Mass, Weight & Density

Question Paper

Level	O Level
Subject	Physics
Exam Board	Cambridge International Examinations
Unit	Newtonian Mechanics
Topic	Mass, Weight & Weight
Booklet	Question Paper

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**
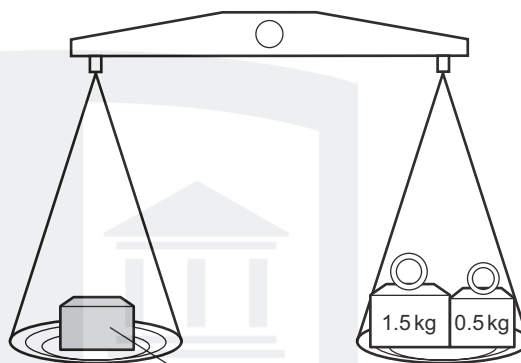
Grade Boundaries:

1 A brick is placed on a newton meter and then on a beam balance.
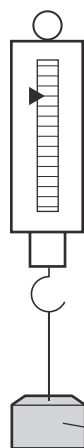
newton meter   beam balance

brick

brick   1.5 kg   0.5 kg
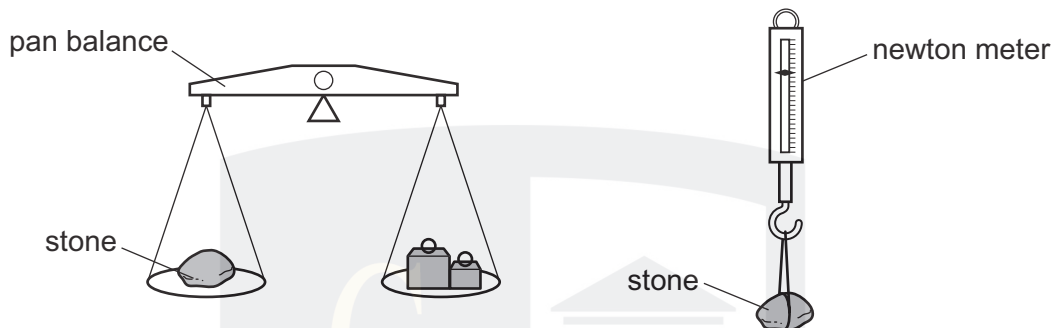
What is measured by each instrument?

	newton meter	beam balance
A	mass	mass
B	mass	weight
C	weight	mass
D	weight	weight

2 Which property of a body resists change from a state of rest or of motion?

A   density

B   mass

C   volume

D   weight

3   The mass of a stone is found on Earth using a pan balance. The weight of the stone is found using a newton meter.

Are the readings the same or different on the Moon?

|	reading on pan balance	reading on newton meter
A	different	different
B	same	different
C	different	same
D	same	same

4   The table shows the weights and masses of four objects on different planets.

On which planet is the gravitational field strength the largest?

	weight/N	mass/kg
A	2.0	20
B	4.0	30
C	6.0	40
D	8.0	50

5   The mass and volume of four different objects are plotted as shown.

Which object has the smallest density?
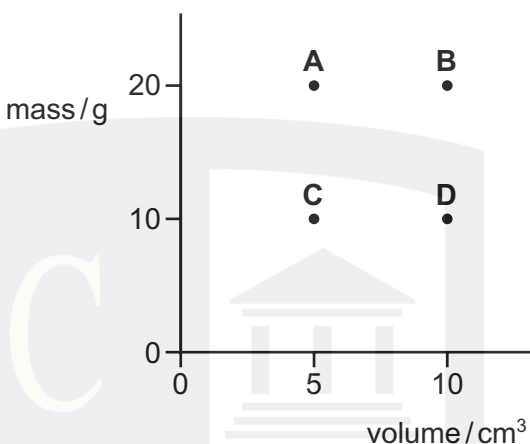

6   Which statement about mass is correct?

   A   Mass is density divided by volume.

   B   Mass is the amount of space occupied by a body.

   C   Mass is weight multiplied by the gravitational field strength.

   D   Mass resists a change in motion.

7   A student produces some revision notes on gravity, mass and weight.

Which statement is **not** correct?

   A   A gravitational field is a region in which a mass experiences a gravitational force.

   B   Gravitational field strength has the unit of N/kg.

   C   Mass is a measure of the amount of matter.

