MCAS Questions: Chemical Interactions

Reporting Category: Physical Sciences
Standard: 3 - Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (e.g., rulers, graduated cylinders, balances) and knowledge and appropriate use of significant digits.
Standard: 4 - Explain and give examples of how mass is conserved in a closed system.
Standard: 5 - Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.
Standard: 6 - Differentiate between an atom (the smallest unit of an element that maintains the characteristics of that element) and a molecule (the smallest unit of a compound that maintains the characteristics of that compound).
Standard: 7 - Give basic examples of elements and compounds.
Standard: 8 - Differentiate between mixtures and pure substances.
Standard: 9 - Recognize that a substance (element or compound) has a melting point and a boiling point, both of which are independent of the amount of the sample.
Standard: 10 - Differentiate between physical changes and chemical changes.
Standard: 14 - Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.
Standard: 15 - Explain the effect of heat on particle motion through a description of what happens to particles during a change in phase.
Standard: 16 - Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.

1. (2013) Which of the following tools would give the most precise measurement of 15 milliliters of water?

   A. a 50 mL beaker

   B. a 50 mL graduated cylinder

   C. a 500 mL beaker

   D. a 500 mL graduated cylinder

2. (2013) Which of the following do water (H_2O), rust (Fe_2O_3), and salt (NaCl) have in common?

   A. Water, rust, and salt are atoms.

   B. Water, rust, and salt are mixtures.

   C. Water, rust, and salt are elements.

   D. Water, rust, and salt are compounds.

3. (2013) When a person's sweat evaporates, the person feels cooler. Which of the following statements **best** describes why sweating helps the person feel cool?

   A. Heat is absorbed by sweat when it evaporates.

   B. Heat is absorbed by the body when sweat evaporates.

C. The temperature of the water in sweat goes down when it evaporates.

D. The temperature of the water in the body goes up when sweat evaporates.

4. (2013) Oxygen and iron combine chemically to form rust. Rust is classified as which of the following?

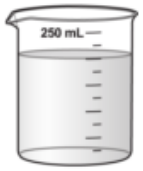
A. an atom

B. a compound

C. an element

D. a mixture

5. (2012) The picture below shows a beaker containing a clear liquid with a temperature of 20°C.



A blue powder is added to the liquid. Which of the following pictures provides the best evidence that the change to the liquid is physical, not chemical?

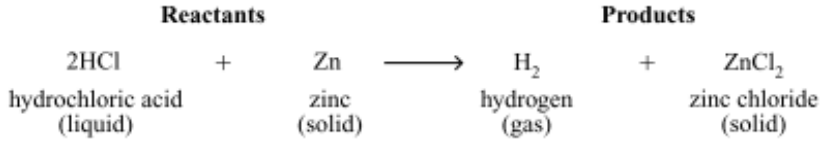
A.

B.

C.

D.

6. (2011) In the chemical reaction shown below, all of the HCl and Zn will react to form H_2 and $ZnCl_2$.



Which of the following statements describes the result of this reaction?

A. The hydrogen gas will have a mass of zero.

B. The zinc chloride will have less mass than the zinc.

C. The mass of the products will equal the mass of the reactants.

D. The mass of the hydrogen atoms will decrease in the products.

7. (2011) Which of the following is produced when two or more elements combine in a chemical reaction?

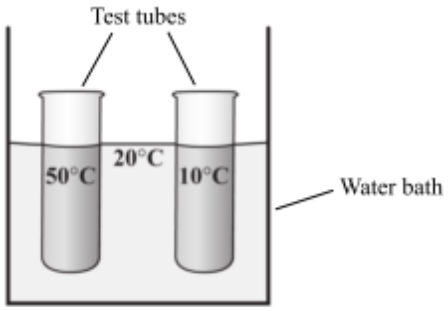
A. atom

B. compound

C. mixture

D. solution

8. (2011) A teacher put one test tube of 50°C liquid and one test tube of 10°C liquid into a 20°C water bath, as shown in the diagram below.



