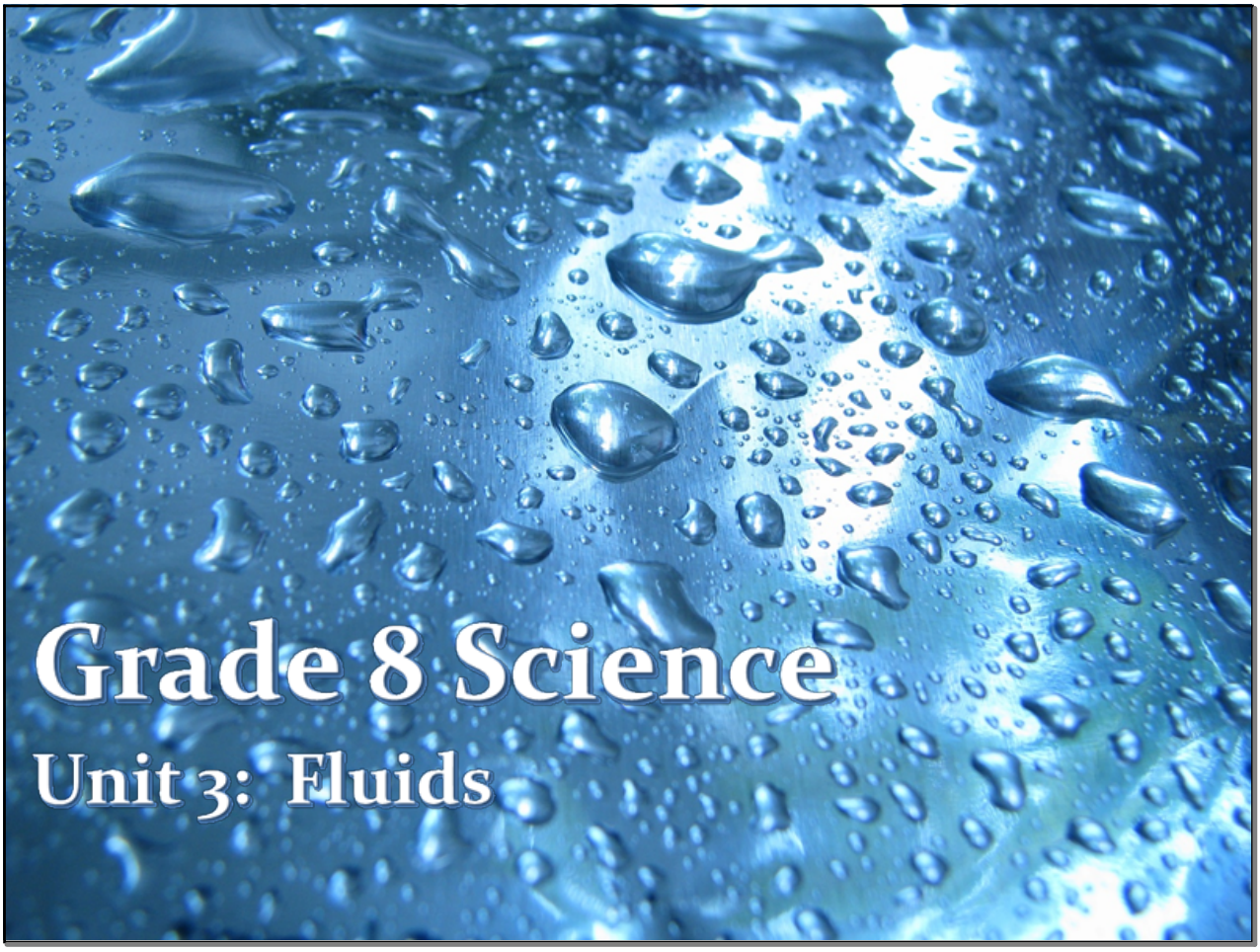


Fluids End of Unit Review

Today we will take up the practise test that you were given last week. Pay close attention as we go through each question. If you do not understand an answer, ask a question, or put a star beside it so you can ask me prior to the test. The test you will write next week covers the same topics, however it is not the same. If you understand everything on this review, you should be fine for the test.