   D   Mass is equal to weight multiplied by gravitational field strength.

8   Two cylinders P and Q are made of copper.

                                  P   Q
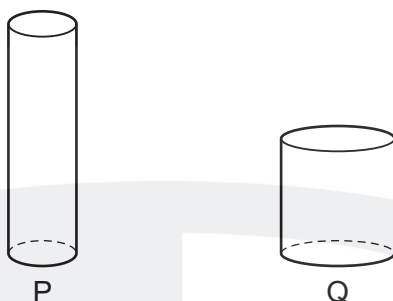
The height of P is twice the height of Q. The diameter of P is half the diameter of Q.

Which statement is correct?

A   The density of cylinder P is four times that of cylinder Q.

B   The density of cylinder P is twice that of cylinder Q.

C   The density of cylinder P is equal to that of cylinder Q.

D   The density of cylinder P is half that of cylinder Q.

9   Four objects are situated in places with different gravitational field strengths.

Which object has the greatest weight?

	mass kg	gravitational field strength N/kg
A	3.0	10.4
B	3.5	9.5
C	4.0	10.2
D	4.5	9.0

10 Four rocks on different planets have masses and weights as shown.

Which planet has the greatest gravitational field strength?

	mass/kg	weight/N
A	2.0	14
B	2.5	20
C	3.0	21
D	3.5	19

11 A stone has a mass of 390 g and a density of $2.7\,g/cm^3$.

Cooking oil has a density of $0.90\,g/cm^3$.

Which mass of oil has the same volume as the stone?

A   130 g   **B**   160 g   **C**   900 g   **D**   1200 g

12 A scientist places a rock on a spring balance. She then places the same rock on a beam balance.

At the North Pole, the gravitational field strength is greater than at the Equator.

She performs the experiment at the North Pole and at the Equator.

How do the readings at the North Pole compare with those at the Equator?

	scale reading on spring balance	masses needed on beam balance
A	different at North Pole	different at North Pole
B	different at North Pole	same at North Pole
C	same at North Pole	different at North Pole
D	same at North Pole	same at North Pole

13 A boy stands on some bathroom scales. The reading on the scales is 50 kg.

What is the mass and what is the weight of the boy?

|	mass	weight
A	50 kg	50 N
B	50 kg	500 N
C	5.0 N	50 kg
D	50 N	5.0 kg

14 Two identical beakers contain the same mass of liquid. There is a different liquid in each beaker.
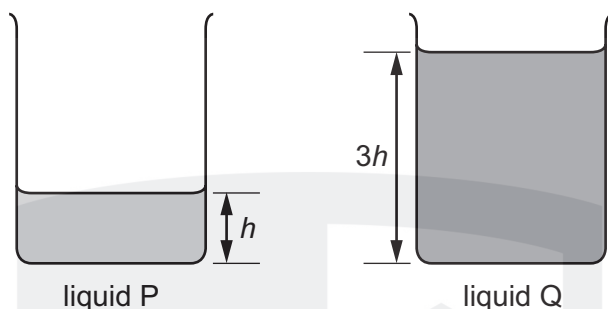
liquid P   liquid Q

Liquid Q has a density ρ.

What is the density of liquid P?

A $\dfrac{\rho}{3}$ **B** ρ **C** 3ρ **D** 9ρ

15 Paper is sold in packets labelled $80\,g/m^2$. This means that a sheet of paper of area $10\,000\,cm^2$ has a mass of $80\,g$.

The thickness of each sheet is $0.11\,mm$.

What is the density of the paper?

A $0.073\,g/cm^3$ **B** $0.088\,g/cm^3$ **C** $0.73\,g/cm^3$ **D** $0.88\,g/cm^3$

16 A measuring cylinder contains $20\,cm^3$ of water. A stone is placed in the water and the water level rises to $38\,cm^3$.
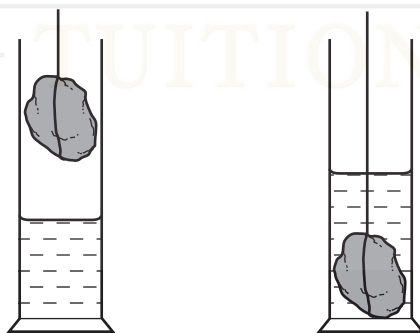
What is the volume of the stone?

