TOPIC 4   Mass, Weight & Density
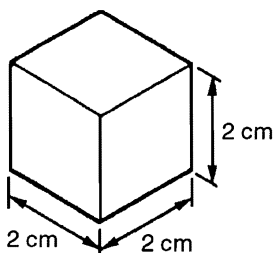
1 A cube with sides 2 cm long is made from a material of density 8 g/cm^3.

What is the mass of the cube?

A   1 g
B   4 g
C   16 g
D   32 g
E   64 g   J90/I/4

2 cm
2 cm   2 cm

2 A pupil carries out an experiment with a beaker and some liquid and obtains the following results:

mass of beaker .... 96 g

mass of beaker containing 100 cm^3 of liquid .... 184 g

What was the density of the liquid?

A   0.84 g/cm^3 D   1.84 g/cm^3
B   0.88 g/cm^3 E   2.80 g/cm^3
C   0.96 g/cm^3 N90/I/4

3 Which formula is used to calculate the density of an object?

A   mass – volume   D   volume – mass
B   mass × volume   E   volume ÷ mass
C   mass ÷ volume   J91/I/5

**4** A rectangular block of wood has length 6.0 cm, width 5.0 cm and height 10.0 cm. Its mass is 150 g.

What is the density of the wood?

A   0.2 g/cm^3 D   2 g/cm^3
B   0.5 g/cm^3 E   5 g/cm^3
C   1 g/cm^3 N91/I/5

5 The measuring cylinder on the left contains 60 cm^3 of water. When a metal object is lowered into the water so that it is completely below the surface, the reading goes up to 78 cm^3.

The mass of the object is 128 g.

60 cm^3

78 cm^3
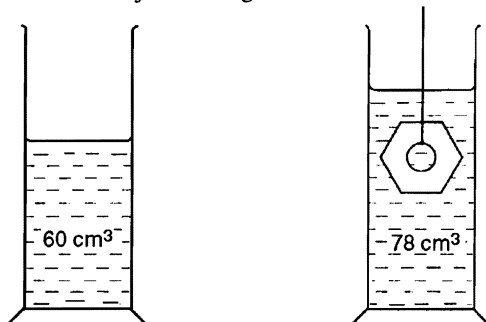
What is the density of the object?

A   0.6 g/cm^3 D   7.1 g/cm^3
B   1.6 g/cm^3 E   18.0 g/cm^3
C   2.1 g/cm^3 J92/I/4

6 A rock on the Moon has a mass of 0.5 kg. It is brought to the Earth where the gravitational field is stronger. On the Earth, the rock will have

A   less mass and less weight.
B   less mass and the same weight.
C   the same mass and the same weight.
D   the same mass and more weight.
E   more mass and more weight.   N92/I/3

7 A body of mass 500 g was suspended in 100 cm^3 of water by a piece of cotton as shown in the diagram.

volume/cm^3

200
150
100
50
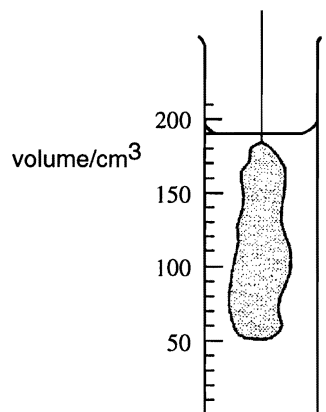
What is the density of the body?

A   0.18 g/cm^3 D   5.00 g/cm^3
B   0.38 g/cm^3 E   5.56 g/cm^3
C   2.63 g/cm^3 N92/I/4

8 Which of the following describes the weight of an object?

A   its density × volume
B   its resistance to changes in motion
C   the amount of matter which it contains
D   the pressure it causes when resting on a surface
E   the pull of gravity on it   N93/I/3

9 The table shows the results of an experiment in which a sample of a solid material is placed in five different liquids.
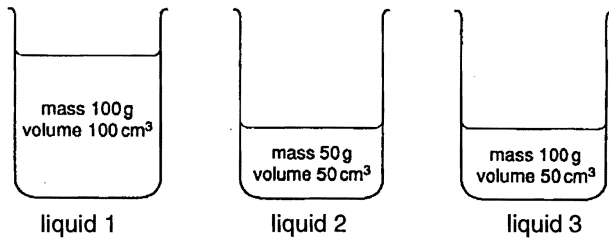
liquid	density of liquid/kg/m^3	observation
mercury	14000	floats
sea-water	1100	floats
pure water	1000	floats
paraffin	700	sinks
organic solvent	550	sinks

What is the density of the sample?