I expect that you:

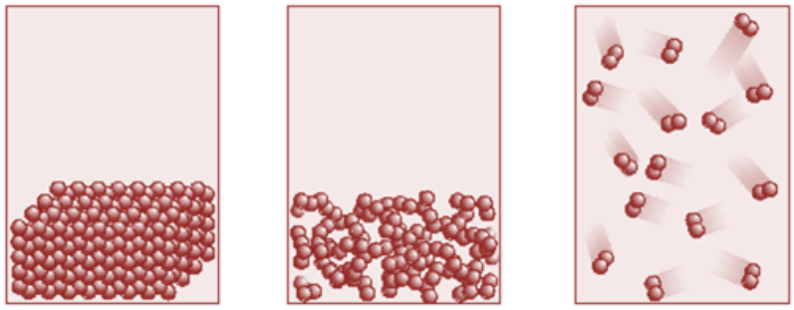
- pay attention while we take it up
- make necessary corrections on your review
- come prepared to write the test next week

Before I begin, please take out your review, a red pen, and any other supplies you feel you may need to mark your test.

If you are not complete, please take a clipboard and go sit in the hall. You can work on it there as we discuss the answers.

1. What are the three main states of matter? Provide dot jot information to differentiate the three and draw a quick sketch to show some of the differences.

   1. Solid — particles very close together, cannot move past one another
   2. Liquid — particles somewhat close together, move around
   3. Gas — particles far apart, move around at rapid speed



2. Write out the three postulates from the particle theory of matter that most affect the concepts we have discussed this unit. Underline one key word from each.

   1. All particles have space between them.
   2. All particles are always moving, the more heat (energy) the faster they move.
   3. All particles are attracted to one another.

3. Explain in your own words what viscosity is. In your explanation, name two fluids, one that has high viscosity and one that has low viscosity.

   Viscosity is how runny a substance is (thick or thin). It determines a fluid's ability to flow. Corn syrup is a very viscous fluid; it takes a long time to pour. Water is not very viscous at all, it pours quickly. Gases have very low viscosity.

4. Name an industry in which viscosity is important. Provide two specific examples (from that industry), and explain how viscosity is important to them.

   Viscosity is important in the food industry. Sauces are monitored for viscosity closely. Something like ketchup needs to be viscous enough that it stays where it is put (on a hotdog for example), but it cannot be too high in viscosity or it will be difficult to get out of the bottle. Salad dressing is another example. The viscosity has to be such that it will spread around a salad, and not clump up. This means the viscosity would have to be lower than something like ketchup.

5. How does temperature affect the viscosity of a gas? Of a liquid?

The effect of temperature on viscosity is opposite for liquids and gases. For a liquid, an increase in temperature will cause a decrease in viscosity. The liquid particles are relatively close together, so by heating them the spacing is increased, reducing the internal friction (the rubbing of particles). For a gas, the particles are already very far apart, so they do not have a lot of internal friction. By increasing the temperature the movement speed of the particles is increased, which results in the particles making contact more. This increases the internal friction, thus increasing the viscosity.

Liquid → Increased Temperature = Decreased Viscosity
Gas → Increased Temperature = Increased Viscosity

6. Explain in your own words what density is. In your explanation, name two fluids, one that has high density and one that has low density.

Density is how much matter is packed into a particular space. It is the mass divided by the volume taken up by that mass. Something that has high density feels heavier than something with low density. For example, if I take the same quantity of mercury (a metal that is liquid at room temperature) and water, the mercury will be much heavier. Gases have very low density when compared to liquids.

7. Explain the relationship between density and the states of matter.

Density is related to the number of particles in a particular volume. Solids have particles that are very close together, and therefore have a density that is high. On the other end, gases have particles that are very far apart, and thus have few particles in a particular volume, thus they have a very low density. Liquid is in the middle.

Water is an exception to this. When water freezes the shape of the molecules cause it to expand slightly, meaning the solid density is actually less than the liquid density. This is why ice floats.

8. Write a procedure for how you would determine the density of an unknown object.

In order to determine density you need to know both mass and volume. There are three scenarios that need to be discussed:

For a Geometric Shape:

1. Use a scale to determine the mass of the object.
2. Use a linear measuring tool to determine the dimensions of the object.
3. Calculate the volume of the object using the appropriate formula (for example, if your object is a rectangular prism, use *lwh*).
4. Divide the measured mass by the calculated volume to determine the density of the object.

