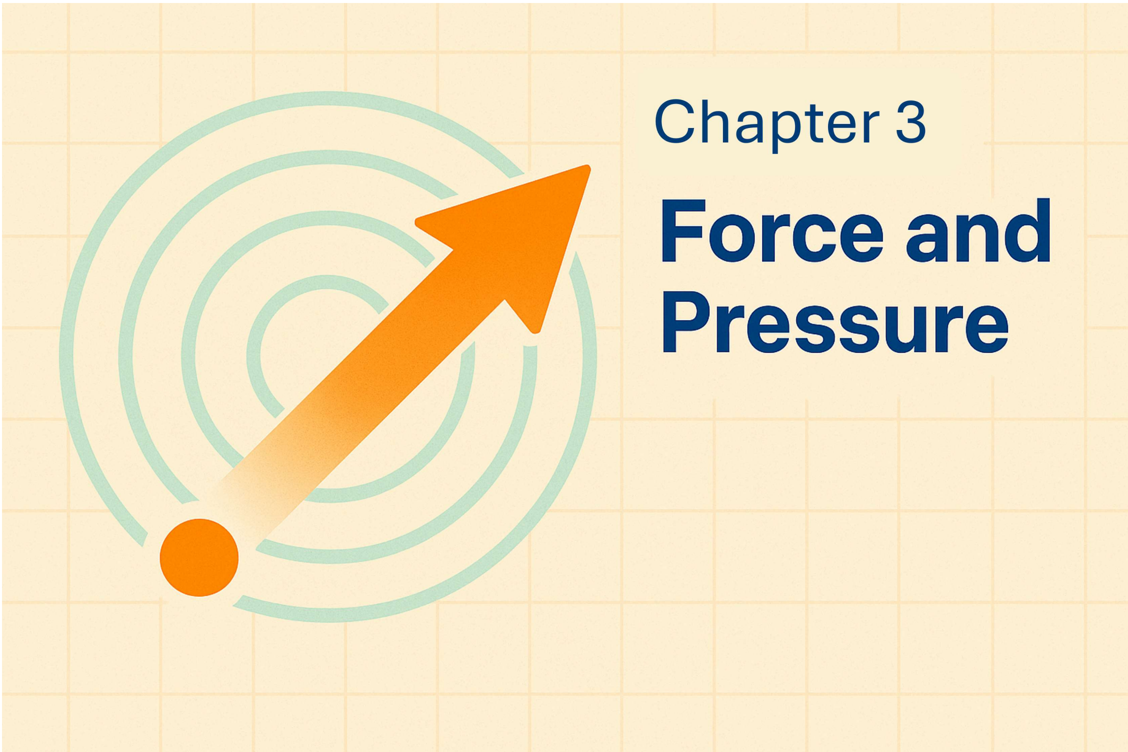
Force and Pressure

Force and Pressure



About This Chapter

This chapter introduces the key ideas needed to analyse how forces act on objects.
It begins by outlining the major **types of forces** and the conditions under which each type arises. These ideas form the foundation for understanding physical interactions in both everyday contexts and scientific settings.

Next, the chapter establishes important relationships involving mass, weight and density.
The distinction between **mass** and **weight** is made precise through the idea of gravitational field strength. The concept of **density** is introduced as a physical quantity that links mass to volume, helping to explain differences between materials.

Finally, these ideas lead to the study of pressure.
The definition of **pressure** as force per unit area is used to explain how solids and liquids respond to applied forces, and how these effects appear in real-world situations.

A. What are the Types of Forces?

1. Contact and Non-Contact Forces

Learning Outcome

Forces can be classified into *contact forces* and *non-contact forces*, depending on whether the interacting objects are touching.

Why this Matters

Being able to classify forces helps us describe interactions clearly and consistently. Different types of forces act under different conditions, and recognising which type is present allows us to analyse how an object will behave. This distinction also forms the starting point for drawing free-body diagrams and for understanding motion in later parts of the chapter.

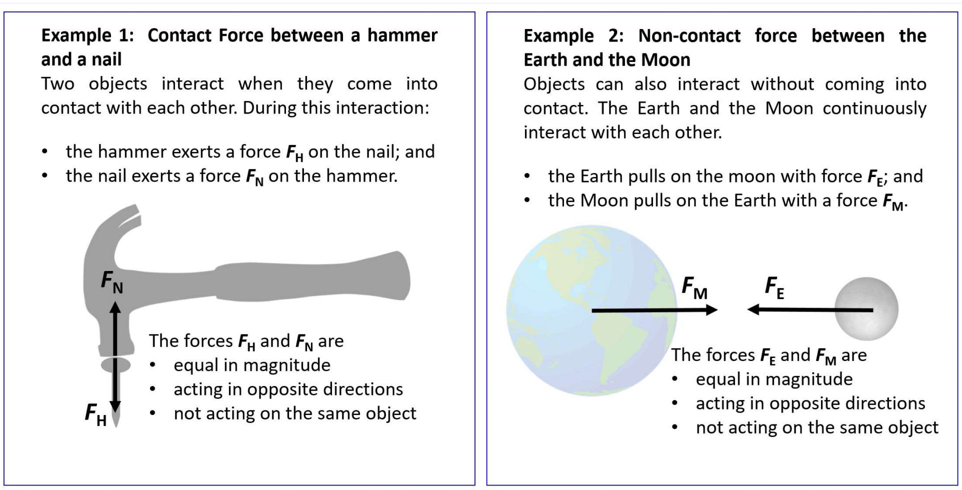
Before You Begin

You already know that a **force** is a **push or a pull**, and that forces can change an object's **shape**, **size**, or **motion**.
As you learn about different types of forces, it is important to remember that many everyday situations involve **more than one force acting at the same time**. Students sometimes find it difficult to identify all the forces in a situation, especially when some forces are not obvious or cannot be seen directly.

Connecting to Disciplinary Ideas in Physics - Matter interacts through forces and fields.

When two bodies interact, they exert forces **on each other**, either through **physical contact** or **across a distance** through a (gravitational, magnetic, or electrostatic) **field**.
A force is not caused by an object having "intent" to push or pull.

The diagram below illustrates that forces occur when two or more bodies interact. If one body exerts a force on another, it also experiences a force from that other body.



Understanding that forces arise from **interactions**, whether objects are touching or not, will help you recognise why different forces appear and how they combine to affect an object.

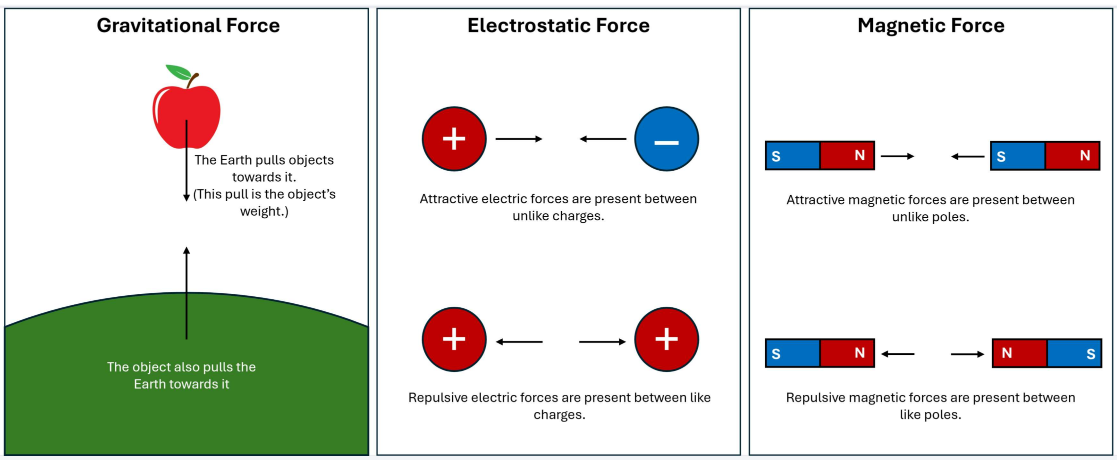
Non-Contact Forces

Non-contact forces do not require objects to be in contact to exist.
They help us understand that matter is affected not only by objects that are touching it, but also by objects that are **far away**. These forces act through **fields**, which allow one object to exert a pull or a push on another object without physical contact.

Some important examples of non-contact forces include:

- **Gravitational force** – the pull exerted by the Earth on an object (its **weight**).
- **Electrostatic force** – the **attractive** (pull) or **repulsive** (push) force between electric charges.
- **Magnetic force** – the **attractive** (pull) or **repulsive** (push) force between magnets.

Understanding non-contact forces helps explain many everyday situations, such as why objects fall towards the Earth or why magnets and charged objects can act on each other without touching.

