# Pressure

11SCI - Mechanics

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2019

## Starter

Calculate the **net** force acting upon these objects:

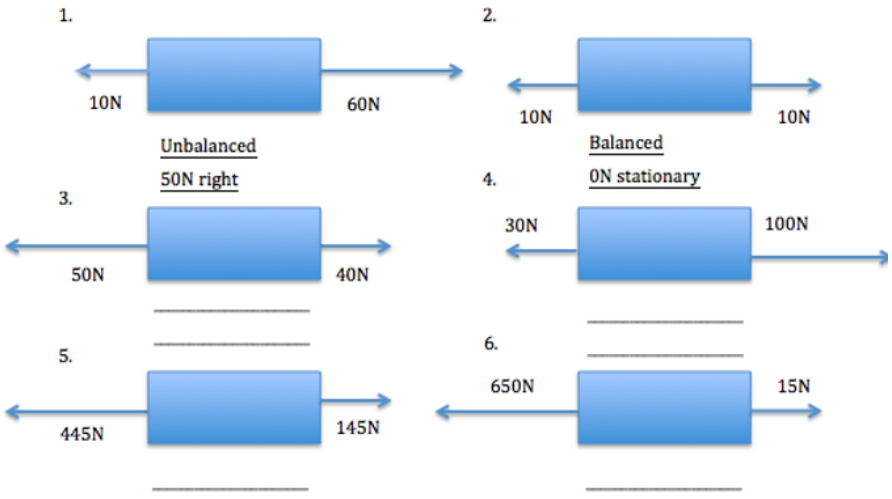


Figure 1: Unbalanced Forces

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### Question 1

What does an unbalanced force do to the motion of an object?

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**Answer 1**

It causes the object to accelerate (or deaccelerate).

We know this because of the equation

$$force = mass \times acceleration$$
$$F = m \times a$$

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## Question 2

For the equation

$$F = m \times a$$

give the **name** and **unit** for each variable in the equation.

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**Answer 2**

- F stands for **force** and has units **Newtons (N)**
- m stands for **mass** and has units **kilograms (kg)**
- a stands for **acceleration** and has units **meters per second squared ($ms^{-2}$)**

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## Question 3

- What do you think of when you think of pressure?
- What affects the pressure exerted by an object?

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**Question 4**

The most classic case of pressure is sharpening a knife. Why do we sharpen knives? What does sharpening a knife change about the knife?

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# Pressure

Pressure is defined as: *the amount of force per unit area.*

$$pressure = \frac{force}{area}$$

$$P = \frac{F}{A}$$

- Force is measured in **Newtons (N)**
- Area is measured in **meters squared ($m^2$)**

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# Pressure Continued

$$P = \frac{F}{A}$$

- Therefore, pressure is measured in Newtons / meters squared ($\frac{N}{m^2}$ OR $Nm^{-2}$)
- This is also known as a Pascal (Pa)

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## Starter (2018 Exam)

Jacob bikes down The Flying Nun. He and his bike have a mass of $82kg$ and he accelerates at $0.8ms^{-2}$.

1. Calculate the **net force** acting upon Jacob and his bike to cause this acceleration
2. Draw a force diagram showing the forces acting upon Jacob as he accelerates
3. Describe the size and direction of the forces compared to each other (horizontal and vertical)

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## Calculating Pressure

$$P = \frac{F}{A}$$

1. Calculate the **pressure** created by a force of $3N$ with an area of $0.5m^2$
2. Calculate the **pressure** created by a force of $3N$ with an area of $0.25m^2$
3. Calculate the **pressure** created by a force of $3N$ with an area of $0.125m^2$

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**Answers**

$$P = \frac{F}{A}$$

1. $P = \dfrac{3}{0.5} = 6Pa$
2. $P = \dfrac{3}{0.25} = 12Pa$
3. $P = \dfrac{3}{0.125} = 24Pa$

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## Calculating Area

$$P = \frac{F}{A}$$

4. Calculate the **area** that a force ($5N$) is acting through if it has a pressure of $7Pa$
5. Calculate the **area** that a force ($7N$) is acting through if it has a pressure of $3Pa$
6. Calculate the **area** that a force ($10N$) is acting through if it has a pressure of $3Nm^{-2}$

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**Answers**

$$A = \frac{F}{P}$$

4. $A = \dfrac{5}{7} = 0.71m^2$
5. $A = \dfrac{7}{3} = 2.33m^2$
6. $A = \dfrac{10}{3} = 3.33m^2$

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## Calculating Force

$$P = \frac{F}{A}$$

7. Calculate the **force** of an object with area $0.25m^2$ and pressure $5Pa$
8. Calculate the **force** of an object with area $0.5m^2$ and pressure $7Pa$
9. Calculate the **force** of an object with area $0.75m^2$ and pressure $10Pa$

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**Answers**

$$F = P \times A$$

7. $F = 0.25 \times 5 = 1.25N$
8. $F = 0.5 \times 7 = 3.5N$
9. $F = 0.75 \times 10 = 7.5N$

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## Exam Question (2018)

Giovanni is running a 100m sprint. Each of his feet have a surface area of $200cm^2$ ($0.0200m^2$), which sink into the track. Together, his feet exert a pressure of $13000Pa$. Calculate Giovanni's weight.

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**Answer**

Because **weight** is a force, we know that we are looking for $F$.

$P = 13000Pa$ $\qquad$ $A = 0.02m^2 \times 2 = 0.04m^2$

$F = P \times A$

$F = 13000 \times 0.04$

$F = 520N$

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## Extra Work

- **Homework:** Education Perfect due Monday 29th 11:25am
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