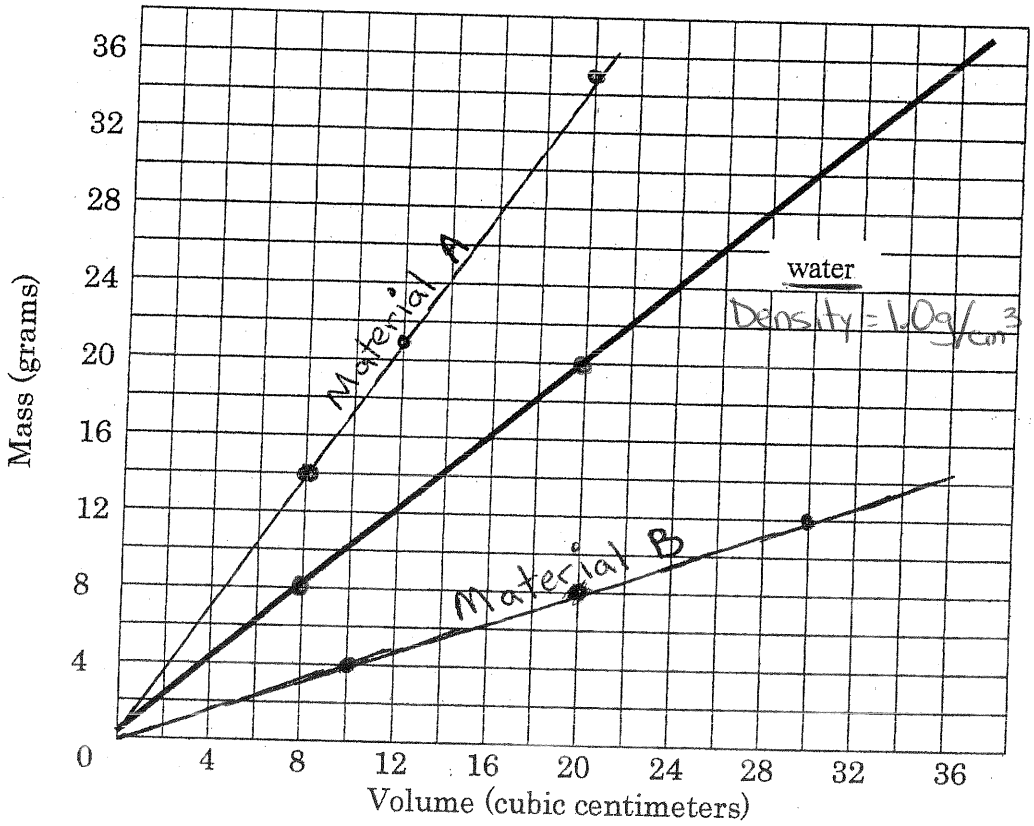
C. Graphing Density: The data below shows the mass and volume for three samples of two different materials. The density for water has been plotted.

1. Plot the three samples of Material A and draw a line to illustrate its density.
2. Plot the three samples of Material B and draw a line to illustrate its density.

Material A			
Sample	(a)	(b)	(c)
Mass (g)	14	35	21
Volume (cm^3)	8	20	12
Density (g/cm^3)	1.75	1.75	1.75

Material B			
Sample	(a)	(b)	(c)
Mass (g)	8	12	4
Volume (cm^3)	20	30	10
Density (g/cm^3)	0.4	0.4	0.4



4. What is the density of material A? $\frac{14g}{8cm^3} = 1.75 g/cm^3$
5. What is the density of material B? $\frac{8g}{20cm^3} = 0.4 g/cm^3$

6. Referring to the line graphs above, compare the line drawn for water and the lines drawn for Materials A and B by answering the questions below.

(a) How can you tell if a material is less dense than water? Density is less than 1.0g/mL (water)
The density line will be below the line for water.

(b) How can you tell if a material is more dense than water?
The density line will be above (steeper) than the line for water.

(c) The greater the density, the STEEPER the slope.

KEY

B. Change in Density:

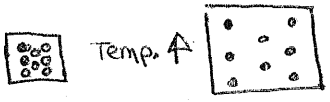
Two factors that do effect density are Temperature and Pressure

1. **Temperature** As temperature increases, molecules begin to move a part (expand), which means the volume increases.

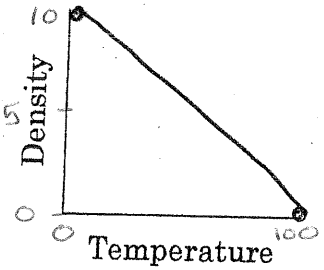
(a) Warm air RISES because it is LESS dense.
An example would be a Hot Air Balloon Rising

(b) State the relationship between temperature and density.