A $18\,cm^3$ **B** $29\,cm^3$ **C** $38\,cm^3$ **D** $58\,cm^3$

17   A spacecraft travels from the Earth to the Moon.

At a certain point in the journey, it has zero weight.

Why is the weight zero at this point?

A   The gravitational fields of the Earth and the Moon cancel each other.

B   The spacecraft leaves the Earth's gravitational field.

C   The spacecraft stops moving.

D   There is no air resistance on the spacecraft.

18   The weight of a cylinder on the Moon is less than its weight on the Earth.

How do the gravitational field strength and the mass of the cylinder on the Moon compare with their values on the Earth?

	gravitational field strength on Moon	mass on Moon
A	the same	less
B	the same	the same
C	less	the same
D	zero	zero

19   A block of metal is taken from the Earth to the Moon. Which property of the block changes?

A   density

B   mass

C   volume

D   weight

2**0**   The mass of a paper-clip is $0.50\,g$ and the density of its material is $8.0\,g\,/\,cm^3$. The total volume of a number of clips is $20\,cm^3$.

How many paper-clips are there?

A   80   **B**   160   **C**   240   **D**   320

21 The mass and the volume of a bar made from metal X are measured.

The masses and volumes of four other bars are measured.

Which bar is made from a metal with a density that is double that of X?

|	mass compared with X	volume compared with X
A	double	half
B	half	same
C	same	double
D	same	half

22 A student collects stones and finds their density.

Which apparatus is needed to measure the mass and the volume of the stones?

	mass	volume
A	newton meter	measuring cylinder and water
B	newton meter	ruler and calipers
C	top-pan balance	measuring cylinder and water
D	top-pan balance	ruler and calipers

23   The weight of a stone is found using a newton meter, and its mass is found using a pan balance.

stone   stone

newton meter   pan balance
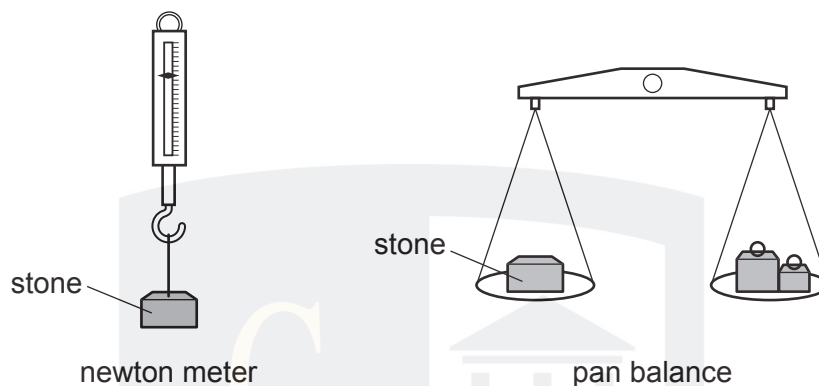
The experiment is carried out on the Earth and on the Moon.

For each meter, is its reading the same or different on the Earth and on the Moon?

	reading on newton meter	reading on pan balance
A	different	different
B	different	same
C	same	different
D	same	same

24   A passenger is sitting in an aeroplane, which takes off and climbs to 10 000 m.

During this time, what happens to the mass and to the weight of the passenger?

|	mass	weight
A	decreases	decreases
B	increases	increases
C	unchanged	decreases
D	unchanged	increases

25 A person of weight 600 N at the bottom of a mountain climbs to the top. The gravitational field strength changes from 10.00 N/kg at the bottom to 9.97 N/kg at the top. His mass is unchanged as he climbs.

What are his mass and his weight at the top of the mountain?

	mass at top of mountain/kg	weight at top of mountain/N
A	60.0	598
B	60.0	600
C	60.1	598
D	60.1	600

26 A box has an internal volume of 1000 cm^3. When a solid object is placed in the closed box, the volume of air in the box is 520 cm^3.

The density of the object is 8.00 g/cm^3.

air

solid object
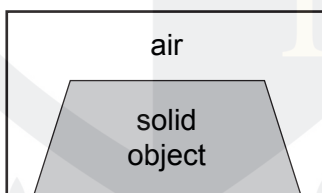
What is the mass of the object?

