A. Name the following.

1. SI unit of mass

Kilogram (kg)

2. Balance used to measure mass accurately

Physical balance

3. SI unit of weight

Newton (N)

4. Balance used to measure weight

Spring balance

5. SI unit of density

kg/m^3

B. Give technical terms for the following.

1. Amount of matter contained in a body

Mass

2. Force of attraction between any two objects

Gravitational force or force due to gravity

3. Gravitational force exerted by the Earth on an object

Weight

4. Mass per unit volume

Density

5. Density of a substance/Density of water

Relative density

C. Choose the correct option.

1. _____ is/are used to measure the mass of an object accurately.

a. beam balance b. spring balance

c. physical balance d. all of these

(c) physical balance

2. If we use the units of gram for mass and cubic centimetres for volume, then the units for density will be

a. gram b. cm^3 c. g/cm^3 d. $g\text{-}cm^3$

(c) g/cm^3

3. A graduated measuring cylinder is used to measure

a. volume b. mass c. weight d. density

(a) volume

4. If we want to know whether an object will float or sink in water, we need to know its

a. weight b. density c. mass d. volume

(b) density

5. A cube has a mass of 250 g and a side of 5 cm. The density of the cube is

a. 50 cm^3 and will float in water b. 2 g/cm^3 and will sink in water

c. 50 g/cm^3 and will float in water d. 2 cm^3 and will sink in water

(b) 2 g/cm^3 and will sink in water

_____

6. Consider three blocks A, B, and C of 7.8 g each. The volumes are 1 cm^3, 3 cm^3, and 10 cm^3, respectively. What would be the density of each block?

a. Density of A = 7.8, Density of B = 2.6, Density of C = 0.78

b. Density of A = 3.9, Density of B = 1.8, Density of C = 1.54

c. Density of A = 1.9, Density of B = 9.8, Density of C = 2.54

d. Density of A = 0.9, Density of B = 8.8, Density of C = 1.04

a. Density of A = 7.8, Density of B = 2.6, Density of C = 0.78

7. The RD of a substance is 8.9. Which of the statements is true?

a. The substance will sink in water.

b. The substance will float in water.

c. The substance is glass.

d. The substance is iron.

a. The substance will sink in water.

D. Write T for True and F for False. Correct the False statements.

1. Mass can vary but weight cannot.

F. Weight can vary but mass cannot.

2. Equal volumes of different substances have same masses.

F. Equal volumes of different substances have different masses.

3. Density is more if the same mass is packed in a small volume.

T

4. The mass of a substance varies with temperature.

F. The mass of a substance remains the same at all temperatures.

5. Mass is the measure of the gravitational force acting on an object.

F. Weight is the measure of the gravitational force acting on an object.

6. Mass cannot be zero.

T

7. The SI unit of weight is kg.

F. The SI unit of weight is newton (N).

E. Choose the correct option to fill in the blank.

1. One tonne = ... (100 kg/1000 kg).

1000 kg

2. In a ..... (beam balance/spring balance), we find the mass of an object by comparing it with standard known masses.

beam balance

3. 1 kg-f is equal to ..... (10 N/100 N).

10 N

4. The density of silver is 10.5 g/cm^3. Its RD will be ..... (10.5/10 500).

10.5

5. An object X floats on liquid Y. The density of Y should be ..... (greater/lesser) than the density of X.

greater

6. The amount of material or matter present in an object is termed its ..... (mass/gravitational force).

mass

F. Circle the odd one. One has been done for you.

1. Tonne, N, kg, mg

N

2. Mass, weight, density, relative density

Relative density

3. kg/m^3, g/cm^3, g/m^3, m^3/g

m^3/g

4. Iron, ice, wood, cork

Iron

G. Give reasons for the following.

1. The gravitational force is negligible between any two objects having very small masses on the Earth.

Since the Earth has a huge mass, it attracts everything on it towards its centre.

2. It is difficult to lift a bag of 10 kg of rice on the Earth, but feels easier on the moon.

The gravitational pull on the surface of the moon is only one sixth of the gravitational pull on the Earth. Hence, a

bag of rice weighing 10 kg on the Earth will weigh only 1.66 kg on the moon, and will be easier to carry.

3. Relative density does not have any units.

Relative density does not have any units because it is the ratio of two densities, which are similar quantities with the same unit.

4. RD of a substance is the same whether we calculate in CGS system or in SI system.

RD is the ratio of two similar quantities, and hence has no unit.
This means its value remains the same even in the CGS system.

