1. Motion, forces and energy

1.4 Density

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates

1 A student determines the density of a metal. Fig. 3.1 shows an irregularly shaped piece of the metal and some equipment.

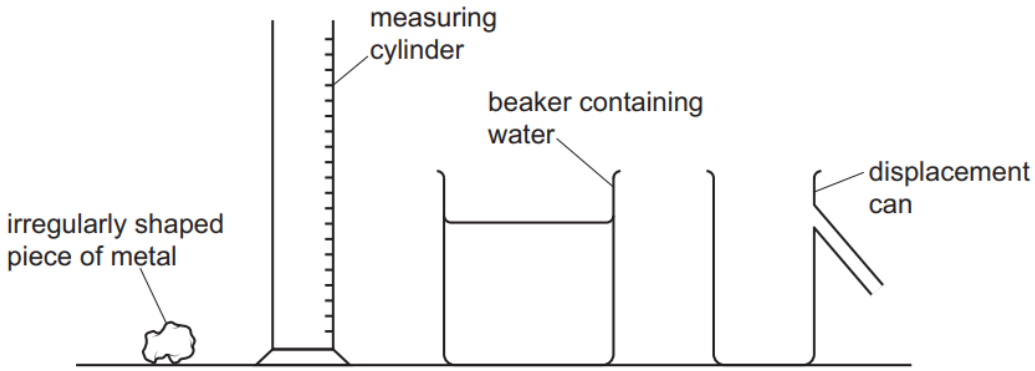

Fig. 3.1

(a) Describe how the student can find the volume of the piece of metal.

In your answer you may refer to some or all of the equipment shown in Fig. 3.1.

.....

.....

.....

.....

.....

..... [4]

(b) The mass of another piece of the metal is 350 g. The volume of this piece of metal is 18 cm^3.

Calculate the density of the metal.

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

[Total: 7]

2 **(b)** The student determines the density of the metal of the wire.
She folds some of the wire into a small shape as shown in Fig. 2.2.

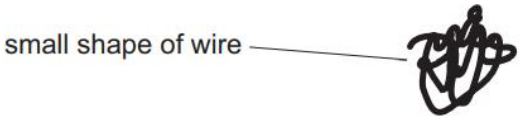

Fig. 2.2

She then puts this small shape of wire into a measuring cylinder containing water. The measuring cylinder is on an electric balance.

This procedure is shown in Fig. 2.3.