Which of the following diagrams **best** represents the directions that heat will move when the test tubes are placed into the water bath?

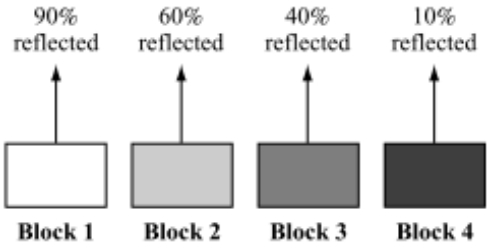
A.

B.

C.

D.

9. (2010) Four different-colored blocks are placed outside in bright sunlight. The blocks are identical except for color. The diagram below shows the amount of light reflected from each block.



Which block will increase in temperature **most** rapidly?

A. block 1

B. block 2

C. block 3

D. block 4

10. (2010) What is the smallest unit of a chemical compound that still has the properties of that compound?

A. a nucleus

B. a molecule

C. an element

D. an atom

11. (2009) Which of the following is an example of a container that is filled with a pure substance rather than with a mixture?

A. a tire filled with air

B. a jar filled with salt water

C. a balloon filled with helium

D. a glass filled with chocolate milk

12. (2009) The table below shows the number of each kind of atom that makes up one molecule of the compounds sucrose and ethanol.

Compound	Number of Atoms per Molecule		
	Carbon	Oxygen	Hydrogen
sucrose	12	11	22
ethanol	2	1	6

Which of the following is the same for both compounds?

A. the mass of each molecule

B. the length of each molecule

C. the types of atoms in each molecule

D. the number of atoms in each molecule

13. (2009) The picture below shows a demonstration of water changing from the liquid phase to the gas phase as it boils in a beaker.

Which of the following statements explains why this demonstration **cannot** be used to prove that matter is conserved during a change of phase?

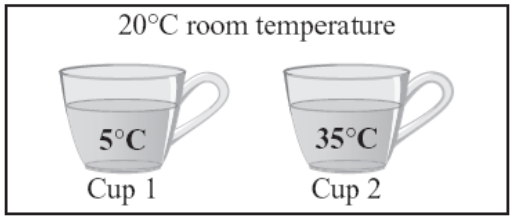
A. The change of phase is incomplete.

B. Water is changing both phase and temperature.

C. Water in the gas phase is lighter than liquid water.

D. The change of phase is taking place in an open system.

14. (2009) During an investigation, Steven filled two cups with the same amount of water and placed them in a 20°C room for 30 minutes. Cup 1 was filled with 5°C water. Cup 2 was filled with 35°C water. The diagram below shows the temperatures of the cups at the beginning of the investigation.



Which of the following graphs shows how the temperatures of the two cups of water most likely changed over 30 minutes?

A.

B.

C.

D.

15. (2009) A student is given a sample of an unknown liquid to test in the laboratory. The student thinks that the liquid is water. Which of the following physical properties of the sample is **most** helpful to determine if the liquid is water?

    A. color of the liquid

    B. mass of the liquid

    C. volume of the liquid

    D. boiling point of the liquid

16. (2008) Which of the following is formed when two elements combine chemically?

    A. an atom

    B. a compound

    C. an electron

    D. a mixture

17. (2008) Ms. Bristol measured the mass of a closed beaker containing several ice cubes. The mass was 100 g. An hour later, after the ice cubes had melted, Ms. Bristol measured the mass of the beaker again.

    What was the mass of the beaker of water the second time?

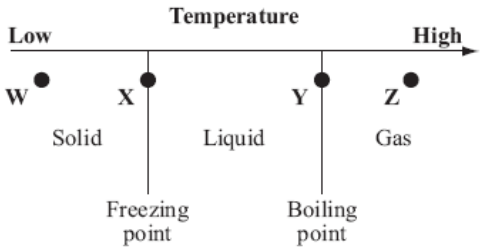
    A. 50 g

    B. 75 g

    C. 100 g

    D. 125 g

18. (2008) The diagram below shows how a change in temperature affects the physical state of a substance. Each of the labeled points represents the same substance at a different temperature.