A   60.0 g   B   3840 g   C   4160 g   D   8000 g

27 A measuring cylinder contains 118 cm^3 of water. When a small object is fully immersed in the water, the reading goes up to 132 cm^3. The object has a mass of 42 g.
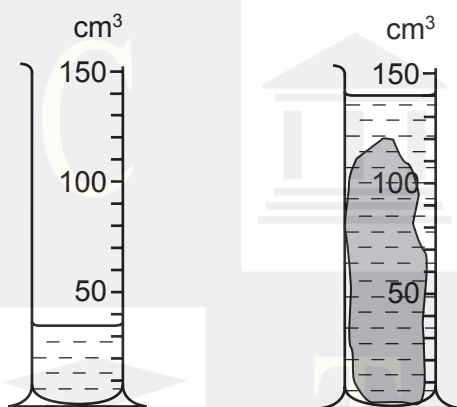
What is the density of the object?

A $\frac{14}{42}$ g/cm^3 B $\frac{42}{14}$ g/cm^3 C $\frac{42}{118}$ g/cm^3 D $\frac{132}{42}$ g/cm^3

28 A room measures $4.0\,\text{m} \times 3.0\,\text{m} \times 2.0\,\text{m}$. The density of the air in the room is $1.3\,\text{kg}/\text{m}^3$.

What is the mass of air in the room?

A 0.054 kg   **B** 18 kg   **C** 24 kg   **D** 31 kg
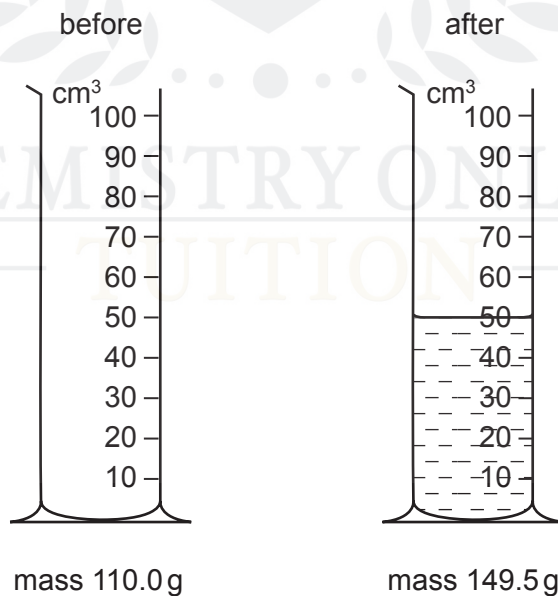
29 A lump of metal has a mass of 210 g. It is lowered into a measuring cylinder containing water. The level of the water rises from $35\,\text{cm}^3$ to $140\,\text{cm}^3$.

What is the density of the metal?

A $0.67\,\text{g}/\text{cm}^3$ **B** $1.5\,\text{g}/\text{cm}^3$ **C** $2.0\,\text{g}/\text{cm}^3$ **D** $6.0\,\text{g}/\text{cm}^3$

30 The mass of a measuring cylinder is measured before and after pouring a liquid into it.

mass 110.0 g   mass 149.5 g

What is the density of the liquid?

A $0.79\,\text{g}/\text{cm}^3$ **B** $1.3\,\text{g}/\text{cm}^3$ **C** $1.4\,\text{g}/\text{cm}^3$ **D** $2.2\,\text{g}/\text{cm}^3$

31   A student does an experiment to estimate the density of an irregularly-shaped stone.

Which items of equipment are needed?

A   a balance and a measuring cylinder containing water

B   a balance and a ruler

C   a ruler and a measuring cylinder containing water

D   only a measuring cylinder containing water

32   A body of mass 10 kg falling freely in the gravitational field close to the Moon's surface has an acceleration of $1.6\,m/s^2$.

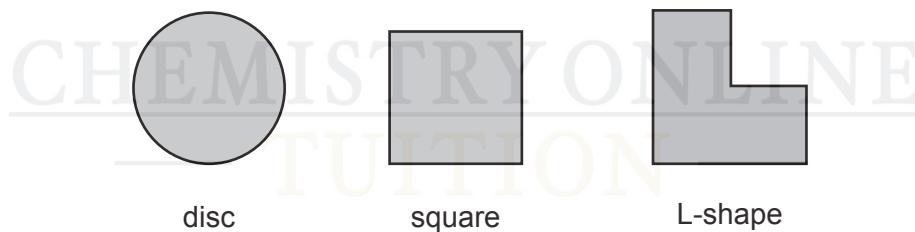What is the gravitational field strength on the Moon?

