1 A sample of sand has a volume of 0.050 m^3. The density of the sand is 1900 kg / m^3. The specific heat capacity of the sand is 1500 J / (kg °C).

(a) Calculate the mass of the sample of sand.

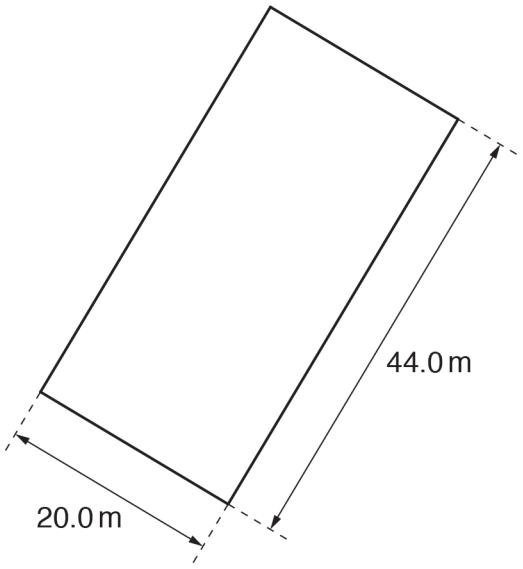
mass = ... [2]

(b) Calculate the thermal capacity of the sample of sand.

thermal capacity = ... [2]

[Total: 4]

2 The diagram shows the top view of a rectangular paddling pool of constant depth. The pool is filled with sea water.



(a) The volume of the sea water in the pool is 264 m^3.

Calculate the depth of the pool.

depth = ... [3]

(b) The mass of the sea water in the pool is 2.70×10^5 kg.

Calculate the density of the sea water. Give your answer to 3 significant figures.

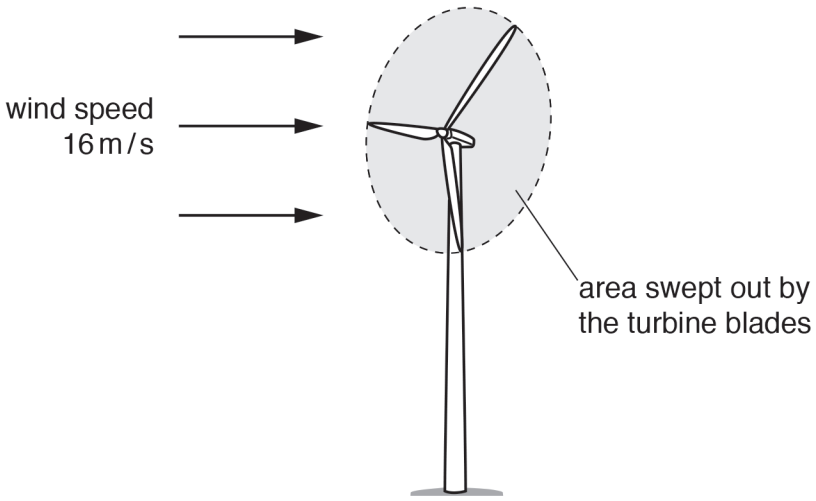
density = ... [2]

(c) Calculate the pressure due to the sea water at the bottom of the pool.

pressure = ... [2]

[Total: 7]

3 The diagram shows a wind turbine.



The wind blows at a speed of 16 m / s towards the turbine blades. In one second, a volume of 24 000 m^3 of air passes through the circular area swept out by the blades. The density of air is 1.3 kg / m^3.

(a) Calculate the mass of air that passes through the circular area swept out by the blades in 1.0 s.

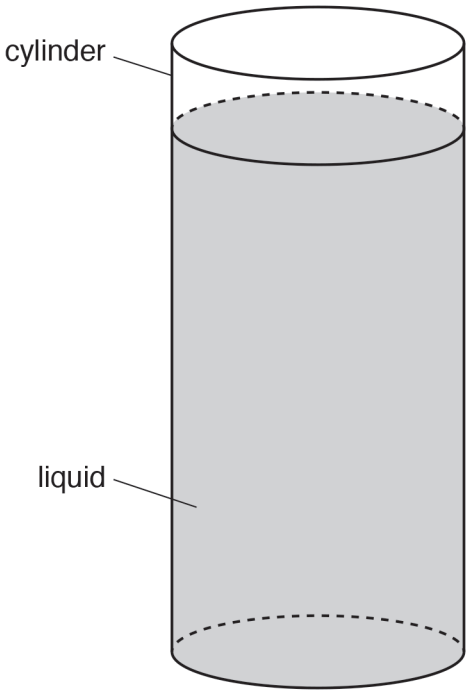
mass= ..... [2]

(b) Calculate the kinetic energy of the mass of air that passes through the area swept out by the blades.

kinetic energy = ... [2]

[Total: 4]

4 The diagram shows liquid in a cylinder.



The table gives some data about the cylinder and the liquid.

radius of cylinder	3.5 cm
weight of empty cylinder	2.5 N
depth of liquid	12.0 cm
density of liquid	900 kg / m^3

The cylinder containing liquid is placed on a digital balance that displays the mass in kg.

