Lesson 7 - Pressure

Physics - KS3

Forces and Motion

Mrs Wolstenholme

What is pressure?

Pressure is related to how spread out a force is over an area.

Complete the task

What is pressure?

Pressure is related to how _____ out a _____ is over a certain _____.
We use the sharp part of the pin because it has a _____ area which means there will be a _____ pressure.

Calculating Pressure

Pressure   =   Force   ÷   Area

$$(\mathbf{N/m^2}) \qquad\qquad (\text{N}) \qquad\qquad (\mathbf{m^2})$$
$$(\mathbf{Pa}) \qquad\qquad\qquad\qquad\qquad (\mathbf{cm^2})$$
$$(\mathbf{N/cm^2})$$

Calculating Pressure

Pressure = Force ÷ Area

(Pa) (N) (m^2)
(N/cm^2) (cm^2)

A hammer strikes a nail with a force of 200 N. The nail has a surface area of 0.1 m^2. What is the pressure on the nail?

Pressure = Force ÷ Area
Pressure = 200 ÷ 0.1
Pressure = 2000 Pa

Calculating Pressure

Pressure   =   Force   ÷   Area

(Pa)   (N)   (m^2)

(N/cm^2)   (cm^2)

A hammer strikes a nail with a force of 100N. The nail has a surface area of 100 cm^2. What is the pressure on the nail?

Pressure = Force ÷ Area

Pressure = 100 ÷ 100

Pressure = 1 N/cm^2

If the unit of area is given as cm² what is the unit of pressure?

Option 1

N/cm^2

Option 2

N/m^2

Option 3

Kilogram (kg)

Option 4

Pa

If the unit of area is given as m^2 what is the unit of pressure?

Option 1

N/cm^2

Option 2

N/m^2

Option 3

Kilogram (kg)

Option 4

Pa

Calculating Pressure: Your Turn

Pressure   =   Force   ÷   Area

(Pa) (N) (m^2)
(N/cm^2) (cm^2)

A hammer strikes a nail with a force of 750 N. The nail has a surface area of 0.1 m^2. What is the pressure on the nail?

Pressure = Force ÷ Area

Calculating Pressure: Your Turn

Pressure   =   Force   ÷   Area

(Pa)   (N) (m^2)

(N/cm^2) (cm^2)

A hammer strikes a nail with a force of 600N. The nail has a surface area of 200 cm^2. What is the pressure on the nail?

Independent Practice

Pressure = Force ÷ Area

(Pa) or (N/cm^2)   (N)   (m^2) or (cm^2)

1. A woman in stilettos, stands on a man's foot with a force of 500 N. If the stilettos have a surface area of 0.01 m^2, what pressure is exerted on the man's foot?

2. A football has a surface area of 0.5m^2. If the football hits a wall with a force of 200 N, what pressure does the ball exert on the wall?

3. A bullet hits a pane of glass. If the bullet has a surface area of 0.5cm^2, and strikes the glass with a force of 10,000 N what pressure does this exert on the glass?

Calculating Force

Pressure $\quad$ = $\quad$ Force $\quad$ ÷ $\quad$ Area

$\quad$ (Pa) $\qquad\qquad$ (N) $\qquad\qquad$ (m^2)

(N/cm^2) $\qquad\qquad\qquad\qquad\qquad$ (cm^2)

A zoologist worked out that the pressure an elephant exerts on the ground is 128000 N/m^2. The area of the elephant's feet is 0.5 m^2.

Pressure = Force ÷ Area

128000 = Force ÷ 0.5

128000 **x 0.5** = Force ÷ 0.5 **x 0.5**

128000 **x 0.5** = Force

64 000 = Force -> Force = 64 000 N

What is the next step?

400 = Force ÷ 4

Option 1

400 **x 4** = Force ÷ 4 **x4**

Option 2

400 **÷ 4** = Force ÷ 4 **÷ 4**

Option 3

400 **x 4** = Force ÷ 4 **÷ 4**

Option 4

PANIC!!

What is the next step?

$600 = \text{Force} \div 2$

Option 1

$600 \ \textbf{÷ 2} = \text{Force} \div 2 \ \textbf{÷ 2}$

Option 2

$600 \ \textbf{x 2} = \text{Force} \div 2 \ \textbf{x 2}$

Option 3

$600 \ \textbf{x 3} = \text{Force} \div 2 \ \textbf{x 3}$

Option 4

PANIC!!

What is the next step?

$$450 = \text{Force} \div 10$$

Option 1

$$450 \times 10 = \text{Force} \div 10 \times 10$$

Option 2

$$450 \div 10 = \text{Force} \div 10 \div 10$$

Option 3

$$450 \times 450 = \text{Force} \div 10 \times 450$$

Option 4

PANIC!!

Calculating Force: Your Turn

Pressure   =   Force   ÷   Area

(Pa)   (N)   (m^2)
(N/cm^2)   (cm^2)

When 0.02 m^2 basketball hits a wall; the pressure applied is 30,000 Pa. What force did the basketball hit the wall with?

Pressure = Force ÷ Area

Calculating Force: Your Turn

Pressure   =   Force   ÷   Area

(Pa)   (N) (m^2)

(N/cm^2) (cm^2)

A runner exerts 450,000 Pa of pressure during a footstep. The area of her foot is 0.1 m^2. Calculate the force.

Which is better for walking on mud?

The elephant foot has a **large area**. This means the force will be spread out over a large area and the pressure will be **low**.

The horse hoof has a **small area**. This means the force will be spread out over a small area and the pressure will be **high**.

We want a **small** pressure so we don't get stuck in the mud! So the elephant foot is better.

Which is better for walking in snow?

- What will the pressure of the snow shoes be like? Why?
- What will the pressure of the high heels be like? Why
- Overall, which is better for walking in snow?

High heels <u>vs</u> Snow shoes

Which is better for walking in snow?

High heels vs **Snow shoes**

The snow shoes have a _____ **area**. This means the force will be _____ out over a large area and the pressure will be _____.

The high heels have a _____ **area**. This means the force will be _____ out over a small area and the pressure will be _____.

We want a _____ pressure so we don't sink into the snow! So the _____ are better.

Extra Practice

1. Calculate the pressure of a knife with an area of 0.005 m^2 and a force of 40N.
2. Calculate the pressure of a shoe with an area of 0.02m^2 and a force of 1400N.
3. Calculate the pressure of a car tyre with an area of 0.5m^2 and a force of 14500N.
4. Calculate the pressure if a car crashes into a wall with 25000N and with a front area of 199cm^2
5. A woman of mass 47.5kg on Earth stands in a pair of shoes with an area of 0.003m^2 . Calculate the pressure she is exerting on the ground. (Hint: First calculate her WEIGHT. The gravitational field strength is 10 N/kg)
6. A child of mass 50.4kg on Earth lies on the bed with an area of 0.75m^2 . Calculate the pressure the child is exerting on the bed.

Extra Practice: Answers

1. $40 \div 0.005 = 8000$ Pa
2. $1400 \div 0.02 = 70\ 000$ Pa
3. $14500 \div 0.5 = 29\ 000$ Pa
4. $25000 \div 199 = 126$ N/cm^2
5. Calculate weight: $47.5 \times 10 = 475$ N Calculate pressure: $475 \div 0.003 = 158\ 333$ Pa
6. Calculate weight: $50.4 \times 10 = 504$ N Calculate pressure: 504 N $\div 0.75$ m$^2 = 672$ Pa