1 An archaeologist digging at an ancient site discovers a spoon. The spoon is made from an unidentified material.

(a) The archaeologist suspects that the spoon is made of metal. She places it above a flame, as shown in Fig. 1.1.

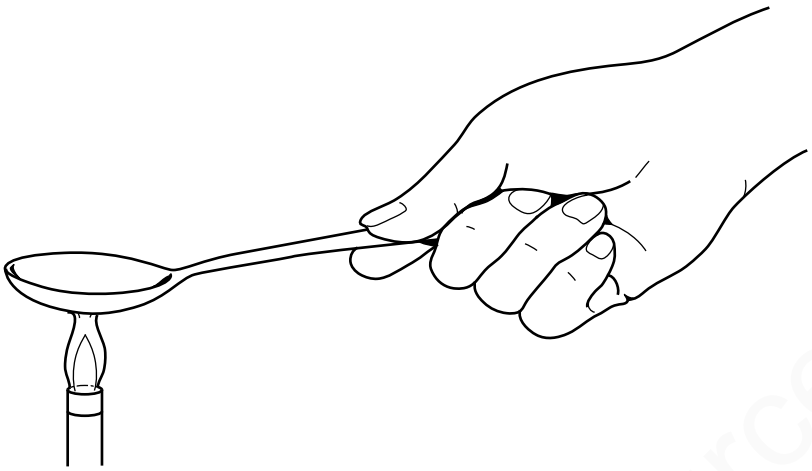

Fig. 1.1

(i) She notices that the handle of the spoon quickly becomes very hot.

State why this observation supports the suggestion that the spoon is made of metal.

.....

..... [1]

(ii) Describe, in terms of its atoms, how thermal energy is transferred through a metal.

.....

.....

.....

.....

..... [3]

(b) The archaeologist hopes that, by determining its density, she will be able to identify the metal.

Describe a method for determining the density of the metal from which the spoon is made.

.....

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.....

.....

.....[4]

[Total: 8]

MARKING SCHEME:

(a)	**(i)**	(metals/they are) (good) conductors (of heat)	B1	[1]
	(ii)	(at hot end) molecules vibrate (more) **or** electrons identified as mechanism of conduction	B1	
		molecules collide with their neighbours **or** electrons move faster/have more energy	B1	
		energy/vibration passed on **or** electrons pass on energy/reach far end/free to move	B1	[3]
(b)		determine mass of spoon (condone weigh provided word mass is used in answer)	B1	
		immerse spoon in water/liquid	B1	
		determine increase in volume/overflow	B1	
		$\rho = m/V$ **or** density = mass/volume	B1	[4]

[Total: 8]

2 A student has 500 identical, rectangular sheets of paper. The mass of 1.0 m^2 of the paper is 0.080 kg.

(a) Using a metre rule, she measures the length of one sheet of paper and its width. The length is 0.300 m and the width is 0.210 m.

(i) Calculate the mass of one sheet of paper.

mass = ...[1]

(ii) The student makes a single pile of the 500 sheets of paper.

With a metre rule, she measures the height of the pile. The height of the pile is 0.048 m.

Calculate the density of the paper.

density = ...[3]

(b) A second student has only 5 sheets of the same type of paper.

Suggest how this student determines the density of the paper to a similar accuracy. Additional apparatus may be used.

.....

.....

.....

.....[2]

[Total: 6]

MARKING SCHEME:

(a) (i) $5.0(4) \times 10^{-3}$ OR 0.0050(4) kg OR 5.0(4) g — B1

(ii) $(\rho =)\ m / V$ OR $0.00504 / (0.30 \times 0.21 \times 0.048)$ OR $0.080 / (1 \times 0.048)$ — C1
$0.00504 \times 500 / (0.30 \times 0.21 \times 0.048)$ OR $0.080 / (1 \times 0.048 / 500)$) — C1
$8.3(3333) \times 10^{2}$ kg / m^3 — A1

(b) micrometer OR screw gauge OR digital / electronic caliper — B1
practical detail of use of micrometer OR micrometer (much) more precise than rule
OR repeat and average OR measure mass with balance / scale — B1

OR
tear into 500 pieces — (B1)
pile up **and** press down OR measure mass with balance / scale — (B1)

[Total: 6]

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

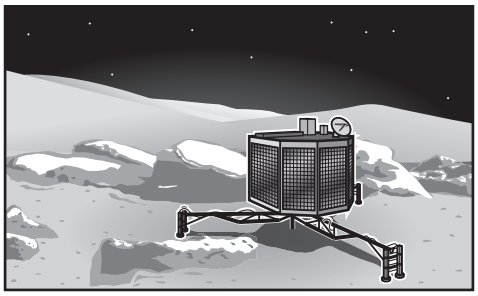

Fig. 3.1

(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]