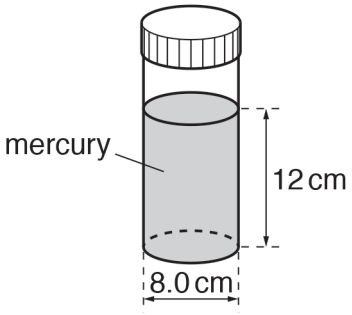
Calculate the reading shown on the balance.

reading ..... kg [4]

[Total: 4]

5 The density of mercury is 1.4×10^4 kg / m^3.

The diagram shows mercury stored in a cylindrical glass jar of internal radius 4.0 cm. The depth of mercury in the jar is 12 cm.



Calculate the weight of mercury in the jar.

weight = ... [3]

[Total: 3]

6 A bubble of gas forms at a point 5.0 m below the surface of a lake.

As the bubble rises to the surface, the mass of gas in the bubble stays constant. The temperature of the water in the lake is the same throughout.

Explain why the bubble rises to the surface and why its volume increases as it rises.

.....

.....

.....

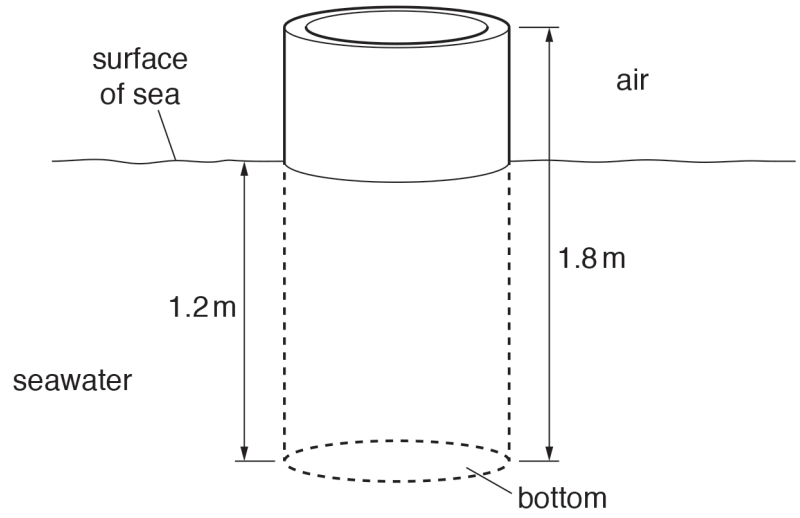
.....

.....

..... [3]

[Total: 3]

7 The diagram shows a hollow metal cylinder containing air, floating in the sea.



(a) The density of the metal used to make the cylinder is greater than the density of seawater.

Explain why the cylinder floats.

.....

..... [1]

(b) The cylinder has a length of 1.8 m. It floats with 1.2 m submerged in the sea. The bottom of the cylinder has an area of cross-section of 0.80 m^2.

The density of seawater is 1020 kg / m^3.

Calculate the force exerted on the bottom of the cylinder due to the depth of the seawater.

force = ... [4]

(c) Deduce the weight of the cylinder. Explain your answer.

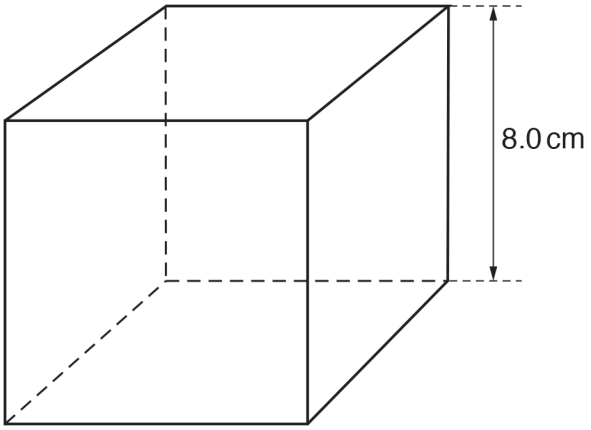
weight = ...

explanation .....

..... [2]

[Total: 7]

8 All the sides of a plastic cube are 8.0 cm long. The diagram shows the cube, (not to scale).



The mass of the cube is 0.44 kg.

(a) Explain what is meant by *mass*.

..... [1]

(b) **(i)** Calculate the density of the plastic from which the cube is made.

density = ... [2]

(ii) The density of one type of oil is 850 kg / m^3.

State and explain whether the cube floats or sinks when placed in a container of this oil.

.....