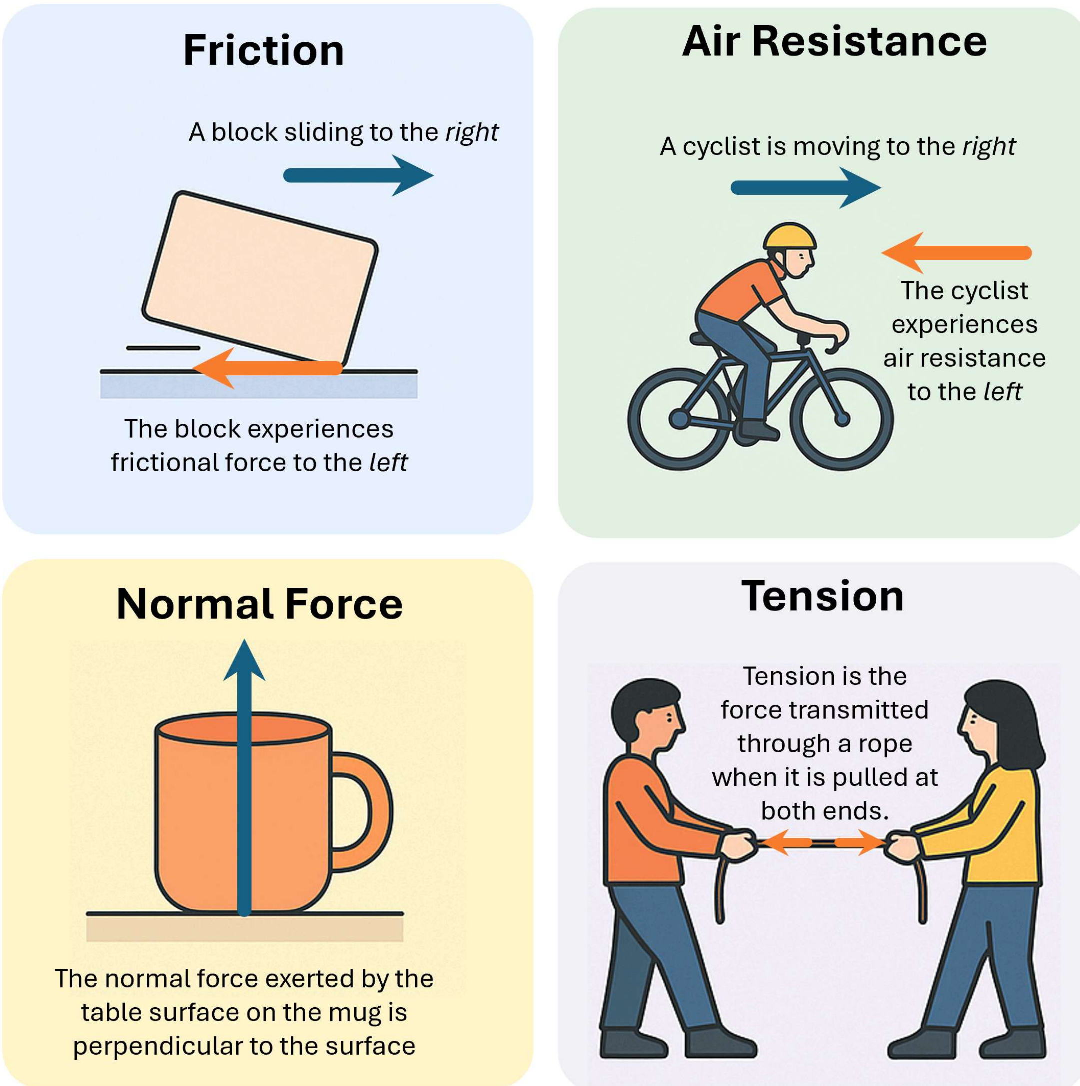


Contact Forces

Contact forces act only when two objects are touching.
They help us understand how surfaces, ropes, and moving objects interact in everyday situations. When objects are in contact, they can push or pull on each other through these interactions.

Some important examples of contact forces include:

- **Frictional force** – a force that opposes motion when two surfaces rub against each other.
- **Air resistance** – a type of friction caused by air pushing against a moving object.
- **Normal force** – the force a surface exerts on an object that is pressing against it.
- **Tension** – the pulling force along a rope, string, or cable when it is stretched.



Quick Check

Q1. Air resistance is a contact force. (T/F)
True
Air resistance is a frictional force from air particles touching the object.

Q2. If you push on a wall, only the wall experiences a force. (T/F)
False
Forces occur in pairs. If you push the wall, it pushes back on you.

Q3. Magnetic forces are always stronger than gravitational forces. (T/F)
False
No type of force is “always stronger”; it depends on the situation.

Q4. A book resting on a table has:
A. Only its weight
B. Weight and normal force

C. Only the normal force
D. No forces acting
B. Weight and normal force
Weight acts downward; the table exerts an upward normal force.

Q5. If you do not "feel" a force, it means no force is acting. (T/F)
False
Feeling a force is not the same as a force acting. You always have weight, even if you don't feel it.

Q6. Which sentence best describes how forces occur?
A. One object decides to push another
B. Forces come from interactions between objects
C. The stronger object creates all the forces
D. A force appears only when an object moves
B. Forces come from interactions
Forces are not caused by intention or agency.

Q7. A single object cannot have a force by itself. (T/F)
True
A force needs two interacting bodies. A single object (like a magnet) may have a (magnetic) field around itself, but no forces are present.

Q8. Electric charges can attract or repel each other without touching. (T/F)
True
Electrostatic forces are non-contact forces.

Q9. When a rope is stretched by two people pulling, the tension is:
A. A force created by the rope
B. A pull transmitted through the rope from both ends
C. A push from the middle of the rope
D. The rope trying to return to its original shape
B . Tension is a pull transmitted through the rope
Tension appears only when both ends pull and the rope becomes taut.

Q10. More than one force can act on an object at the same time. (T/F)
Q10. True
Most real situations involve multiple forces at the same time.

Q1:

INSTRUCTIONS
You may select more than 1 option

Which of the following is/are example(s) of non-contact force?

- [ ] Air resistance
- [ ] Electrostatic force
- [ ] Frictional force
- [ ] Gravitational force
- [ ] Magnetic force

☐ Normal force

MARKS ☐ /1

Force and Pressure

B. How is Mass Different from Weight?

1. Mass and Weight

Learning Outcomes

- Mass is the amount of matter in a body, while weight is the gravitational force acting on that body.
- A gravitational field is a region where a mass experiences a force due to gravitational attraction
- Gravitational field strength is the gravitational force per unit mass at a point.
- Weight = mass × gravitational field strength

Why this Matters

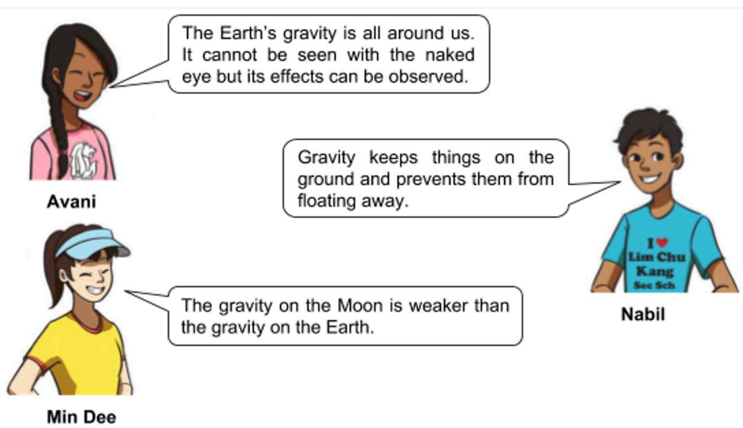
Distinguishing between **mass** and **weight** is essential because they describe **different physical quantities**, even though the terms are often used interchangeably in everyday language.
Mass depends on the amount of matter in an object and stays the same everywhere, while weight depends on the **gravitational field strength** at a location and can change from place to place. Understanding gravitational fields and field strength provides a clear way to explain why objects feel heavier or lighter on different planets, why satellites stay in orbit, and why weighing scales measure force rather than mass. These ideas also prepare you to analyse motion, interactions, and forces in later chapters.

Before You Begin

You already know that **gravity pulls objects towards the Earth**, and that this pull causes objects to fall or stay on the ground. In everyday language, the word *gravity* is often used loosely, but in physics it can refer to **different but related ideas**.

Look at the statements made by the three students in the graphic.
Did you notice that they were using the term "gravity" in different ways?
One student was referring to the **gravitational field**, another to the **gravitational force**, and the third to the **gravitational field strength**.

Do you know which student was referring to which idea?
The next panels will help you understand the difference between these terms.



Mass

What is mass?

Mass is the amount of matter in a body.

Mass is a property of a body.

- It depends on the composition and number of atoms and molecules (i.e. amount of matter) in the body.
- It does **not** change with the location or shape of the body.

Measurement of mass

Mass is measured using a beam balance or a calibrated electronic balance. The S.I. unit of mass is the kilogram (kg).

This media cannot be printed due to copyright issues

Caption A: This is a beam balance.
A beam balance measures mass by comparing an object with standard masses. Because mass is the amount of matter in a body, the reading on a beam balance will be the same on Earth, on the Moon, or anywhere.

Caption B: This is an electronic balance.
An electronic balance is a calibrated instrument used to measure mass in kilograms (kg). Like the beam balance, it gives the same mass reading no matter where the measurement is taken.

Quick check

Q1:

Which of the following processes involves a change in an object's mass?

- A lump of plasticine is squeezed into a ball
- A seedling grows into a tree

An astronaut travels from the Earth to the Moon

MARKS /1

Gravitational field

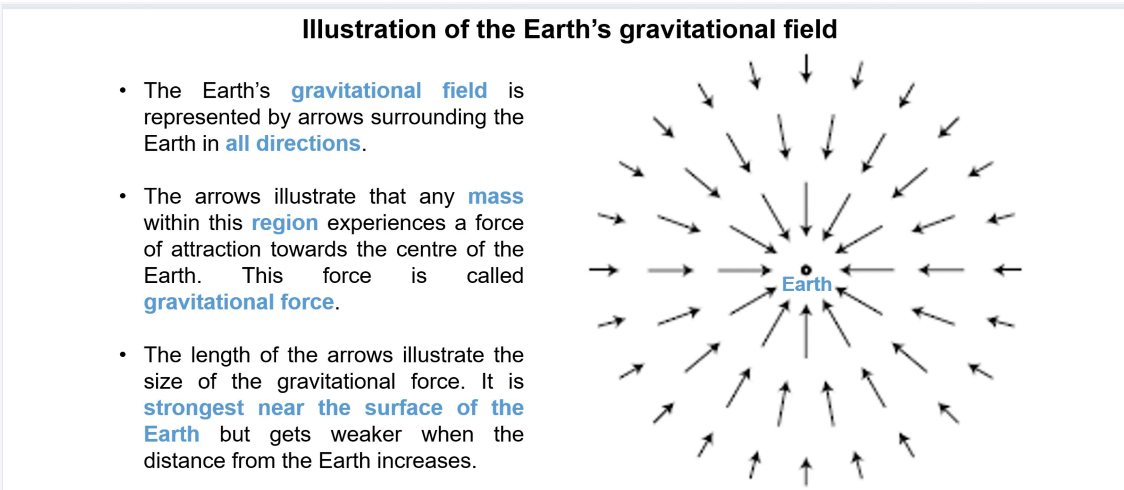
What is gravitational field?