A   exactly 700 kg/m^3
B   between 700 kg/m^3 and 1000 kg/m^3
C   exactly 1000 kg/m^3
D   between 1000 kg/m^3 and 1100 kg/m^3
E   exactly 1100 kg/m^3 N93/I/4

10 Three liquids are poured into beakers as shown.

mass 100g volume 100 cm³	mass 50g volume 50 cm³	mass 100g volume 50 cm³
liquid 1	liquid 2	liquid 3

Which statement about the densities of the liquids is correct?

A   Liquid 1 has twice the density of liquid 3.
B   Liquid 3 has twice the density of liquid 2.
C   The liquids all have different densities
D   The liquids all have the same density.   N94/I/5

11 A satellite is launched from Earth into orbit.

What happens to the mass and weight of the satellite?

	mass	*weight*
A	decreases	decreases
B	decreases	stays constant
C	stays constant	decreases
D	stays constant	stays constant J95/I/4

12 Some students want to calculate the density of a type of wood. They measure the mass and volume of different sized samples of the wood.

Which graph shows their results?
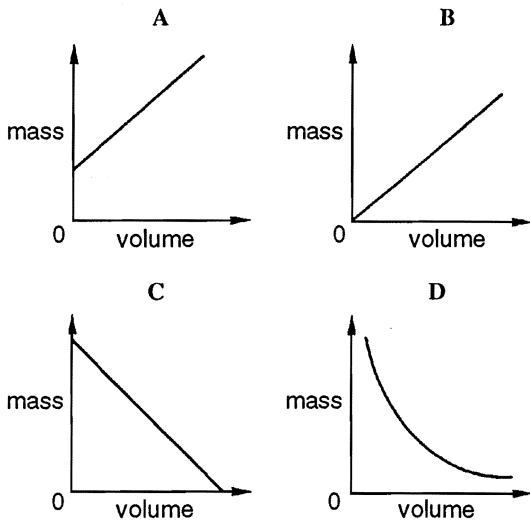
J95/I/5

13 A body resists changes to its motion.

Which property of the body is responsible for this resistance?

A   density
B   gravitational potential energy
C   inertia
D   kinetic energy   N95/I/4

14 As part of an experiment to find the density of stone, a stone is lowered into a measuring cylinder partly filled with water.

final reading (with stone)

initial reading (no stone)
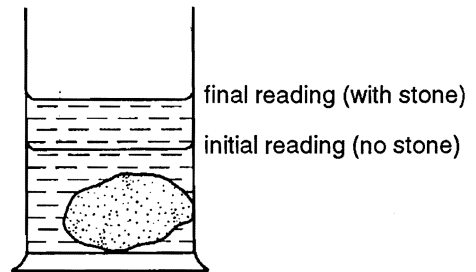
What information can be obtained from the measuring cylinder readings?

A   The difference between the readings gives the density of stone.

B   The difference between the readings gives the volume of the stone.

C   The final reading gives the density of stone.

D   The final reading gives the volume of the stone.   N95/I/5

15 The diagram shows two cubes made out of the same material. One cube has sides that are twice as long as the other cube.
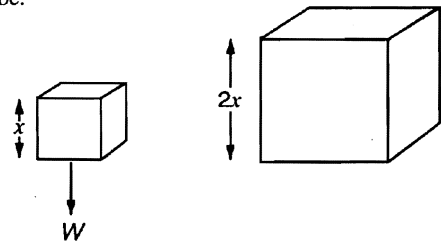
If the weight of the small cube is W, what is the weight of the larger cube?

A $2W$
B $4W$
C $8W$
D $16W$ J96/I/5

16 The temperature inside a spacecraft which has landed on the Moon is the same as it was on the Earth.

Which property of an aluminium block would have a **different** value on the Moon compared with that on the Earth?