Which point represents the substance in the physical state with the particles moving the least?

A. point W

B. point X

C. point Y

D. point Z

19. (2008) Sugar is composed of carbon, hydrogen, and oxygen. Sugar is an example of which of the following?

A. an atom

B. a compound

C. an electron

D. a mixture

20. (2008) The surface of a heated metal object measures 120°C. It is dropped into a bucket filled with water measuring 10°C.

Which of the following is **most likely** to occur?

A. Both the water and metal will adjust to the same temperature below 10°C.

B. The water and metal will adjust to different temperatures above 120°C.

C. The water will remain the same temperature, but the metal will cool to 10°C.

D. The water and metal will adjust to the same temperature between 10°C and 120°C.

21. (2008) A pot of cold water was heated on a stove until the water boiled. Which of the following **best** explains why the water was able to boil?

A. The hot stove absorbed cold from the pot.

B. The cold water absorbed heat from the pot.

C. The hot stove gave off heat to the surrounding air.

D. The cold water gave off cold to the surrounding air.

22. (2007) The law of conservation of mass can be demonstrated by a chemical reaction. Which of the following models of a chemical reaction **best** represents the law of conservation of mass?

A.

B.

C.

D.

23. (2007) Which of the following is an example of a physical change but **not** a chemical change?

A. A log gives off heat and light as it burns.

B. A tree stores energy from the Sun in its fruit.

C. A penny lost in the grass slowly changes color.

D. A water pipe freezes and cracks on a cold night.

24. (2007) Which of the following is an example of the formation of a mixture?

A. rust forming on an iron nail
B. sugar crystals dissolving in water
C. sodium and chlorine forming table salt
D. hydrogen and oxygen reacting to produce water

25. (2007) Laura adds 50 mL of boiling water to 100 mL of ice water. If the 150 mL of water is then put into a freezer, at what temperature will the water freeze?

A. 0°C
B. 15°C
C. 37°C
D. 50°C

26. (2007) Which of the following substances can be separated into several elements?

A. nitrogen
B. zinc
C. air
D. aluminum

27. (2007) Which of the following is a characteristic of **all** chemical changes?

A. A different state of matter is produced.
B. Some mass is converted to energy.
C. Some form of light is given off.
D. A new material is formed.

28. (2007) What is the smallest unit of an element that still has the properties of that element?

A. an atom

B. a compound

C. an electron

D. a molecule

Open Response Questions

1. (2013) A scientist has three unlabeled samples of pure metals. He wants to determine the identity of each metal.

a. Identify which **one** of the following properties the scientist should use to determine the identity of the pure metal in each sample: color, melting point, mass, or volume.

b. Explain why the property you identified in part (a) can be used to determine the identity of the pure metal in each sample.

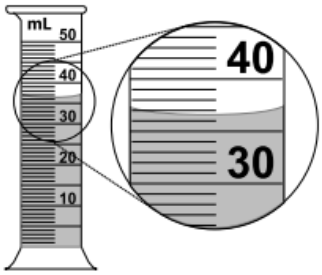
The scientist cuts each of the samples of pure metal into two smaller pieces.

c. Is the property that is used to determine the identity of the metal affected when each sample is cut into two pieces? Explain your answer.

The scientist can also use density to determine the identity of the pure metal in each sample.

d. Describe how the scientist can determine the density of the pure metal in each sample.

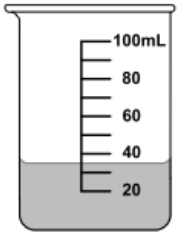
2. (2010) The picture below shows a sample of liquid in a graduated cylinder.



a. Identify what property of the sample is being measured with the graduated cylinder.

b. Identify the measurement of the sample in the graduated cylinder. Include units and use the correct number of significant digits in your answer.