Gravitational field is the region in which a mass experiences a force due to gravitational attraction.

Connections to Disciplinary Ideas in Physics - Matter Interacts Through Forces and Fields

A gravitational field is not something special that only the Earth has. **Every object with mass** creates an invisible influence around it**.** This influence extends to the space surrounding the object. When another mass enters this region, it experiences a **gravitational force**, even though there is **no physical contact**.

For example, the Earth creates a gravitational field around it, and any mass within this region, such as an apple, a stone, or even you, is pulled towards the Earth.



Thinking in terms of **fields** helps us understand how objects can affect one another across a distance. A field is **not a material or a substance**. It is a way of describing how one object can cause another object to experience a force simply by being nearby.

Quick check

Q2:

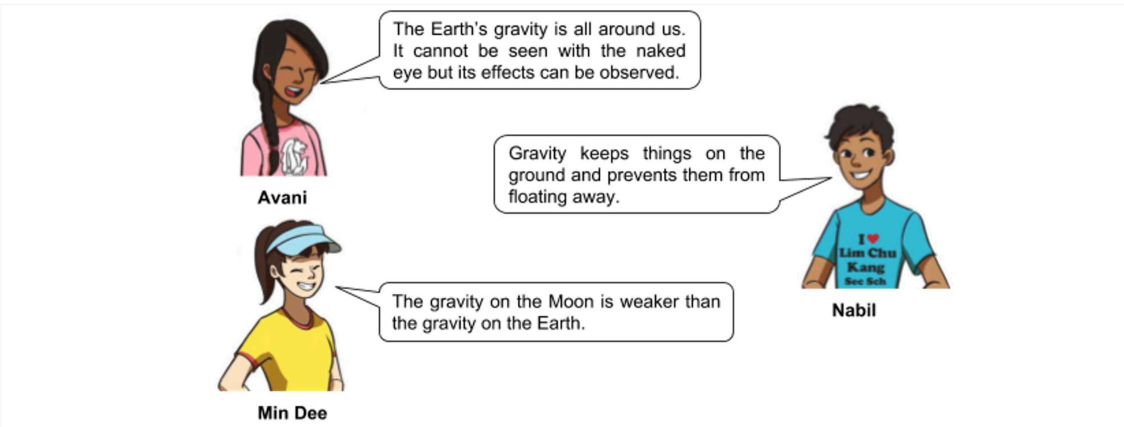
A gravitational field exists in the region around the following *except* ________.

- A shadow
- The moon
- An apple

MARKS /1

Q3:

Which student was using the term 'gravity' to refer to **gravitational field**?



- Avani
- Nabil
- Min Dee

MARKS /1

Gravitational field strength

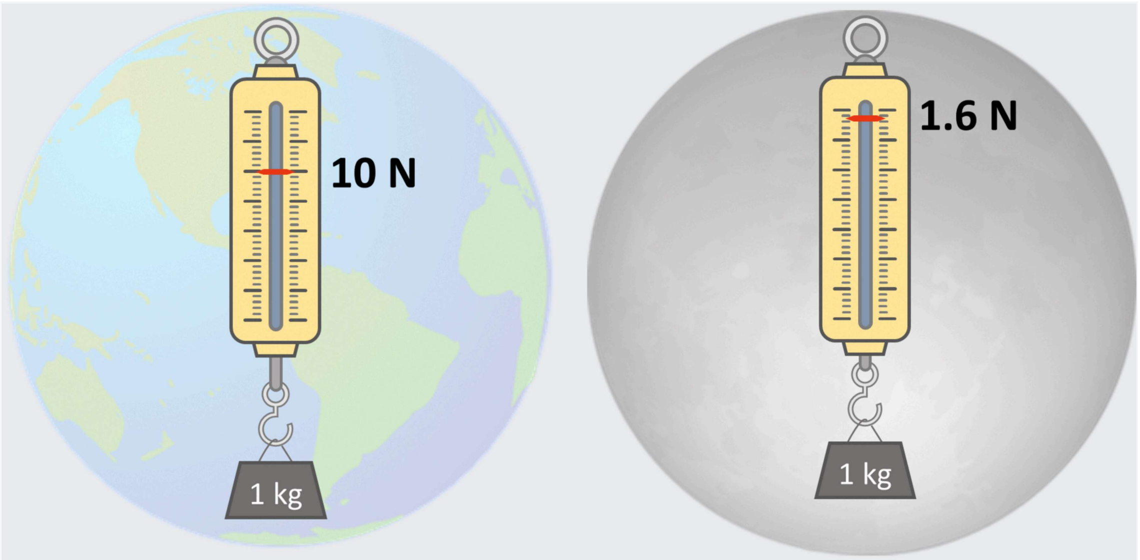
Gravitational field strength, *g*, is the gravitational force acting per unit mass placed at that point.

Gravitational field strength varies from location to location.

- On the surface of the **Earth**, the gravitational field strength is approximately **10 N/kg** .

- On the surface of the **Moon**, the gravitational field strength is approximately **1.6 N/kg**.

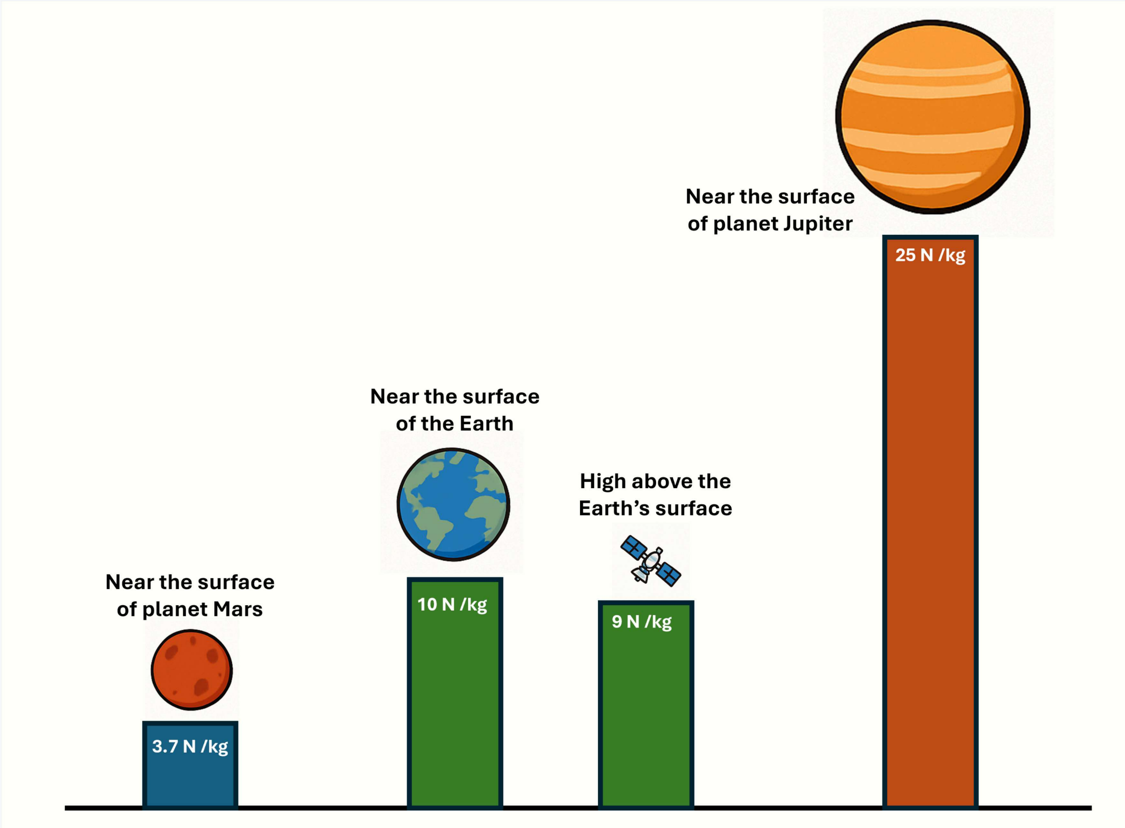
The diagram below illustrates the difference in (gravitational) force acting on the same one kilogram mass on the Earth and on the Moon. Although the mass remains the same (1 kg), the force exerted experienced by the object is much less on the Moon than on the Earth, due to a difference in gravitational field strength at the respective locations.



An object of mass 1 kg experiences a gravitational force (or weight) of 10 N on the Earth due to the Earth's gravitational field.

The same 1 kg object experiences a gravitational force (or weight) of only 1.6 N on the Moon due to the Moon's gravitational field.

Although gravitational fields exist around every mass, their **strength** is not the same everywhere. The value of *g* depends on the mass of the planet *and* how far you are from its centre. This means that different planets, and even different locations around the same planet, can have different gravitational field strengths.



Q4:

Which location has a larger gravitational field strength?

