ESS 100 (Stapleton) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Physical Properties of Matter, with an emphasis on Density

Match each term to the appropriate description: Volume, Mass, Weight, Density

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ The amount of “**stuff**” in something.

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ The amount of space something takes up; how big something is; **size** in three dimensions



3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ How compressed or **crowded** the stuff inside an object is; a ratio of stuff to size. $Density= \frac{mass}{volume}$

4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ The **force of gravity** pulling an object toward a planet.



The circles on the right represent objects with varying masses, volumes, and densities. The dots inside the objects represent identical particles of “stuff.” The rest of the object is empty space.

5. Which object has the greatest volume? \_\_\_\_\_\_

6. Which object has the least volume? \_\_\_\_\_\_

7. Which object has the greatest mass? \_\_\_\_\_\_

8. Which object has the least mass? \_\_\_\_\_\_

9. Which object has the greatest density? \_\_\_\_\_\_

10 Which object has the least density? \_\_\_\_\_\_

11. \*Which object has the greatest weight? \_\_\_\_\_\_

12. \*Which object has the least weight? \_\_\_\_\_\_

13. There are asterisks above because, in special circumstances, all of the objects can have the same weight. Explain.

Read the descriptions below and decide whether each property increases (+), decreases (-), or stays the same (=). *Some answers will vary depending on your assumptions (such as whether air has significant mass).*

|  |  |  |  |
| --- | --- | --- | --- |
| **Description of Change** | **Property** | **Change in Property (+, -, or =)** | **Explanation** |
| 14. A dry towel is squeezed. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 15. A piece of paper loses its corner when the corner is cut off and thrown away. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 16. A balloon is inflated by mouth. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 17. A moon rock is taken to the Earth. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 18. An actor needs to gain weight for a movie, so he packs on an extra 40 pounds of fat. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 19. An army recruit has his head shaven (buzzed). | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 20. A plastic bottle of water splits open when the water inside freezes | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 21. An earthworm stretches as it inches forward. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 22. Someone takes your stick of solid wood, drills some holes in it, and gives it back to you. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 23. Someone exercises and gets much stronger, but her weight does not change. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| 24. A hot air balloon is hovering over your town. The pilot turns on the flame, and the balloon begins to rise. | Mass |  |  |
| Volume |  |  |
| Density |  |  |
| Weight |  |  |

Film Canister Submarine

Using a film canister, some weights, some effervescent tablets, some water, and a drill (or the equivalent) your goal is to create a film canister “submarine” that sinks to the bottom of an “ocean” of water, comes to a complete stop, and then (after a while) rises back to the top of the water – all by itself.

* Design a and test a solution
* Clearly describe your procedure so that it could be repeated by a very literal reader.
* Explain how changes in your submarine’s volume, mass, and density cause it to sink and then rise.
* Explain what is causing those changes.