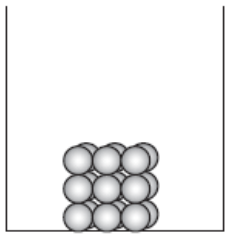
The entire sample was transferred to a 100 mL beaker, as shown below.



c. Identify the measurement of the sample in the beaker. Include units and use the correct number of significant digits in your answer.

d. Explain why the measurements would be recorded differently when the sample is in the graduated cylinder and when it is in the beaker.

3. (2007) The diagram below shows a model in an open container. The model represents the arrangement of particles of matter in a solid phase.



Solid

a. Draw a diagram showing the arrangement of these particles in a liquid phase. Explain why the particles have this arrangement. Be sure to describe the energy of the particles.

b. Draw a diagram showing the arrangement of these particles in a gas phase. Explain why the particles have this arrangement. Be sure to describe the energy of the particles.

MCAS Questions: Chemical Interactions

Multiple Choice Answers

1. B	11.C	21.B
2. D	12.C	22.A
3. A	13.D	23.D
4. B	14.C	24.B
5. A	15.D	25.A
6. C	16.B	26.C
7. B	17.C	27.D
8. C	18.A	28.A
9. D	19.B	
10.B	20.D	

Open Response Answers

1. Pure Metals

Score Point 4

A. The scientist should find the melting point of the three metal.

B.) The melting point is able to identify the metal because the metals have different melting points

C) No. it is not affected because melting point was not get affected by mass or volume. They have the same melting points no matter what.

D.) The scientist can determine the density by finding the mass and the volume. Then dividing mass by volume to get density

Score Point 4

a.) The scientist would use the melting point to determine the identity of the pure metal.
b.) The property I identified in part (a) was it's melting point. I thought that the melting point was the property to identify the pure metal because every pure metal has it's own distinct melting point.
c.) No. The property that is used to find the metal's identity is not going to be affected when each sample is cut into two pieces because the scientist will not be chemically changing it. he is physicaly changing it and if you cut something in two then their is no change to it, only that there is another part to it. The melting point will not change
D.) The scientist can determine the density of each of the pure metals in each sample by findings its mass on the triple-beam-balance scale and then by finding its volume by using the graduated cylinder. Then he will take the mass and divide it by the volume. That is how the scientist will determine each of the metals density.

Score Point 3

A. The scientist should find the melting point of the metals.

B. The property that I chose in part A can determine each of the pure metals. I think this because each of the metals should most-likely have different melting points. They could possibly have the same color, mass, or volume. So the scientist should base his identification off of the melting point.

C. No, when the scientist cuts the metal into 2 smaller pieces it does not affect the melting point. Your still melting the same metal, size of it doesn't matter.

D. He can use the triple beam balance to determine the density of each metal.

Score Point 2

A. The scientist should use the melting point to identify the pure metal in each sample.

B. It can be used to determine the identity of the metal because most different kind of metals have different melting points

C No because it still isn't going to melt without having a melting point

D. They can determine the density by dropping it into a beaker with water in it and recording how far the water goes up.

Score Point 1

A.) one property the scientist can use to figure out what metal they are is finding the mass.
B.) The scientist can use the mass of an object to detirmine the identy of the pure metal because the mass of an object never changes.

C.) The property used to detirmine the identity of the pure metal is not effected when cut in half. No matter how big or small, the mass will always stay the same
D.) The scientist can detirmine the density of the samples, by finding the mass and the volume. once the mass and volume are found, the equation to find the density is mass ÷ volume = density.
or $\frac{m}{v} = d$.

