# PHYSICS

# BOOKS - MODERN PUBLICATION

# Pressure

**Example**

**1.** A force of 40N Aisa prananil whose area of cross section 0.001 $cm^2$. find the pressure on the tip

**2.** Toricelli's barometer used mercury. Pascal duplicated it using French wine of density $984 kgm^{-3}$. Determine the height of the wine column for normal atmospheric pressure.

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**3.** A cubical block of wood of edge 0.2 m weighing 6.4 kgf floats on water. Find the

depth of immersion. Given, density of water 1,000 $kgm^{-3}$.

**4.** The gauge pressure in both the tyres of a bicycle is $6.9 \times 10^5$ Pa. If the bicycle and the person riding it have a combined mass of 90 kg, what is the area of contact of each tyre with the ground?

**5.** A hydraulic automobile life has input and output pistons with diameters of 10 cm and 30 cm. The life is used to hold up a car with a weight of $1.44 \times 10^4 N$ . What is the force on the input piston ?

**6.** A hydraulic automobile lift is designed to lift cars with a maximum mass of 3000 kg. The area of cross-section of the piston carrying the

load is $425cm^2$. What maximum pressure would the smaller piston have to bear ?

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**7.** What is the total pressure on the earth back of a scuba diver in a lake at a depth of 10m , if the atmospheric pressure is equal to $1.01 \times 10^5 Nm^{-2}$

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**8.** What is the force on the scuba diver's back due to water alone, taking the surface of the back to be a rectangle of dimensions 60 cm x 50 cm.

**9.** If a standard atmosphere supports a column height of exactly 0.76 m of mercury, what is the standard atmospheric pressure in pascal ?

Given that density of mercury -

$13.6 \times 10^3 kgm^{-3}$

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**10.** What would be the height of a barometer column for one standard atmosphere, if water were used instead of mercury?

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**11.** The pressure exerted by a person's lungs can be measured by having the person blow as hard as possible into one side of a manometer. If a person blowing into one side of an open-tube manometer produces a 0.7 m difference in the heights of the column of water in the manometer arms, what is the lung pressure ?

**12.** A U-tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are in level with 10.0 cm of water in one arm and 12.5 cm of spirit in the other. What is the specific gravity of spirit ?

**13.** What is the buoyant force on a helium balloon with a radius of 30 cm in air, if the

density of air is $1.9 kgm^{-3}$

**14.** A sample of milk diluted with pure water bas density of $1032 kg/m^3$. If pure milk has density of $1080 kg/m^3$. Find the % of water by volume in milk.

**15.** The density of ice is $917 kg m^{-3}$. What fraction of the volume of a piece of ice will be above water, when floating in fresh water

**16.** A piece of pure gold ($\rho = 19.3 g cm^{-3}$) is suspected to be hollow inside. It weighs 38.250 g in air and 33.865 g in water. Calculate the volume of the hollow portion in the gold, if any.

**17.** A cube of ice floats in a beaker of water. When the ice melts, the level of water in beaker

**18.** A large block of ice 5 m thick has a vertical hole drilled through it and is floating in the middle of a lake. What is the minimum length of the rope required to scoop up a bucket full

of water through the hole ? Given that density of ice= $0.9x10^3 kgm^{-3}$

**19.** To what height should a cylindrical vessel be filled with a homogeneous liquid to make the force with which the liquid presses on the sides of the vessel to be equal to the force exerted by the liquid on the bottom of the vessel?

**20.** Why can a liquid easily change its shape, while a solid cannot?

**21.** The bags and suitcases are provided with broad handles. Explain why.

**22.** Why a sharp knife cuts better than a blunt one ?

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**23.** drawing pin having a broad head can be easily fixed on a board. explain how

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**24.** the sports boot for soccer and hockey have studs on their soals. Why?

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**25.** While sking on snow, a skier wears skis addition to the shoes. why?

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**26.** What is one torr of pressure?

**27.** What is one bar?

**28.** write the relation between torr and millibar.

**29.** Why water does not come out of a dropper unless its rubber head is pressed hard?

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**30.** The blood pressure in humans is usually taken using the arm. suppose the pressure reading where taken on the calf of the leg of a standing position, would there be a difference?

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**31.** Why liquids exert pressure on the walls of the containing vessel?

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**32.** a storage tank may not be made as thick as near its bottom. Why?

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**33.** The three vessels shown in the figure are filled to the same height with water. The three versions of the same base area. In which vessel will the force on the base be minimum?

**34.** In the vessels shown in the figure equal volumes water are poured. In which person

will the force on the base be maximum?



