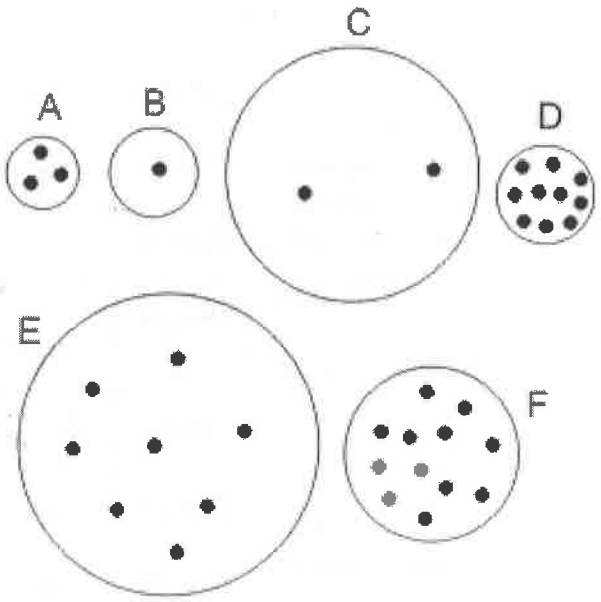
EPS (Stapleton)
Physical Properties of Matter, Density

Name: Answers

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

1. Mass — The amount of "**stuff**" in something. ← matter
2. Volume — The amount of space something takes up; how big something is; **size** in three dimensions
3. Density — How compressed or **crowded** the stuff inside an object is; a ratio of stuff to size. $Density = \frac{mass}{volume}$
4. Weight — 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? E
6. Which object has the least volume? A

7. Which object has the greatest mass? F
8. Which object has the least mass? B

9. Which object has the greatest density? D
10. Which object has the least density? C

11. *Which object has the greatest weight? F
12. *Which object has the least weight? B

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

When there is no gravity, all of the objects have zero weight.

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	-	A tiny mass of air is lost
	Volume	-	gets smaller
	Density	+	- compressed.
	Weight	-	Air is lost (has weight
15. A piece of paper loses its corner when the corner is cut off and thrown away.	Mass	-	Stuff is removed
	Volume	-	Smaller
	Density	=	Remaing portion not compressed Just as likely to float
	Weight	-	
16. A balloon is inflated by mouth.	Mass	+	Tiny mass of Air and water are added
	Volume	+	Gets bigger
	Density	-	More likely to float. More "empty" space. Volume grows more than mass
	Weight	+	Same
17. A moon rock is taken to the Earth.	Mass	=	Same rock.
	Volume	=	Same size
	Density	=	No more or less crammed inside
	Weight	+	More gravity on Earth
18. An actor needs to gain weight for a movie, so he packs on an extra 40 pounds of fat.	Mass	+	More stuff
	Volume	+	Bigger
	Density	-	More likely to float.
	Weight	+	

Same unless gravity changes

19. An army recruit has his head shaven (buzzed).	Mass	−	Stuff (hair) is lost
	Volume	−	Person takes up less space without hair
	Density	? = ← If the hair was causing him/her to sink . = ← If the hair was helping him/her float +	
	Weight	−	Less mass means less weight

20. A plastic bottle of water splits open when the water inside freezes	Mass	= *	Same amount of stuff (*assuming none spills)
	Volume	+	Bottle expands when it freezes
	Density	−	The mass is more spread out
	Weight	=	Same mass → same weight

21. An earthworm stretches as it inches forward. → the shape changes.	Mass	=	Not gaining or losing stuff
	Volume	=	Shape is changing, but not size
	Density	=	Same stuff in same space, so crowdedness is not changing
	Weight	=	Same mass

*If we assume that only

22. Someone takes your stick of solid wood, drills some holes in it, and gives it back to you.	Mass	−	Wood is lost
	Volume	* −	Takes up less space (* if you don't include the holes as part of the wood)
	Density	* =	Just as likely to float (* unless the lost wood was a different density)
	Weight	−	Less mass, less weight

23. Someone exercises and gets much stronger, but her weight does not change.	Mass	=	Same weight means same mass
	Volume	−	An equal mass of muscle takes up less space than fat
	Density	+	Same stuff crowded into less space
	Weight	=	"weight doesn't change"

Trading fat for muscle

less dense

more dense

1 pound muscle

1 pound fat

24. A hot air balloon is hovering over your town. The pilot turns on the flame, and the balloon begins to rise.	Mass*	–	If size is the same and crowdedness is decreasing, stuff must be getting removed.
	Volume*	=	Size doesn't change (maybe a tiny bit)
	Density*	–	Balloon is floating better, so density is decreasing
	Weight*	–	Less mass → less weight

*If the balloon were sealed air-tight, the answers would be M =
V +
D –
W =

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.