MEASUREMENT:

(a)(i)	(Weight is) force/pull of gravity (acting on an object)	**B1**
(a)(ii)	Mass × acceleration due to gravity OR *m*g OR 350 × 7.5	**C1**
	2600 N	**A1**
(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**

4 Fig. 2.1 shows a vehicle designed to be used on the Moon.

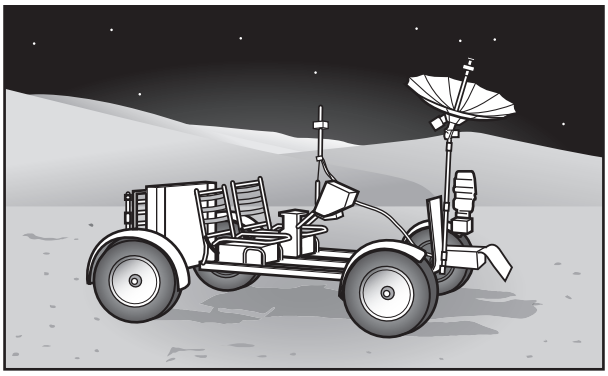

Fig. 2.1

The brakes of the vehicle are tested on Earth.

(a) The acceleration of free fall on the Moon is one sixth ($\frac{1}{6}$) of its value on Earth.

Tick **one** box in each column of the table to predict the value of that quantity when the vehicle is used on the Moon, compared to the test on Earth.

	mass of vehicle on Moon	weight of vehicle on Moon	deceleration of vehicle on Moon with same braking force
10 × value on Earth			
6 × value on Earth			
same as value on Earth			
$\frac{1}{6}$ × value on Earth			
$\frac{1}{10}$ × value on Earth			

[3]

MARKING SCHEME:

	Column 1 Box 3 mass same	**B1**
	Column 2 Box 4 weight 1/6	**B1**
	Column 3 Box 3 deceleration same	**B1**

5 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]

MARKING SCHEME:

(a)	$(\rho =)\frac{m}{V}$ OR 180 ÷ 210 OR 0.18 ÷ 210	**C1**
	$0.86\ g/cm^3$	**A1**
(b)	floats OR words to the same effect	**B1**
	density of wood is less than density of liquid	**B1**
	Total:	**4**

6 All the sides of a plastic cube are 8.0 cm long. Fig. 3.1 shows the cube.

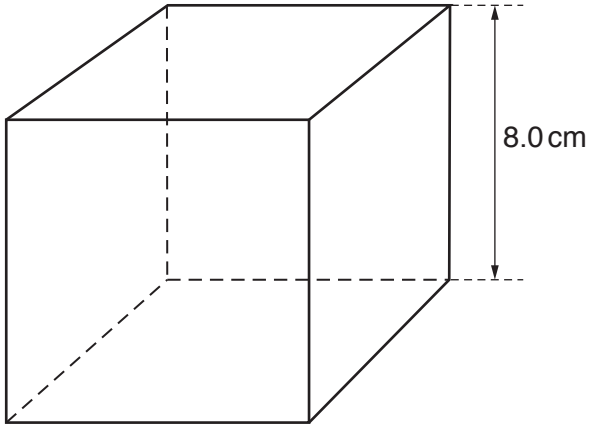

Fig. 3.1 (not to scale)

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]

MARKING SCHEME:

(a)	(Measure of) quantity / amount of matter OR (property) that resists change in motion / speed / momentum OR measure of a body's inertia	**B1**
(b)(i)	$d = m / V$ OR in words OR $0.44 / 0.080^3$ OR $0.44 / 5.12 \times 10^{-4}$ OR $440 / 8^3$ OR $440 / 512$ OR $0.44 / 8^3$ OR $0.44 / 512$	**C1**
	$0.86\ g / cm^3$ OR $860\ kg / m^3$ OR $8.6 \times 10^{-4}\ kg / cm^3$	**A1**
b)(ii)	Sinks OR does not float AND (cube) denser (than oil)	**B1**
(c)(i)	$W = mg$ OR (g =) W / m OR $0.70 / 0.44$	**C1**
	1.6 N / kg	**A1**

7 Fig. 1.1 shows a cylinder made from copper of density 9000 kg / m^3.

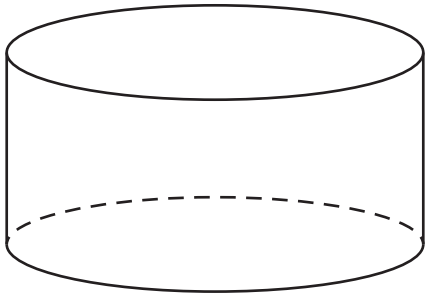

Fig. 1.1

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]

(c) Fig. 1.2 shows the cylinder immersed in a liquid.