..... [1]

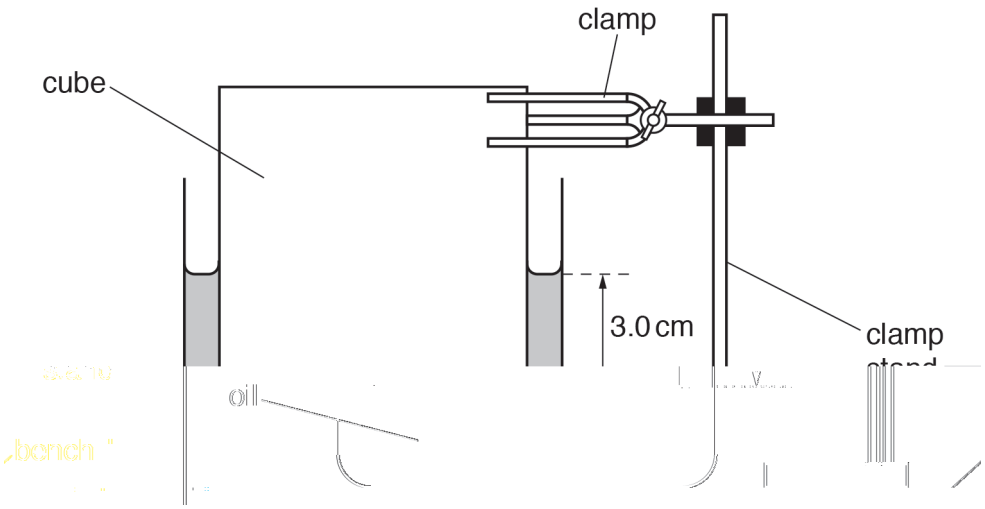
(c) On the Moon, the weight of the cube is 0.70 N.

(i) Calculate the gravitational field strength on the Moon.

gravitational field strength = ... [2]

(ii) In a laboratory on the Moon, the plastic cube is held stationary, using a clamp, in a beaker of the oil of density 850 kg / m^3.

The arrangement is shown in the diagram.



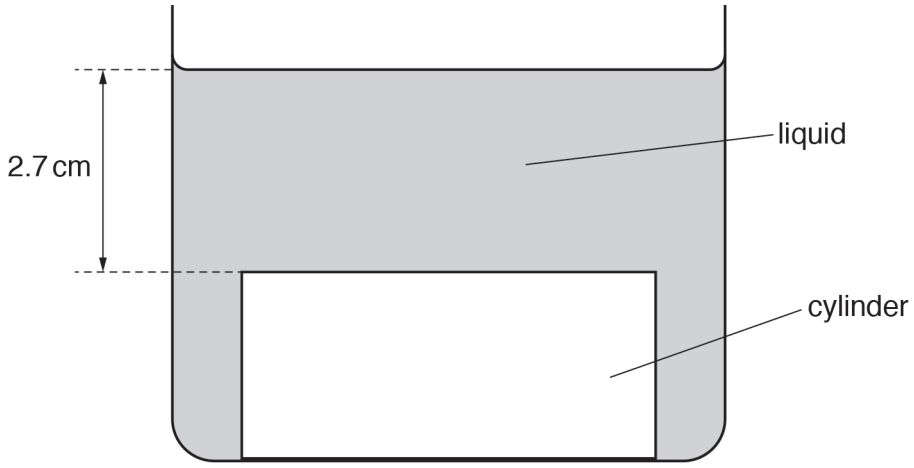
The lower face of the cube is 3.0 cm below the surface of the oil.

Use your answer to **(c)(i)** to calculate the pressure due to the oil on the lower face of the cube.

pressure = ... [2]

[Total: 8]

9 The diagram shows a cylinder immersed in a liquid.



The upper face of the cylinder is at a depth of 2.7 cm below the surface of the liquid.

The pressure due to the liquid at the upper face of the cylinder is 560 Pa.

(a) Calculate the density of the liquid.

density = ... [2]

(b) Explain why the cylinder does **not** float in this liquid.

.....

..... [1]

[Total: 3]

10 A student wishes to determine the density of a small, irregularly shaped stone.

(a) With the aid of a labelled diagram, describe an experiment to determine the volume of the stone.

.....

.....

.....

.....

..... [4]

(b) The student now wishes to determine the volume of a small, irregularly shaped piece of wood that floats in water. He notices that a small lead weight tied to the wood makes it sink in water.

Describe how the student can adapt the experiment in **(a)** to determine the volume of the wood. You may draw a diagram.

.....

.....

.....

.....

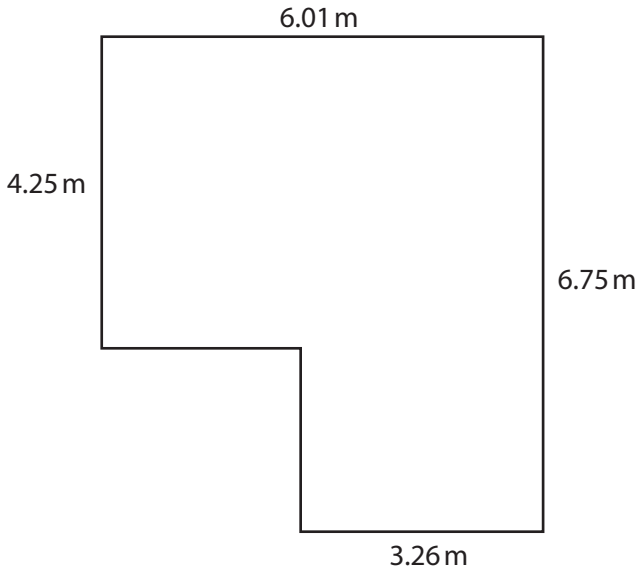
.....