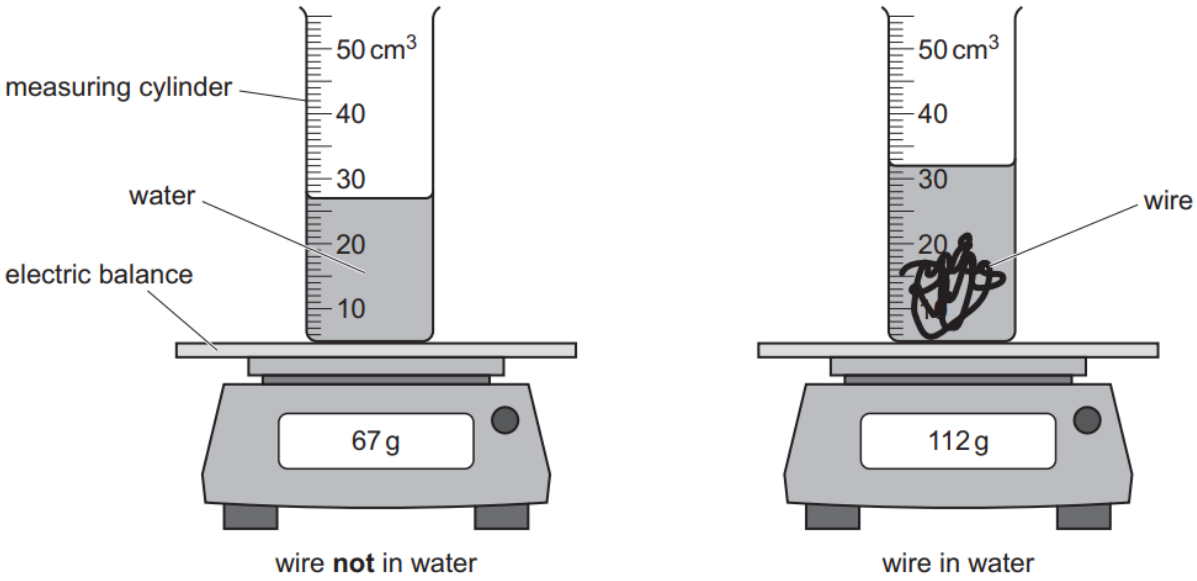

Fig. 2.3

Using the information in Fig. 2.3, calculate:

(i) the mass of the wire

mass of the wire = ... g [1]

(ii) the volume of the wire.

volume of the wire = ... cm^3 [2]

(c) The mass of a different wire is 64 g. The volume of this wire is 7.2 cm^3.
Using this information, calculate the density of this wire.

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

[Total: 9]

3 A student wants to find the volume of a piece of metal. The student can use any of the items of equipment shown in Fig. 2.1.

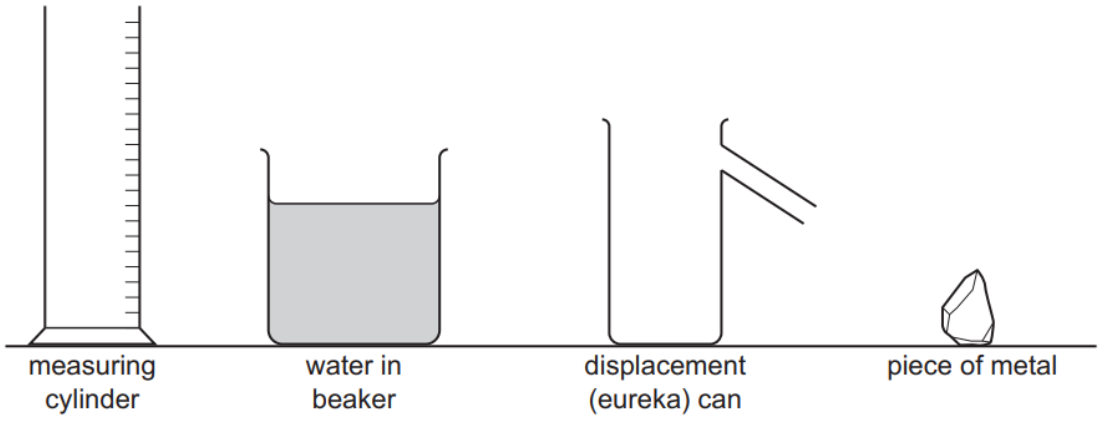

Fig. 2.1

(a) Describe how the student can find the volume of the piece of metal by using equipment from Fig. 2.1.

.....

.....

.....

.....

.....

..... [4]

(b) The volume of a different piece of metal is 30 cm^3. The mass of this piece of metal is 192 g.

Calculate the density of the metal. Include the unit.

density of the metal = ...

unit .....
[4]

[Total: 8]

4 The mass of a solid metal cylinder is 400 g and its volume is 52 cm^3.

(a) Calculate the density of the metal. Include the unit.

density = ... [4]

5 **(b)** The mass of some steel balls is 54 g and the total volume of these steel balls is 6.9 cm^3.

Calculate the density of the steel.

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

[Total: 7]

6 **(a)** Fig. 3.1 shows a metal block and its dimensions.

