Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

STEM | Exam Builder

Mass, weight and density

Time allowed: 1 hour 35 minutes

Subject code **0625**

Physics

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 84

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 84 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

STEM | Exam Builder

Print at 100% (Actual size) so diagrams keep their real measurements.

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

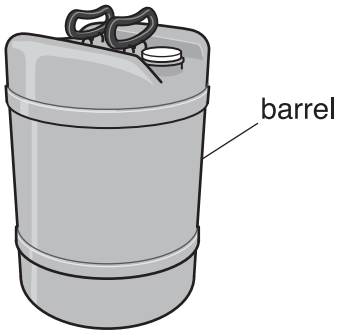


Fig. 1.1

(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]

Density Click for more variations

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1(a)	density = mass ÷ volume in any form OR (mass =) density × volume	**C1**
	mass = 1000 × 0.05	**C1**
	50 (kg)	**A1**
1(b)	Floats OR does not sink	**M0**
	density of full barrel OR its density OR density of plastic OR density of barrel OR density of (pure) water is less than sea water	**C1**
	density of plastic OR barrel AND (pure) water is less than sea water	**A1**

STEM | Exam Builder

2 **(a)** The mass of 35 cm^3 of mercury is measured as 476 g.

Calculate the density of mercury. Give the unit.

density = ... [4]

(b) The density of water is much less than the density of mercury.

How does the mass of 35 cm^3 of water compare with the mass of 35 cm^3 of mercury?

Tick one box.

mass of water is less than mass of mercury	☐
mass of water is the same as mass of mercury	☐
mass of water is greater than mass of mercury	☐

[1]

(c) The mercury in a thermometer expands when it is heated.

(i) What happens to the mass of the mercury? Tick one box.

decreases	☐
stays the same	☐
increases	☐

(ii) What happens to the density of the mercury? Tick one box.

decreases	☐
stays the same	☐
increases	☐

[2]

[Total: 7]

Density Click for more variations

STEM | Exam Builder

2	**(a)**	(D =) mass/volume	C1
		476/35	C1
		13.6 OR 13 600	A1
		g/cm^3 OR kg/m^3	B1
		note: if value calculated, unit must agree with value)	
	(b)	top box ticked (mass of water is less than mass of mercury)	B1
	(c) **(i)**	middle box ticked (stays the same)	B1
	(ii)	top box ticked (decreases)	B1

[Total: 7]

STEM | Exam Builder

3 **(a)** A student determines the volume of a piece of metal. The student pours 30 cm^3 of water into a measuring cylinder. The piece of metal is submerged in the water and the new volume reading on the measuring cylinder is 42 cm^3.

Calculate the volume of the piece of metal.

volume = ... cm^3 [1]

(b) The mass of another piece of metal is 320 g. The volume of the piece of metal is 40 cm^3. Calculate the density of the metal. Give the correct unit.

density = ...

unit .....
[4]

(c) The student drops the piece of metal into a tank of water. Two vertical forces act on the piece of metal as it falls through the water in the tank.
On Fig. 2.1, each arrow represents a vertical force.

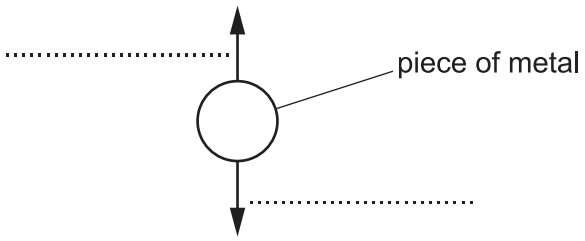


Fig. 2.1

(i) Complete the diagram in Fig. 2.1 by labelling the two forces. [2]

(ii) The upward force is the same size as the downward force.

Describe the motion of the piece of metal as it falls through the water.