A   its mass
B   its heat capacity
C   its volume
D   its weight   J96/I/14

**17** Which statement correctly describes the mass of an object?

A   the amount of space taken up by the object
B   the amount of substance the object contains
C   the material from which the object is made
D   the pull of gravity on the object   N96/I/3

18 What is the name of the property of a body which resists a change in its state of rest or of uniform motion?

A   acceleration C   inertia
B   density D   velocity J97/I/4

19 A can, filled with sand, is hung on a long string close to the surface of the Earth. An identical can is hung in the same way close to the surface of the Moon. The cans are given a sideways push.


push→ push→
surface of Earth surface of Moon
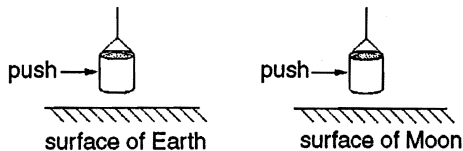
Compared with the can hanging close to the Earth, the can close to the Moon starts to move

A   more easily, as it has less mass.
B   more easily, as it has less weight.
C   with the same ease, as it has the same mass.
D   with the same ease, as it has the same weight. J97/I/5

20 The mass of a measuring cylinder and its contents are determined before and after putting a stone in it.

measuring cylinder
same volume of water
stone
balance
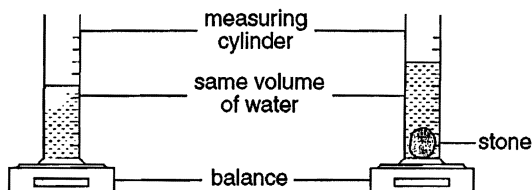
Measurements using the apparatus shown can be used to calculate the density of

A   the liquid only.
B   the stone only.
C   both the liquid and the stone.
D   neither the liquid nor the stone. J97/I/6

21 Which block is made of the densest material?

block	mass / g	length / cm	breadth / cm	height / cm
A	360	10	4	3
B	480	5	4	4
C	600	5	4	3
D	800	10	5	2

N97/I/6

22 The acceleration of free fall on the Moon is 1.6 m/s^2. The acceleration of free fall on the Earth is 10 m/s^2.

A rock has a mass of 10 kg on the Earth.

Which statement about the rock is correct?

A   Its mass on the Moon is 1.6 kg.
B   Its mass on the Moon is 10 kg.
C   Its weight on the Moon is zero.
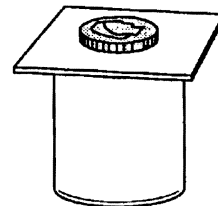D   Its weight on the Earth is 10 N. J98/I/3

23 Some students want to calculate the density of a type of wood. They measure the masses and volumes of different sized samples of the wood.

Which graph shows their results?
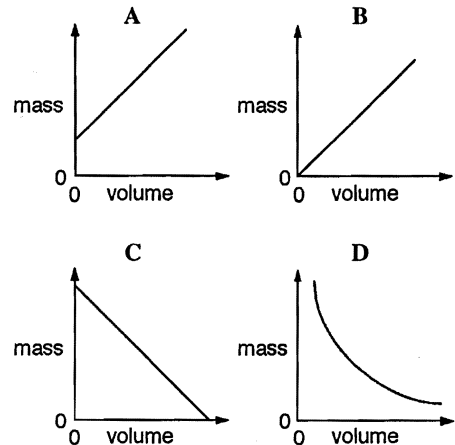
J98/I/4

24 A coin is placed on a card on top of a beaker, as shown. If the card is pulled away quickly, the coin does not move sideways but falls into beaker.

Which property of the coin makes this possible?

A   density
B   inertia
C   volume
D   thickness N98/I/3

25 In an experiment to find the density of a material, a student measures mass and volume and then does a calculation.

What is the correct unit for density?

A   kg / m^2
B   m^3 / kg
C   Pa
D   kg / m^3 N98/I/5

26 Which property of a body is affected by a change in gravitational field?

A   mass
B   temperature
C   volume
D   weight J99/I/2

27 A stone of mass of 12 g and having a density of 3 g/cm^3 is carefully lowered into 25 cm^3 of water in a measuring cylinder.

What is the new reading on the measuring cylinder?

A   21 cm^3
B   28 cm^3
C   29 cm^3
D   37 cm^3 J99/I/4

28 What causes a moving body to resist a change in its state of motion?

A   its acceleration
B   its inertia
C   its speed
D   its weight   N99/I/4

29 The gravitational field strength on the surface of the Moon is 1.6 N/kg.

Which values of mass and weight are correct for an object placed on the Moon's surface?

	mass/kg	weight/N
A	10	1.6
B	10	16
C	16	10
D	16	160

                                                  N99/I/5

30 A quantity of gas in a sealed balloon is cooled down.

No gas is allowed to enter or leave the balloon.