.....

..... [2]

[Total: 6]

11 A surveyor measures the dimensions of a room of constant height. The figure is a top view of the room and shows the measurements taken.



The volume of air in the room is 76.4 m^3. The density of the air is 1.2 kg/m^3.

Calculate the mass of air in the room.

mass = ... [2]

[Total: 2]

12 A student has a measuring cylinder, a beaker of liquid and a balance.

Describe how the student can use this equipment to determine the density of the liquid.

.....

.....

.....

.....

.....

..... [3]

[Total: 3]

13 A metal block has a mass of 86 g and a volume of 8.0 cm^3.

(a) Calculate the density ρ of the metal using the equation

$$\rho = \frac{m}{V}.$$

density of metal = ... g / cm^3 [2]

(b) The metal block is placed in some liquid. The metal block floats on the liquid.

Suggest a value for the density of the liquid.

..... g / cm3 [1]

[Total: 3]

14 A stone has a mass of 98.4 g. The volume of this stone is 41.0 cm^3.

Calculate the density of the stone.

density = ... g / cm^3 [3]

[Total: 3]

15 In an experiment, a metal block is heated and the temperature of the metal block increases by 100 °C.

State the effect, if any, of the temperature increase on:

1. the volume of the metal block .....

2. the mass of the metal block .....

3. the density of the metal block ..... [3]

[Total: 3]

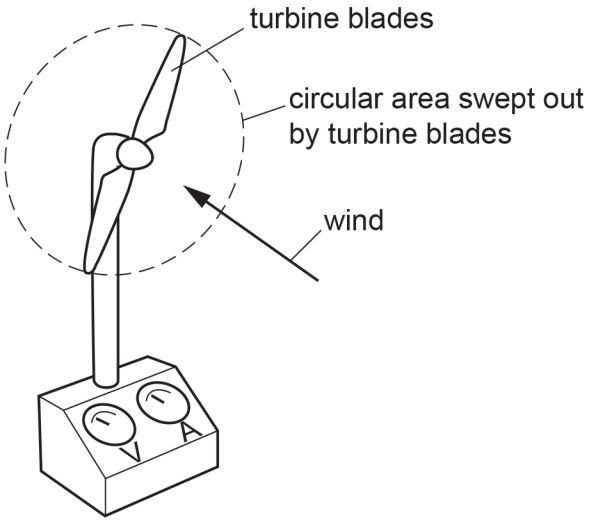
16 A scientist fills a container with sea water. The container has dimensions 30 cm × 30 cm × 40 cm. The density of sea water is 1020 kg / m^3.

Calculate the mass of the sea water in the container.

mass = ... [3]

[Total: 3]

17 The diagram shows a model of a wind turbine used to demonstrate the use of wind energy to generate electricity. The wind is blowing towards the model, as shown.



The mass of air passing through the circular area swept out by the turbine blades each second is 7.5 kg.

The density of air is 1.3 kg / m^3.
Calculate the volume of air passing through the circular area swept out by the turbine blades each second.

volume = ... [2]

[Total: 2]

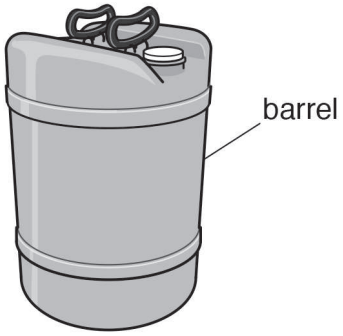
18 A student measures the mass of a piece of metal. Its mass is 146 g. The volume of the piece of metal is 20 cm^3.

Calculate the density of the metal. State the unit.

density = ... [4]

[Total: 4]

19 The diagram shows a plastic water barrel. The barrel is full of water.



(a) The water barrel contains 0.050 m^3 of pure water. The density of pure water is 1000 kg / m^3.

Calculate the mass of pure water in the barrel.

mass of water = ... kg [3]

(b) The density of sea water is 1030 kg / m^3. The density of the plastic is 1000 kg / m^3. Use this information and the information in **(a)** to state and explain whether the full barrel will float in sea water.

statement .....