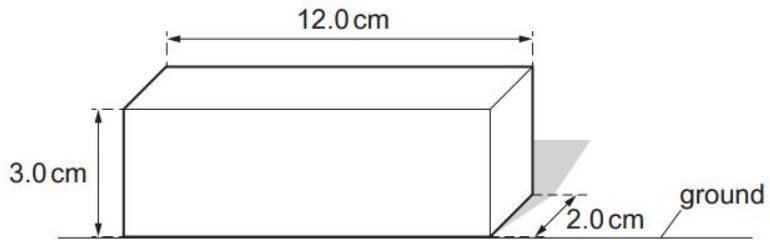

Fig. 3.1 (not to scale)

(i) Calculate the area of the metal block in contact with the ground.

area = ... cm^2 [2]

(ii) The mass of the metal block is 0.84 kg.

Calculate the weight of the metal block.

weight = ... N [2]

(b) A different metal block has a weight of 24 N. The area of this metal block in contact with the ground is 4.0 cm^2.

Calculate the pressure of this block on the ground.

pressure = ... N/cm^2 [3]

[Total: 7]

7 **(a)** A coin collector has 19 identical coins, as shown in Fig. 2.1.

Fig. 2.1

Fig. 2.2 shows one of the coins in the coin collector's hand.

Fig. 2.2

The coin collector wants to check the thickness of one coin. She has a 30 cm ruler.

Describe how she can use the 30 cm ruler to determine the thickness of one coin accurately.

You may include a diagram if you wish.

.....

.....

..... [3]

(b) The coin collector finds another coin. She thinks this coin is made of gold.

She performs an experiment to find the coin's density.

She obtains the following results:

mass of coin = 52.5 g

volume of coin = 5.4 cm^3

(i) Show that the density of this coin is about 10 g/cm^3.

[3]

(ii) The density of liquid mercury is 13.6 g/cm^3. State and explain whether the coin in **(b)(i)** floats on liquid mercury.

.....

..... [1]

[Total: 7]

8 Fig. 1.1 shows the core of a transformer. It is made from thin sheets of iron.

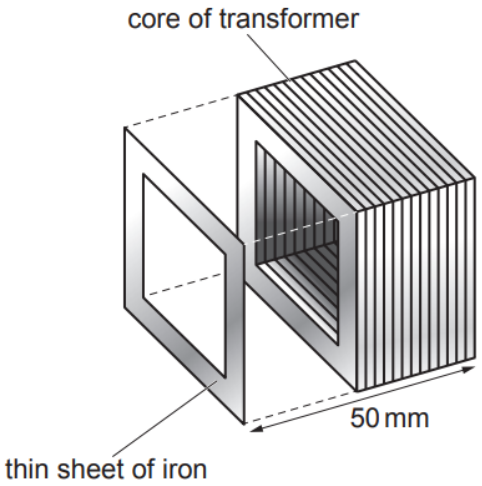

Fig. 1.1 (not to scale)

(a) There are 200 sheets of iron in the core of the transformer. The thickness of the core is 50 mm.

Calculate the average thickness of **one** sheet of iron.

average thickness of one sheet = ... mm [3]

(b) The density of the iron in the core is 7.65 g/cm^3. The mass of the core is 1377 g.

Calculate the volume of the core.

volume = ... cm^3 [3]

(c) State the name of a device used to measure mass.

..... [1]

[Total: 7]

9 Fig. 1.1 shows a plastic water barrel. The barrel is full of water.

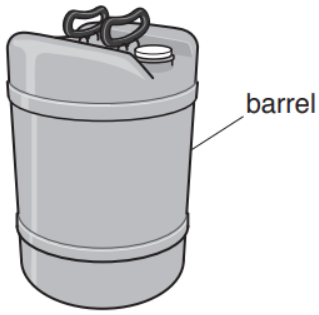

Fig. 1.1

(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]

10 **(a)** A student has an irregularly shaped piece of metal, a beaker of water and a measuring cylinder, as shown in Fig. 2.1.

