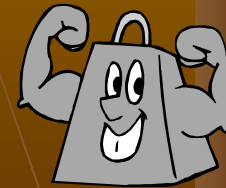Q) Which weighs more:-

A kilogram of feathers or a kilogram of iron?
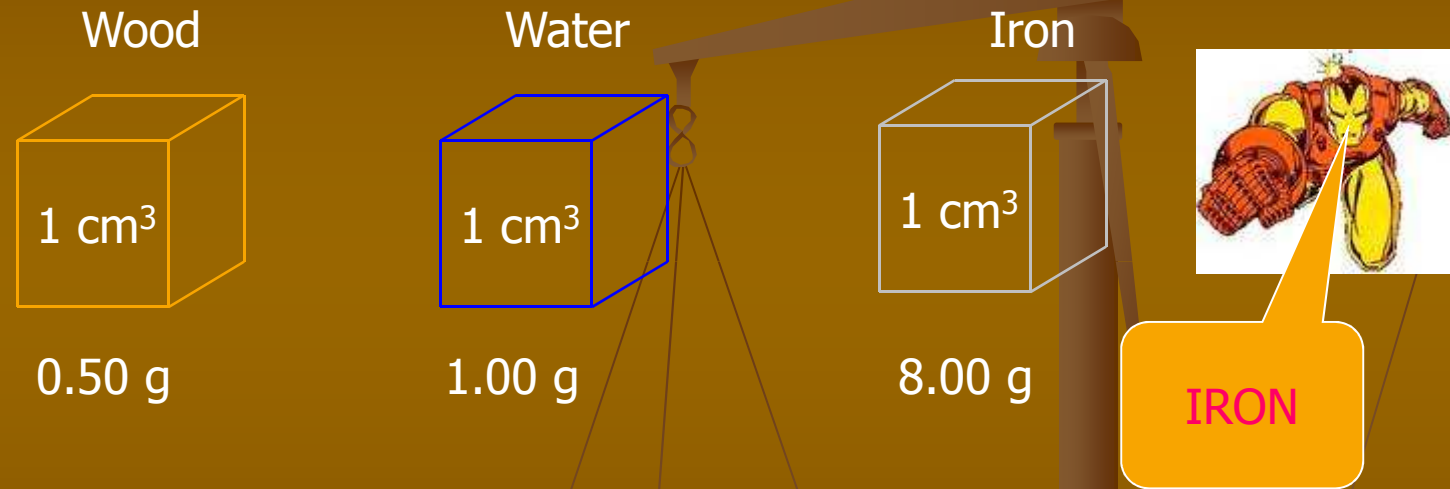
DENSITY

GEL2007

What is Density?

If you take the same volume of different substances, then they will weigh different amounts.

Wood

Water

Iron

1 cm^3

1 cm^3

1 cm^3

IRON

0.50 g

1.00 g

8.00 g

Q) Which has the greatest mass and therefore the most dense?