..... [1]

[Total: 8]

Density Click for more variations

STEM | Exam Builder

3(a)	(42 – 30 =) 12 (cm^3)	**B1**
3(b)	(ρ =) 8(.0)	**A3**
	(ρ =) 320 ÷ 40	(C2)
	(density =) mass ÷ volume **OR** (ρ =) m / V in any form	(C1)
	g / cm^3	**B1**
3(c)(i)	friction / drag (upward arrow)	**B1**
	weight (downward arrow)	**B1**
3(c)(ii)	(falling with) {constant / steady / uniform} speed	**B1**

4 **(a)** Fig. 2.1 shows a brick.

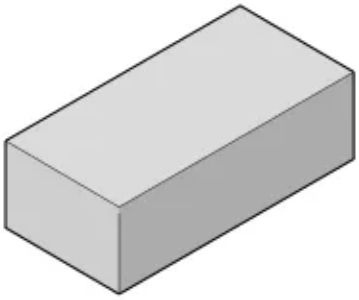


Fig. 2.1

500 bricks like the one shown in Fig. 2.1 are stacked on a wooden platform, known as a pallet. The pallet of bricks is to be loaded on to a lorry by means of a fork-lift truck, as shown in Fig. 2.2.



Fig. 2.2

Each brick has a volume of $0.0012\,m^3$ and is made of a material of density $2300\,kg/m^3$.

(i) Calculate the mass of one brick.

mass = ... kg [3]

(ii) The fork-lift truck can safely lift a load of mass 2 tonnes (2000 kg). The wooden pallet has a mass of 100 kg.

1. Calculate the total mass of the pallet and 500 bricks.

total mass = ... kg

2. Is it safe for the fork-lift truck to lift the total mass of the pallet and 500 bricks?

yes ☐

no ☐

[3]

(b) The brick shown in Fig. 2.3 has the same dimensions as the brick in Fig. 2.1 and is made of the same material. However, this brick has a hollow in one face.

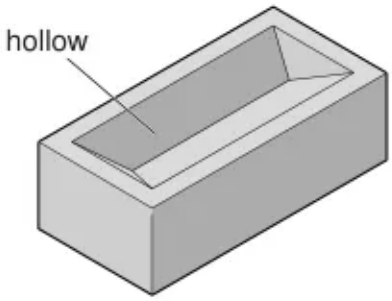


Fig. 2.3

Complete the following sentences.

(i) The density of the brick in Fig. 2.3 is ..... the density of the brick in Fig. 2.1, because .....

.....

(ii) The mass of the brick in Fig. 2.3 is ..... the mass of the brick in Fig. 2.1.

[2]

[Total: 8]

Density Click for more variations

4	**(a)**	**(i)**	D = M / V in any form OR D × V	C1
			2300 × 0.0012	C1
			2.76 OR 2.8 (kg)	A1
		(ii)	(mass of bricks =) 500 × 2.76 OR 500 × candidate's **(a)(i)**	C1
			(total mass =) 1480 OR e.c.f. candidate's **(a)(i)**	C1
			yes / no ticked (expect yes), must be compatible with candidate's total mass	A1
	(b)	**(i)**	the <u>same</u> because made of <u>same material</u>	B1
		(ii)	less than OR equivalent answer	B1

[Total: 8]

STEM | Exam Builder

5 A builder buys some tiles to repair a floor. He checks that the new tiles are the same size as the tiles on the floor.

The dimensions of the tiles on the floor are 25 cm × 20 cm × 0.30 cm.

The new tiles are shown in Fig. 2.1.

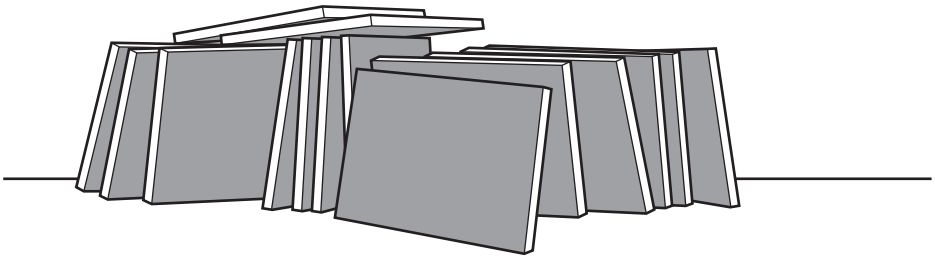


Fig. 2.1

(a) (i) State the name of a suitable instrument for measuring the length and width of each tile.