5. Kerosene floats on water whereas glycerine sinks in water.

The RD of kerosene is less than 1, hence it floats on water.
However, the RD of glycerine is greater than 1, so it sinks in water.

H. Explain the following terms.

1. Weight

Weight is the gravitational force exerted on an object. The SI unit of weight is the newton (N). The weight of an object is expressed in N. For example, the weight of a sack of rice having mass of 10 kg will be 100 N.

2. Density

Density is the mass per unit volume of a substance .The SI unit of density is kg/m^3 and the CGS unit is g/cm^3. The density of water is 1 g/cm^3 or 1000 kg/m^3.

_____

3. Relative density

Relative density is the density of a substance with respect to the density of water. Relative density has no units. The density of iron is 7870 kg/m^3 and that of water is 1000 kg/m^3. Hence, the RD of iron will be 7870 kg/m^3 divided by 1000 kg/m^3, which is equal to 7.8.

_____

I. Distinguish between the following.

1. Mass and weight

Mass	Weight
The amount of material or matter present in an object is termed its mass.	The weight of an object on the Earth is the gravitational force exerted by the Earth on that object.
The SI unit of mass is the kilogram (kg). It is measured with the help of a beam balance. It does not vary from place to place.	The SI unit of weight is the newton (N). It is measured with the help of a spring balance. It can vary from place to place.

2. Beam balance and spring balance

Beam balance	Spring balance
A beam balance is used to measure the mass of an object.	A spring balance is used to measure the weight of an object.
It consists of a horizontal beam with a fulcrum (support) at its centre. Two pans of equal masses are suspended from both ends of the beam. When both pans are empty or are equally loaded, the beam is horizontal and the pointer points vertically upwards.	It consists of a spring fixed with a pointer at the upper end and a hook at the lower end to suspend the object. The principle on which it works is that the extension (increase in length) produced in a spring is directly proportional to the gravitational force acting on it.

3. Mass and density

Mass	Density
Mass is defined as the amount of material or matter present in an object. The SI unit of mass is the kilogram (kg). Mass does not vary from place to place.	The density of a substance is defined as its mass per unit volume, i.e., Density (D) = Mass (M)/Volume (V) The SI unit of density is kg/m^3 and the CGS unit is g/cm^3. The density of a substance can be increased by either increasing its mass for a given volume or decreasing its volume for a given mass (and vice versa).

4. Density and relative density

Density	Relative density
The density of a substance is defined as its mass per unit volume, i.e., Density (D) = Mass (M)/Volume (V) The SI unit of density is kg/m^3 and the CGS unit is g/cm^3. The density of a substance can be increased by either increasing its mass for a given volume or decreasing its volume for a given mass (and vice versa).	Relative density (RD) is the density of a substance with respect to the density of water. RD of a substance = Density of the substance/Density of water RD has no units. Its value remains the same even in the CGS system. It tells us how dense or heavy an object is, when compared with water.

J. Short answer questions.

1. What is the relation between mg, g, and kg?

1000 mg = 1 g, 1000 g = 1 kg

2. The amount of attraction between any two objects on the Earth depends on two factors. What are these?

The amount of attraction between any two objects on the Earth
depends on the masses of the objects and the distance between them.

3. A, B, C, and D are four different objects with relative densities 1.2, 0.8, 2.7, and 0.93, respectively. Write down which objects will
float and which ones will sink in water.

B and D will float and A and C will sink in water.

4. Why does an iron nail sink in water whereas a large metal ship floats?

A large metal ship can float because its average density (i.e., the average of the density of the ship's body and that of the air it contains) is less than the density of water it floats on. On the other hand, a small iron nail is more compact and has a lesser volume compared to its mass. This makes it dense, and thus it sinks.

5. What is the principle behind a hot-air balloon?

When a gas is heated, it becomes lighter as its density decreases. As a result, the warmer fluid rises up and the colder fluid (being heavier) moves down to take its place. This process is called convection, which is the principle behind a hot-air balloon.

6. How does temperature affect the density of a substance?

The density of a substance decreases with increase in temperature.