Fig. 3.14

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**35.** Which is a practical unit of pressure in meteorological science?

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**36.** On what factors, the atmospheric pressure at a place depends?

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**37.** What does the sudden fall, gradual fall and gradual increase in barrometer level indicate?

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**38.** How is barometric height is altered, if a drop of water is introduced in a Mercury barometer tube?

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**39.** What is principle of floatation?

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**40.** one small and one big piece of cork are pushed below the surface of water. Which will have greater tendency to rise swiftly?

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**41.** A cork is floating in a water tube. What is the apparent weight of the cork?

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**42.** A vessel containing water is equalized on a balance and then the end of a wooden rod is im rod is immersed in the water, its other end being held by hand What additional weight should be placed on the other pan to restore the equilibrium if the volume of the submerged part of the wood is $50 cm^3$?

**43.** Why it may be difficult to stop bleeding from a cut in the body at higher altitude?

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**44.** Sleepers are laid below rails to

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**45.** To empty an oil tin, two holes are made. Why?

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**46.** state and explain Pascal's law

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**47.** In adult man,normal blood pressure is:

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**48.** In a mercury barometer, at sea level, the normal pressure of the air (one atmosphere) acting on the mercury in the dish supports a 76 cm column of mercury in a closed tube. If you go up in the air, until the density has fallen to half its sea level value, what height of mercury column would you expect?

**49.** Water cannot be used in place of mercury in a barometer. Why?

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**50.** Why is mercury used in thermometer ?

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**51.** Straws are used to take soft drinks. Why?

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**52.** The passengers used to remove ink from their fountain pens, while travelling by an aeroplane. Why?

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**53.** Cork is only one fourth as dense water. Could you lift a sphere of cork one metre in diameter ?

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**54.** How is an iron ship able to float where as an iron needle sinks?

**55.** Why is it easier to swim in sea water than in rise water?

**56.** A swimmer floats face up motionless, the whole of his body being submerged in the water except for a small part of the face. The swimmer weighs 75 kgf. Find the volume of the body of the swimmer.

**57.** The force required by a man to move his limbs immersed in water is smaller than the

force for the same movement in air. Explain, why.

**58.** A balloon filled with helium does not rise in air indefinitely but halts after a certain height (neglect winds). explain why.

**59.** The mass of the earth has been calculated to be $5.98 \times 10^{24}$ kg and its mean radius as $6.38 \times 10^6$ m. (a) What is the average density of the earth.

**60.** The mass of the earth has been calculated to be $5.98 \times 10^{24}$ kg and its mean radius as $6.38 \times 10^6$ m. Would you expect the average density of the material near the surface to be

same as the average density near the centre of the earth ? Give reasons.

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**61.** A boat carrying a number of large stones is floating in a water tank. what will happen to the level of water in the tank if the stones are unloaded into water?

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**62.** A man is sitting in a boat which is floating in a pond. if the man drinks some water from the pond what will happen to the level of water in the pond?

**63.** A cubical body floats on mercury with 0.25 of its volume below the surface. What fraction of the volume of the body will be immersed in the mercury, if a layer of water poured on top

of the mercury covers the body completely? Given, density of mercury-$13.6 \times 10^3 kgm^{-3}$ and density of water = $10^3 kgm^{-3}$

**64.** In accurate weighing, a correction is usually introduced to account for weight losses in air for the body being weighed and for the set of small weights. In what case may this correction be dispensed without impairing the accuracy of weighing?

**65.** Ice floats in water with about nine-tenths of its volume submerged. What is the fractional volume submerged for an iceberg floating on a fresh water lake of a (thypothetical) planet, whose gravity is ten times that of the earth?

**66.** What is the fractional volume submerged of an ice cube in a pail of water placed in a enclosure which is freely falling under gravity?

**67.** The two thigh bones (femurs), each of cross-sectional area $10cm^2$ support the upper part of a human body of mass 40 kg. Estimate the average pressure sustained by the femurs.

**68.** How much pressure will a man of weight 80 kgf exert on the ground, when he is lying. Given that area of the body of the man is $0.6m^2$ and that of a foot is $80cm^2$

**69.** How much pressure will a man of weight 80 kgf exert on the ground, when he is standing on the feet? Given that area of the body of the man is $0.6m^2$ and that of a foot is $80cm^2$

**70.** Atmospheric pressure is $1.01 \times 10^5$ Pa. How large a force does the air in a room exert on the inside of a window pane that is 40 cm x 80 cm?

