Problems of Pressure and hydrostatics, Pascal's and Arquimedes' principles

1) A 990 kg car rests on 4 tires each inflated to 200 kPa. What surface area (in cm^2) does each tire have in contact with the ground? (assume the weight is evenly distributed on each wheel).
Answer: 121 cm^2.

2) Find the pressure (in pascals) produced by a kilogram of nickel on a horizontal surface if the area it rests on is 370 cm^2.
Answer: 265 Pa.

3) Find the pressure (in pascals) exerted on the floor by a 260 N box whose bottom area is 36 cm × 69 cm.
Answer: 1050 Pa.

4) Find the pressure exerted on the ground (in pascals) by a 45 kg person who is sitting on a chair whose 4 legs touch the ground with an area of 4 cm × 2 cm each.
Answer: 1.38×10^5 Pa.

5) Find the force exerted on a 3 m × 50 m wall by the atmosphere, if atmospheric pressure is 101325 Pa.
Answer: 1.52×10^7 N.

6) A human hand has an area of 100 cm^2. Determine the amount of force it experiences at one atmosphere of pressure (101325 Pa).
Answer: 1013 N.

7) If your mass is 95 kg and the total area of the soles of your feet is 405 cm^2, what pressure would you exert on the ground?
Answer: 23000 N/m^2 = 23000 Pa.

8) Find the pressure exerted on the ground by a three legged milking stool if the stool has a mass of 8 kg, the mass of the milker is 68 kg and the legs are circular each with a diameter of 3 cm.
Answer: 3.51×10^5 N/m^2 = 3.51×10^5 Pa.

9) Find the gauge pressure, in pascals, at a depth of 110 m in fresh water.
Answer: 1.078×10^6 Pa.

10) If the density of sea water is 1041 kg/m^3, what is the gauge pressure, in pascals, at 35 m below sea level?
Answer: 3.571×10^5 Pa.

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11) The density of sea water is 1040 kg/m^3. Find the absolute pressure, in pascals, at 189 m below the surface of the sea. Atmospheric pressure is 101325 Pa.
Answer: 2.028×10^6 Pa.

12) At what depth below the surface of the sea is absolute pressure five times atmospheric pressure? Atmospheric pressure is 101325 Pa. Density of sea water is 1039 kg/m^3.
Answer: 39.8 m.

13) The density of mercury is 13550 kg/m^3, what is the gauge pressure, in pascals, under 19 m of mercury?
Answer: 2.523×10^6 Pa.

14) At what depth of mercury would the absolute pressure seven times atmospheric pressure? Density of mercury is 13600 kg/m^3. Atmospheric pressure is 101325 Pa.
Answer: 4.561 m.

15) My friend goes swimming at diving pool. She goes down to a depth of 5 m. Determine the gauge pressure, in pascals, she is experiencing. Density of water is 1000 kg/m^3.
Answer: 49000 Pa.

16) If in a hydraulic lift, one of the areas is three times larger than the other and a force of 330 N is applied to the larger area, what force will be measured at the smaller area?
Answer: 110 N.

17) In a hydraulic lift a force F_1 = 510 N is applied to a piston with area A_1 = 1200 cm^2. If the force on the other piston is 2168 N, find the area of the other piston.
Answer: 0.51 m^2 = 5100 cm^2.

18) We want to build a hydraulic press to be able to squeeze metal bars down to thin metal disks. The small piston has a radius of 4 cm and we will be able to exert a force of 590 N on it. If the large piston has a radius of 84 cm determine the force against the metal bars.
Answer: 2.602×10^5 N.

19) In a hydraulic lift a force F_1 = 320 N is applied to a piston with area A_1 = 0.07 m^2. If the area of the other piston is 0.46 m^2, find the force on the other piston.
Answer: 2103 N.

20) A rock with a mass of 760 kg and a volume of 255 dm^3 lies at the bottom of a freshwater lake. How much force is needed to lift it at constant velocity?
Answer: 4949 N.

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21) A 37–cm^3 block of wax weighs 0.2839 N. The wax is submerged in a container of gasoline. One cm^3 of gasoline weighs 7.036×10^{-3} N. **a)** What is the weight of the gasoline displaced by the wax? **b)** Will the block sink or float in the gasoline? **c)** Find the density of the block.
Answer: **a)** 0.2603 N,   **b)** Sink,   **c)** 783 kg/m^3.

22) A ring weighs 0.2352 N in air and 0.2006 N when submerged in water. **a)** What is the volume of the ring? **b)** What is the density of the ring?
Answer: **a)** 3.529 cm^3,   **b)** 6800 kg/m^3.

23) A motor boat is being launched at a freshwater lake. When it is placed in the water, it sinks into the water enough to displace 5 m^3 of water. Assuming that this is enough for the boat to float, determine the mass of the motor boat.
Answer: 5000 kg.

24) Find the upthrust on an object of volume 700 dm^3 submerged in water. What would it be if it were submerged in mercury? Density of water is 1000 kg/m^3 and density of mercury is 13580 kg/m^3.
Answer: 6860 N, 93160 N.