Density is the Mass per unit Volume
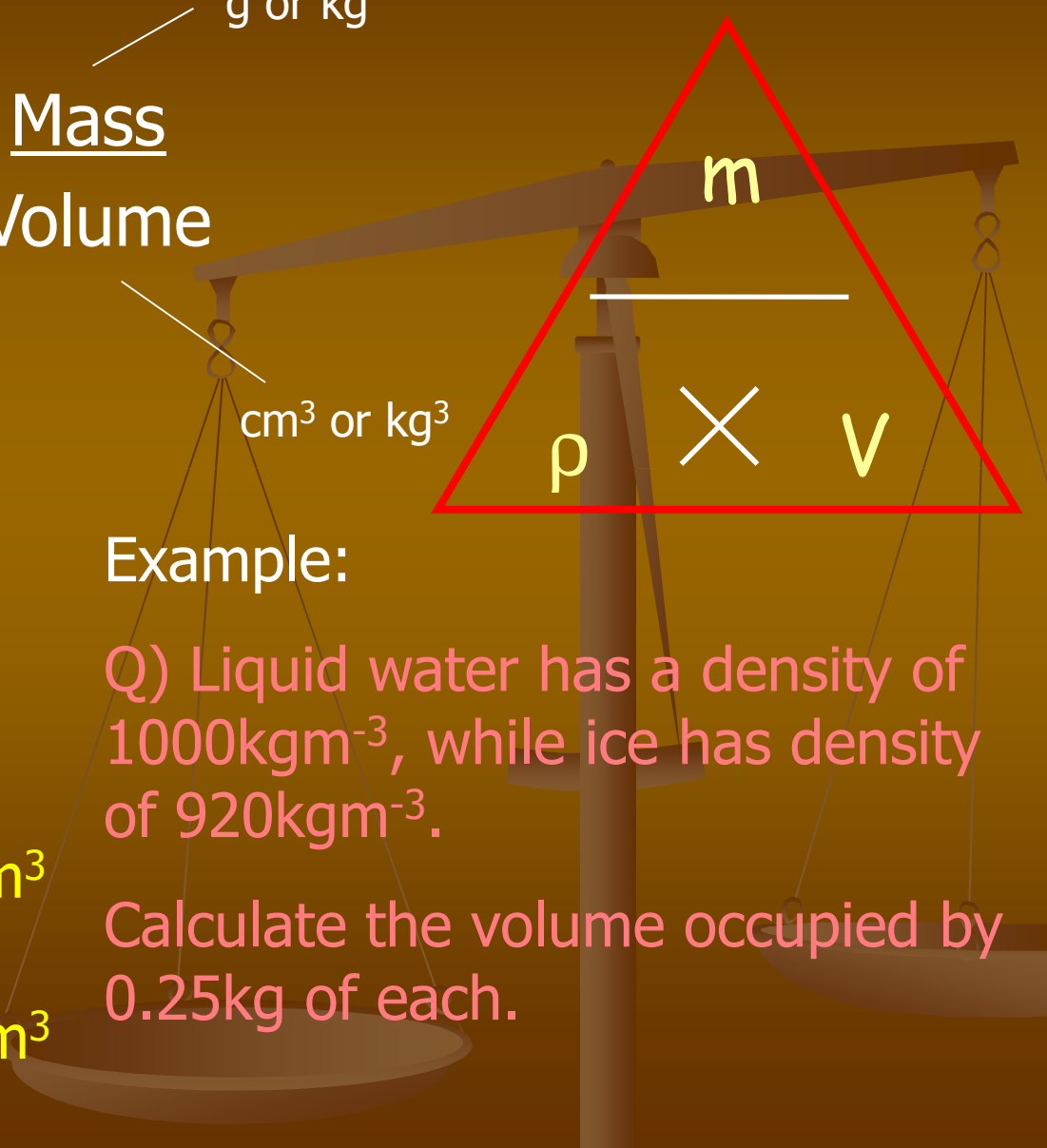
Density Equation:

g or kg

Density = $\dfrac{\text{Mass}}{\text{Volume}}$

gcm^{-3} or kgm^{-3}

cm^3 or kg^3

$$\rho = \dfrac{m}{v}$$

m

$\rho \times v$

Example:

Q) Liquid water has a density of 1000kgm^{-3}, while ice has density of 920kgm^{-3}.

Calculate the volume occupied by 0.25kg of each.