K. Long answer questions.

1. Describe how the density of a solid can be determined.

The density of a solid is calculated using the formula, $D = M/V$
In the case of regular solids, volume (V) can be calculated using formulae. For example, volume of a rectangular block = length × breadth × height
volume of a square block = length^3
The volume of irregular solids (e.g., a stone) can be found with the help of a graduated measuring cylinder. The measuring cylinder is half-filled with water and the water level is noted as V_1. Then the stone is immersed completely in water with the help of a thread. The stone should not touch the bottom of the cylinder. The reading of the water level is noted as V_2. The difference between the readings ($V_2 - V_1$) gives the volume of the stone. The mass (M) of the stone is determined using a physical balance. Then, the density is found using the formula:
$D = M/(V_2 - V_1)$

2. Describe how the RD of a liquid can be determined in a lab.

The relative density of a liquid can be determined with the help of a relative density bottle. It is a small, thin-walled glass bottle with a stopper having a fine hole. The mass of the clean, dry, and empty bottle (m_1) is determined using a physical balance. The bottle is filled with the liquid whose density is to be measured and its mass (m_2) is determined. The mass of the liquid is found by subtraction, $m_2 - m_1$.
Then the bottle is cleaned thoroughly and filled with water. Since the same bottle is being used, the volume of the liquid and that of water are the same. Now the mass of the density bottle filled with water (m_3) is determined. The mass of water is then found by $m_3 - m_1$.

$$\text{RD of the liquid} = \frac{\text{Density of liquid}}{\text{Density of water}} \quad \text{Density of liquid Density of water}$$

$$= \frac{\text{Mass of liquid/Volume of liquid}}{\text{Mass of water/Volume of water}} \text{Mass of liquid/Volume of liquid}$$

$$= \frac{\text{Mass of liquid}}{\text{Mass of water}} \text{ (since volume is the same)}$$

$$\text{RD} = (m_2 - m_1)/(m_3 - m_1)$$

3. What are the practical applications of relative density?

With the knowledge of the RD of different substances, we can find out whether a substance will sink or float in water. For example, the RD of cork is 0.2, whereas the RD of copper is 8.9. The RD of cork is less than the RD of water (which is equal to 1), so it floats on water. The RD of copper is greater than 1, so it sinks in water.
A submarine works by changing its relative density. It does so by taking in or releasing water and air from tanks located inside the submarine.
A hydrometer is a device specially designed to float on a liquid. It is used to find the RD of a liquid. There are special hydrometers designed for testing the density of liquids lighter and denser than water, the purity of milk, the concentration of acid in batteries, etc.

4. How does a submarine work?

A submarine works by changing its density by varying its average mass. It does so by taking in or releasing water and air from tanks located inside the submarine. By filling in water, its mass becomes more, and it submerges as its density becomes more. By releasing water or filling in air, its average mass becomes less, and it comes to the surface as its density becomes less.

5. Discuss variation in the density of solids, liquids, and gases with temperature.

The mass of a substance remains the same at all temperatures. However, the volume of a substance varies with temperature. Many substances expand when they are heated and contract when they are cooled. As a substance that expands takes up more volume, its density decreases. The change in volume with temperature is less in solids, more in liquids, and very large in gases. This is because in liquids and gases, particles are loosely packed compared to solids and hence can move freely.

L. Numerical questions.

1. An object of area 15 cm^2 and height 2 cm has a mass of 50 g. What is its density in SI system?

Mass of the object = 50 g
Volume of the object = area × height (area = length × breadth)
= 15 × 2 = 30 cm^3
Density = Mass/Volume = 50/30 = 1.667 g/cm^3 = 1.667 x 1000 = 1667 kg/m^3

2. A block of steel has a volume of 2.5 m^3 and density 7850 kg/m^3. What is its mass?

Volume of steel = 2.5 m^3
Density of steel = 7850 kg/m^3
Density = Mass/Volume
7850 = Mass/2.5
Mass = 7850 × 2.5 = 19 625 kg

3. If the mass of an object is 40 kg and its density is 800 kg/m^3, find its volume.

Mass of the object = 40 kg
Density of the object = 800 kg/m^3
Density = Mass/Volume
800 = 40/Volume
Volume = 40/800 = 0.05 m^3

4. An RD bottle weighs 57 g when empty, 163 g when filled with water, and 189 g when filled with glycerine. Calculate the (a) relative density of glycerine, (b) its density in SI system, and (c) its density in CGS system.

(a) m_1 = 57 g, m_2 = 189 g, m_3 = 163 g
RD of glycerine = $(m_2 - m_1)/(m_3 - m_1)$
= (189 — 57) /(163 — 57)= 1.24
(b) RD of glycerine = Density of glycerine/Density of water
1.24 = Density of glycerine/1000
Density of glycerine = 1.24 × 1000 = 1240 kg/m^3
(c) Density of glycerine in CGS system = (1240 × 1000)/100 × 100 × 100
= 1.24 g/cm^3