Name: _____ Class: _____

Pressure

Pressure is the amount of force exerted per unit area on a surface that is perpendicular to the force. In mathematical terms:

$$Pressure = \frac{Force}{Area}$$

Pressure is measured in Pascals, where 1 Pascal is 1 Newton per square meter. More commonly used is the Kilopascal, which is 1000 Newtons per square meter.

For example, if a person has a weight of 490 N (50 kg x 9.8 N/kg – this is gravitational force) and their feet take up an area of 400 cm^2, then the pressure they exert on the ground may be calculated as follows:

Force = 490 N
Area = 400 cm^2 = 0.04 m^2
Pressure = ?

$$Pressure = \frac{Force}{Area}$$

$$Pressure = \frac{490N}{0.04m^2}$$

$$Pressure = 12250 \, {}^{N}/_{m^2}$$

$$Pressure = 12.25kPa$$

∴ The pressure on the ground would be 12.25 kPa.

Complete the following questions related to pressure.

1. A block, resting on the ground, has a cross sectional area of 2 m^2 is being pushed with a force of 100 N. What is the pressure exerted by the block on the ground?

$F = 100\ N$
$A = 2\ m^2$
$P = ?$

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

$$P = \frac{100\ N}{2\ m^2}$$

$$P = 50\ Pa$$

∴ The pressure on the ground is 50 Pa.

2. An aquarium holds 100 L of water (recall that 1 L of water has a mass of 1 kg). The base of the aquarium is 1 m by 0.5 m. What pressure is exerted on a table by the filled aquarium?

100 L of water has a mass of 100 kg. To find the weight of an object you multiply its mass by the gravitational constant

$F = 100\ kg\ \times 9.8\ {}^{N}/_{kg}$

$F = 980\ N$

The area of the aquariam can be calculated, as both the length and width are provided

$A = lw$

$A = 1\ m\ \times 0.5\ m$

$A = 0.5\ m^2$

$F = 980\ N$

$A = 0.5\ m^2$

$P =?$

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

$P = \frac{980\ N}{0.5\ m^2}$

$P = 1960\ Pa$

∴ The pressure on the table is $1960\ Pa$.

3. Tom's hand print is 30 cm^2 but Sean's handprint is only 20 cm^2. If Tom is able to push with a force of 70 N and Sean can push with a force of 50 N, who can exert a larger pressure on an object?

Tom

$F_T = 70\ N$

$A_T = 30\ cm^2$

$A_T = 0.0030\ m^2$

$P_T =?$

$P_T = \frac{F_T}{A_T}$

$P_T = \frac{70\ N}{0.0030\ m^2}$

$P_T = 23\ 333.\bar{3}\ Pa$

$P_T = 23.\bar{3}\ kPa$

∴ Tom can push with a pressure of $23.\bar{3}\ kPa$.

Sean

$F_S = 50\ N$

$A_S = 20\ cm^2$

$A_S = 0.0020\ m^2$

$P_S =?$

$P_S = \frac{F_S}{A_S}$

$P_S = \frac{50\ N}{0.0020\ m^2}$

$P_S = 25\ 000\ Pa$

$P_S = 25.0\ kPa$

∴ Sean can push with a pressure of $25.0\ kPa$.

∴ Sean is capable of exerting a larger pressure on an object.

4. If a box is applying 24 kPa of pressure on a table and the area of the box is 80cm^2, what must the weight of the box be?

$F =?$

$A = 80\ cm^2$

$A = 0.0080\ m^2$

$P = 24\ kPa$

$P = 24\ 000\ Pa$

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

$F = P \times A$

$F = 24\ 000\ Pa\ \times 0.0080\ m^2$

$F = 192\ N$

∴ The weight of the box is $192\ N$.