Score Point 0

a. The scientist should use mass to determine the identity.

b. Mass can be used to determine the identity of the pure metal because elements have their own specific mass. Also, size or amount of the sample will not matter because the mass of an object is always the same.

c. No, the property that is used is not affected when the sample is cut into two pieces because the mass of an object or material always stays the same, it doesn't depend on amount or size, only the amount of gravity can change the mass.

d. The scientist can determine the density of each pure metal sample by using the formula: density = mass / weight
the mass and weight of the metals can be found by using two different scales, one being designed to find mass, and the other being designed to find weight.

2. Liquid Measurement

Score Point 4

a. The volume of the sample is being measured with the graduated cylinder.
b. The sample in the graduated cylinder is 36.5 mL.
c. The sample in the beaker is 35mL.
d. In the graduated cylinder, the measurements of the sample are more precise because the lines show every mililiter mark. In the beaker however, the measurements of the sample are more vague because the lines only mark every 10 mililiters.

Score Point 4

a. Volume of the sample is being measured, as graduated cylinders are used to measure volume.
b. 36.5 mL is the measurment of the sample, as the water's meniscus is between 36 ml and 37mL, enabling me to reasonably estimate the volume to be 36.5 mL while adding another significant digit.
c. 35 mL is the measurment of the sample in the beaker, as I am only allowed to add one significant digit in estimation of the water's level, which looks to be around the middle of 30 mL and 40 mL.
d. The measurments would be recorded differently because the beaker is less accurate than the graduated cylinder. The graduated cylinder allows up to 3 significant digits of accuracy when you account for the digit you can add on through estimation, while the beaker only allows up to 2 significant digits of accuracy when you account for the added digit possible through estimation.

Score Point 3

a. The mass of the liquid is being measured with the graduated cylinder.

b. The measure of the sample is 36.5 mL.

c. The measurement is about 35 mL.

d. When it is in the graduated cylinder it is more exact because there are more measurements on the cylinder than the beaker. The beaker only has a mark for every 10 mL, while the cylinder has a mark for every mL.

Score Point 2

A. The property of the Sample that is being measured is the upper portion of the cylinder and were is the highest amount of water.
B. The measurement of the sample in the graduated cylinder is 34mL.
C. the measurment of the sample in the Beaker is 35mL.
D. The measurement would be recorded differently when the Sample is in the graduated cylinder than the Beaker because in the Beaker there are no presise lines to count by but .10's and in the Beaker the unit is spread more but in the cylinder the units are closer so you can count the presise amount of liquid in the holders.

Score Point 1

A. The property that is being identified by the graduated cylander is the waters volume.

B. The measurment of the sample in the graduated cylander is 36.5 g/mL.

C. The measurment of the sample in the 100mL beaker is 36.5 mL

D. The measurment would be recorded differently in the beaker than in the graduated cylander because the graduated cylander is measuring the volume of a liquid and the beaker is just measuring the amout of liquid.

Score Point 0

(A) The liquid is the property being measured in a graduated cylinder.

(B) The measurement in the graduated cylinder is about 37mL.

(C) The sample that is being measured is the same liquid, and the measurement is about 30mL.

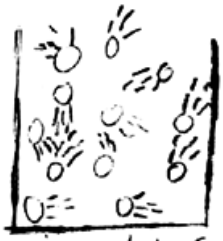
(D) The measurements are recorded differently because, one is a 100mL beaker, on the other one is a 50mL graduated cylinder

3. Particles of Matter

Score Point 4

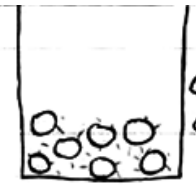
(a) 

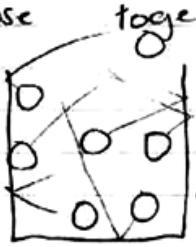
If the particles of matter were changed into a liquid phase they would assume the shape of their container. The particles would begin moving faster, increasing their energy. The particles would stay together but not be as tightly packed as when they were a solid.