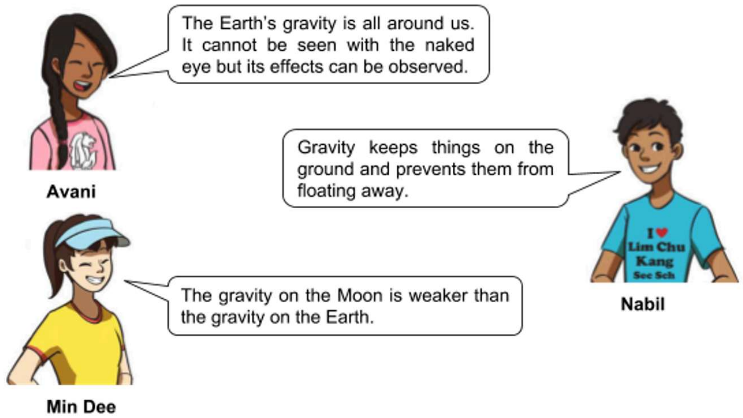
Location	Mass of object at the location /kg	Gravitational force exerted on the object /N
A	1.0	10
B	3.0	12

- **A**
- **B**
- Equal at **A** and **B**

MARKS /1

Q5:

Which student was using the term 'gravity' to refer to **gravitational field strength**?



- Avani
- Nabil
- Min Dee

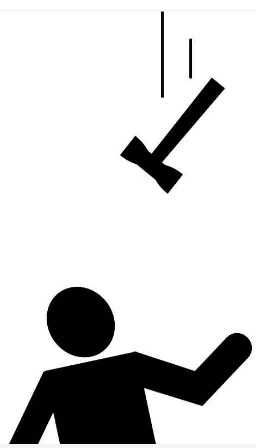
MARKS /1

Gravitational force (Weight)

What is gravitational force?

The gravitational force acting on an object is known as its **weight**.

Objects fall to the ground after you throw them up in the air because the Earth exerts a gravitational force that pulls them towards the centre of the Earth.



hammer_fall.png

The diagram shows a hammer weighing 14.8 N. What is the magnitude of the gravitational force exerted on it by the Earth? [See answer]

Measurement of weight (gravitational force)

Because weight is a (gravitational) force, its S.I. unit is the newton (N), not the kilogram (kg).

Weight is measured using a **spring balance** or newton-meter (see picture below).

Caption: This is a spring balance. A larger weight pulls down with a greater force, causing the spring to stretch more.

Relating mass and weight (gravitational force)

The relationship between mass and weight (gravitational force) can be expressed mathematically as

$$W = mg$$

Where
W = weight (in N)
m = mass of the object (in kg)
g = gravitational field strength at that point (in N/kg)

Quick check

Q6:

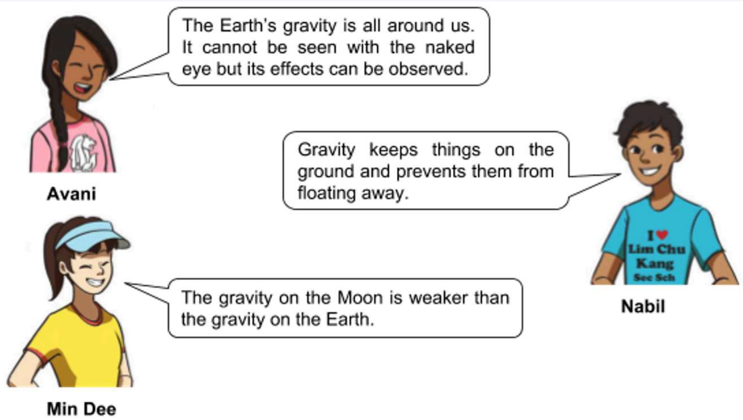
Mr Kumar has a mass, m of 68 kg. Calaculate his weight if the gravitational field strength on the earth, g is 10 N/kg.

- 6.8 N
- 68 N
- 680 N

MARKS /1

Q7:

Which student was using the term 'gravity' to refer to **gravitational force**?



- Avani
- Nabil
- Min Dee

MARKS /1

2. Check Your Understanding

Q1:

INSTRUCTIONS

Match the empty boxes in the image with the options below by selecting the empty box and the correct option.

Complete the table of differences between **mass** and **weight** by dragging the labels below into the correct columns.

	Mass	Weight
What is mass/weight?		
What is its S.I. unit?		
How is it affected by location?		
What instrument(s) is used for measuring it?		

A Depends on the gravitational field strength at the location

B Always constant in any location

C Beam balance or electronic balance

D

Gravitational force acting on a body

E — Amount of matter in a body

F — kilogram (kg)

G — newton (N)

H — Spring balance

MARKS /8

For questions 2 - 4, refer to the cartoon below.

Q2:

Is the following statement true or false?

Since the gravitational field strength on planet X's surface is only half that on the Earth, the alien's mass on the Earth's surface will be double that on planet X.

True

False

MARKS /1

Q3:

Is the following statement true or false?

Since the gravitational field strength on planet X's surface is only half that on the Earth, the alien’s weight on the Earth's surface will be double that on planet X.

True

False

MARKS /1

Q4:

If the gravitational field strength on the Earth's surface is 10 N/kg, the weight of the alien is ______ N on the Earth's surface and ______ N on planet X's surface.

MARKS /2

C. How is Mass Related to Density?

1. Density

Learning Outcome

Density is the mass per unit volume of a substance.

Why this Matters

Density is not just a formula. It is a key idea that explains many everyday observations. Two objects may look similar but have very different masses because they are made of substances with different densities. Understanding density helps you explain why some objects float, why others sink, and why large structures like ships can stay afloat even though they are made of dense materials.

By connecting **mass**, **volume**, and **density**, you gain a clearer picture of how materials behave, how mixtures are analysed, and how engineers design objects ranging from ice cubes to submarines. This relationship is also important in later topics involving fluids, forces, and pressure.

Determining the Density of an Object

Watch the animation to learn more about density.

This media cannot be printed due to copyright issues

From the video, we recall that:

- The density of a substance is its mass per unit volume.
- Formula for density:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

- The formula can be re-expressed as:

$$\text{mass} = \text{density} \times \text{volume}$$

- It can also be re-expressed as:

$$\text{volume} = \frac{\text{mass}}{\text{density}}$$

- Density is a scalar quantity and is commonly expressed in units of kg/m^3 or g/cm^3.
- We can determine the density of an object by measuring the mass and volume of the object and then applying the density formula.
- The density of the object depends on the substance that the object is made of.
- If an object has a *higher* density than its surrounding medium (e.g., water), the object will *sink*.
- If an object has a *lower* density than its surrounding medium, the object will *float*.
- If an object is made up of more than one substance, we should consider its average density.
- Formula for average density:

$$\text{average density} = \frac{\text{total mass}}{\text{total volume}}$$

- For example, a heavy ship can float on water because the average density of the ship is lower than the density of seawater. The air in the hull helps to lower the average density of the ship.

Connections to Disciplinary Ideas in Physics - Microscopic Models Can Explain Macroscopic Phenomena

We can understand density better by thinking about what is happening **inside** a substance. Different substances are made up of particles that may have **different masses**, or may be packed more tightly or loosely. When there is **more mass in the same amount of space**, the substance has a **higher density**.
This way of thinking helps us explain what we observe at the larger scale.

For example, a can of regular Coke sinks in water while a can of Diet Coke floats.

This media cannot be printed due to copyright issues

https://www.youtube.com/watch?v=S0wrB78J_CA

Both cans have roughly the same volume, but regular Coke contains much more dissolved sugar, which **increases its total mass**. Diet Coke uses sweeteners that add very little mass, so its overall density stays below that of water.

These particle-level ideas help us understand why some objects float, why others sink, and why mixtures or objects with air spaces (like ships) have **average densities** that determine their behaviour in fluids.

2. Check Your Understanding

Q1:

A solid has a mass of 2.0 kg and a volume of 5.0 m^3. Determine the density of the solid.

- 0.40 kg/m^3
- 2.5 kg/m^3
- 10 kg/m^3

MARKS /1

Q2:

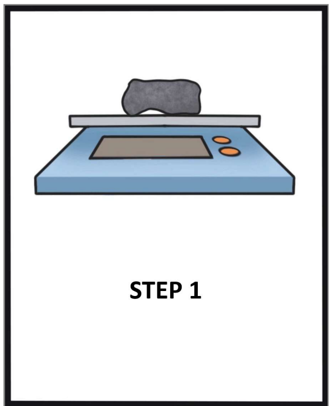
Mercury has a density of 13.6 g/cm^3. A liquid-in-glass thermometer contains 0.100 cm^3 of mercury. Determine the mass of mercury in the thermometer.

- 0.00735 g
- 1.36 g
- 136 g

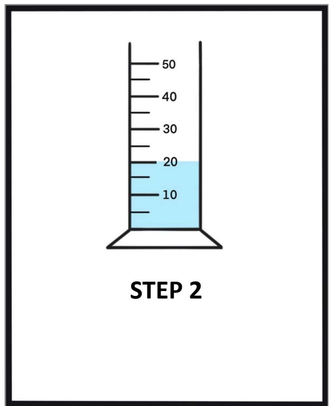
MARKS /1

Q3:

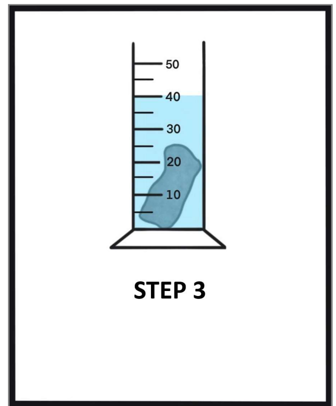
The instruction cards below describe how the density of a rock can be determined. However, some text is missing from the cards.



card_1.png ©



card_2.png ©



card_3.png ©

a.