8. Write a procedure for how you would determine the density of an unknown object.

For a Non-Geometric Shape

1. Use a scale to determine the mass of the object
2. Fill a container, large enough to hold the object, with water.
3. Place the container somewhere where any spilled water can be collected.
4. Place your object in the water.
5. Determine the volume of water that overflows from the container.
6. Divide the measured mass by the volume of overflowed water to determine the density of the object.

For a Fluid:

1. Use a scale to determine the mass of the fluid.
2. Use a volumetric measuring tool to determine the volume of the fluid.
3. Divide the measured mass by the measured volume to determine the density of the fluid.

9. What is Archimedes' principle? Explain how it rationalizes the ability of a boat to float.

Archimedes' principle states that the upward buoyant force of a fluid is equal to the weight of the fluid displaced. This means that when you place an object in a fluid, it will sink until the point that the volume of the object under the fluid is such that the weight of the fluid would have the same weight as the whole object that is floating. To determine if something will float you can determine the average density (the mass of the object divided by the overall volume, not just the volume of the materials used to make it.) If the average density is less than the fluid, it will float.

The way this explains a boat floating is because when a boat is placed in water you look at the average density of the boat. A boat encloses a lot of air, which increases the overall volume that the boat takes up, but does not increase the mass. When the boat is placed in water, the shape of it allows it to displace enough water to equal the overall weight without having to be fully submerged.

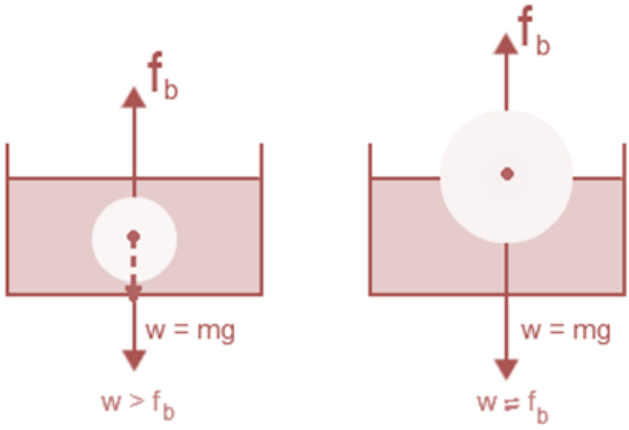
10. With the use of force balance diagrams, explain why an object floats and why an object sinks.

Let's say we take two objects that are the same mass, but of different volumes:

The smaller object will have a higher density than the larger object. The larger object has the capability to displace more fluid than the smaller object.

When the large object is placed in the fluid it will start to sink. The buoyant force is equal to how much fluid it pushes out of the way. The object will continue to sink until the buoyant force is equal to the gravitational force (weight of the object). At that point the object has balanced forces and will float.

The same will happen in the smaller object, however if it is too small, it will not be able to displace enough water to balance the weight of the object. This means that the fluid cannot create enough buoyancy, so the forces cannot be balanced, and the object will move down (sink).

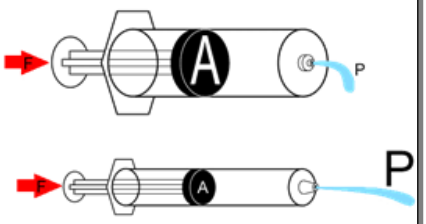


11. In dot-jots, explain why a straw and a ball of Play-Doh can function as a hydrometer.

- A hydrometer is used to measure fluid density (specific gravity – a comparison of the weights of fluids)
- It works by floating in a fluid
- A scale is placed on it, and the depth to which it sinks determines the density
- It relies on buoyant forces – gravity will pull the hydrometer down until the buoyancy equals the weight of the hydrometer
- A hydrometer can be made by placing a ball of Play-Doh on the end of a straw
- The Play-Doh provides weight to pull down the straw (which is filled with air)
- The fluid provides the buoyant force to push it back up
- The Play-Doh's placement also provides stability, forcing the straw to stand upright in the fluid
- The straw can have a scale drawn on it, from which one can read the density

12. In the diagram provided, the water is coming out differently with the same force. Explain why.

This is a pressure related problem. Pressure is the amount of force per unit area. A force applied to a small area creates a larger pressure than the same force applied to a large area. In the image, the bottom syringe has approximately half the area of the top syringe, but the same force acting. This means that there is approximately double the pressure in the bottom syringe. This causes the water to shoot out harder.