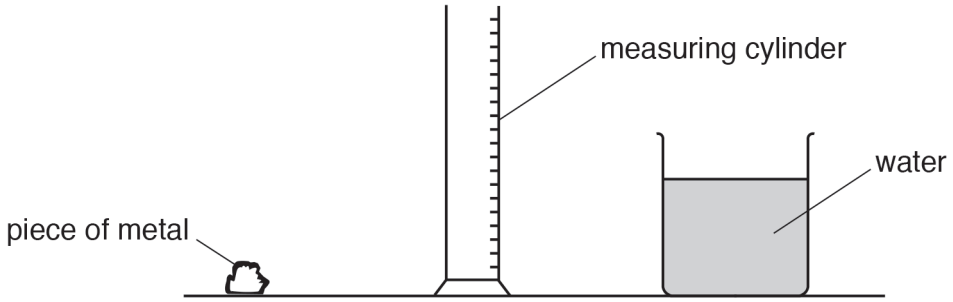
explanation .....

.....

..... [2]

[Total: 5]

20 A student has an irregularly shaped piece of metal, a beaker of water and a measuring cylinder, as shown in the diagram.



Describe how the student can accurately determine the volume of the piece of metal using the equipment provided.

.....

.....

.....

.....

.....

..... [4]

[Total: 4]

21 A metal block is made of brass. Its mass is 200 g.

The density of brass is 8.4 g / cm^3.

Calculate the volume of the brass block.

volume = ... cm^3 [3]

[Total: 3]

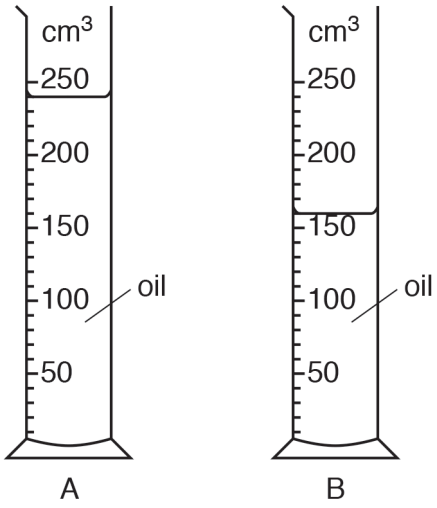
22 A bottle contains some oil.

(a) The mass of the oil and the bottle is 678 g. The mass of the empty bottle is 318 g.

Calculate the mass of the oil.

mass = ... g [1]

(b) Some of the oil from **(a)** is poured into measuring cylinder A. The rest of the oil is poured into measuring cylinder B, as shown in the diagram.



(i) State the volume of oil in measuring cylinder B, as shown in the diagram.

volume = ... cm^3 [1]

(ii) Calculate the total volume of oil.

volume = ... cm^3 [1]

(iii) Calculate the density of the oil.

density = ... g/cm^3 [3]

[Total: 6]

23 A student has a metal object.

(a) The mass of the metal object is 1260 g. The volume of the metal is 150 cm^3.

Calculate the density of the metal. Include the unit.

density = ... [4]

(b) The mass of the metal object is given in grams. State the mass in kg.

mass = ... kg [1]

[Total: 5]

24 Describe a method for determining the volume of a small, dense, irregularly-shaped object.

You may draw a labelled diagram.

.....

.....

.....

.....

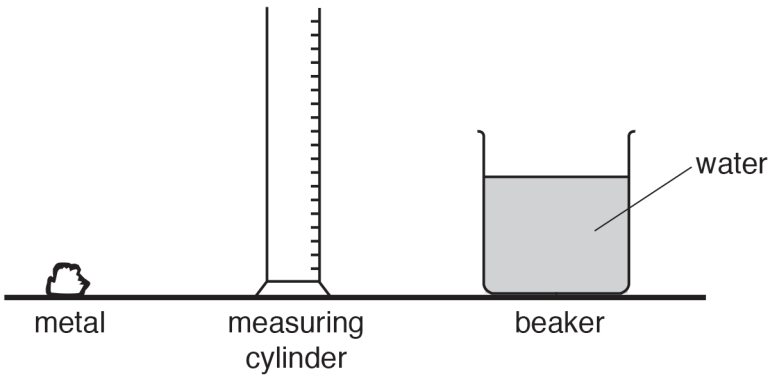
.....

..... [4]

[Total: 4]

25 The diagram shows a piece of metal, a measuring cylinder and a beaker containing water.

The metal has an irregular shape and weight of 3.0 N.



(a) Describe how to determine the volume of the metal, using the equipment in the diagram.

.....

.....

.....

.....

.....

..... [4]

(b) Explain why the procedure in **(a)** is not suitable for finding the volume of a piece of low-density wood that is of similar shape and size to the piece of metal in **(a)**.

.....