**71.** The neck and bottom of a bottle are 2 cm and 20 cm in diameter respectively. If the cork

is pressed with a force of 1-2 kgf in the neck of the bottle, calculate the force exerted on the bottom of the bottle.

72. In a car lift, compressed air exerts a force $F_1$ on a small piston having a radius of 5 cm. This pressure is transmitted to the second piston of radius 15 cm. If the mass of the car to be lifted is 1,350 kg, what is $F_1$?

**73.** The density of the atmosphere at sea level is $1.29 kgm^{-3}$. Assume that it does not change with altitude. Then, how high would the atmosphere extend?

**74.** What is the total pressure on the earth back of a scuba diver in a lake at a depth of 10m , if the atmospheric pressure is equal to $1.01 \times 10^5 Nm^{-2}$

**75.** A hole of area $5cm^2$ is formed in the side of a ship 3 m below the water level. What minimum force is required to hold on a patch covering the hole from the inside of the ship?

**76.** A column of water 40 cm high supports a 31 cm column of an unknown liquid. What is

the density of the liquid?

77. What will be the length of mercury column in a barometer tube, when the atmospheric pressure is 75 cm of mercury and the tube is inclined at an angle of $60°$ to the vertical?

**78.** How high would water rise in the pipes of a building, if the water pressure gauge shows the pressure at the ground floor to be 270 kPa.

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**79.** The manual of a car instructs the owner to inflate the tyres to a pressure of 200 kPa. What is the recommended absolute pressure?

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**80.** The manual of a car instructs the owner to inflate the tyres to a pressure of 200 kPa. What is the recommended absolute pressure?

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**81.** The manual of a car instructs the owner to inflate the tyres to a pressure of 200 kPa. If after the required inflation of the tyre, the car is driven to a mountain peak, where the atmospheric pressure is 10% below that at sea level, what will the tyre gauge read?

**82.** A body weighs 25 gf in air and 20 gf in water. What would be its weight in a liquid of density $0.8 gcm^{-3}$?

**83.** A piece of cork of density $250 kgm^{-3}$ is tied with a lump of metal of density $8 \times 10^3$ kg mand of mass 0.024 kg. The combination just

floats in water. Calculate the volume and the mass of the cork.

**84.** A piece of metal of mass 17 g is tied to a cork of mass 5 g and the two remain suspended under water without sinking, when lowered into water. If the density of cork is $0.25 gcm^{-3}$ find the density of metal.

**85.** A metal cube of 5 cm side and relative density 9 is suspended by a thread so as to be completely immersed in a liquid of density $1.2 \times 10^3 kgm^{-3}$. Find the tension in the thread.

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**86.** The weight of a body in water is one-third of its weight in air. What is the density of the material of the body?

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**87.** A piece of iron weighs 400 gf in water. Determine its volume. Given that density of iron = $7.8 gcm^{-3}$

**88.** A cork of density $0.15 gcm^{-3}$ floats in water with $10 cm^3$ of its volume above the surface of water. Calculate the mass of the cork.

**89.** The density of ice is $917kgm^{-3}$. What friction of ice lies below water? The density of sea water is $1,024kgm^{-3}$. What fraction of iceberg do we see, assuming that it has the same density as ordinary ice ($917kgm^{-3}$).

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**90.** A body floats with $\frac{2}{5}$th of its volume above the surface of water. Calculate the density of the material of the body.

**91.** A piece of iron floats in mercury. Given that the density of iron is $7.8 x 10^3 kg m^{-3}$ and that of mercury is 13.6x 10^3 kg m-3, calculate the fraction of the volume of iron piece that remains outside the mercury.

**92.** The densities of sea water and ice are $1130 kgm^{-3}$ and 920 kg m^-3`. What fraction of the volume of an iceberg will float above the sea level? [Ans. 0-186]

**93.** A piece of wood of relative density 0.25 floats in a pail containing oil of relative density 0.81 . What is the fraction of volume of the wool above the surface of the coil?

