

## READING PASSAGE

**Matter and Measurement**

Matter, in science, is the general term applied to anything that has the property of occupying space and the attributes of gravity and inertia. In classical physics, matter and energy were considered two separate concepts that lay at the root of all physical phenomena. Modern physicists, however, have shown that it is possible to transform matter into energy and energy into matter and have thus broken down the classical distinction between the two concepts. When dealing with a large number of phenomena, however, such as motion, the behavior of liquids and gases, and heat, scientists find it simpler and more convenient to continue treating matter and energy as separate entities.

Certain elementary particles of matter combine to form atoms; in turn, atoms combine to form molecules. The properties of individual molecules and their distribution and arrangement give to matter in all its forms various qualities such as mass, hardness, viscosity, fluidity, color, taste, electrical resistivity, and heat conductivity, among others. In philosophy, matter has been generally regarded as the raw material of the physical world, although certain philosophers of the school of idealism, such as the Irish philosopher George Berkeley, denied that matter exists independent of the mind.

Matter exists in three states: solid, liquid and gas. A solid, for example a stone, has a definite shape and a definite volume; a liquid, for example oil, has definite volume but no definite shape; a gas, for example hydrogen (H), has neither definite shape nor volume. Water can exist in all three states; below 0o C as a solid (ice); between 0o C and 100o C as a liquid (water); and above 100o C as a gas (vapor). All matter consists of elements such as zinc (Zn) or oxygen (O), or of compounds such as nitric acid (HNO<sub>3</sub>) or sulphur dioxide (SO<sub>2</sub>).

When we measure quantities of matter, we may use the fundamental units of time (e.g. the second), mass (e.g. the kilogram) and length (e.g. the meter). Or we may use the units such as area (e.g. m<sup>2</sup>) or volume (e.g. cm<sup>3</sup>) or density (e.g. g/cm<sup>3</sup>). These are known as derived units. The area of a rectangle is found by multiplying the length by the width. The density of a substance is equal to the mass divided by the volume ( $d = m/v$ ). We use the terms specific density or relative density to indicate density relative to the density of water. The table of densities below shows that mercury (Hg) has a density of 13.6g/cm<sup>3</sup>. This means that a cubic centimeter of mercury has 13.6 times the mass of a cubic centimeter of water.

Substance	Density (g/cm <sup>3</sup> )
Gold	19.3
mercury	13.6
Aluminum	2.7
Water	1.0
Ice	0.92
Hydrogen*	0.00009
Air*	0.0013

\* at standard temperature and pressure

*(Adapted from different sources)*

## COMPREHENSION QUESTION

**Exercise 1:** Answer the following questions by referring to the reading passage.

1. How is matter generally defined?

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2. Were the concepts on matter and energy in classical physics no longer valid? Why?

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3. What decides the qualities of matter?

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4. What do many philosophers consider matter as?

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5. How many states can matter exist in? What are they?

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**Exercise 2:** Complete each of the following statements with words/ phrases from the reading passage

1. Matter is a general term applied to anything that has the ..... of occupying space

2. Matter and energy were considered two separate .....

3. Modern ..... have shown that it is possible to transform matter into energy

4. Scientists find it simpler and more ..... to continue treating matter and energy as separate entities.

5. Certain ..... particles of matter combine to form atoms

6. The properties of ..... molecules and their distribution and arrangement give to matter various qualities.

7. In philosophy, matter has been ..... regarded as the raw material of the physical world.

8. The Irish philosopher George Berkeley ..... that matter exists independent of the mind.

9. We use the terms specific density or relative density to ..... density relative to the density of water.

10. This ..... that a cubic centimeter of mercury has 13.6 times the mass of a cubic centimeter of water.

**Exercise 3:** *Decide whether each of the following statements is true (T), false (F) or with no information to clarify (N).*

1. ....Matter is seen as anything that occupies space and has gravity and inertia.
2. ....In classical physics, matter and energy were studied separately.
3. ....Modern physicists have shown that matter can be changed into energy and vice versa.
4. ....Atoms are made up by certain elementary particles of matter.
5. ....Such qualities of matter as mass, hardness, viscosity...are controlled by the properties of individual molecules and their distribution and arrangement.
6. ....In general, philosophers consider matter as the raw materials of the physical world.
7. ....Matter exists in three states: solid, liquid, and gas at the same time.
8. ....The fundamental units of measurement come from the derived ones.
9. ....Specific density is the one which has been put in comparison with that of water.
- 10.....The volume of a substance can be found by dividing the mass by its density.