Fill in the blanks in the following statements.

Step 1: Measure the mass of the rock using a/an ________.

Step 2: Pour some liquid into a ________ and read the volume of the liquid, V_1.

Step 3: Lower the rock gently into the liquid.

Step 4: Read the new volume of the liquid and the rock in the measuring cylinder, V_2.

Step 5: Find the volume of the ________ using $V_2 - V_1$.

Step 6: Divide the ________ of the rock by its ________ to determine the density of the rock.

MARKS ____ **/5**

b.

A student follows the instructions in part (a) and records the following:

- mass of rock = 48 g
- volume of liquid = 20 cm^3
- volume of liquid and the rock = 50 cm^3

Determine the density of the rock in g/cm^3.

density of rock = g/cm^3

MARKS /1

c.

Explain why a measuring cylinder may not be required if the rock has a regular shape (e.g., a cube).

Feedback

MARKS /1

d.

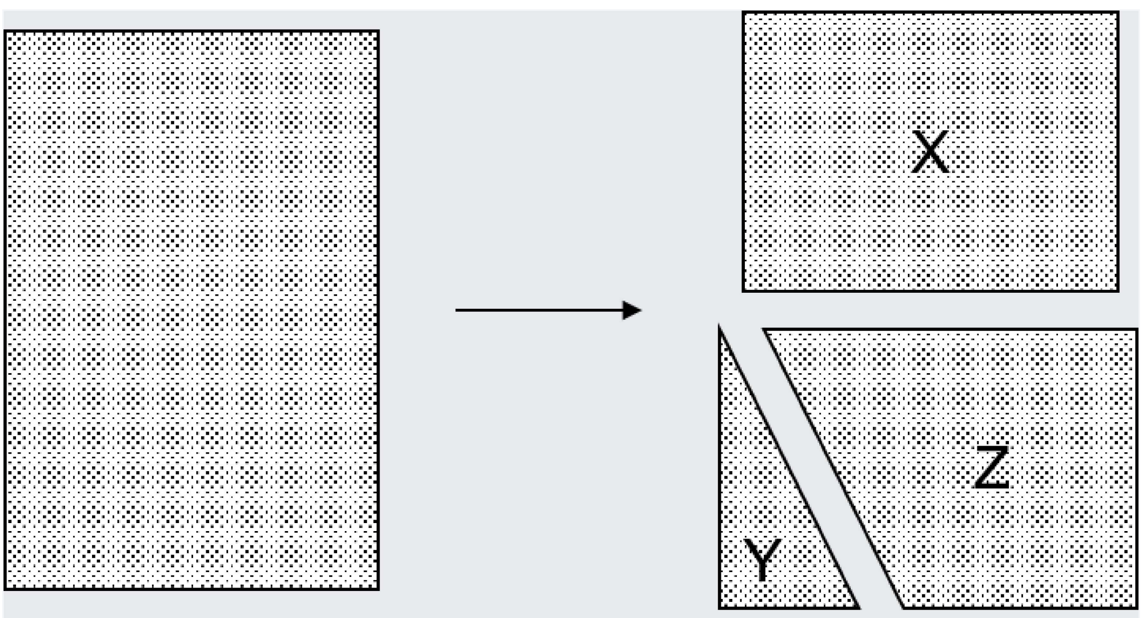
Suggest how the steps on the instruction cards can be modified to determine the density of an irregularly-shaped object that floats on water.

Feedback

MARKS /1

Q4:

A uniform sheet of steel is cut into three pieces - X, Y and Z.



©

a.

Which piece has the largest volume?

- X
- Y
- Z
- All pieces have the same volume.

MARKS /1

b.

Which piece has the largest mass?

- X
- Y
- Z
- All pieces have the same mass.

MARKS /1

c.

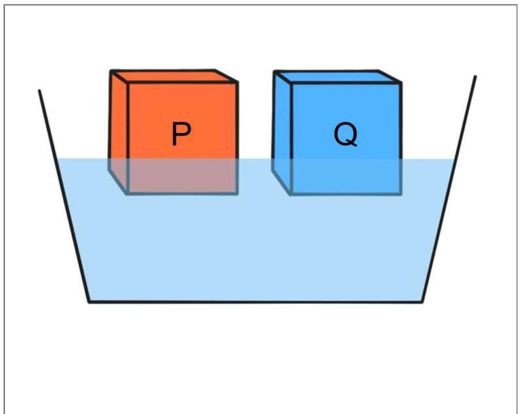
Which piece has the greatest density?

- X
- Y
- Z
- All pieces have the same density.

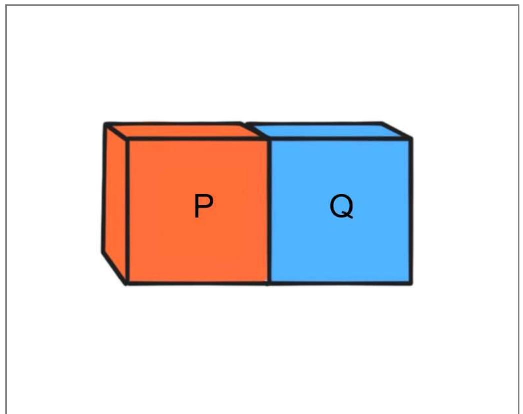
MARKS /1

Q5:

Blocks P and Q float on water. The two blocks are glued firmly together.



P_Q_in_water.png ©



P_Q_combined.png ©

What happens to the combined block when it is in water?

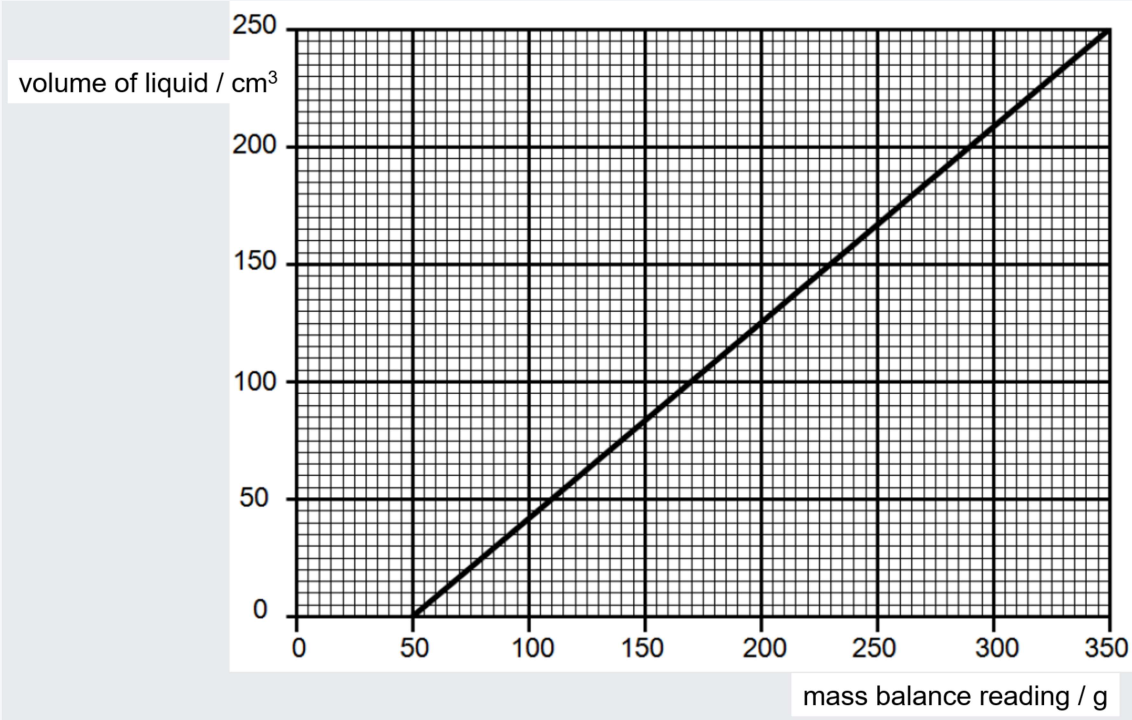
- It will float.
- It will sink.
- It will suspend in the water.

MARKS /1

Q6:

A chef checks the purity of honey by measuring its density. She pours the liquid slowly into an empty measuring cylinder that is placed on a mass balance. The mass of the measuring cylinder and its contents are measured regularly as the liquid is being poured into the measuring cylinder.

The figure below shows a graph of the variation of the volume of liquid with the mass balance readings.



©

a.

What is the mass of the measuring cylinder?

- 0 g
- 50 g
- 350 g

MARKS /1

b.

What is the mass of the liquid when the volume of liquid is 100 cm^3?

- 40 g
- 120 g
- 170 g

MARKS /1

c.

Calculate the density of the liquid. Give your answer in g/cm^3.

- ◯ 0.833 g/cm^3
- ◯ 1.20 g/cm^3
- ◯ 1.45 g/cm^3

MARKS ☐ /1

d.

The density of pure honey is 1.36 g/cm^3. Is the liquid made of pure honey?

- ◯ Yes
- ◯ No

MARKS ☐ /1

e.

Given that the density of water is 1.00 g/cm^3 and the density of corn syrup is 1.38 g/cm^3, which of the following explains why the density of the liquid is lower than the density of pure honey?

- ◯ Water was added to pure honey.
- ◯ Corn syrup was added to pure honey.

MARKS ☐ /1

f.

Some liquid was stuck to the side of the measuring cylinder when the mass and volume readings were recorded. How does it affect the density of the liquid found in part (c)?

- ◯ The actual density of the liquid may be lower than 1.2 g/cm^3.
- ◯ It does not affect the density found in part (c).
- ◯ The actual density of the liquid may be higher than 1.2 g/cm^3.