As Temperature ↑,
Density ↓ (Indirect)



(c) Draw the relationship between temperature and density in the graph below.



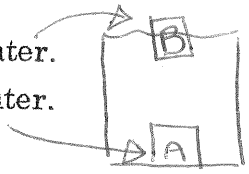
INDIRECT ↑↓

Phases of Matter:

(a) Most materials have their greatest density as a Solid
The exception is water, because water expands when it freezes. (ice cubes)

(b) Water is at its greatest density at a temperature of 4.0 °C
The density of water is 1.0 g/ml

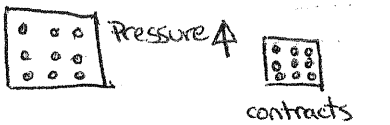
(c) If an object floats on water, it is less dense than the water.
If an object sinks in water, it is more dense than the water.



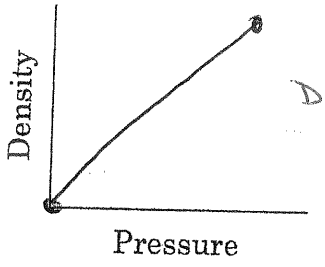
2. **Pressure:** When pressure is added, it causes the material to become smaller (compress), volume decreases.

(a) State the relationship between pressure and density.

As Pressure ↑,
Density ↑ (DIRECT)



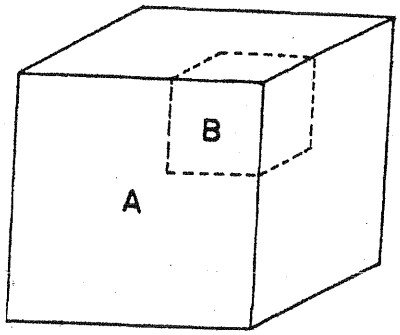
(b) Draw the relationship between pressure and density in the graph below.



Direct ↑↑

Practice problems: Read

Base your answers to questions 1 through 3 on the diagram below. Object *A* is a solid cube of uniform material having a mass of 65 grams and a volume of 25 cubic centimeters. Cube *B* is a part of cube *A*. Uniform Density! same density



1) The density of the material in cube *A* is determined at different temperatures and phases of matter. At which temperature and in which phase of matter would the density of cube *A* most likely be greatest? COLD + SOLID
   (1) at 20°C and in the solid phase
   (2) at 200°C and in the solid phase
   (3) at 1800 °C and in the liquid phase
   (4) at 2700°C and in the gaseous phase

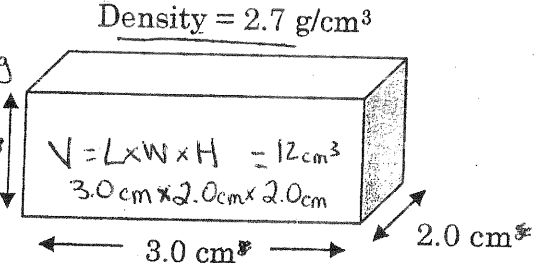
2) If cube *B* is removed from cube *A*, the density of the remaining part of cube *A* will
   (1) decrease (2) increase (3) remain the same Size does NOT matter

3) The mass of cube *B* is measured in order to calculate its density. The cube has water on it while its mass is being measured. How would the calculated value for density compare with the actual density? massing cube and water; mass will be too high; density will be higher also
   (1) The calculated density value would be less than the actual density.
   (2) The calculated density value would be greater than the actual density.
   (3) The calculated density value would be the same as the actual density.

Base your answers to questions 4 through 6 on the diagram below, which represents a solid material of uniform composition.

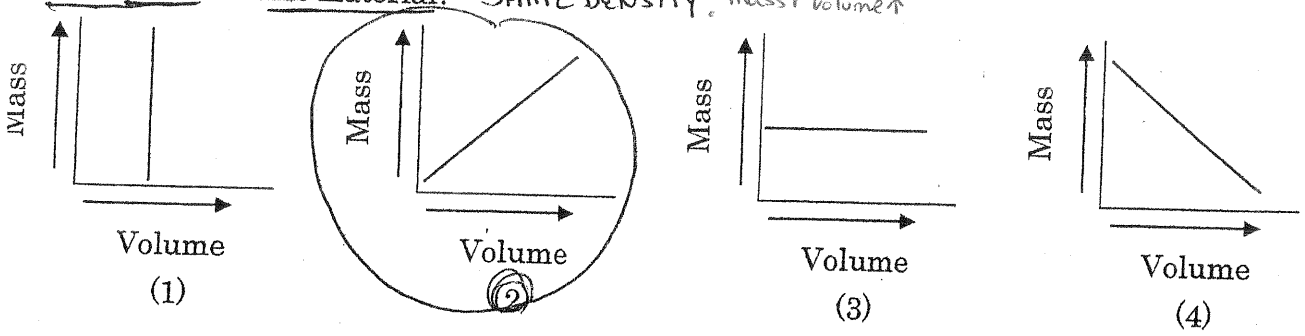
4) What is the mass of the material? $M = D \times V$
   (1) 18.9 g (3) 4.5 g
   (2) 32.4 g (4) 40 g