13. What is Pascal's Law? Explain how this relates to hydraulics and pneumatics.

Pascal's Law states that the pressure in an enclosed fluid is uniform throughout. Hydraulics and pneumatics refer to systems that use pressure in fluids to perform a task. Because fluid pressure is constant in an enclosed system, it can be used to transmit or amplify a force. For example, you can put a force on one end of a hydraulic system, and using different size pistons, you can make that force larger at the other end of the system.

14. Compare the compressibility of liquids and gases. Be sure to reference the particle theory.

Gases are much more compressible than liquids. The particle theory of matter states that there is space between all particles. As indicated earlier in this review, gas particles are spread much further apart. As a result, it is easier to move gas particles closer together. Compressibility is the ability to squeeze something into a smaller volume. In a gas this can be accomplished because of the particle spacing. In a liquid the particles are relatively close together, and as a result liquids are almost incompressible.

15. Your circulatory system is hydraulic. Explain.

Circulatory system refers to the movement of blood within the body. Blood is a liquid. The movement of blood around the body is controlled by the heart and a series of valves. The heart is basically a pump; it uses the muscles surrounding it to squeeze chambers that force the blood out of the heart and into the body. By squeezing the chambers of the heart, it is applying a force to the fluid. This force puts the blood under pressure. That pressure is used to move all of the blood forward through the system. When the heart relaxes, the valves in the body stop the blood from moving backwards. The circulatory system is a hydraulic system because it involves a liquid under pressure.

16. Explain the relationship between pressure and temperature and pressure and volume.

Pressure vs Temperature - The particle theory of matter tells us that when the temperature of an object is increased, the particles then move faster. This does two things; one, it causes the particles to move further away from one another and two, it causes the particles to bump into one another more often. Both of these results contribute to an increase in pressure. When a fluid is heated, the particles try to move away from one another, meaning the fluid tries to expand; this would mean that the particles are pushing on the walls of the container more. When the particles are moving faster, not only do they hit each other more, but they also hit the walls of the container more. Each time a particle hits the walls of the container it creates a small force, more small forces means more overall force per area, meaning increased pressure.
Increased Temperature = Increased Pressure

Pressure vs Volume - The particle theory of matter tells us that there is space between all particles. At any given temperature, this space is constant. If the volume of a container enclosing a fluid is reduced, that means that the spacing between particles is also reduced. Being that there is no change in temperature, the particles are then no longer in their natural state, and will try to get back to it. This means that they are trying to expand. As the fluid tries to expand, the particles will push on the walls of the container. Each time a particle hits the walls of the container it creates a small force, more small forces means more overall force per area, meaning increased pressure.
Decreased Volume = Increased Pressure

17. Name three examples of environmental impacts from fluid related technology.

1. Hydraulic systems often use oils as their liquid. These oils are under high pressure, and the forces they apply can cause failure in the system. If a part fails it can lead to a leak of the hydraulic fluid, which is often very bad for the environment.
2. Humans have harnessed the power of hydraulic and pneumatic systems to make many jobs easier and more efficient. Construction equipment is one of the things that take advantage of this. By having more efficient construction equipment, it is much easier to take down trees and replace the natural environment with man-made structures.
3. The understanding of fluid properties allows us to understand that oil floats on water. This knowledge has been used in many areas to extract oil from deep underground. Water, which is at a higher density, is pumped into oil reservoirs, which forces the oil to rise. This makes it easier to extract oils from underground, which makes them more readily available to be used (burned), which in turn is creating more pollution.

Fluids End of Unit Review

If you did not get some of these answers, I will be posting this file online once all classes have taken up the review.

Your test will begin one week today. You will be given three periods to write the test. HOWEVER, **I will be marking page one of the test after the first day**. Be sure you know your fluids vocabulary, as it will be required for question 1.

When you show up for the test, please be sure you have limited belongings with you, that you walk in quietly and arrive in class quickly.

I will be in during my regularly scheduled breaks, as well as some mornings before school. Start studying early, and come see me if you need assistance or clarification.

Please use any remaining time to study with a partner.

Please bring your review with you next period.