A $0\,N/kg$ **B** $1.6\,N/kg$ **C** $10\,N/kg$ **D** $16\,N/kg$

33   The inertia of a body is its resistance to changes in motion.

Which property is a measure of the body's inertia?

A   its density

B   its mass

C   the height of its sides

D   the size of its base

34 An object of mass 100 g is immersed in water as shown in the diagram.
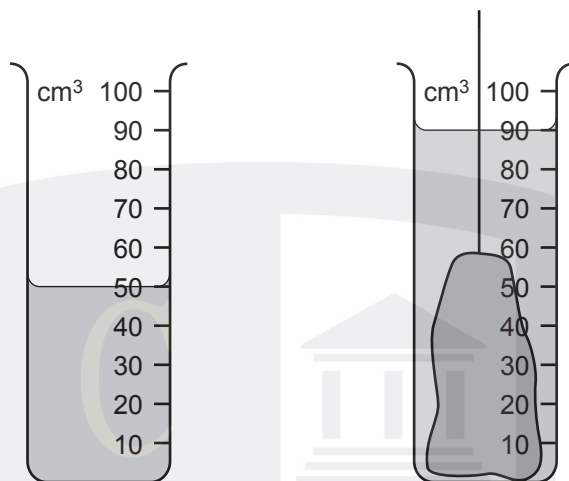
What is the density of the material from which the object is made?

A $0.4\,g/cm^3$

B $0.9\,g/cm^3$

C $1.1\,g/cm^3$

D $2.5\,g/cm^3$

35 Three objects are cut from the same sheet of steel. They are different shapes but they all have the same mass.

disc   square   L-shape

Which object has the greatest density?

A   the disc

B   the L-shape

C   the square

D   they all have the same density

36 At a point on the surface of the Earth, the gravitational field strength is 9.8 N/kg.

Which pair of values for mass and weight are correct for an object placed at this point?

	mass/kg	weight/N
A	9.8	10
B	10	9.8
C	10	98
D	98	10

37 Some students measure the masses and the volumes of different sized samples of a type of wood.
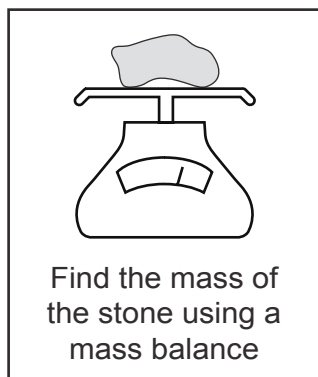
Which graph shows their results?
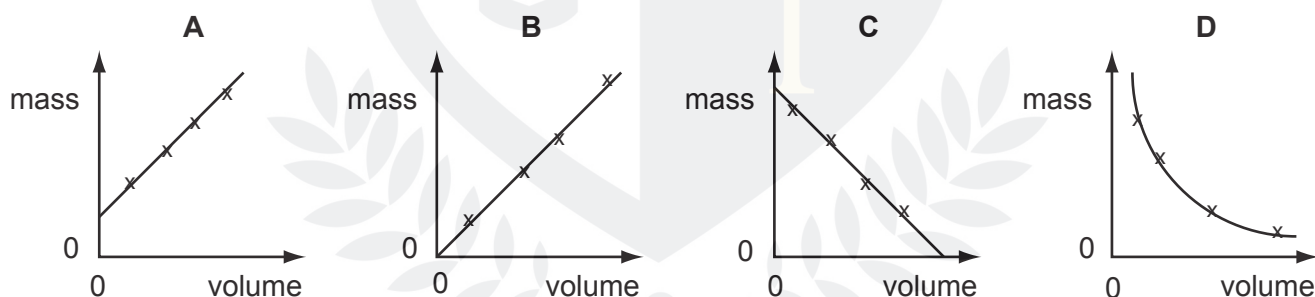
38 An object that has a mass of 15 kg on the Earth is taken to the Moon.

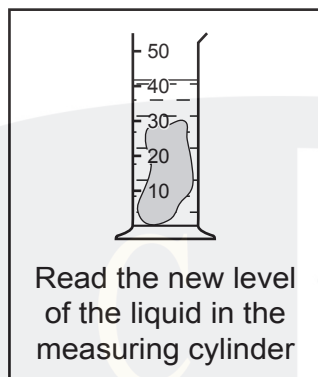The gravitational field strength on the Earth is 10 N/kg and on the Moon is 1.6 N/kg.