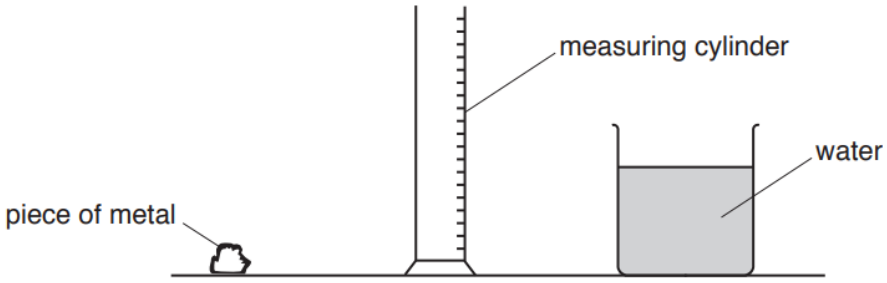

Fig. 2.1

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

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.....

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.....

.....

..... [4]

(b) The student measures the mass of the piece of metal. Its mass is 146 g.

(i) State the name of the instrument used to measure the mass.

..... [1]

(ii) The volume of the piece of metal is 20 cm^3.
Calculate the density of the metal. State the unit.

density = ... [4]

[Total: 9]

11 **(a)** A student has a metal object.

(i) The student measures the mass of the object.

State the name of the equipment used to measure the mass.

..... [1]

(ii) 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]

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

mass = ... kg [1]

12 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 Fig. 2.1.

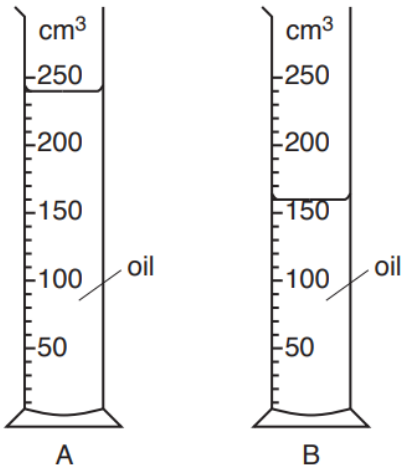

Fig. 2.1

(i) State the volume of oil in measuring cylinder B, as shown in Fig. 2.1.

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]

13 A 250 cm^3 beaker containing some liquid is shown in Fig. 2.1.

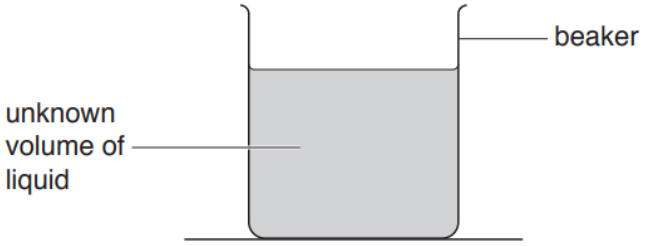

Fig. 2.1

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

Describe an experiment to determine the density of the liquid.

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.....

.....[5]

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

.....[1]

(b) Fig. 2.2 shows a block of polythene.

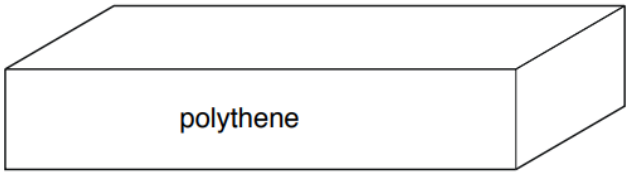

Fig. 2.2

(i) Polythene floats in water. Explain why polythene floats.

.....[1]

(ii) The weight of the polythene block is 0.84 N.

Calculate the mass of the block.

mass = ... kg [3]

[Total: 10]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

14 Fig. 1.1 is the top view of a rectangular paddling pool of constant depth. The pool is filled with sea water.

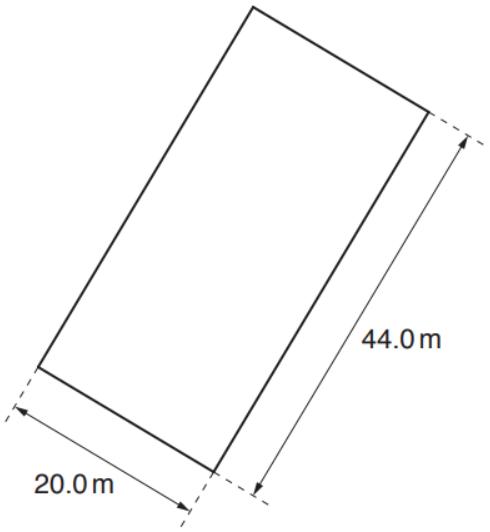

Fig. 1.1 (not to scale)

(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]

15 **(a)** Fig. 4.1 shows liquid in a cylinder.