..... [1]

(ii) Describe how to determine the average thickness of **one** new tile.

.....

.....

..... [3]

(b) The dimensions of a tile are 25 cm × 20 cm × 0.30 cm.

The mass of the tile is 410 g.

(i) Calculate the volume of the tile.

volume = ... cm^3 [1]

(ii) Calculate the density of the tile. Include the unit in your answer.

density = ... unit ..... [4]

(iii) Calculate the weight of the tile.

weight = ... N [3]

[Total: 12]

Density Click for more variations

STEM | Exam Builder

5(a)(i)	rule(r) / metre stick / tape measure	**B1**
5(a)(ii)	place n tiles on top of each other owtte AND n = 10 or more	**B1**
	measure the (total) thickness of more than one tile	**B1**
	divide by n AND n = 2 or more	**B1**
5(b)(i)	(volume =) (25 × 20 × 0.30 =) 150 (cm^3)	**B1**
5(b)(ii)	2.7	**A3**
	410 ÷ 150 OR 410 ÷ (their ans **(b)(i)**)	(C2)
	density = mass ÷ volume in any form	(C1)
	g / cm^3	**B1**
5(b)(iii)	4.1(0) (N)	**A3**
	0.41(0)	(C1)
	(W =) m × g OR m × 10 in any form	(C1)

STEM | Exam Builder

6 Table 2.1 contains information about the planet Mars.

Table 2.1

mass	6.4×10^{23} kg
gravitational field strength at surface	3.7 N / kg
average density	3900 kg / m^3

(a) Define gravitational field strength.

.....

..... [1]

(b) **(i)** An object has a weight of 42 N at the surface of the Earth.

Calculate the weight of the object at the surface of Mars.

weight = ... [2]

(ii) Calculate the volume of Mars.

volume = ... [2]

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(c) Fig. 2.1 shows a space buggy that is tested on Earth. The buggy is travelling at a constant speed in a straight line. The driving force on the buggy is 30 N.

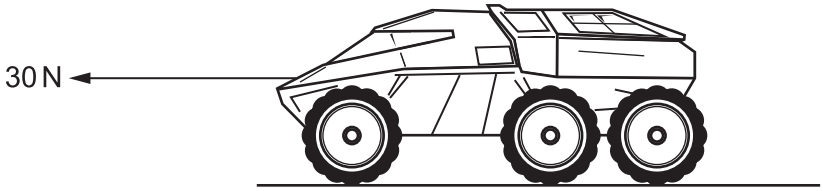


Fig. 2.1

(i) Draw and label **one** arrow on Fig. 2.1 to show the size and direction of the resistive forces on the buggy. [2]

(ii) Air resistance on Mars is less than air resistance on Earth.
The same driving force, 30 N, is exerted on the buggy on Mars.

1. State the effect this has on the resultant force on the buggy on Mars.

.....

2. State the relationship between resistive forces, driving force and resultant force.

.....
[1]

[Total: 8]

Mass and weight Click for more variations

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6(a)	(gravitational field strength is) force per unit mass (on an object in a gravitational field)	**B1**
6(b)(i)	16 N	**A2**
	$W = mg$ **OR** (m =) $W \div g$ **OR** 42 / 9.8 **OR** (mass of object =) 4.3 (kg)	C1
6(b)(ii)	1.6×10^{20} m^3	**A2**
	$(V =)\ m / \rho$ **OR** $(V =)$ $6.4 \times 10^{23} / 3900$	C1
6(c)(i)	arrow parallel to driving force **AND** pointing to the right	**B1**

6(c)(i)	(arrow pointing to the right) labelled 30 N	**B1**
6(c)(ii)	1 (resultant force) increases **OR** there is a resultant force (in the direction of the driving force) **OR** 2 resultant force = driving force – resistive force(s)	**B1**

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7 **(a)** Oil of density 0.80 g / cm^3 is poured gently onto the surface of water of density 1.0 g / cm^3. The oil and the water do **not** mix.