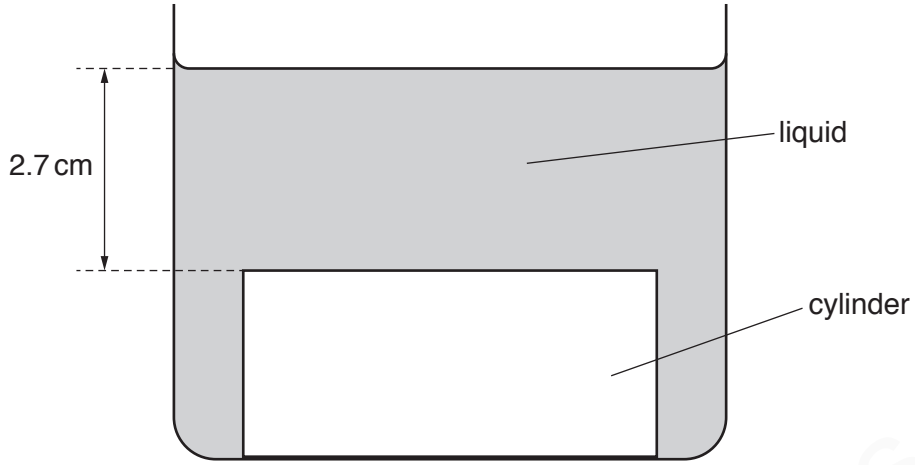

Fig. 1.2 (not to scale)

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.

(i) Calculate the density of the liquid.

density = ...[2]

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

.....

.....[1]

[Total: 8]

MEASUREMENT;

(a)	$\rho = m / V$ in any form OR (m =) ρV OR (m =) $9000 \times 7.5 \times 10^{-5}$	**C1**
	(m =) 0.68 kg **accept** 680 g	**A1**
(b)(i)	$W = mg$ in any form or (W =) mg OR (W =) 0.68×10	**C1**
	(W =) 6.8 N	**A1**
(b)(ii)	any **one** of: weight has direction / mass does not weight is a vector / mass is not weight varies / mass does not mass is amount of matter weight is a force / mass is not	**B1**
(c)(i)	$\rho = h\rho g$ in any form OR (ρ =) ρ / hg OR (ρ =) 560 / (0.027 × 10)	**C1**
	(ρ =) 2.1×10^3 kg / m^3	**A1**
(c)(ii)	explains why there is a resultant downward force	**B1**

8 Fig. 2.1 shows a measuring cylinder that contains a coloured liquid.

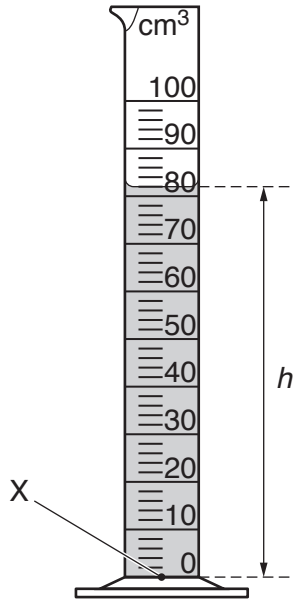

Fig. 2.1

The measuring cylinder contains 82 cm^3 of the liquid. The density of the liquid is 950 kg/m^3.

(a) Calculate the mass of the liquid.

mass = ...[3]

(b) The height *h* of the liquid in the measuring cylinder is 0.094 m.

(i) Calculate the pressure due to the liquid at point X in Fig. 2.1.

pressure = ...[2]

(ii) The true pressure at point X is different from the value calculated in **(b)(i)**. Explain why.

.....

.....[1]

(c) A small object is made of steel. It is placed level with the top surface of the liquid in the measuring cylinder and then released. The object sinks in this liquid.**(**

i) Explain why the object sinks in this liquid.

.....

.....[1]

(ii) Describe how the volume of the object can now be determined.

.....

.....

.....[1]

[Total: 8]

MARKING SCHEME:

(a)	(m =)ρV **or** $950 \times 8.2 \times 10^{-5}$ **or** 0.95×82	**C1**
	$7.8 / 7.79 \times 10^{N}$ (where N is a integer)	**C1**
	0.078 / 0.0779 kg **or** 78 / 77.9 g	**A1**
(b)(i)	(p =)$h\rho g$ **or** $0.094 \times 950 \times 10$	**C1**
	890 / 893 Pa	**A1**
(b)(ii)	atmospheric pressure (is acting)	**B1**
(c)(i)	steel is denser (than liquid) **or** denser than 950 kg / m^3	**B1**
(c)(ii)	take new reading **and** subtract 82 (cm^3) / original reading	**B1**