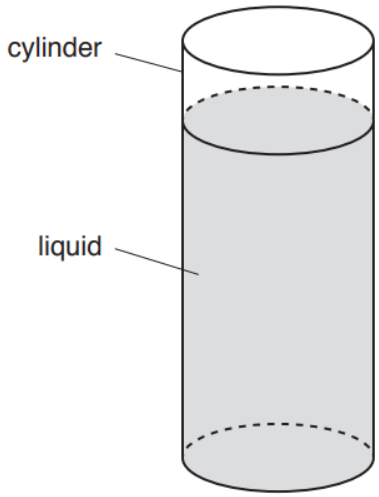

Fig. 4.1

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]

16 **(a)** Fig 2.1 shows liquid in a cylinder.

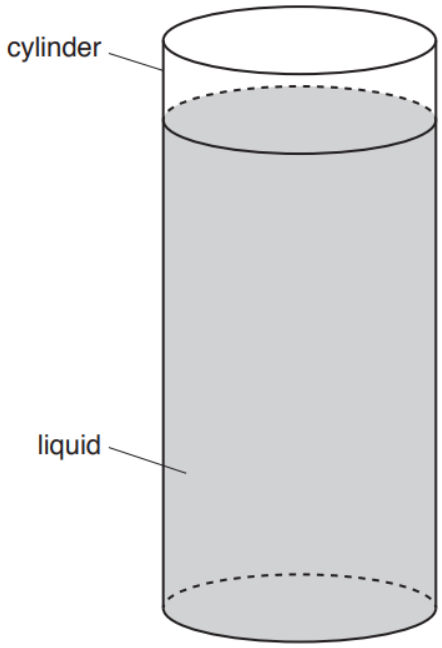

Fig. 2.1

Table 2.1 gives some data about the cylinder and the liquid.

Table 2.1

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]

17 A rectangular container has a base of dimensions 0.12 m × 0.16 m. The container is filled with a liquid. The mass of the liquid in the container is 4.8 kg.

(c) The depth of liquid in the container is 0.32 m.

Calculate the density of the liquid.

density = ...[2]

18 Fig. 2.1 shows a hollow metal cylinder containing air, floating in the sea.

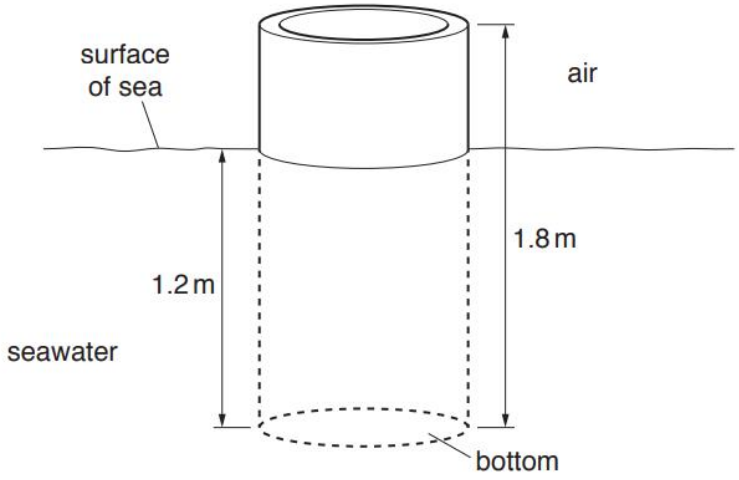

Fig. 2.1

(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. **(extended only)**

force = ...[4]

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

weight = ...

explanation .....

.....

[2]

[Total: 7]