Describe and explain the final position of the oil relative to the water.

description .....

.....

explanation .....

.....

[2]

(b) An irregularly shaped solid object has a density of 2.7 g / cm^3.

(i) Describe a method to measure the volume of the irregularly shaped solid object.

.....

.....

..... [2]

(ii) The volume of the object is 83 cm^3.

Calculate the mass of the object.

mass = ... [3]

[Total: 7]

Density Click for more variations

STEM | Exam Builder

7(a)	(oil) stays on surface / floats on the water	**B1**
	(oil has) lower density than water **OR** liquids of lower density float on liquids of higher density	**B1**
7(b)(i)	measure (initial) volume of liquid / water AND immerse object **OR** immerse object in a known / measured volume of liquid / water	**B1**
	subtract initial / start volume from final / new volume **OR** calculate the difference in volume **OR** measure change in volume	**B1**
	OR (alternative answer)	
	fill displacement can / container with water **AND** immerse object	**(B1)**
	measure volume of displaced water	**(B1)**
7(b)(ii)	220 g	**A3**
	$\rho = m / V$ **OR** $(m =) \rho V$ **OR** 2.7×83	C1
	$(m =) 2.7 \times 83$ **OR** 2.2×10^{n}	C1

STEM | Exam Builder

8 Fig. 3.1 shows remote sensing equipment on the surface of a distant planet.

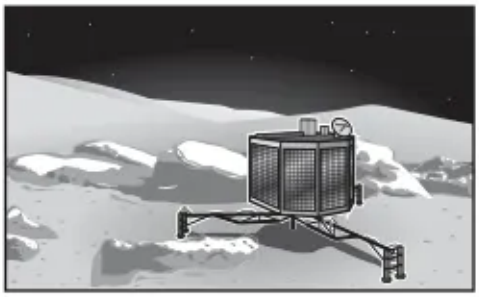


Fig. 3.1

(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]

Density Click for more variations

8(a)(i)	(Weight is) force/pull of gravity (acting on an object)	**B1**
8(a)(ii)	Mass × acceleration due to gravity OR mg OR 350 × 7.5	**C1**
	2600 N	**A1**
8(b)	(ρ =) m / V in any form	**C1**
	0.27 (kg / m^3) OR 270 (g / m^3)	**A1**
	Balloon moves/floats up	**B1**
	(Floats when) density of balloon less than density of atmosphere OR (sinks when) density of balloon greater than atmosphere	**B1**
	OR (ρ =) m / V in any form	**(C1)**
	110 g	**(A1)**
	Balloon rises	**(B1)**
	(Floats when) mass/weight of balloon less than mass/weight of atmosphere (of same volume as balloon) (Sinks when) mass/weight of balloon greater than mass/weight of atmosphere (of same volume as balloon)	**(B1)**
	Total:	**7**

STEM | Exam Builder

9 A student determines the density of a block of wood.

(a) Fig. 1.1 shows one face of the block of wood that the student uses.

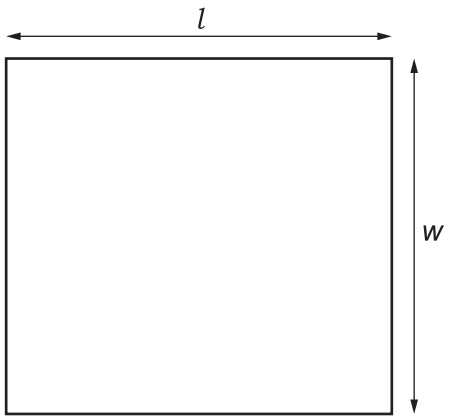


Fig. 1.1

(i) Measure the length l and width w of the block of wood. Fig. 1.1 is drawn actual size.

l = ... cm

w = ... cm
[1]

(ii) The student measures the height h of the block of wood.

h = 4.0 ..... cm

Calculate the volume V of the block of wood using the equation $V = l \times w \times h$.