MARKS ☐ /1

Q7:

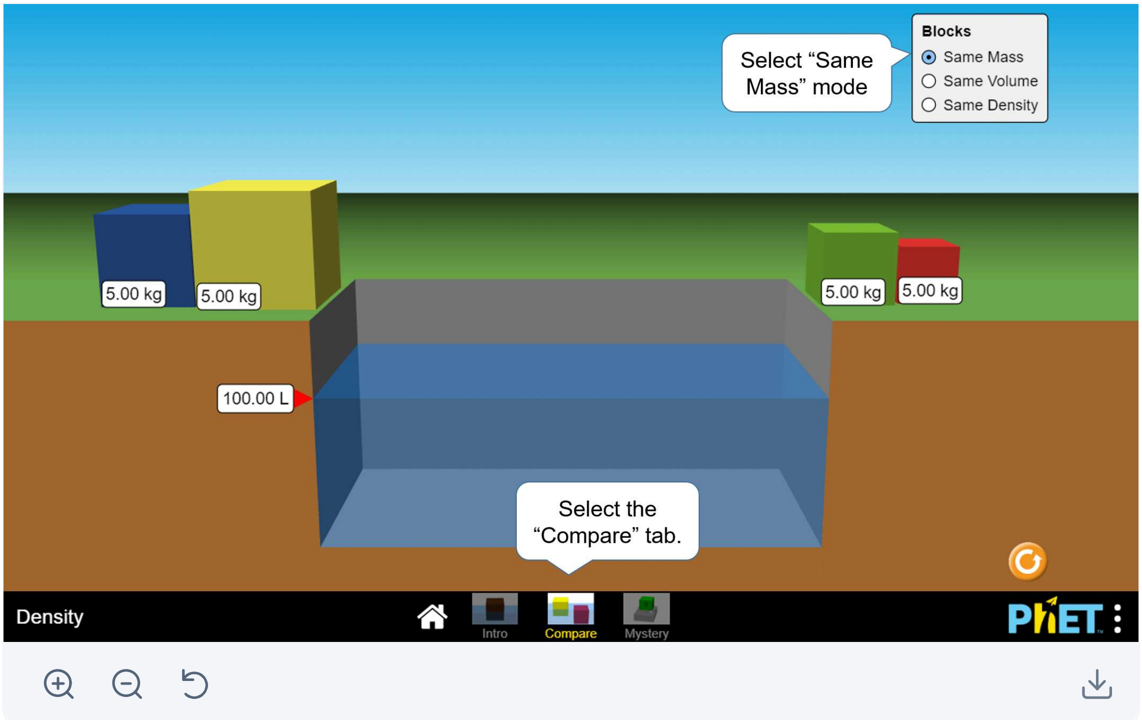
Use the interactive simulation below to answer part (a) to (c):

https://phet.colorado.edu/sims/html/density/latest/density_en.html

a.

A student claims that a heavier object will sink in a liquid. However, you have learnt that the density of an object determines whether it floats or sinks.

Use the “Compare” tab and the “Same Mass” mode (see image below) to design a simple demonstration to convince the student that the mass of an object does not determine whether it floats or sinks.



Outline the steps of your demonstration.

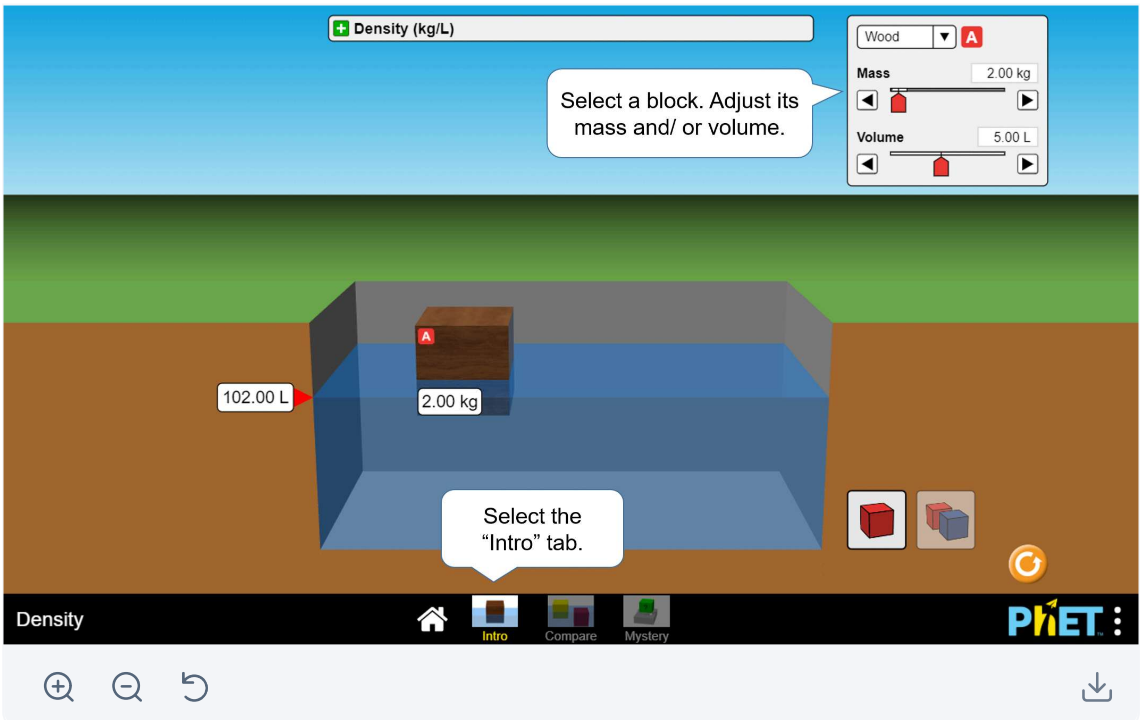
Feedback

MARKS /1

b.

The student is unconvinced by your demonstration and thinks that your demonstration was not a fair test as the blocks may not be made of the same substance.

Use the “Intro” tab (see image below) to design another simple demonstration to convince the student that the mass of an object does not determine whether it floats or sinks.



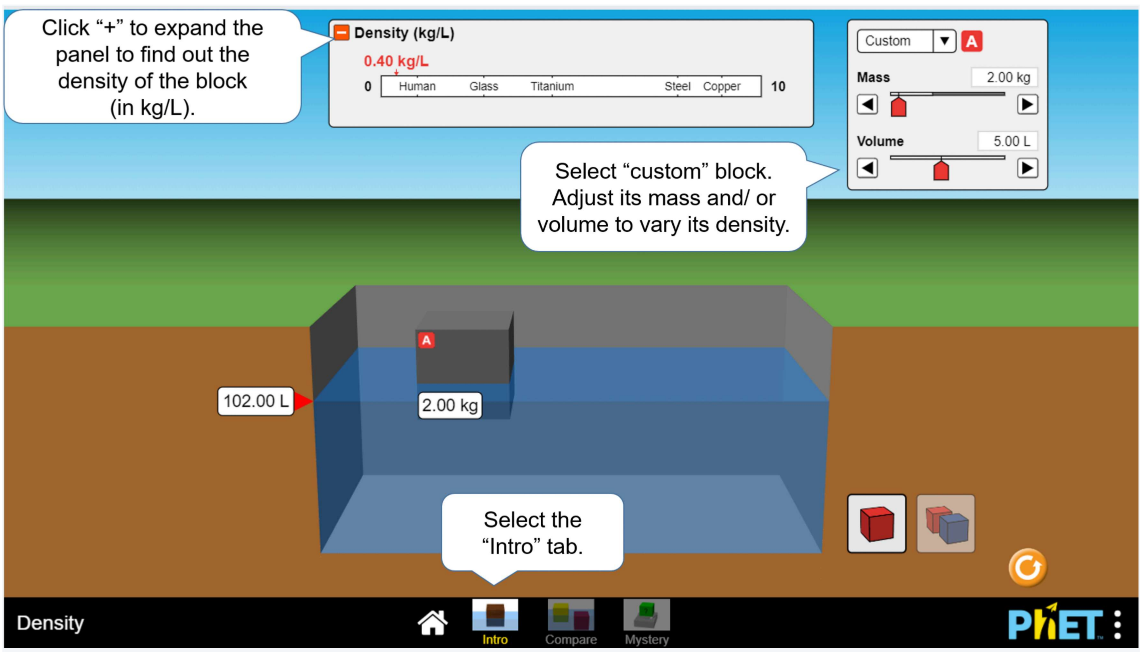
Outline the steps of your demonstration.

Feedback

MARKS /1

c.

Use the “Intro” tab and adjust the mass and volume of the “custom” block (see image below) to determine the density of the liquid in g/cm^3 [1 L = 1000 cm^3].



density of liquid = g/cm^3

MARKS /1

D. How is Force Related to Pressure?

1. Investigating Pressure

Learning Outcome

- Pressure depends on both the force applied and the area over which the force acts.

Why this Matters

Understanding how force and area affect pressure helps explain many situations that appear surprising at first. A person can lie safely on a bed of nails, yet a balloon can burst when pressed against a single sharp tack. These examples are not exceptions. They follow a consistent principle: **when a force is spread over a large area, the pressure at each point becomes small; when the same force acts on a small area, the pressure becomes large**.

Caption: A man can lie safely on a bed of more than a thousand sharp nails. The downward force that his body exerts is shared among many nails, so the pressure at each point is too small to puncture his skin.

balloon_meets_thumb_tacks_edited.mp4

Caption: A balloon can be pressed against many thumbtacks without bursting because the force is shared among many points. Each tack presses on the balloon with only a small pressure, so the rubber is not stretched enough at any point to tear or burst.