$2.7\,g/cm^3 \times 12\,cm^3 = 32.4\,g$



5) If this material is heated and expands, the density of the material will Vol ↑ = Density ↓
   (1) decrease (3) remain the same
   (2) increase

6) Which graph best represents the relationship between the mass and volume of various-sized pieces of this material? SAME DENSITY; mass ↑ volume ↑



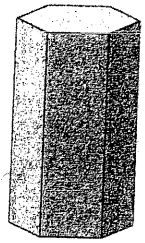
7) As water cools from 4°C to 0°C, its density = MOST DENSE for Water
(1) decreases (2) increases (3) remains the same

8) As the volume of air expands due to heating, the density of this air will
(1) decrease (2) increase (3) remain the same

9) Water has the greatest density at approximately
(1) 100°C in the gaseous phase
(2) 0°C in the solid phase
(3) 4°C in the solid phase
(4) 4°C in the liquid phase

Base your answers to questions 10 and 11 on the diagram below, which is an irregularly shaped objects in which certain measurements were made.

10) A student measured the mass and volume of the mineral crystal below and recorded the data shown below. The student used these data to calculate the density of the crystal. What is the density according to the student's data?
(1) 1.0 g/ cm^3
(2) 1.5 g/ cm^3
(3) 2.0 g/ cm^3
(4) 2.5 g/ cm^3

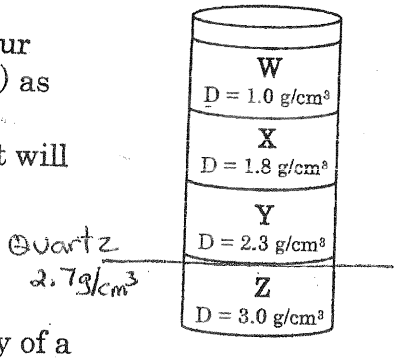


Data
Mass = 80 g
Volume = 32 cm^3
Density = ?
$\frac{80g}{32\,cm^3}$

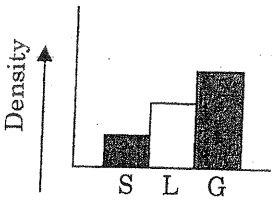
11) What is the student's percent error if the actual density of the crystal is 2.7 grams per cubic centimeter?
(1) 0.4%
(2) 5.0%
(3) 7.4%
(4) 8.0%

$\frac{\text{actual - wrong}}{\text{actual}} \times 100\% \quad \frac{2.7-2.5}{2.7} \times 100\% = \frac{0.2}{2.7} \times 100\% = 7.4\%$

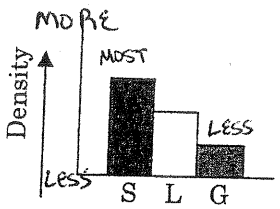
12) The diagram to the right represents a cylinder which contains four different liquids, *W*, *X*, *Y*, and *Z*, each with a different density (D) as indicated. A piece of solid quartz having a density of 2.7 g/cm^3 is placed on the surface of liquid W. When the quartz is released, it will pass through
(1) *W*, but not *X*, *Y*, or *Z*
(2) *W* and *X* but not *Y*, or *Z*
(3) *W*, *X*, and *Y*, but not *Z*
(4) *W*, *X*, *Y*, and *Z*



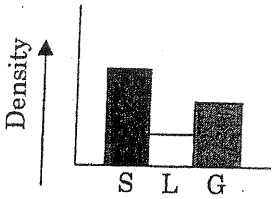
13) Which graph best represents the relationship between the density of a substance and its state of matter (phase) for most earth materials, *excluding* water?



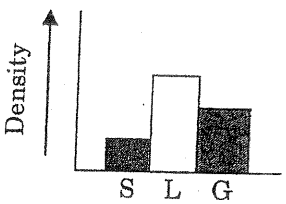
(1)



(2)



(3)



(4)