How do the listed properties of the gas change?

	mass	volume	density
A	decreases	stays the same	increases
B	increases	stays the same	decreases
C	stays the same	decreases	increases
D	stays the same	increases	decreases

                                                  N99/I/40

31 A heavy lorry has a high inertia.

How difficult is it to start the lorry moving and to stop it moving?

	to start	to stop
A	difficult	difficult
B	difficult	easy
C	easy	difficult
D	easy	easy

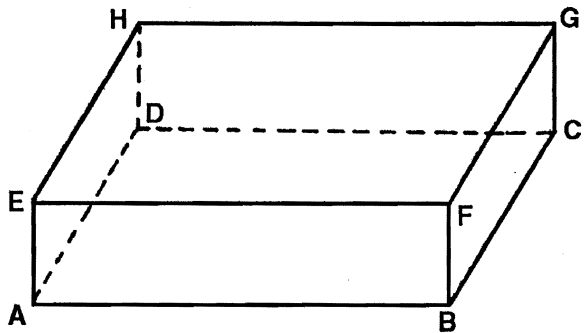   J2000/I/4

32 A rectangular block of wood has length 6.0 cm, width 5.0 cm and height 10.0 cm. It has mass 150 g.

What is the mass of a block of the same type of wood of length 3.0 cm, width 5.0 cm and height 20.0 cm?

A   75 g
B   150 g
C   300 g
D   600 g   J2000/I/5

33 The rectangular block shown in the diagram has a mass 7200 kg and is made of material of density 1200 kg/m^3. The area of the base ABCD is 8.0 m^2.

(a) Calculate the height AE of the block.

(b) If gravity exerts a force of 10 N/kg, calculate the pressure which the block exerts on the horizontal surface on which ABCD rests.   J79/I/1
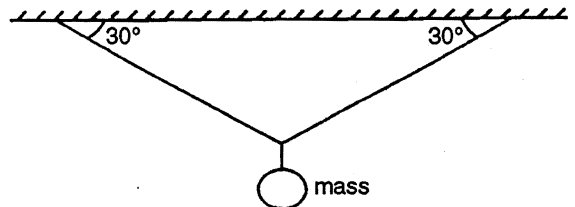
34 A cube of volume 0.080 m^3 is made of material of density 200 kg/m^3.

Calculate

(a) the mass of the cube,

(b) the weight of the cube.   N82/I/2

35 A mass of weight W is supported by two strings, as shown in the diagram. The tension in each string is 30 N.

By means of a scale diagram, find the result of the two tensions and hence the value of W.   J84/I/2

36 (a) A piece of metal pipe is 3.0 m long, and its internal and external diameters are 20.0 mm and 24.0 mm respectively.
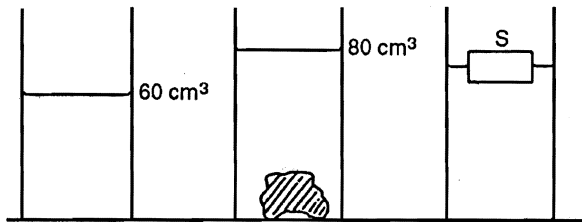
Calculate

(i)   the volume of metal in this piece of pipe,

(ii) the mass of the pipe, given that the density of the metal is 8 900 kg/m^3.   [Take $\pi = {}^{22}/_7$]

(b) Describe how you would obtain experimentally accurate values for (i), the internal diameter and (ii), the external diameter of a thick metal pipe (available in specimens of any length), the diameters of which are approximately the same as those of the pipe in (a).

Suggest a method for checking whether the thickness of the wall of the pipe is constant.   J85/II/1

37 A graduated vessel containing 60 cm³ of liquid weighs 0.80 N (Fig. i). When a stone is immersed in the liquid the total weight of the vessel and its contents is 1.24 N and the liquid level rises to the 80 cm³ mark (Fig. ii).

Total weight = 0.80 N   Total weight = 1.24 N

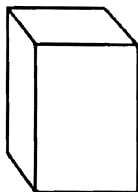**Fig. (i)**   **Fig. (ii)**   **Fig. (iii)**

Using these results calculate the density of the stone. [Take the weight of 1 kg to be 10 N].

Why is it not possible to use this simple method to find the density of a solid such as S which floats in the liquid (Fig. iii)?   J86/I/1

38 The diagram below shows an oil tank.

It contains 1.2 m³ of oil of density 800 kg/m³.