..... [1]

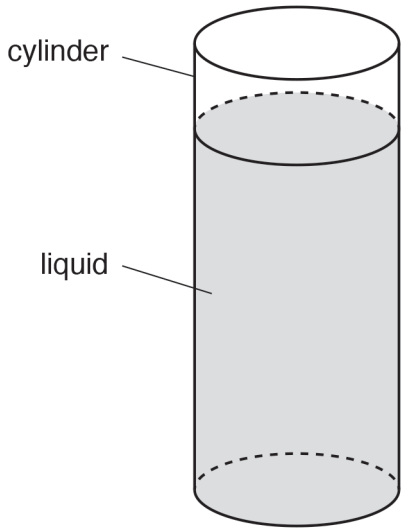
[Total: 5]

26 The mass of a piece of metal is 405 g and its volume is 150 cm^3. Calculate the density of the metal. State the unit.

density = ... [3]

[Total: 3]

27 The diagram shows liquid in a cylinder.



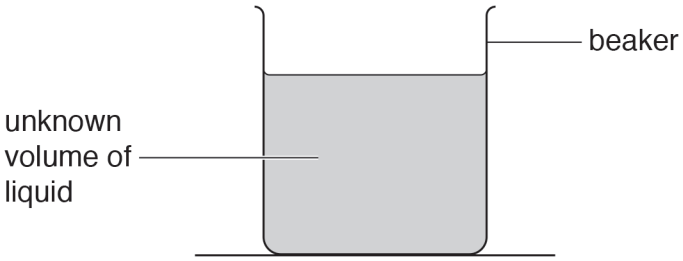
The depth of the liquid is 10 cm and the radius of the cylinder is 3.0 cm. The weight of the liquid in the cylinder is 2.5 N.

Calculate the density of the liquid.

density = ... [3]

[Total: 3]

28 A 250 cm^3 beaker containing some liquid is shown in the diagram.



(a) A student has a measuring cylinder and a balance.

Describe an experiment to determine the density of the liquid.

.....

.....

.....

.....

.....

.....

.....

..... [5]

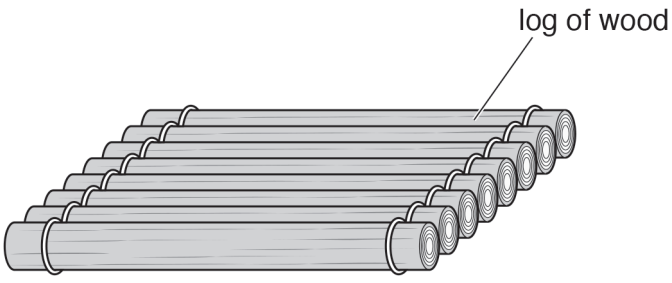
(b) Suggest the unit of density used by the student.

..... [1]

[Total: 6]

29 The diagram shows a wooden raft. The raft is made from 8 logs.

The logs are all of the same type of wood.



(a) The mass of one of the logs is 66.0 kg. It is 3.0 m long and has a cross sectional area of 0.040 m^2.

Calculate the density of the wood in the log.

density = ...kg / m^3 [3]

(b) Explain why the log in **(a)** floats on water.

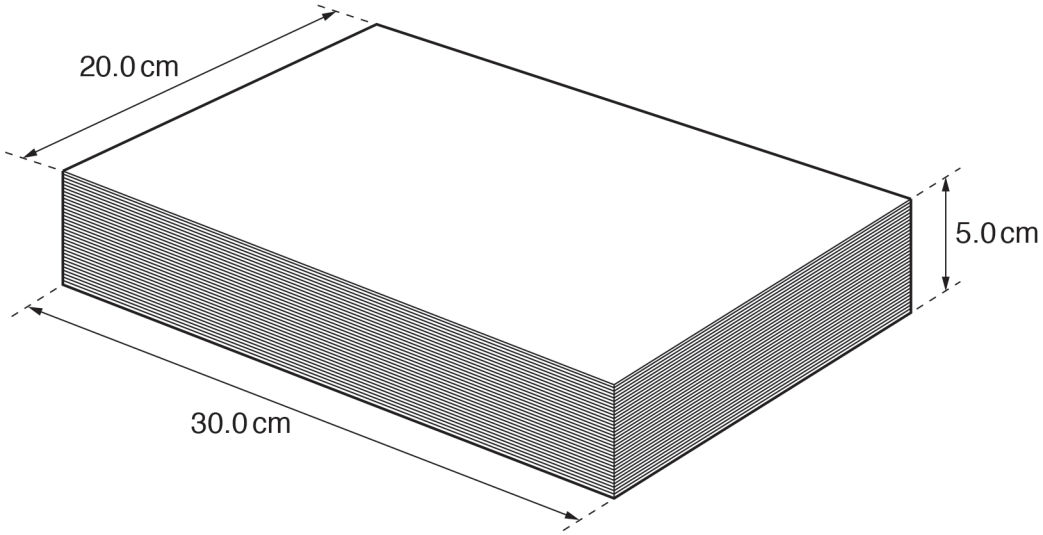
.....

..... [1]

[Total: 4]

30 A student has a pile of A4 paper for his computer printer.

The diagram shows the dimensions of the pile of paper.



(a) Show that the pile of paper has a volume of 3000 cm^3. Use the information shown in the diagram.