V = ... cm^3 [1]

(iii) The student measures the mass m of the block of wood on a balance.

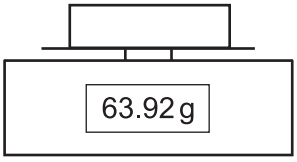


Fig. 1.2

Write down the mass m of the block as shown in Fig. 1.2. Give your answer to the nearest gram.

m = ... g [1]

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(iv) Calculate the density ρ of the wood using the equation $\rho = \frac{m}{V}$. Give your answer to a suitable number of significant figures for this experiment and include the unit.

ρ = ... [2]

(b) The student places the block of wood carefully in water in a glass dish. The wood floats as shown in Fig. 1.3.

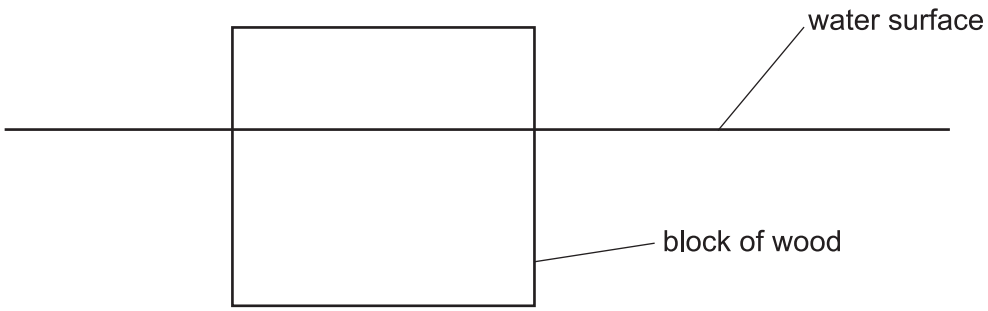


Fig. 1.3

(i) Using Fig. 1.3, estimate, without taking a measurement, the volume V_1 of wood that is below the water surface.

V_1 = ... cm^3 [1]

(ii) Calculate m_W, the mass of water with volume V_1, using the equation $m_W = \rho_W \times V_1$, where $\rho_W = 1.00$ in the same units as ρ in part **(a)(iv)**.

m_W = ... [1]

(c) A student suggests that the mass m of the block of wood should be equal to the mass m_W of the water with volume V_1.

(i) Calculate the difference d between your values of m and m_W.

d = ... [1]

(ii) Discuss whether the difference d is small enough to conclude that $m = m_W$.

.....

.....

..... [1]

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(d) Another student wants to obtain a more accurate value for V_1. He uses the method of floating the block of wood in water as described in **(b)**.

Suggest how the student could obtain a more accurate value by taking a measurement.

.....

.....

..... [2]

[Total: 11]

Density Click for more variations

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9(a)(i)	l = 5.1 (cm) and w = 4.7 (cm)	**1**
9(a)(ii)	V = 95.88 (cm^3)	**1**
9(a)(iii)	64 (g)	**1**
9(a)(iv)	ρ to 2 or 3 significant figures	**1**
	unit g / cm^3	**1**
9(b)(i)	estimate of V_1 given to the nearest cm^3 and > ½V < V	**1**
9(b)(ii)	m_W numerically equal to V_1	**1**
9(c)(i)	d = candidate's **(a)(iii)** – **(b)(ii)** correct	**1**
9(c)(ii)	YES/NO and suitable comparison of d with m or m_W	**1**
9(d)	(float wood and) mark water level / remove and mark the water level	**1**
	measure submerged depth and multiply by the cross-sectional area	**1**
	OR	
	measure height of block that is not submerged	(1)
	multiply by the cross-sectional area then subtract from total volume of block.	(1)
	OR	
	use of a measuring cylinder / displacement can	(1)
	measure the volume of water displaced (by the floating block)	(1)

STEM | Exam Builder

10 A student determines the density of a ball.

(a) He places the ball between two wooden blocks, as seen from above in Fig. 1.1.

