

Name Class Date

Floating and sinking

Specification reference:

- P5.5.1.2 Pressure in a fluid 2 **H**

Aims

In this exercise, you will consider the forces acting on a body that has been immersed in a fluid and you will consider why a body will sink or float in certain liquids or gases. You will apply your knowledge of floating, sinking, and density to perform calculations and explain why bodies float or sink. You will also answer questions where you have to apply your knowledge of floating, sinking and density to new situations or ideas such as Plimsoll lines and the hydrometer.

Learning outcomes

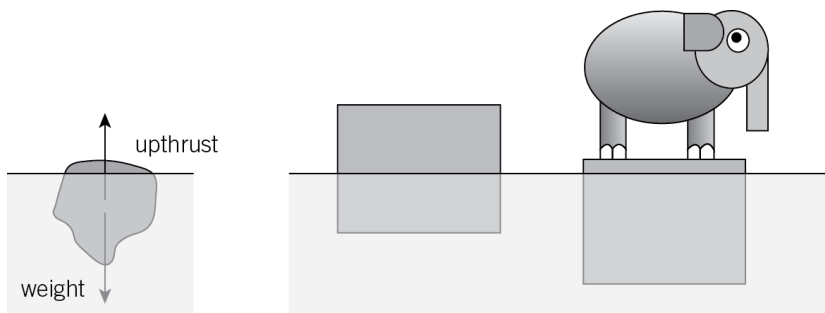
After completing this activity, you should be able to:

- explain why there is an upwards force on a floating object
- explain why some objects float and some objects sink
- apply ideas relating to density, floating and sinking to new situations
- calculate the height at which a body will float in a given liquid.

Questions

1 Fill in the gaps in the following text using the words in the box (you will need to use some more than once). Use the artwork to help you too.

| | | | | |
|-------|-----------|----------|-------|-----------|
| small | less than | equal to | large | more than |
|-------|-----------|----------|-------|-----------|



A body will float in water if it displaces its own mass when placed in the water.

A body will sink in water if it displaces its own mass when placed in the water.

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If the density of a body is the density of water then it will float in water.

If the density of the body is the density of water then it will sink in water.

The weight of water that a floating body displaces is
the upthrust force acting on it. A small weight that floats will experiences a
upthrust and a large weight that floats will experiences a upthrust.

(7 marks)

2 The following table shows values for the densities of a number of solids and liquids. Use the information in the table to answer the questions that follow.

| Solid | Density in kg/m ³ | Liquid | Density in kg/m ³ |
|-----------|------------------------------|-----------|------------------------------|
| wood | 710 | water | 1000 |
| aluminium | 2700 | mercury | 13 546 |
| lead | 11 340 | olive oil | 912 |
| cork | 240 | glycerol | 1261 |

a Name two solids that will float in water.

1.

2.

(2 marks)

b Explain why lead will float in mercury but sink in glycerol.

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(2 marks)

c Describe what you would see if wood, aluminium, olive and glycerol were added to a large tank of water.

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(2 marks)

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3 The height at which a body floats in a liquid depends on the density of the liquid in which it has been immersed. The greater the density of the liquid, the higher up a given mass will float. In order to calculate this height, you need to use the equation:

$$\text{height (m)} = \frac{\text{weight of body (N)}}{\text{density of liquid (kg/m}^3) \times g \text{ (N/kg)} \times \text{area of bottom of body (m}^2)}$$

a Calculate the height that a ship of weight 4.0×10^9 N will float in sea water of density 1030 kg/m^3 , if the value if g is 10 N/kg and the area of the bottom of the ship is $20\,000 \text{ m}^2$?

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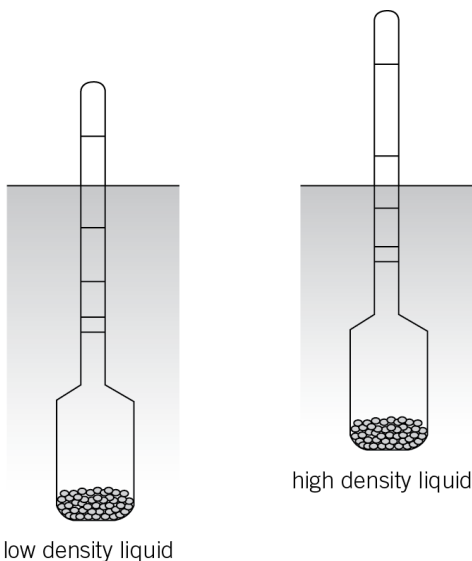
(3 marks)

b Explain what will happen to the height at which the ship floats if the sea water is replaced with fresh water of density 1000 kg/m^3 .

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.....
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(3 marks)

4 A hydrometer is a piece of equipment used to find the density of a liquid, as shown by the diagram below. The hydrometer is made from a glass tube which contains small balls of lead of a known mass. The vertical stem has a scale from which the density of the liquid can be read.



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Explain why the hydrometer will float lower down in a liquid of low density and higher up in a liquid of higher density.

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(3 marks)

5 a Explain why ships float, despite being made from steel which is much denser than water.

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(3 marks)

b Give two factors which will affect the density of the water in which the ship floats.

- 1.
- 2.

(2 marks)

c Explain why a ship travelling in sea water can be loaded with a greater cargo than a ship travelling in freshwater.

.....
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(3 marks)

d Ships often have a marking on the hull called the Plimsoll line. This shows lowest that a ship is legally allowed to be submerged when loaded with cargo.

Explain one reason why the position of the Plimsoll line painted on a ship's hull will change from ship to ship.

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(2 marks)