$V = \dfrac{m}{\rho} = \dfrac{0.25}{1000} = 0.000250\text{m}^3$

$V = \dfrac{m}{\rho} = \dfrac{0.25}{920} = 0.000272\text{m}^3$

DENSITY OF A REGULAR SOLID

m = 240 g

2.0 cm

3.0 cm

4.0 cm

$$\rho = \frac{m}{V} = \frac{240}{24} = 10.0 \text{ g/cm}^3$$
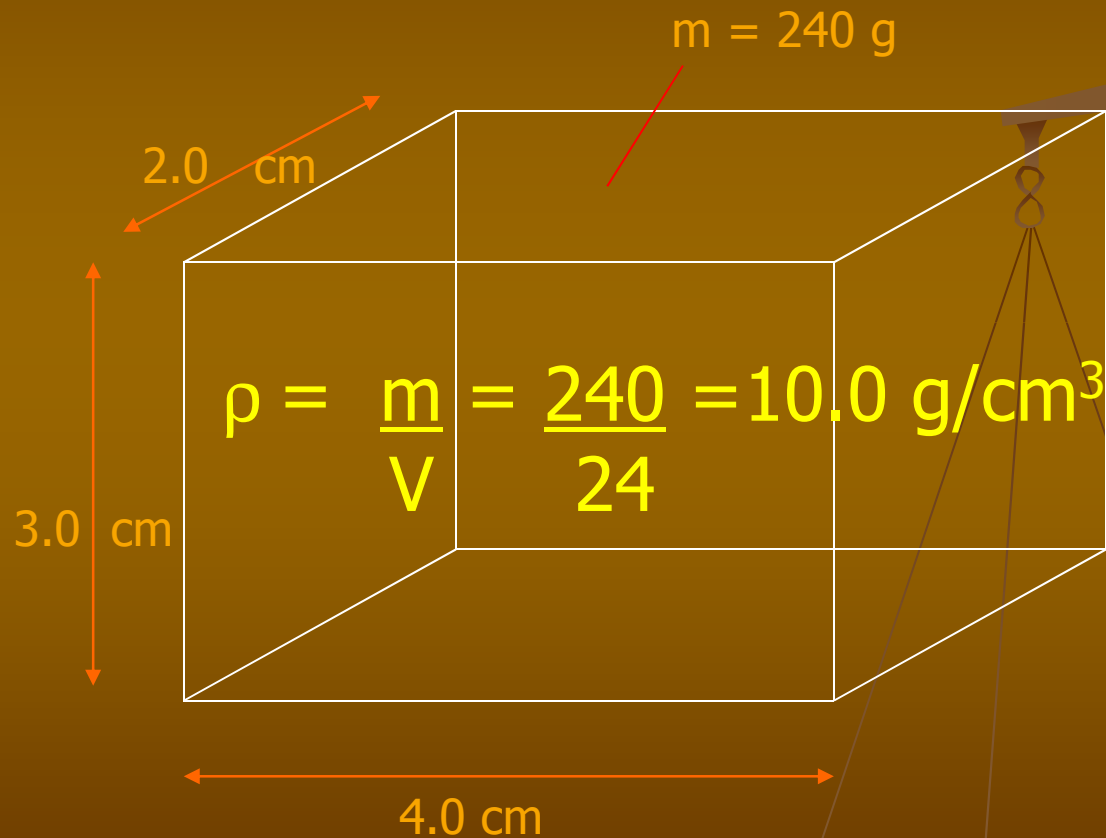
- Find the Mass of the solid on a balance.
- Measure the three lengths and calculate the Volume.

(ie V = l x w x h)

- Calculate the Density.

Material	Mass in g	Length in cm	Width in cm	Height in cm	Volume in cm³	Density in g/cm³

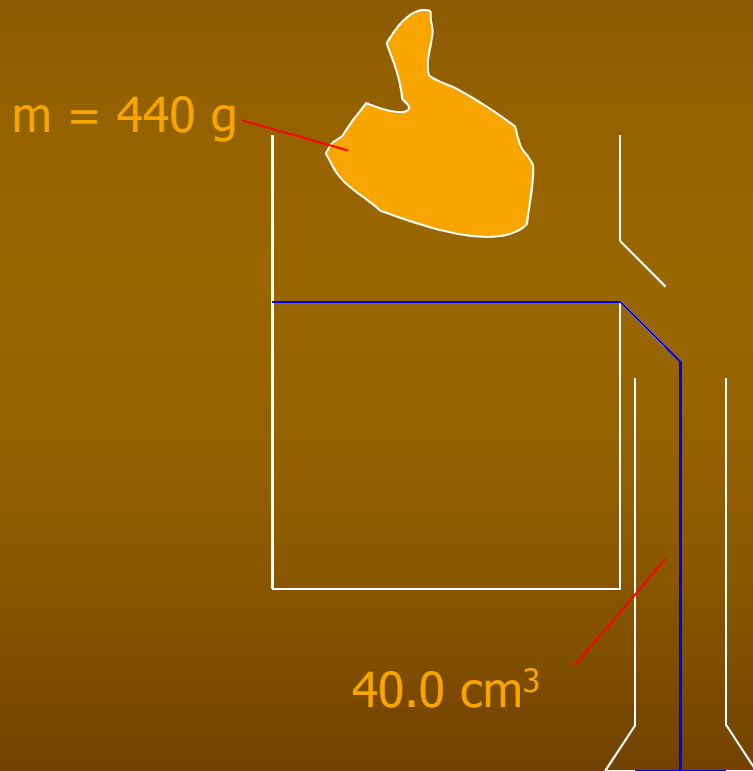| DENSITY	g/cm^3
Aluminium	2.70
Iron	7.86
Brass	8.50
Wood	0.50
Slate	2.80
Glass	2.50
Lead	11.3
Marble	2.70
Wax	0.89