Apart from these examples, pressure also helps you make sense of familiar experiences, such as why knives cut better when sharp, why snowshoes prevent sinking into snow, or why high heels exert more pressure on the ground than sneakers. By understanding how force and area combine, resulting in pressure, you will be able to analyse a wide range of everyday and scientific problems.

Connections to Practices of Science - Conducting Investigations

Scientists often vary one factor at a time so they can study its effect clearly. In the two investigations below, you will use this approach to observe how force and area influence the effect produced on a material.

- In the first investigation, the **area of contact** changes while the **force is kept the same**.
- In the second investigation, the **force applied** changes while the **area of contact remains the same**.

By observing how these controlled changes affect the pressure exerted by a pen, you will gather evidence that prepares you to understand and apply the mathematical relationship for pressure later in this section.

Investigation 1: Pressure and area of contact

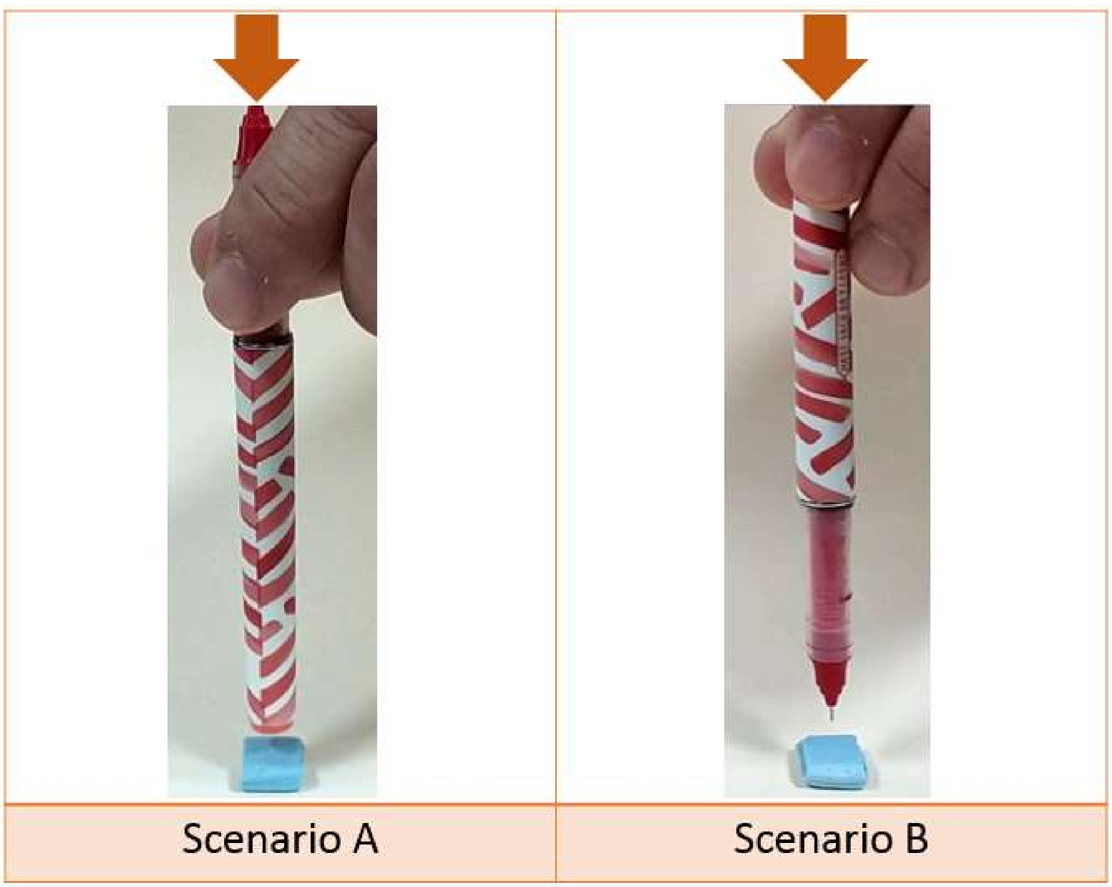
Here, you will keep the force the same but change the area of contact.

You will **predict** what will happen, **observe** how the pen deforms the blu-tack in each case, and **explain** how your observations relate to the difference in contact area.

Predict

The pictures below show two scenarios where each end of a pen is pushed into a lump of blu-tack.

- In scenario A, the **flat end** of the pen is pushed into the blu-tack.
- In scenario B, the **sharp tip** of the same pen is pushed into the blu-tack.



pen_and_blutack_-_predict__area__2.jpg ©

Q1:

In both scenarios, a depression is formed in the blu-tack.

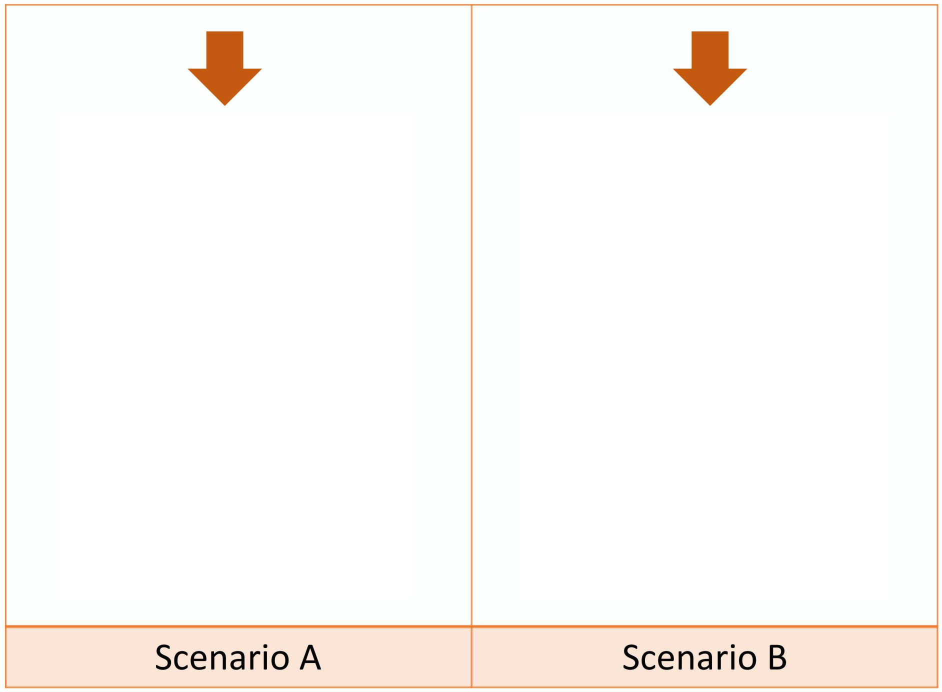
Predict whether a deeper depression is formed in scenario A or scenario B.

Feedback

MARKS /0

Observe

Click on the pen to push it down and observe what happens in both scenarios.



pen_and_blutack_-_observe__area__final.zip ©

Q2:

What did you observe about the depressions in both scenarios?

Feedback

MARKS /0

Explain

These observations can be explained using ideas about **pressure**.

Q3:

INSTRUCTIONS
You may select more than 1 option

Select the correct words to fill in the blanks below.

1. The sharp tip of the pen has _______ **(a smaller / the same / a larger) area of contact** with the blu-tack than the flat end of the pen.

2. Thus, for the **same amount of force applied**, the sharp tip of the pen exerts a **larger pressure** on the blu-tack than the flat end of the pen.

3. This allows the sharp tip of the pen to penetrate the blu-tack to ________ (a smaller / the same / a greater) depth than the flat end of the pen.

- [ ] 1. a smaller
- [ ] 1. the same
- [ ] 1. a larger
- [ ] 3. a smaller
- [ ] 3. the same
- [ ] 3. a greater

MARKS /1

In general,

The smaller the area of contact, the larger the pressure exerted (for the same amount of force applied).

Q4:

The larger the area of contact, the _______ the pressure exerted (for the same amount of force applied).

- smaller
- larger

MARKS /1

Investigation 2: Pressure and Force

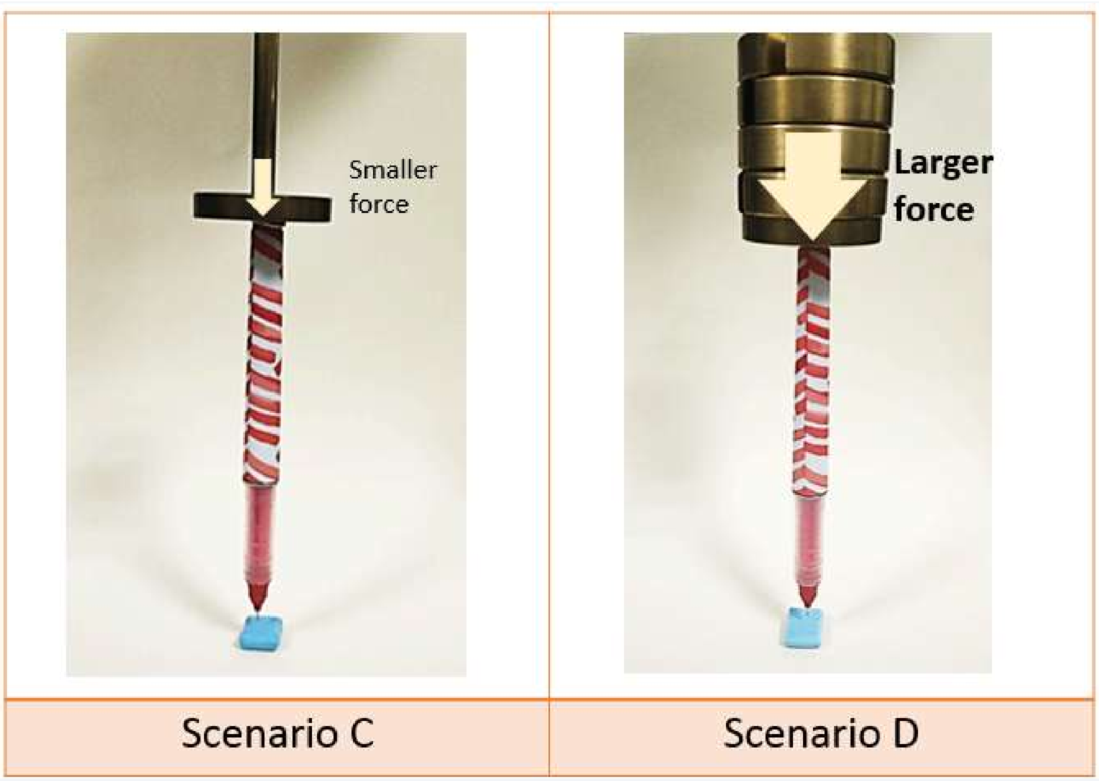
Here, you will keep the area of contact the same but change the force applied.