What are the mass and the weight of the object on the Moon?

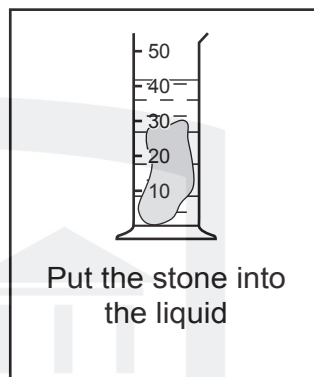|	mass/kg	weight/N
A	15	24
B	15	150
C	24	15
D	150	24

39 A student is trying to find the density of a stone, but he has mixed up the instruction cards.

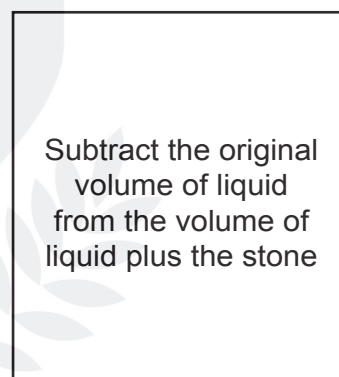|			
Find the mass of the stone using a mass balance	Read the new level of the liquid in the measuring cylinder	Put the stone into the liquid	Divide the mass of the stone by its volume to find the density
Card 1	**Card 2**	**Card 3**	**Card 4**

Put some liquid into a measuring cylinder and read the level of the liquid	Flick the cylinder to get rid of any air bubbles	Subtract the original volume of liquid from the volume of liquid plus the stone
Card 5	**Card 6**	**Card 7**

What order should the cards be in?

A $5 \rightarrow 3 \rightarrow 6 \rightarrow 2 \rightarrow 1 \rightarrow 4 \rightarrow 7$

B $1 \rightarrow 5 \rightarrow 3 \rightarrow 6 \rightarrow 2 \rightarrow 7 \rightarrow 4$

C $5 \rightarrow 6 \rightarrow 3 \rightarrow 2 \rightarrow 1 \rightarrow 7 \rightarrow 4$

D $1 \rightarrow 4 \rightarrow 5 \rightarrow 3 \rightarrow 6 \rightarrow 2 \rightarrow 7$
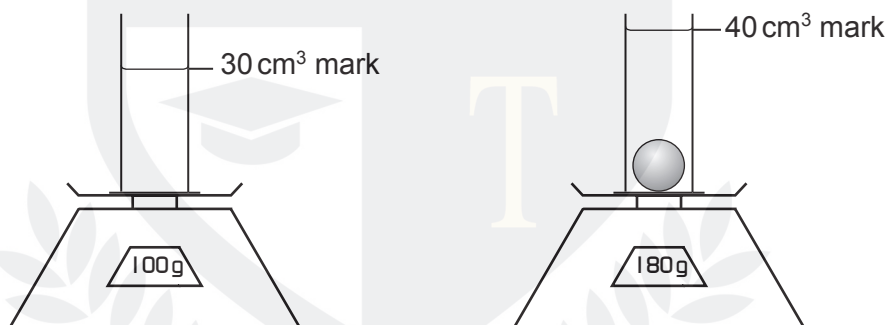
40   Which relationship defines gravitational field strength?

