilograms of lead?

5. Which has greater density – a single uranium atom or Earth?

6. Which has greater volume – 10 kg of lead or 5 kg of aluminum?

7. What is the specific gravity of gold?

8. What is the specific gravity of copper?

9. What is the mass of 5.4 m^3 of aluminum?

10. What is the volume of 6.72 kg of platinum?

11. What is the ***weight*** of a cubic meter of cork? The density of cork is 400 kg/m^3. (Be sure to answer with weight rather than mass!)

12. Find the density of a 5-kg solid cylinder that is 10 cm tall with a radius of 3 cm.

13. The planet Saturn has a mass of 5.69×10^{26} kg and a volume of 8.01×10^{23} m^3.

a) What is the density of Saturn?

b) Would Saturn float or sink if you could place it in a gigantic bathtub filled with water? Explain your answer with a complete sentence. Think about the balloon lab and how the relative densities of materials determine whether one will float or sink in the other.

14. You are handed a 5.00×10^{-3}-kg coin and told that it is gold. You discover (by using water displacement) that the coin has a volume of 5.90×10^{-7} m^3. Is the coin really gold, or simply a good imitation? Look up the density of gold on the table in your book to help you answer the question. Show your work!

15. When we compress a certain quantity of air so that its volume is cut in half, and the temperature is held constant, what happens to the pressure that the air exerts on the walls of its container? What law did you use to answer this question? What happens to the density of the air?

16. Explain what forces are acting on liquid that you drink through a straw. Draw a picture and use force vectors to indicate what is pushing or pulling on the liquid.

17. Consider the balloon lab. Assume your hot air balloon had a volume of 342 Liters when the air was at a temperature of 80°C. What volume would the same amount of air occupy at room temperature, 20°C? Remember what units the temperatures need to be in to use Charles's Law!!

For Problems 18-22, keep in mind that the specific heat capacity of water is 1 calorie/g°C, or 4.184 J/g°C. Think about your units!!!!

18. In 1985, 2-year-old Michael Trode, whose mass is 10.0 kg, was found in the snow near his Milwaukee home with a body temperature of 16.0°C. Normal human body temperature is 37.0°C. The specific heat capacity of the human body is 3470 J/kg°C. How much heat did Michael's body lose?

19. Gwyn's bowl is filled with 0.175 kg of 60.0°C soup (same specific heat capacity as water). She drops a spoon into the bowl. The specific heat capacity of the spoon is 240.0 J/kg°C. What final temperature will the spoon and soup reach if the spoon is initially at 20.0°C and has a mass of 40.0 grams? Be careful with your units!!!!

20. How much 5°C water must be added to 90 grams of 80°C water in order for the final temperature to be 20°C? Give your answer in grams *and* Liters.

21. Which loses more energy: 10 grams of water cooling from 90°C to 30°C or 100 grams of iron cooling from 80°C to 20°C? Show your calculations or explain your answer conceptually. You may have to look up the specific heat capacity of iron (it's in your book, in one of the problems at the end of Chapter 21).

22. I pour 50.0 mL of water at 50.0°C into a bowl containing 100.0 mL of water, and the final temperature of the mixture is 38.0°C. What was the initial temperature of the 100.0 mL of water, assuming that no heat is lost to the bowl or the atmosphere?