You will **predict** the depth of the depressions, **observe** the actual outcomes, and **explain** how your observations show the effect of increasing force.

Predict

The pictures below show two scenarios where a pen is pushed into a lump of blu-tack.

- In scenario C, the sharp tip of the pen is pushed into the blu-tack with a **smaller force**.
- In scenario D, the sharp tip of the same pen is pushed into the blu-tack with a **larger force** (by placing more slotted masses on top of the pen to increase the total weight).



pen_and_blutack_-_predict__force__2.jpg ©

Q5:

In both scenarios, a depression is formed in the blu-tack.

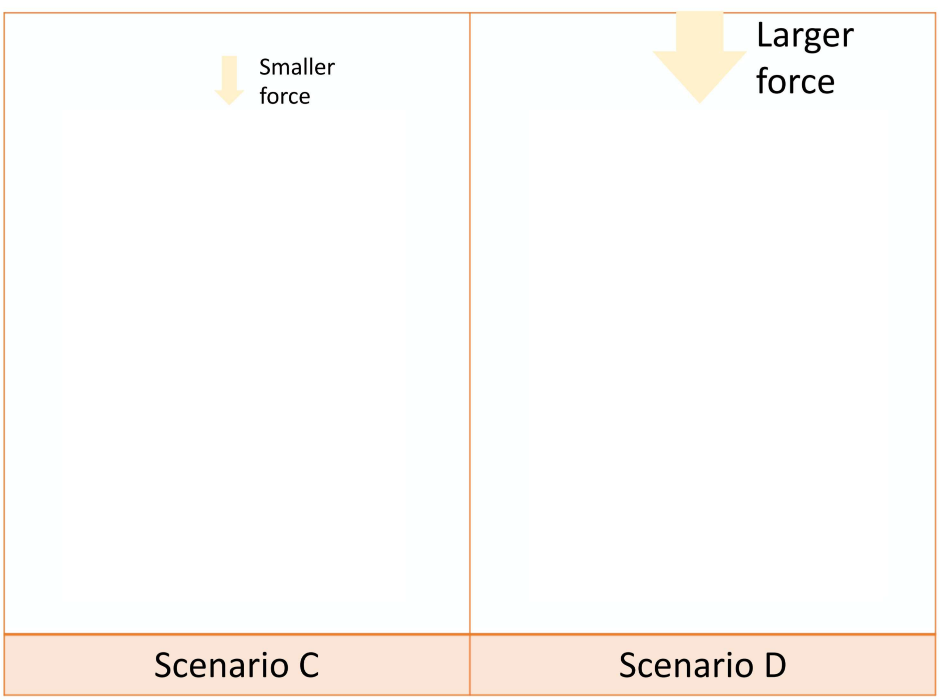
Predict whether a deeper depression is formed in scenario C or scenario D.

Feedback

MARKS /0

Observe

Click on the pen to push it down and observe what happens in both scenarios.



pen_and_blutack_-_observe__force__final.zip

Q6:

What did you observe about the depressions in both scenarios?

Feedback

MARKS /0

Explain

These observations can again be explained using ideas about **pressure**.

Q7:

INSTRUCTIONS

You may select more than 1 option

Select the correct words to fill in the blanks below.

1. A _______ **(smaller / larger) force** is applied to the pen in scenario D than in scenario C.

2. Thus, the pen in scenario D exerts a _______ **(smaller / larger) pressure** on the blu-tack than in scenario C.

3. This allows the pen in scenario D to penetrate the blu-tack to a ________ (smaller / greater) depth as compared to scenario C.

Important note: In both scenarios, there is the **same area of contact** between the pen and blu-tack.

- 1. smaller
- 1. larger
- 2. smaller
- 2. larger
- 3. smaller
- 3. greater

MARKS /1

In other words,

The larger the force applied, the larger the pressure exerted (for the same area of contact).

Q8:

The smaller the force applied, the ______ the pressure exerted (for the same area of contact).

- smaller
- larger

MARKS /1

Relating Pressure, Force and Area of contact

Definition of pressure

Pressure is defined as the force acting per unit area.

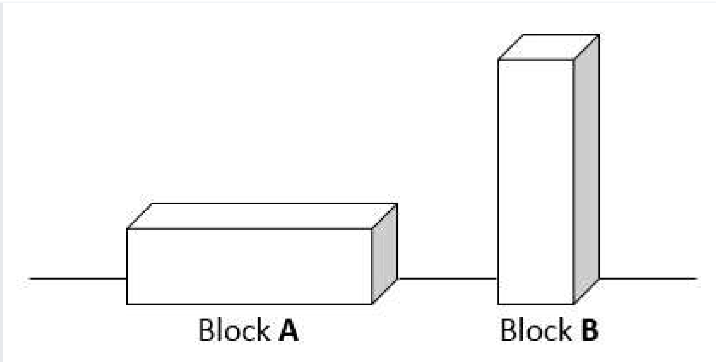
The SI unit of pressure is the **newton per square metre (N/m^2)**, also known as the **pascal (Pa)**.

$$p = F / A$$

where p is the pressure (Pa), F is the force applied (N) and A is the area (m^2).

Quick check question 1
Q9:

Two identical blocks **A** and **B** are placed in different orientations on the table.



blocks_on_table.PNG ©

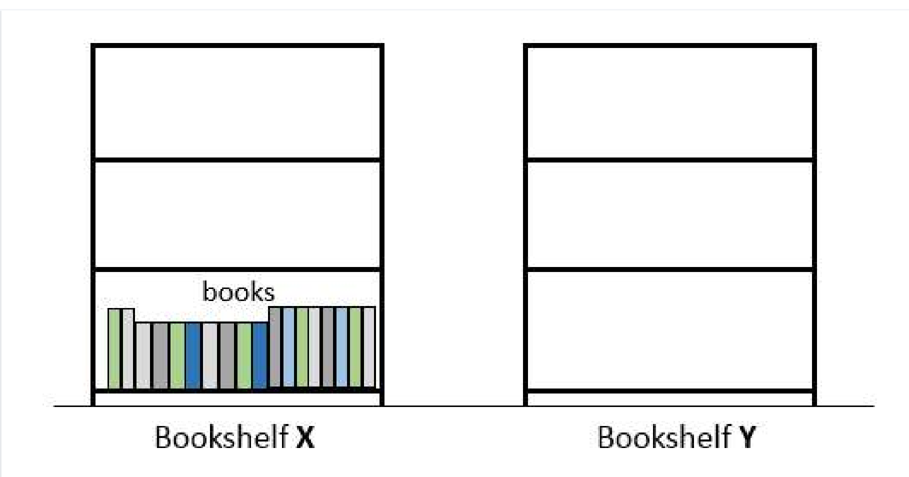
Which one exerts more pressure on the table?

- Block **A** exerts more pressure because it has a larger area of contact with the table.
- Block **B** exerts more pressure because it has a smaller area of contact with the table.
- Both blocks exert the same pressure because the force acting on the table is the same.

MARKS /1

Quick check question 2
Q10:

Two identical bookshelves **X** and **Y** rest on the ground. Bookshelf **Y** is empty.



bookshelves.PNG ©

Which one exerts more pressure on the ground?

- Bookshelf **X** exerts more pressure because there is a larger force acting on the ground.
- Bookshelf **Y** exerts more pressure because there is a smaller force acting on the ground.
- Both bookshelves exert the same pressure because the area of contact with the ground is the same.

MARKS /1

2. Check Your Understanding: Pressure

Solve the following problems using what you have learnt about pressure.

Q1:

A boy wearing sneakers stands on the ground.
How much pressure does he exert on the ground if his weight is 450 N and the total base area of his sneakers is 0.050 m^2?

- 2.25 N/m^2
- 22.5 N/m^2
- 900 N/m^2
- 9 000 N/m^2

MARKS /1

Q2:

A lady of mass 54 kg wears high heels. The total area of her high heels in contact with the ground is 0.015 m^2. The gravitational field strength g is 10 N/kg.
How much pressure does she exert on the ground?

- 0.81 N/m^2
- 8.1 N/m^2
- 3 600 N/m^2
- 36 000 N/m^2

MARKS /1

Q3:

A thumbtack is pushed into a notice board with a force of 2 N. The tip of the thumbtack has an area of 0.01 cm^2.
How much pressure does the thumbtack exert on the notice board?

- 200 N/cm^2

- 200 N/m^2
- 20 000 N/cm^2
- 20 000 N/m^2

MARKS /1

Q4:

Challenge: 1 N/m^2 = ________ N/cm^2?

Feedback

MARKS /0

Q5:

Explain why a sharp knife cuts food better than a blunt one.

Feedback

MARKS /0