    A   mass x 10

    B   mass x weight

    C   mass / weight

    D   weight / mass

41   A measuring cylinder containing some water stands on a scale pan. A solid ball is lowered into the water.

The water level rises from the $30\,cm^3$ mark to the $40\,cm^3$ mark.
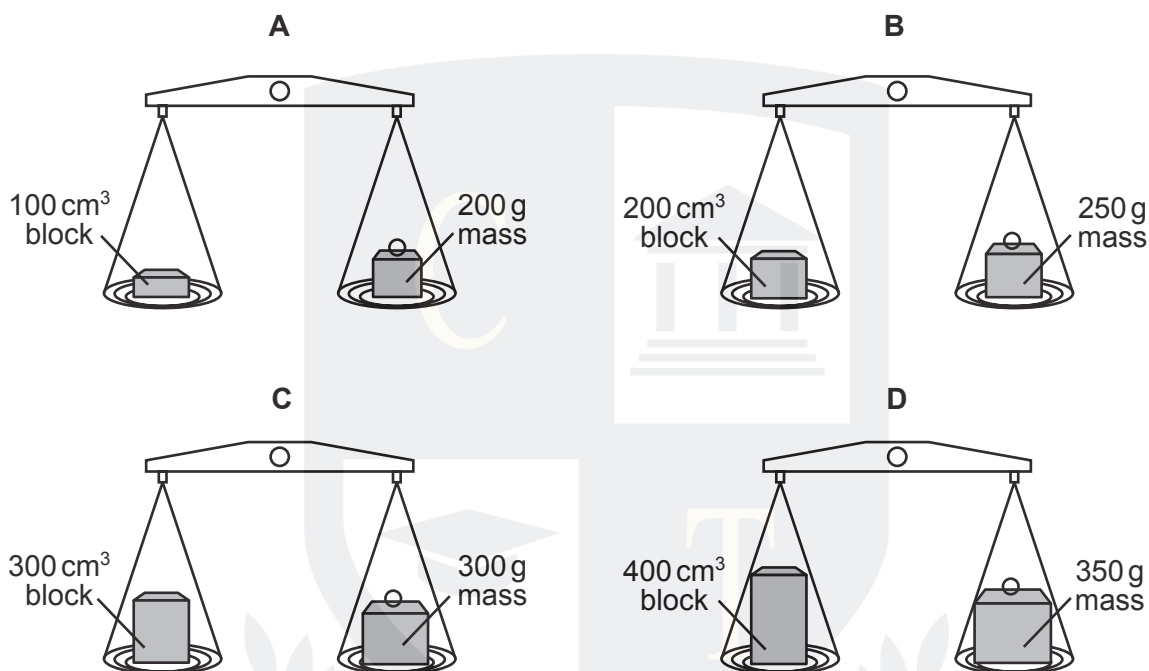
The scale reading increases from $100\,g$ to $180\,g$.

What is the density of the material of the ball?

A $2.0\,g/cm^3$ **B** $4.5\,g/cm^3$ **C** $8.0\,g/cm^3$ **D** $18\,g/cm^3$

42 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams below.

In which diagram does the block have the greatest density?

A

100 cm³ block   200 g mass

B

200 cm³ block   250 g mass

C

300 cm³ block   300 g mass

D

400 cm³ block   350 g mass

43 On the Earth, the gravitational field strength is 10 N/kg. On the Moon, the gravitational field strength is 1.6 N/kg.

If an object has a weight of 50 N on Earth, what is its weight on the Moon?

A   1.6 N   B   5.0 N   C   8.0 N   D   80 N

44 Ten identical steel balls, each of mass 27 g, are immersed in a measuring cylinder containing 20 cm³ of water.

The reading of the water level rises to 50 cm³.

What is the density of the steel?

A   0.90 g/cm³   B   8.1 g/cm³   C   9.0 g/cm³   D   13.5 g/cm³

45 A box **X** full of large granite rocks is weighed. An identical box **Y** full of small granite chippings is then weighed.

X   Y

large granite rocks   small granite chippings
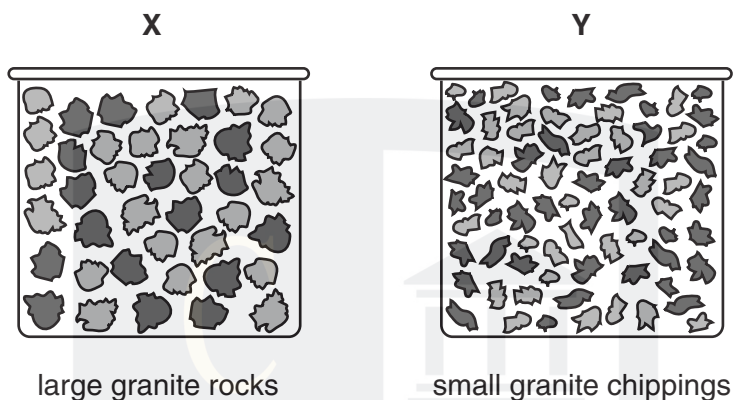
Which box weighs more and why?

	heavier box	reason
A	**X**	there is more air in box **X**
B	**X**	the density of a chipping is less than a rock
C	**Y**	there is less air in box **Y**
D	**Y**	the density of a chipping is greater than a rock