**Skill Sheet: Density**

***What You Need to Know:***

The density of a material can be used with the volume of a part to calculate the mass of the part. Its units are typically g cm-3 or kg m-3. Density can be used to calculate:

***Examiners***

***Top Tip***

*Remember the formulae for volumes:*

*For a cuboid, V = L x W x H*

*For a cylinder, V = π r2 x L*

* the amount of material required to make a number of parts
* the cost of the material in a part.

The formulae for the density is:

Density, ρ = mass / volume = m / V

This can be rearranged to give the mass, m = ρ x V.

The cost of materials in a part (£) = mass (kg) x cost per unit mass (£ kg-1)

***Example:***

***Examiners***

***Top Tip***

*Remember:*

1 m = 100 cm = 1000 mm

1 l = 1000 ml = 1000 cm3 = 1000000 mm3

1 tonne = 1000 kg

A metal block is cuboid in shape, with dimensions 0.3 m x 0.3 m x 0.5 m.

The density of the metal is 8 tonnes m-3.

Calculate the mass of the metal block in kg.

***Answer:***

Volume of the container = L x W x H = 0.3 x 0.3 x 0.5 = 0.045 m3

Density = 8 x 1000 = 8000 kg m-3

Mass = ρ x V = 8000 x 0.045 = 360 kg

***Now Try These:***

1. A component has a volume of 76 cm3. The mass of the component is 342 g.

Calculate the density of the component.

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1. A block of material has a mass of 2.886 kg. The density of the material is 5.2 g cm-3.

Calculate the volume of the block.

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1. A cylinder of material has radius 20 cm and length 90 cm. The density of the material is 1.5 g cm-3 and it costs £6 kg-1. Calculate the cost of the cylinder.

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**Practice Sheet: Density**

***Now Try These:***

1. The design of a new product contains 280 cm3 of material. The density of the material that will be used to make the product is 4.8 g cm-3. Calculate the mass of the product.

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1. A container contains 8.8 kg of polymer granules. The density of the polymer is 2.2 g cm3. It is being used to manufacture products that each contain 50 cm3 of the polymer.

Calculate the number of products that can be made from the container.

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1. An artist needs to buy a block of brass, which will be melted to cast a sculpture. He has found a block that is 0.9 m x 1.2 m x 1.4 m.
2. The density of the brass is 8.7 tonnes m-3. Calculate the mass of the block.

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1. The cost of the material is £9 kg-1. Calculate the cost of the material used in the block.

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1. A manufacturer is making cylinders of recycled plastic. The diameter of each cylinder is 0.2 m and the density of the plastic is 900 kg m-3.

If the maximum mass of each cylinder is 27 kg, calculate the maximum acceptable length of the cylinder.

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**Answers:**

**Skill Sheet: Density**

1. ρ = m / V = 342 / 76 = 4.5 g cm-3
2. mass = 2886 g

Volume = 2886 / 5.2 = 555 cm3

1. V = π r2 x L = 113040 cm3

Mass = ρ x V = 1.5 x 113040 = 169560 g = 169.56 kg; Cost = 169.56 x 6 = £1017.36 = £1017 to the nearest £.

**Practice Sheet: Density**

1. M = ρ x V = 4.8 x 280 = 1344 g
2. V = M / ρ = 8800 / 2.2 = 4000 cm3

Number of products that can be made = 4000 / 50 = 80 products

1. a) Volume of the block = L x W x H = 0.9 x 1.2 x 1.4 = 1.512 m3

 Density = 8.7 x 1000 = 8700 kg m-3

 Mass = ρ x V = 8700 x 1.512 = 13154.4 kg

b) Cost = 13154.4 x 9 = £118,389.60

1. Maximum volume V = 27 / 900 = 0.03 m3

Rearranging V = π r2 x L, L = V / π r2 = 0.03 / 3.14 x 0.12 = 0.955 m