DENSITY OF AN IRREGULAR SOLID

m = 360 g

80 cm³

50 cm³
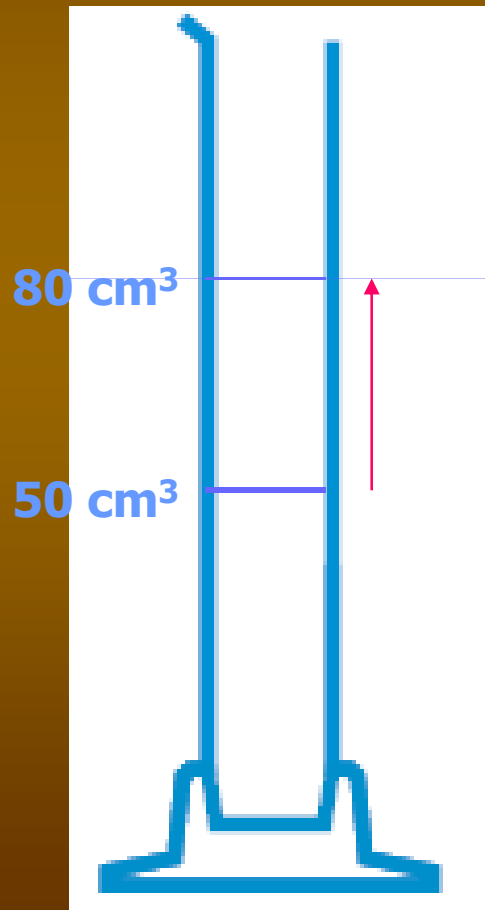
$$\rho = \frac{m}{V} = \frac{360}{30} = 12.0 \ g/cm^3$$

- Find the Mass of the solid on a balance.
- Fill the Measuring Cylinder with Water to a known Volume.
- Add the Object.
- Work out the Volume of Water that is displaced.
- Calculate the Density.
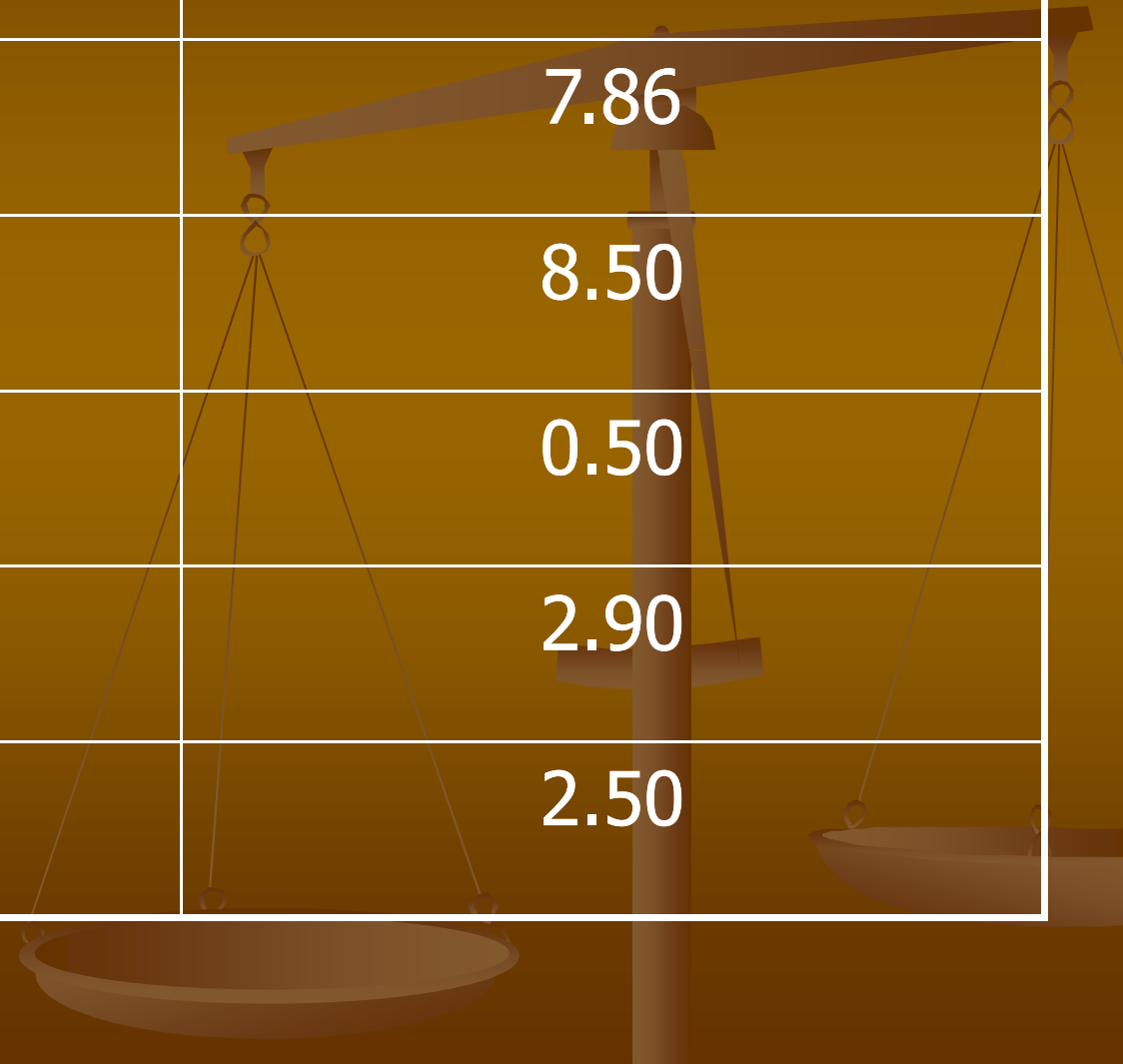
DENSITY OF AN IRREGULAR SOLID