[1]

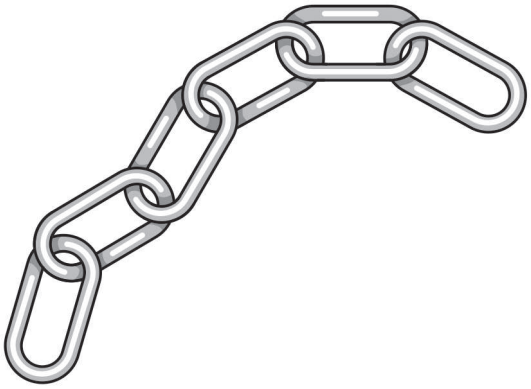
(b) The mass of the paper in the pile is 2400 g.

Calculate the density of the paper.

density = ...g / cm^3 [3]

[Total: 4]

31 The diagram shows part of a metal chain. It is made from small metal loops.



A damaged loop is removed from the chain. Describe a method to determine the density of the metal from which the loops are made.

.....

.....

.....

.....

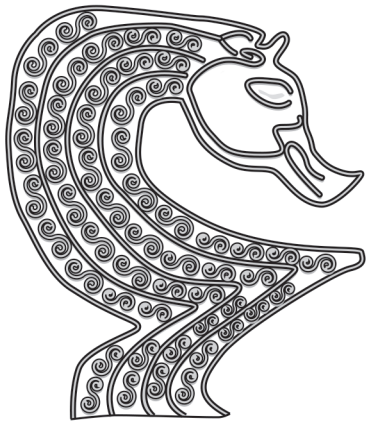
.....

.....

..... [5]

[Total: 5]

32 The diagram shows a metal object discovered by a scientist using a metal detector.



The scientist wants to know the type of metal from which the object is made. She needs to find the density of the metal.

(a) Describe how the scientist can measure the volume of the object, using the method of displacement.

.....

.....

.....

.....

.....

..... [4]

(b) The mass of the metal object is 347 g and its volume is 18 cm^3.

Calculate the density of the metal.

density = ... g/cm^3 [3]

[Total: 7]

33 The diagram shows a glass vase used for displaying flowers.

(a) The mass of the glass is 450 g. The volume of glass in the vase is 145 cm^3.

(i) Calculate the density of the glass.

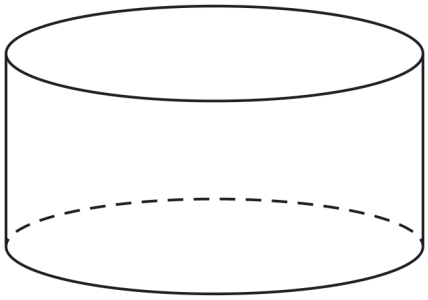
density = ... g/cm^3 [3]

(ii) Calculate the weight of the glass.

weight = ... N [3]

[Total: 6]

34 The diagram shows a cylinder made from copper of density 9000 kg/m^3.



The volume of the cylinder is 75 cm^3.

(a) Calculate the mass of the cylinder.

mass = ... [2]

(b) The gravitational field strength is 10 N / kg.

(i) Calculate the weight of the cylinder.

weight = ... [2]

(ii) State **one** way in which weight differs from mass.

.....

.....

..... [1]

[Total: 5]

35 A steel ball bearing has a mass of 24 g and a density of 8.0 g / cm^3. It is lowered into a measuring cylinder containing 12 cm^3 of water.

What is the new water level in the cylinder?

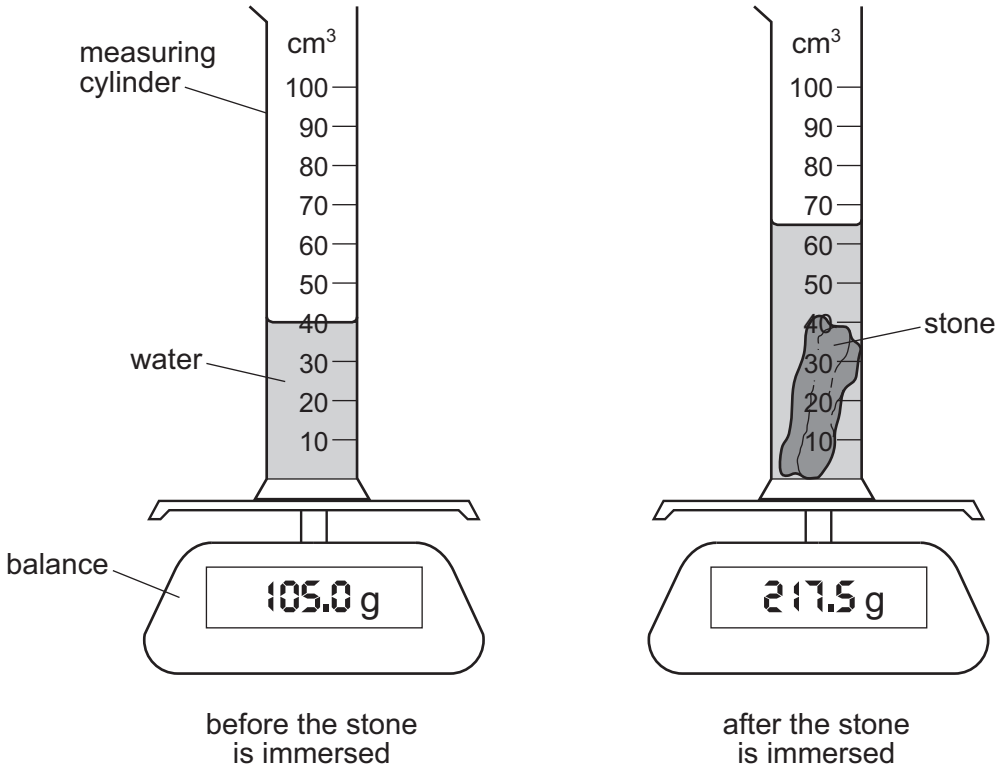
A 3.0 cm^3 **B** 4.0 cm^3 **C** 15 cm^3 **D** 16 cm^3