**94.** A copper ball with a hollow centre weighs 264 gf in air and 221 gf in water. Determine the volume of the hollow portion of the ball. Given, the density of copper = $8.8 gcm^{-3}$
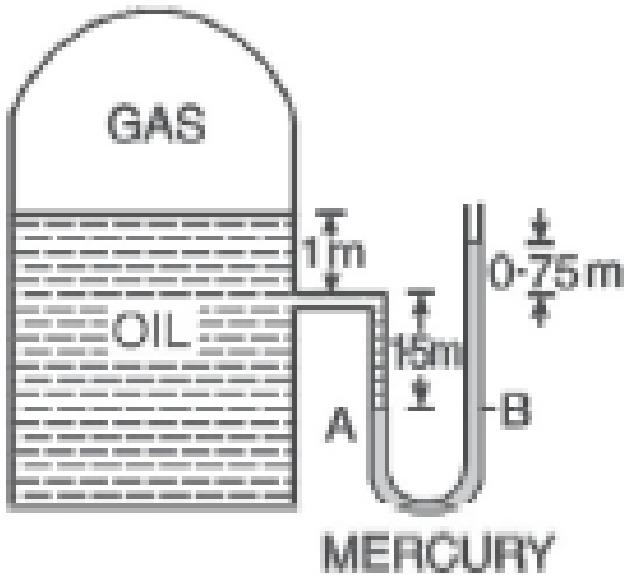
**95.** What is the absolute and gauge pressure of the gas above the liquid surface in the tank shown in Fig. Given that density of oil =

$820 kgm^{-3}$, density of mercury =

$13.6 \times 10^3 kgm^{-3}$ and 1 atmospheric

pressure=$1.01 \times 10^5 Pa$.



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**96.** When a body of mass 240 kg is placed on an iceberg floating in sea water, it is found that the iceberg just sinks. What is the mass of the iceberg ? Take the relative density of ice as 0.9 and that of sea water as 1.02.

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**97.** A vessel contains oil of density 800 kg mover mercury of density $13,600 kgm^{-3}$. A homogeneous sphere floats with half of its

volume immersed in mercury and other half in the oil. Find the density of the material of the sphere.

**98.** A cubical body floats on mercury with 0.25 of its volume below the surface. What fraction of the volume of the body will be immersed in the mercury, if a layer of water poured on top of the mercury covers the body completely?

Given, density of mercury-$13.6 \times 10^3\,kgm^{-3}$

and density of water $= 10^3\,kgm^{-3}$

**99.** What must the ratio of volumes of water and alcohol be for their mixture to have a density of $900\,kgm^{-3}$? When the alcohol is mixed with the water, the volume of the mixture diminishes to 0-97 of the initial volume of the water and the alcohol. Given that the density of alcohol $= 795\,kgm - 3$

**100.** A cube of wood floating in water supports a 200 g mass resting at the centre of its top face. When the mass is removed, the cube rises 2 cm. Find the volume of the cube.

**101.** The volume of an air bubble becomes 8 times the original volume in rising from the bottom of a lake to its surface. If the

barometric height is 0.76 m of mercury, what is the depth of the lake? Given that density of mercury is $13.6 \times 10^3 kgm^{-3}$

**102.** A balloon filled with hydrogen has a volume of 1,000 litres and its mass is 1 kg. What would be the volume of the block of a very light material, which it can just lift? One litre of the material has mass of 91.3 g. Given that density of air=$1.3 glitre^{-1}$

**Exercise**

**1.** Define thrust and pressure. Give their units. Show that when a liquid is in equilibrium, forces acting on the liquid must be perpendicular to its free surface.

**2.** Define thrust and pressure. Give their units. Show that when a liquid is in equilibrium, forces acting on the liquid must be perpendicular to its free surface.

**3.** state and explain Pascal's law

**4.** State Pascal's law as to the transmission of pressure in a liquid. How does it get changed in the presence of gravity?

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**5.** State Pascal's law and write a short note on hydraulic lift.

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**6.** Discuss Hydraulic lift.

**7.** What is the principle of hydraulic brakes ?

Explain its working with a suitable diagram.

**8.** Discuss Hydraulic lift.

**9.** Explain the construction and working of a hydraulic brake.

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**10.** What is the principle of hydraulic brakes ? Explain its working with a suitable diagram.

> ▶ **Watch Video Solution**

**11.** Derive an expression for the pressure exerted by a liquid column.

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**12.** What is the unit of torr?

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**13.** Discuss the variation in atmospheric pressure with altitude.

**14.** Derive an expression for the pressure exerted by a liquid column.

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**15.** State Archimedes' principle.

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**16.** State Archimedes' principle.

**17.** State Archimedes' principle.

**18.** What are laws of floatation?

**19.** Discuss two practical applications of Pascal's law.

**20.** Explain the working of the following along with the underlying principle:hydraulic lift

**21.** What is the principle of hydraulic brakes ? Explain its working with a suitable diagram.

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**22.** Explain, how Archimedes' principle may be used to find the volume of a body

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**23.** Explain, how Archimedes' principle may be used to find to determine the condition of floatation of a body.

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**24.** Explain, how Archimedes' principle may be used to find to determine the condition of floatation of a body.

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