- OR use a Eureka Can to find the Volume.

m = 440 g

40.0 cm^3

$\rho = \dfrac{m}{V} = \dfrac{440}{40} = 11.0$ g/cm3

- Find the mass of the solid on a balance.
- Add water until just overflowing.
- Place a Measuring Cylinder under the spout.
- Add the Object.
- Collect the Water and read off the Volume.
- Calculate Density

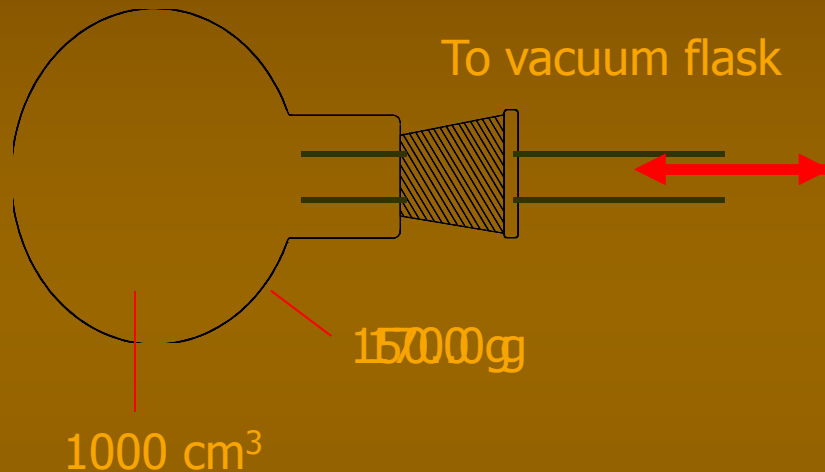| DENSITY	g/cm^3
Aluminium	2.70
Iron	7.86
Brass	8.50
Wood	0.50
Slate	2.90
Glass	2.50

DENSITY OF A LIQUID

45.0 g

25.0 g

20.0 cm³

45 – 25 = 20 g

- Find the Mass of an empty Measuring Cylinder.
- Add a certain Volume of Liquid.
- Find the Mass of the Measuring Cylinder and Liquid
- Calculate the Mass of Liquid.
- How?
- Calculate Density of Liquid.

$$\rho = \frac{m}{V} = \frac{20}{20} = 1.00 \text{ g/cm3}$$

Liquid	Mass of empty Measuring Cylinder in g	Mass of Measuring Cylinder and Liquid in g	Mass of Liquid in g	Volume in cm³	Density in g/cm³

DENSITY OF A GAS

To vacuum flask

170000 gg

1000 cm³

170 -150 = 20.0g

$\rho = \dfrac{m}{V} = \dfrac{20}{1000} = 0.0200$ g/cm3

- Remove the air from a flask of a known Volume, using a vacuum pump.
- Find its Mass.
- Add the gas to be tested.
- Reweigh.
- The difference is the Mass of gas.
- Calculate Density.