[1]

[Total: 1]

36 A measuring cylinder containing only water is placed on an electronic balance. A small, irregularly shaped stone is now completely immersed in the water.

The diagrams show the equipment before and after the stone is immersed.



What is the density of the material of the stone?

A $1.7\,g/cm^3$ **B** $3.3\,g/cm^3$ **C** $4.5\,g/cm^3$ **D** $8.7\,g/cm^3$

[1]

[Total: 1]

37 **(a)** The walls of a room are to be painted.

A tin of paint has a total mass of 7000 g and a volume of $5000\,cm^3$.

The empty tin has a mass of 500 g.

(i) Determine the mass of the paint.

mass of paint = ... g [1]

(ii) Calculate the density of the paint. Include the unit.

density = ... [3]

(b) The painter drops a brush into the tin of paint. The brush floats.

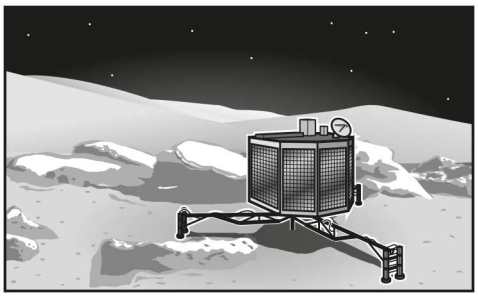
Suggest why the brush floats.

.....

..... [1]

[Total: 5]

38 The diagram shows remote sensing equipment on the surface of a distant planet.



(a) The mass of the equipment is 350 kg. The acceleration of free fall on the surface of this planet is $7.5\,m/s^2$.

(i) State what is meant by the term *weight*.

.....

..... [1]

(ii) Calculate the weight of the equipment on the planet.

weight = ... [2]

(b) The equipment releases a balloon from a point that is a small distance above the surface of the planet. The atmosphere at the surface of this planet has a density of $0.35\,kg/m^3$. The inflated balloon has a mass of 80 g and a volume of $0.30\,m^3$.

Make an appropriate calculation and then predict and explain the direction of any motion of the balloon. Show your working.

prediction .....

explanation .....

..... [4]

[Total: 7]

39 A block of wood has a volume of $210\,cm^3$ and a mass of 180 g.

(a) Calculate the density of the block of wood.

density = ... [2]

(b) The block is held just above the surface of a liquid of density $0.88\,g/cm^3$.

Predict and explain what happens when the block is released.

.....

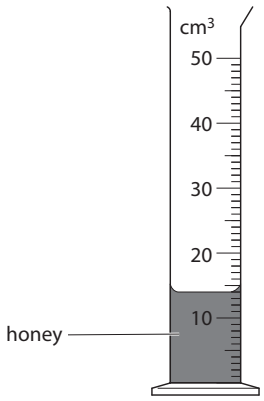
.....

..... [2]

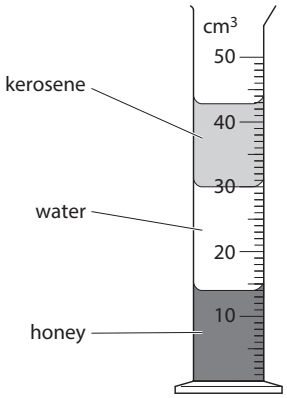
[Total: 4]

40 A student investigates the density of three different liquids.

The student pours liquid honey into a container, as shown in the figure.



The student then carefully adds some water and then some kerosene. The liquids do not mix but form three separate layers as shown in the figure below.



Identify the correct statements about the densities of the liquids. Tick only **two** boxes.

- ☐ Honey has the smallest density.
- ☐ Honey has a larger density than water.
- ☐ Kerosene has the largest density.
- ☐ Kerosene has a smaller density than water.
- ☐ Water has a larger density than honey.
- ☐ Water has a smaller density than kerosene.

[2]

[Total: 2]