Floating Objects

Name: _____ **Class:** _____ **Date:** _____

Quick Review

Objects placed in fluids may **float, sink, or remain suspended** depending on their density and the forces acting on them.

- **Floating:** An object rests at the surface when the upward buoyant force balances its downward weight.
- **Sinking:** An object moves downward when its weight is greater than the buoyant force.
- **Neutral buoyancy:** An object remains suspended in a fluid when its buoyant force equals its weight.
- **Density:** The mass of a substance per unit volume. Objects with an average density lower than the fluid tend to float, while objects with a greater density tend to sink.

Important formulas:

Density = Mass ÷ Volume

$\rho = m \div V$

Net force = Buoyant force − Weight

For this worksheet, assume:

- Density of freshwater = 1000 kg/m³
- All objects are placed in still freshwater unless stated otherwise.
- Ignore other forces such as drag unless a question mentions them.

Part A — Multiple Choice

Circle the correct answer.

1. What condition allows an object to float at rest?

A. Its weight is greater than the buoyant force
B. Its buoyant force equals its weight
C. Its buoyant force is zero
D. Gravity stops acting on it

2. Which object is most likely to sink in freshwater?

A. An object with a density of 600 kg/m³
B. An object with a density of 800 kg/m³
C. An object with a density of 1200 kg/m³
D. An object with a density of 500 kg/m³

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3. What is neutral buoyancy?

A. An object floating partly above the surface
B. An object sinking rapidly
C. An object moving upward with increasing speed
D. An object remaining suspended in a fluid with balanced forces

4. Which force acts downward on an object in water?

A. Weight
B. Buoyant force
C. Upthrust
D. Water resistance acting upward

5. Why can a large ship made of steel float?

A. Steel has no mass when placed in water
B. The ship's hollow hull allows it to displace enough water to support its weight
C. The ship does not experience gravity
D. Water cannot exert forces on steel

Part B — Matching

Match each term to its correct description.

Term	Answer	Descriptions
1. Floating	_____	A. The upward force exerted by a fluid
2. Sinking	_____	B. The mass of an object divided by its volume
3. Neutral buoyancy	_____	C. An object remains suspended within a fluid
4. Density	_____	D. An object moves downward through a fluid
5. Buoyant force	_____	E. An object remains at the surface with balanced forces

Part C — Floating, Sinking, or Neutral?

The following objects are completely submerged in freshwater and are released from rest.

Object	Density (kg/m³)
A	700
B	1000
C	1300
D	900

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1. Which objects will rise toward the surface and eventually float?

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2. Which object will sink?

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3. Which object has neutral buoyancy?

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4. Explain why Object C behaves differently from Object A.

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5. What would happen to Object B if it were placed in a liquid with a density of 1200 kg/m³?

Part D — Calculating Forces

Use: Net force = Buoyant force − Weight

A positive result means an upward net force. A negative result means a downward net force.

1. An object weighs 15 N and experiences a buoyant force of 20 N.

a) Calculate the net force.

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b) Will the object initially rise or sink?

2. An object weighs 30 N and experiences a buoyant force of 18 N.

a) Calculate the net force.

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b) Describe its motion if released from rest.

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3. A floating object has a weight of 25 N. What buoyant force must act on it while it floats at rest?

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4. A submarine experiences a buoyant force of 5000 N and has a weight of 5000 N.

a) Calculate the net force.

b) What type of buoyancy does this represent if the submarine is fully submerged and stationary?

Part E — Real-World Applications

1. Why is it generally easier to float in salt water than in freshwater?

2. Explain how a submarine can change from sinking to rising.

3. Why does an empty plastic bottle float, but the same bottle filled with water may float much lower in the water?

4. A wooden block floats in a swimming pool. What happens when a heavy object is placed on top of it? Explain.

Part F — Predict and Explain

1. A block has a mass of 600 kg and a volume of 1 m^3.

a) Calculate its density.

b) Will it float or sink in freshwater?

2. A second block has a mass of 1500 kg and a volume of 1 m^3.

a) Calculate its density.

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b) Will it float or sink in freshwater?

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3. Explain why density is more useful than mass alone when predicting whether an object will float.

Exit Ticket

1. What two forces determine whether an object rises or sinks in water?

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2. Explain the difference between floating and neutral buoyancy.

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3. What happens when an object's density is greater than the density of the surrounding fluid?

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4. A floating object weighs 40 N. What is its buoyant force?

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5. Give one practical example of how people use buoyancy.

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Floating Objects — Answer Key

Part A — Multiple Choice

1. B — Its buoyant force equals its weight.
2. C — An object with a density of 1200 kg/m³.
3. D — An object remaining suspended in a fluid with balanced forces.
4. A — Weight.
5. B — The ship's hollow hull allows it to displace enough water to support its weight.

Part B — Matching

Term	Answer	Description
1. Floating	E	An object remains at the surface with balanced forces
2. Sinking	D	An object moves downward through a fluid
3. Neutral buoyancy	C	An object remains suspended within a fluid
4. Density	B	The mass of an object divided by its volume
5. Buoyant force	A	The upward force exerted by a fluid

Part C — Floating, Sinking, or Neutral?

Object	Density (kg/m³)	Behaviour
A	700	Rises and floats
B	1000	Neutral buoyancy
C	1300	Sinks
D	900	Rises and floats

1. Which objects will rise toward the surface and eventually float?

Objects A and D.

Their densities are lower than the density of freshwater (1000 kg/m³).

2. Which object will sink?

Object C.

Its density of 1300 kg/m³ is greater than that of freshwater.