He takes two measurements, d_1 and d_2.

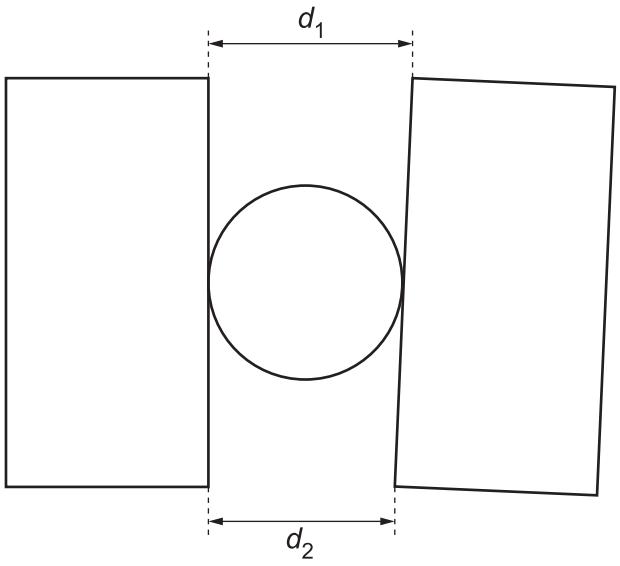


Fig. 1.1

(i) On Fig. 1.1, measure the lengths d_1 and d_2.

d_1 = ... cm

d_2 = ... cm
[1]

(ii) Using your measurements, calculate the diameter d of the ball. Show your working.

d = ... cm [1]

(iii) Explain why this method is used to measure the diameter of the ball.

.....

..... [2]

(b) Calculate the volume V of the ball using the equation $V = 0.52d^3$.

Include the unit.

V = ... [2]

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(c) The student measures the mass m_D of a dish.

m_D = 102.5 g

He places the ball in the dish and measures the combined mass m_C of the dish and the ball.

Fig. 1.2 shows the dish and the ball on a balance.

Record the reading shown on the balance.

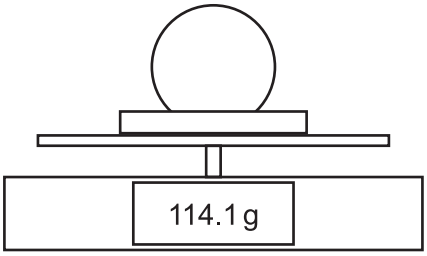


Fig. 1.2

m_C = ... g

Calculate the mass m_B of the ball. Show your working.

m_B = ... g
[2]

(d) Calculate the density ρ of the ball using the equation:

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

Give your answer to a suitable number of significant figures for this experiment. Include the unit.

ρ = ... [3]

[Total: 11]

Density Click for more variations

STEM | Exam Builder

10(a)(i)	two measurements in cm 2.7 and 2.5, both given to nearest mm	**1**
10(a)(ii)	correct average: expect 2.6 (cm)	**1**
10(a)(iii)	any reasonable advantage for the method in the question given **OR** it is difficult to measure the diameter directly **OR** hard to find centre of ball	**1**
	a ruler for measuring the diameter directly would give rise to parallax errors	**1**
10(b)	V = 9.1(4)	**1**
	unit: cm^3	**1**
10(c)	correct **method** for calculation of m_B shown	**1**
	m_B = 11.6 (g)	**1**
10(d)	ρ on answer line correctly calculated to 2 or more significant figures	**1**
	unit: g / cm^3	**1**
	answer given to 2 or 3 significant figures	**1**

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