Calculate

(a) the mass of the oil,

(b) the weight of the oil,

***(c)* the pressure exerted by the oil on the horizontal base of the tank if the area of the base is 0.60 m².

[Take the force of gravity on 1 kg to be 10 N.]   N86/I/I

39 A rectangular block of metal is 50 mm long, 35 mm wide and has a thickness of 3.0 mm. It weighs 0.15 N. Calculate

(a) the volume of the piece of metal,

(b) the density of the metal. (Take the weight of 1 kg to be 10 N.)   J87/I/I

40 A can weighs 5 N empty and 35 N when completely full of petrol.

The capacity of the can is 4×10^{-3} m³ (4 litres).

Calculate

(a) the mass of petrol in the can when it is full (assume that the force of gravity acting on a mass of 1 kg is 10 N),   [2]

(b) the density of the petrol.   [2]
                                                J88/I/1

41 A measuring cylinder contains 30 cm³ of liquid. When a stone of weight 0.92 N is dropped into the liquid, it sinks to the bottom and the liquid level rises to the 70 cm³ graduation.

Taking the weight of 1 kg to be 10 N, calculate

(i)   the mass of the stone,   [1]

(ii) the density of the stone.   [2]

Explain why it would not be possible to use this method to determine the density of cork which would float in the liquid.   [1]
                                                N88/I/1

42 *(a)* When a block of metal is hung in air from a spring balance, the reading is 9.6 N.

  (i)   What is the weight of the block of metal?

  (ii) Assuming that the weight of a 1 kg mass is 10 N, what is the mass of the block of metal?   [2]
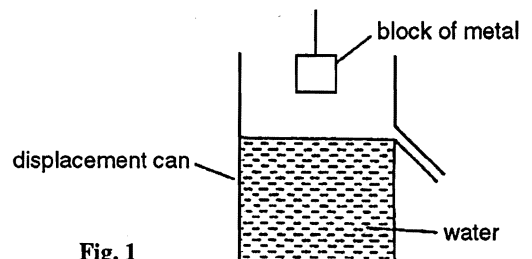
(b)

Fig. 1

Fig. 1 shows a displacement can which has been filled with water.

When the block of metal in *(a)* is lowered into the can until it is totally immersed in the water, 110 cm³ of water overflows. Calculate the density of the metal. [2]
                                                N89/I/1

43 *(a)* The mass of 600 spherical lead pellets is found to be 66 g and the total volume of the pellets is found to be 5.7 cm³. Calculate

  (i)   the total weight of the pellets,

  (ii) the volume of one pellet,

  (iii) the density of the pellets in kg/m³,

  (iv) the number of pellets which has a mass of 1.00 kg. [The force of gravity acting on a mass of 1.00 kg is 10.0 N.]   [7]
                                                J93/II/11(a)

44 *(a)* The acceleration of free fall near the surface of the Earth is 9.8 m/s².

The acceleration of free fall near the surface of the Moon is 1.6 m/s².

Calculate the weight of an object of mass 5.0 kg

(i)   near the surface of the Earth,

(ii) near the surface of the Moon.   N97/II/3(a)

ANSWERS

1. **E**   2. **B**   3. **C**   4. **B**   5. **D**
6. **D**   7. **E**   8. **E**   9. **B**   10. **B**
11. **C**   12. **B**   13. **C**   14. **B**   15. **C**
16. **D**   17. **B**   18. **C**   19. **B**   20. **B**
21. **C**   22. **B**   23. **B**   24. **B**   25. **D**
26. **D**   27. **C**   28. **B**   29. **B**   30. **C**
31. **A**   32. **B**

33. *(a)* 0.75 m   *(b)* 9000 N/m^2
34. *(a)* 16 kg   *(b)* 160 N
35. 30 N
36. *(a)* (i) 4.15×10^{-4} m^3 (ii) 3700 g
37. 0.0022 kg/cm^3
38. *(a)* 960 kg   *(b)* 9600 N   *(c)* 16 000 Pa
39. *(a)* 5.25 cm^3 *(b)* 2.86 g/cm^3
40. *(a)* 3 kg   *(b)* 7.5×10^2 kg/m^3
41. (i) 92 g   *(b)* 23 g/cm^3
42. *(a)* (i) 9.6 N   (ii) 960 g
    (b) 23 g/cm^3
43. *(a)* (i) 0.66 N   (ii) 9.5×10^{-3} cm^3
        (iii) 11 580 kg/m^3
44. *(a)* (i) 49 N   (ii) 8 N