

Foundation GCSE: Pressure, Force, Area Calculations

Name: _____

Class: _____

Instructions: Answer all questions. Questions are ordered from easiest (1) to hardest (20). Working out should be shown where appropriate.

1. A box exerts a force of 120 N on a floor over an area of 4 m². Calculate the pressure in N/m².
2. A table exerts a pressure of 50 N/m² on the ground. If the contact area is 3 m², calculate the downward force in Newtons.
3. A person exerts a force of 600 N on the ground. If their shoes have a total contact area of 0.02 m², calculate the pressure exerted.
4. A container exerts a pressure of 400 N/m² under a force of 1600 N. Calculate the area of contact in square meters.
5. A heavy crate has a base area of 1.5 m² and a mass of 300 kg. Taking $g = 10$ N/kg, calculate the pressure exerted by the crate.
6. A woman with a mass of 60 kg stands on stiletto heels, each having a contact area of 0.0002 m². Calculate the pressure exerted on the floor by both heels ($g = 10$ N/kg).
7. A rectangular metal block measures 0.5 m $\times$ 0.2 m $\times$ 0.1 m with a density of 5000 kg/m³. Calculate the maximum pressure it can exert on a table ($g = 10$ N/kg).
8. An elephant of mass 4800 kg stands evenly on four feet, each with a circular footprint of radius 0.2 m ($\pi \approx 3$). Calculate the pressure exerted by the elephant ($g = 10$ N/kg).
9. A hydraulic press has a small piston of area 0.05 m² subjected to a force of 250 N. What force is exerted on a larger piston of area 0.8 m²?
10. A storage tank rests on four identical cylindrical pillars. Each has a radius of 0.1 m ($\pi \approx 3$). If total mass is 3600 kg, calculate the pressure exerted by each pillar ($g = 10$ N/kg).
11. A snowboarder of mass 75 kg uses a board measuring 1.5 m by 0.25 m. Calculate the pressure exerted on the snow ($g = 10$ N/kg).
12. A wooden beam of mass 80 kg has dimensions 4 m $\times$ 0.2 m $\times$ 0.1 m. Calculate the minimum pressure it can exert on the floor ($g = 10$ N/kg).
13. A car of mass 1200 kg rests on four tyres. Each tyre has a contact patch of 20 cm by 15 cm. Calculate the pressure exerted on the road in N/m² ($g = 10$ N/kg).
14. A vertical cylinder of cross-sectional area 0.04 m² contains gas. A piston of mass 20 kg rests on the gas. If atmospheric pressure is 100000 N/m², find the total base pressure ($g = 10$ N/kg).
15. A brick of mass 3 kg ($g = 10$ N/kg) measures 20 cm $\times$ 10 cm $\times$ 5 cm. Find the difference in pressure between resting on its largest face and its smallest face.
16. A diving bell is submerged where water column pressure is 250000 N/m². If the top hatch has a circular area of radius 0.3 m ($\pi \approx 3$), calculate the total downward force.
17. A tractor has a mass of 6000 kg ($g = 10$ N/kg) and tracks with total contact area 5 m². If mud gives way above 15000 N/m², will the tractor sink? Show calculations.
18. A metal cube of side 20 cm and density 8 g/cm³ rests on a workbench ($g = 10$ N/kg). Calculate the pressure exerted in Pascals (N/m²).
19. A table has mass 20 kg and supports an 80 kg load ($g = 10$ N/kg). It stands on four square legs of side 5 cm. Calculate the pressure exerted by each leg.
20. A knife blade has a contact area of 0.0002 m². If a person applies a force of 15 N when cutting, calculate the pressure exerted at the edge in Pascals.

Answers & Worked Solutions

1. $30 \text{ N/m}^2 : 120 \div 4 = 30$.
2. $150 \text{ N} : 50 \times 3 = 150$.
3. $30000 \text{ N/m}^2 : 600 \div 0.02 = 30000$.
4. $4 \text{ m}^2 : 1600 \div 400 = 4$.
5. $2000 \text{ N/m}^2 : \text{Force } 3000 \text{ N, area } 1.5 \text{ m}^2$.
6. $1500000 \text{ N/m}^2 : \text{Force } 600 \text{ N, area } 0.0004 \text{ m}^2$.
7. $25000 \text{ N/m}^2 : \text{Weight } 500 \text{ N, smallest area } 0.02 \text{ m}^2$.
8. $100000 \text{ N/m}^2 : \text{Weight } 48000 \text{ N, total area } 0.48 \text{ m}^2$.
9. $4000 \text{ N} : \text{Pressure } 5000 \text{ N/m}^2 \times 0.8 \text{ m}^2$.
10. $300000 \text{ N/m}^2 : \text{Load } 9000 \text{ N per pillar, area } 0.03 \text{ m}^2$.
11. $2000 \text{ N/m}^2 : \text{Force } 750 \text{ N, area } 0.375 \text{ m}^2$.
12. $1000 \text{ N/m}^2 : \text{Weight } 800 \text{ N, max area } 0.8 \text{ m}^2$.
13. $100000 \text{ N/m}^2 : \text{Weight } 12000 \text{ N, total tyre area } 0.12 \text{ m}^2$.
14. $105000 \text{ N/m}^2 : 100000 + (200 \div 0.04)$.
15. $4500 \text{ N/m}^2 : \text{Max pressure } 6000, \text{ min pressure } 1500$.
16. $67500 \text{ N} : 250000 \times 0.27 \text{ m}^2$.
17. No, it will not sink : Pressure = $12000 \text{ N/m}^2 < 15000 \text{ N/m}^2$.
18. $16000 \text{ N/m}^2 : \text{Weight } 640 \text{ N, area } 0.04 \text{ m}^2$.
19. $100000 \text{ N/m}^2 : \text{Load } 250 \text{ N per leg, area } 0.0025 \text{ m}^2$.
20. $75000 \text{ N/m}^2 : 15 \div 0.0002 = 75000$.