

SCIENCE (PHYSICS)
NUMERICALS WORKSHEET (SOLUTION)_150924
(FORCE AND PRESSURE)

1. The average weight of an elephant is 4000 N. The surface area of the sole of its foot is 0.1 m^2 . Calculate the pressure exerted by one foot of an elephant.

Solution. Average weight of the elephant = 4000 N

Weight of one leg = Force exerted by one leg = $4000/4 = 1000\text{ N}$ Area of the sole of one foot = 0.1 m^2

Pressure = Force/Area = $1000/0.1 = 10000\text{ N/m}^2 = 10^4\text{ Nm}^{-2}$

Pressure exerted by one leg of the elephant is 10,000 newtons on one square metre.

2. A stone weighs 500 N. Calculate the pressure exerted by it if it contacts a surface of area 25 cm^2 . Solution. Weight of a stone $F = 500\text{ N}$

Solution: Area $A = 25\text{ cm}^2 = 25 \times 10^{-4}\text{ m}^2$

Pressure $P = ?$

Pressure $P = F/A = 500 / [25 \times 10^{-4}]$

Pressure $P = 20 \times 10^4\text{ Nm}^{-2}$ (or) $20 \times 10^4\text{ Pa}$

3. In a hydraulic lift, the surface area of the input piston is 10 cm^2 . The surface area of the output piston is 3000 cm^2 . A 100 N force applied to the input piston raises the output piston. Calculate the force required to raise the output piston.

Solution: Pressure input on piston, $P = F/A = 100 / [10 \times 10^{-4}] = 10^5\text{ N}$ According to Pascal's law
 $P = F/A$

$10^5 = F / [3000 \times 10^{-4}] = [F \times 10^4] / 3000$

$10^4 \times F = 10^5 \times 3000$

$F = 3 \times 10^4\text{ N}$

4. A force of 1200 N acts on the surface of area 10 cm^2 normally. What would be the thrust and pressure on the surface?

Solution: Force $F = 1200\text{ N}$, Area $A = 10\text{ cm}^2 = 10 \times 10^{-4}\text{ m}^2 = 10^{-3}\text{ m}^2$ Thrust = Normal pressure
 $= F = 1200\text{ N}$

Pressure = F/A

$P = 1200/10^{-3} = 1.2 \times 10^6\text{ N/m}^2$

5. The elephant weighs 20,000 N stands on one foot of area 1000 cm^2 . How much

pressure would it exert on the ground?

Solution: Force applied by elephant $F = 20,000 \text{ N}$, area $A = 1000 \text{ cm}^2 = 1000/100 \times 100 \text{ m}^2 = 0.1 \text{ m}^2$ The pressure is given by

Pressure $P = F/A = 20,000\text{N}/0.1\text{m}^2 = 2,00,000 \text{ N/m}^2$.

6. Calculate the pressure produced by a force of 800 N acting on an area of 2.0 m^2 .

Solution: Pressure is defined as force per unit area or $P = F / A$ $P = (800 \text{ N}) / (2.0 \text{ m}^2)$

$P = 400 \text{ N} / \text{m}^2 = 400 \text{ Pa}$

7. The pressure of a gas contained in a cylinder with a movable piston is 300 Pa. The area of the piston is 0.5 m^2 . Calculate the force that is exerted on the piston.

Solution: Pressure is defined as force per unit area or $P = F / A$

We multiply both sides of the equation by the area to solve for the force as $F = P A$ $F = (300 \text{ Pa}) (0.5 \text{ m}^2)$

$F = 150 \text{ N}$

8. A swimming pool of width 9.0 m and length 24.0 m is filled with water to a depth of 3.0 m. Calculate pressure on the bottom of the pool due to the water.

Solution: The pressure due to a column of fluid is calculated as the product of the height of the fluid times the density of the fluid times the acceleration due to gravity.

For water the density is $d = 1000 \text{ kg} / \text{m}^3$ $P = d h g$

$P = (1000 \text{ kg} / \text{m}^3) (3.0 \text{ m}) (9.8 \text{ m} / \text{s}^2)$ $P = 29400 \text{ Pa}$