

Upthrust and flotation.

All answers to calculations should be to 2 significant figures.

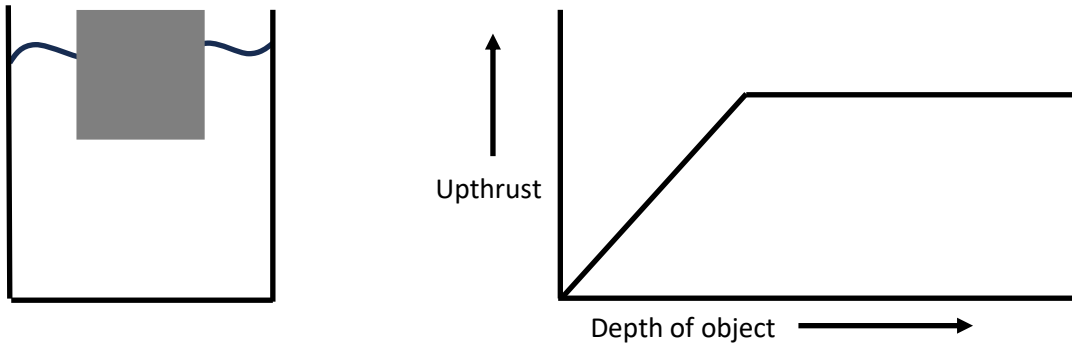
1. Define the term upthrust.

The upthrust on an object in a fluid is the upward force on the object due to the fluid.

2. A stone is carefully lowered into a measuring cylinder that contains some water. Explain why the level of water in the measuring cylinder rises.

As the stone is lowered into the water, some of the water is displaced, causing the level of water to rise.

3. Below is an image of an object being lowered into water and a graph showing how upthrust changes with depth.



3a. Using both the image and the graph explain the changes seen in the graph line for upthrust with increasing depth of object.

As the object is lowered into the water, a larger volume of water will be displaced and so the upthrust increases.

Once the object is fully submerged, no greater volume of water can be displaced, so the upthrust is constant.

4. Chelsea's teacher does a demonstration where a ping pong ball of weight 0.1N is pushed under the surface of the water. State the upthrust experienced by the ping pong ball

0.1N

4a. Chelsea's teacher now repeats the experiment using a plastic bottle of water that contains 100g of water. Calculate the upthrust experienced by the 100g of water. Ignore the effect of the bottle

Weight = mass x gravitational field strength

Weight = 0.1kg x 10 N/kg = 1N

Therefore, 1N of upthrust

4. Below is an image of a cargo ship



4a. Explain in terms of upthrust and weight why the ship is able to float when there are either no containers on board, or only a few containers

As more containers are added onto the ship the weight increases, this means that the container ship is lower in the water.

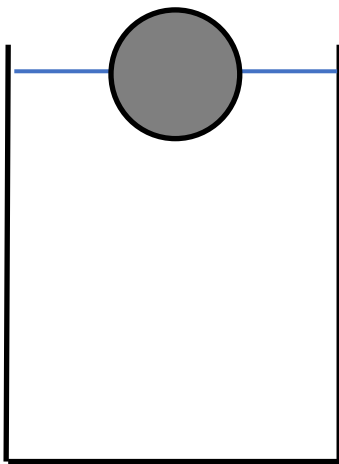
As the weight increases, more water is displaced, so the upthrust on the ship increases.

Overall, the ship is able to float because the weight is equal to the upthrust.

4b. When too many containers are loaded onto the ship it sinks. Explain why in terms of upthrust and weight why the ship sinks

The weight of the containers on the ship means that the total weight of the ship is greater than the upthrust.

5. Using the diagram below answer the following questions



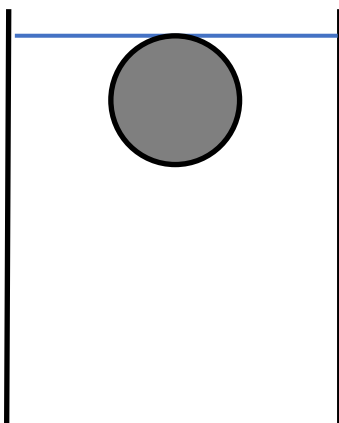
5a. Is the object or water more dense, or do they both have equal density?

Water is more dense than object

5b. The weight of the object in this case is equal the weight of water that it displaces.

5c. For the object to float the upthrust is equal to the weight of the object.

6. Using the diagram below answer the following questions

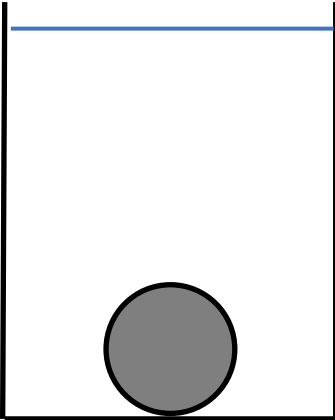


6a. Is the object or water more dense, or do they both have equal density?

Water and object have equal density

6b. When the object is fully immersed and floating the weight of the object is equal the upthrust on the object

7. Use the diagram below to answer the following questions



6a. Is the object or water more dense, or do they both have equal density?

Object is more dense than water

6b. The weight of the object is **greater** than the weight of water displaced

6c. For the object to sink the upthrust is **less** than the weight of the object.