

Math Skills - Pascal's Principle

EXAMPLE PROBLEM

A dentist's chair makes use of Pascal's principle to move patients up and down. Together, the chair and a patient exert a downward force of 2,269 N. The chair is attached to a large piston with an area of 1,221 cm². To move the chair, a pump applies force to a small piston with an area of 88.12 cm². What force must be exerted on the small piston to lift the chair?

PRACTICE

1. A hydraulic lift office chair has its seat attached to a piston with an area of 11.2 cm². The chair is raised by exerting force on another piston, with an area of 4.12 cm². If a person sitting on the chair exerts a downward force of 219 N, what force needs to be exerted on the **small piston** to lift the seat?

2. In changing a tire, a hydraulic jack lifts 7,468 N on its large piston, which has an area of 28.27 cm². How much force must be exerted on the **small piston** if it has an area of 1.325 cm²?

3. An engine shop uses a lift to raise a 1,784 N engine. The lift has a large piston with an area of 76.32 cm². To raise the lift, force is exerted on a **small piston** with an area of 12.56 cm². What force must be exerted to raise the lift?

EXAMPLE PROBLEM

An engineering student wants to build a hydraulic pump to lift a 1,815 N crate. The pump will have two pistons connected via a fluid chamber. The student calculates that a force of 442 N will be exerted on the small piston, which will have an area of 50.2 cm². What must the area of the large piston be to exert the desired force?

PRACTICE

4. In a newly designed car with a hydraulic braking system, a force of 85 N is applied to one of the master cylinders, which has an area of 8.1 cm^2 . The master cylinder is connected to one brake piston, which exerts a force of 296 N. What is the **area** of the brake piston?

5. A mechanic uses a hydraulic car jack to lift the front end of a car to change the oil. The jack used exerts 8,915 N of force from the larger piston. To pump the jack, 444 N of force is exerted on the small piston, which has an area of 3.14 cm^2 . What is the **area** of the large piston?

EXAMPLE PROBLEM

The motor on a construction-grade hydraulic shovel exerts $3.11 \times 10^7 \text{ Pa}$ of pressure on a fluid tank. The fluid tank is connected to a piston that has an area of 153 cm^2 . How much force does the piston exert?

PRACTICE

6. A small crane has a motor that exerts $2.41 \times 10^7 \text{ Pa}$ of pressure on a fluid chamber. The chamber is connected by a fluid line to a piston on the crane arm. If the piston has an area of 168 cm^2 , how much force does the piston exert?

7. A bicycle pump uses Pascal's law to operate. The air in the hose acts as a fluid and transfers force and pressure from the piston to the tire. If a pump has a piston with an area of 7.1 cm^2 , how much force must be exerted on it to create a pressure of $8.2 \times 10^5 \text{ Pa}$?

8. A small backyard log splitter has an engine that applies $1.723 \times 10^7 \text{ Pa}$ of pressure to a fluid tank. The tank is connected to a piston with an area of 81.07 cm^2 . How much force can the piston exert?