3. Which object has neutral buoyancy?

Object B.

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Its density equals the density of freshwater.

4. Explain why Object C behaves differently from Object A.

Object C is denser than water, so its weight is greater than the buoyant force when fully submerged. It sinks.

Object A is less dense than water, so the buoyant force initially exceeds its weight. It rises until it reaches the surface and floats with balanced forces.

5. What would happen to Object B if it were placed in a liquid with a density of 1200 kg/m³?

Object B would rise and float at the surface.

Its density (1000 kg/m³) is lower than that of the surrounding liquid (1200 kg/m³).

Part D — Calculating Forces

Use:

Net force = Buoyant force − Weight

A positive result indicates an upward net force; a negative result indicates a downward net force.

1. An object weighs 15 N and experiences a buoyant force of 20 N.

a) Calculate the net force.

Net force = 20 − 15

Answer: +5 N (5 N upward)

b) Will the object initially rise or sink?

Rise. The upward buoyant force exceeds its weight.

2. An object weighs 30 N and experiences a buoyant force of 18 N.

a) Calculate the net force.

Net force = 18 − 30

Answer: −12 N (12 N downward)

b) Describe its motion if released from rest.

It will accelerate downward, because its weight exceeds the buoyant force.

3. A floating object has a weight of 25 N. What buoyant force must act on it while it floats at rest?

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Answer: 25 N upward

A floating object at rest has balanced forces.

4. A submarine experiences a buoyant force of 5000 N and has a weight of 5000 N.

a) Calculate the net force.

Net force = 5000 − 5000

Answer: 0 N

b) What type of buoyancy does this represent if the submarine is fully submerged and stationary?

Neutral buoyancy.

The upward buoyant force balances the downward weight, allowing the submarine to remain suspended at a constant depth.

Part E — Real-World Applications

1. Why is it generally easier to float in salt water than in freshwater?

Salt water is denser than freshwater.

For the same submerged volume, salt water provides a greater buoyant force. Therefore, a floating object generally needs to displace less volume and floats higher in salt water.

2. Explain how a submarine can change from sinking to rising.

A submarine adjusts the amount of water in its ballast tanks.

- To sink, water enters the tanks, increasing the submarine's mass and overall average density.
- To rise, compressed air forces water out, reducing its mass and overall average density.
- To remain suspended, the submarine adjusts its ballast until buoyant force balances weight.

3. Why does an empty plastic bottle float, but the same bottle filled with water may float much lower in the water?

An empty, sealed plastic bottle contains air, giving it a relatively low overall average density.

Filling the bottle with water increases its mass without greatly increasing its external volume.

Therefore, it must displace more water to balance its weight and floats lower. Depending on the bottle and its contents, it may even sink.

4. A wooden block floats in a swimming pool. What happens when a heavy object is placed on top of it? Explain.

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The block sinks deeper into the water because the combined weight increases.

To remain floating, the block must displace more water, producing a greater buoyant force.

If the combined weight becomes greater than the maximum buoyant force available, the block and its load will sink.

Part F — Predict and Explain

1. A block has a mass of 600 kg and a volume of 1 m^3.

a) Calculate its density.

Density = Mass ÷ Volume

$\rho = 600 \div 1$

Answer: 600 kg/m^3

b) Will it float or sink in freshwater?

Float.

Its density (600 kg/m^3) is less than that of freshwater (1000 kg/m^3).

2. A second block has a mass of 1500 kg and a volume of 1 m^3.

a) Calculate its density.

$\rho = 1500 \div 1$

Answer: 1500 kg/m^3

b) Will it float or sink in freshwater?

Sink.

Its density (1500 kg/m^3) is greater than that of freshwater.

3. Explain why density is more useful than mass alone when predicting whether an object will float.

Density compares an object's mass with its volume.

A large object may have considerable mass but also displace a large volume of water, allowing it to float.

A smaller object may have less mass but a higher density and therefore sink.

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Comparing the object's average density with the surrounding fluid's density helps predict whether it will float, sink, or remain neutrally buoyant.

Exit Ticket

1. What two forces determine whether an object rises or sinks in water?

Weight (gravity) and buoyant force (upthrust).

2. Explain the difference between floating and neutral buoyancy.

- Floating: An object rests at the surface with buoyant force equal to weight.
- Neutral buoyancy: An object can remain completely submerged at a constant depth because buoyant force equals weight.

Both involve balanced forces, but the object's position in the fluid is different.

3. What happens when an object's density is greater than the density of the surrounding fluid?

It generally sinks because, when fully submerged, its weight exceeds the buoyant force.

4. A floating object weighs 40 N. What is its buoyant force?

40 N upward.

5. Give one practical example of how people use buoyancy.

Accept any appropriate example, including:

- Ships floating on water
- Submarines controlling their depth
- Life jackets helping people float
- Hot-air balloons rising in air
- Hydrometers measuring liquid density

Teaching Notes

Important concepts to reinforce:

- Floating and neutral buoyancy both involve balanced forces. The main distinction is whether the object is floating at the surface or suspended within the fluid.
- A sinking object still experiences buoyant force. Its weight is simply greater than the buoyant force when fully submerged.
- Density determines floating behaviour for freely moving objects. An object with an average density below the fluid's density floats, while an object with a greater density sinks.
- Floating objects displace their own weight of fluid. Adding a load causes an object to displace more fluid until equilibrium is restored or it sinks.

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- Net force determines acceleration, not necessarily motion. An object with zero net force may remain stationary or continue moving at constant velocity.

Calculation reminder: Encourage students to include units and indicate whether their calculated net force acts upward or downward.

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