(b) 

If the particles of matter in the container were changed from a liquid state to that of a gas there would be some drastic changes. The particles would start moving alot faster, They would be warmer and have alot more energy. The particles would try to spread out and fill up as much space as possible. Because of this the particles would not be as close and not colliding as often. When cooled they would change back into a liquid state (condensation). When they are formed into a gas they tend to rise when warmed and sink when cooled.

Score Point 4

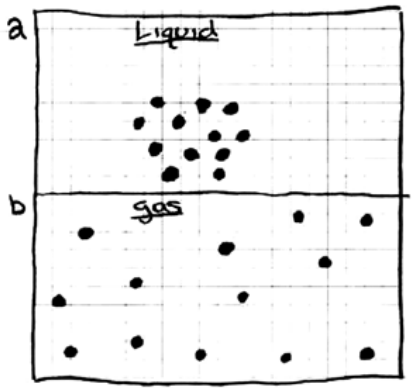
a  The particles are in this arrangement because in a liquid, the particles are loose enough to move around but still stay in the container close together. This is because they have more energy.

b.  The particles are in this arrangement because in a gas, the particles are in such a loose arrangement and they have so much energy, that if they are not in a closed off space, they will escape.

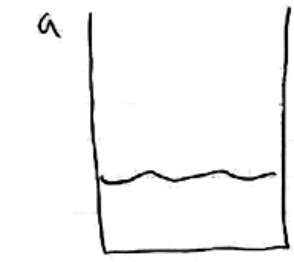
Score Point 3

a. The particles are arranged like this in a liquid state because they are more free to move around then solids. Also they are higher in enery than solids because the particles are bouncing around where as in a solid they are just sitting there.

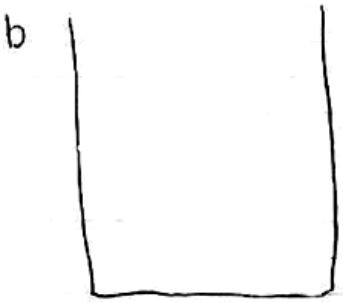
b. The particles are arranged like this in a gas state because they are even more able to move around than liquids. The energy of the particles is very higher, higher than in liquids because these particles are frantically bouncing around constantly.



Score Point 2



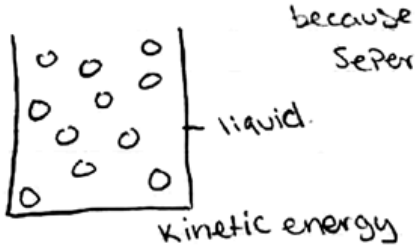
The energy is high, it would have to have been heated to turn into a liquid



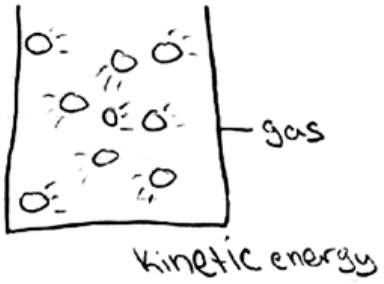
The energy is real high the liquid must have been heated a lot to turn it into a gas.

Score Point 1

A. The particles have kinetic energy cause there bouncing all over the place because there in liquid which seperates the particles.

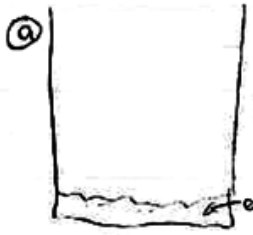


B.

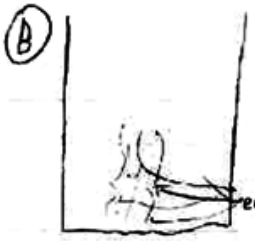


They have kinetic energy because there is no matter in the gas to hold them in place so there bouncing rapidly back and forth.

Score Point 0



They have these arrongement because it like water so it just sinks in.



They are in the arrongement because that is where the solids where and the gases are moving up.