1. Define the term thrust. State its S.I. unit.

2. What is meant by pressure ? State its S.I. unit.

3. (a) What physical quantity is measured in bar ?
   (b) How is the unit bar related to the S.I. unit pascal ?
   Ans. (a) Pressure, (b) 1 bar = 10^5 pascal

4. Define one pascal (Pa), the S.I. unit of pressure.

5. State whether thrust is a scalar or vector ?
   Ans. Vector

6. State whether pressure is a scalar or vector ?
   Ans. Scalar

7. Differentiate between thrust and pressure.

8. How does the pressure exerted by a thrust depend on the area of surface on which it acts ? Explain with a suitable example.

9. Why is the tip of an allpin made sharp ?

10. Explain the following :
    (a) It is easier to cut with a sharp knife than with a blunt one.
    (b) Sleepers are laid below the rails.

11. What is a fluid ?

12. What do you mean by the term fluid pressure ?

13. How does the pressure exerted by a solid and a fluid differ ?
    Ans. A solid exerts pressure only on its base downwards while a fluid exerts pressure at all points in all directions.

14. Describe a simple experiment to demonstrate that a liquid enclosed in a vessel exerts pressure in all directions.

15. State *three* factors on which the pressure at a point in a liquid depends.

16. Write an expression for the pressure at a point inside a liquid. Explain the meaning of the symbols used.

17. Deduce an expression for the pressure at a depth inside a liquid.

18. How does the pressure at a certain depth in sea water differ from that at the same depth in river water ? Explain your answer.

19. Pressure at free surface of a water lake is P_1, while at a point at depth h below its free surface is P_2. (a) How are P_1 and P_2 related ? (b) Which is more P_1 or P_2 ?
    Ans. (a) $P_2 = P_1 + h\rho g$, (b) $P_2 > P_1$

20. Explain why a gas bubble released at the bottom of a lake grows in size as it rises to the surface of lake.

21. A dam has broader walls at the bottom than at the top. Explain.

22. Why do sea divers need special protective suit ?

23. State the laws of liquid pressure.

24. A tall vertical cylinder filled with water is kept on a horizontal table top. Two small holes A and B are made on the wall of the cylinder, A near the middle and B just below the free surface of water. State and explain your observation.

25. How does the liquid pressure on a diver change if :
    (i) the diver moves to the greater depth, and
    (ii) the diver moves horizontally ?
    Ans. (i) Pressure increases, (ii) Pressure remains unchanged

26. State Pascal's law of transmission of pressure.

27. Name *two* applications of Pascal's law.

28. Explain the principle of a hydraulic machine. Name *two* devices which work on this principle.

29. Name and state the principle on which a hydraulic press works. Write *one* use of the hydraulic press.

30. The diagram in Fig. 4.12 shows a device which makes use of the principle of transmission of pressure.

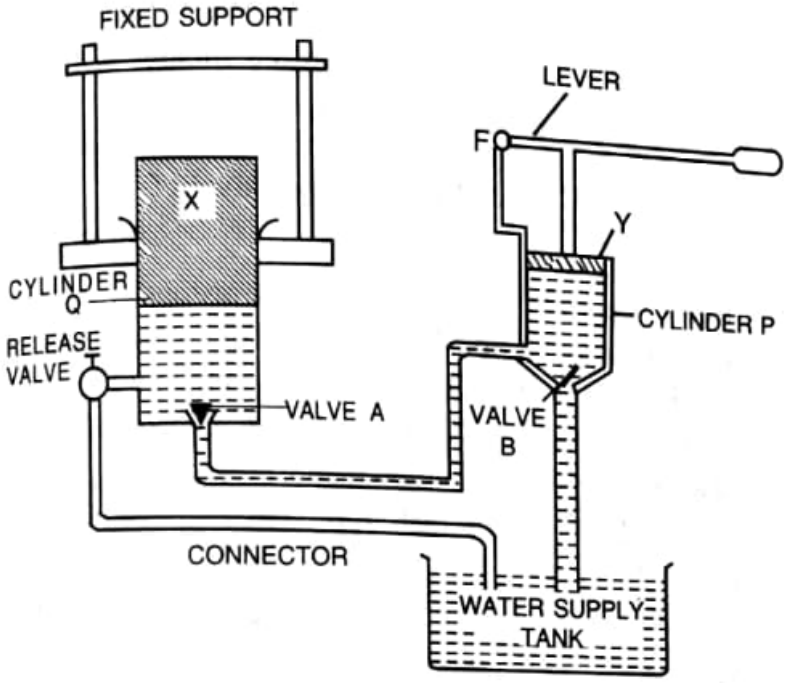


Fig. 4.12

(i) Name the parts labelled by the letters *X* and *Y*.

(ii) Describe what happens to the valves *A* and *B* and to the quantity of water in the two cylinders when the lever arm is moved down.

(iii) Give reasons for what happens to the valves *A* and *B* in part (ii).

(iv) What happens when the release valve is opened ?

(v) What happens to the valve *B* in cylinder *P* when the lever arm is moved up ?

(vi) Give a reason for your answer in part (v).

(vii) State *one* use of the above device.

31. Draw a simple diagram of a hydraulic jack and explain its working.

32. Explain the working of a hydraulic brake with a simple labelled diagram.

Solution 1S.

Thrust is the force acting normally on a surface.
Its S.I. unit is 'newton'.

Solution 2S.

Pressure is the thrust per unit area of the surface.
Its S.I. unit is 'newton per metre^{2}' or 'pascal'.

Solution 3S.

(a) Pressure is measured in 'bar'.
(b) 1 bar = 10^{5} pascal.

Solution 4S.

One pascal is the pressure exerted on a surface of area 1 m^{2} by a force of 1N acting normally on it.

Solution 5S.

Thrust is a vector quantity.

Solution 6S.

Pressure is a scalar quantity.

Solution 7S.

Thrust is the force applied on a surface in a perpendicular direction and it is a vector quantity. The effect of thrust per unit area is pressure, and it is a scalar quantity.

Solution 8S.

Pressure exerted by thrust is inversely proportional to area of surface on which it acts. Thus, larger the area on which the thrust acts, lesser is the pressure exerted by it.
Example: If we stand on loose sand, our feet sink into the sand, but if we lie on that sand, our body does not sink into the sand. In both the cases, the thrust exerted on the sand is equal (equal to the weight of the body). However, when we lie on sand, the thrust acts on a large area and when we stand, the same thrust acts on a small area.

Solution 10S.

(a) It is easier to cut with a sharp knife because even a small thrust causes great pressure at the edges and cutting can be done with less effort.
(b) Wide wooden sleepers are placed below the railway tracks so that the pressure exerted by the rails on the ground becomes less.

Solution 11S.

A substance which can flow is called a fluid.

Solution 12S.

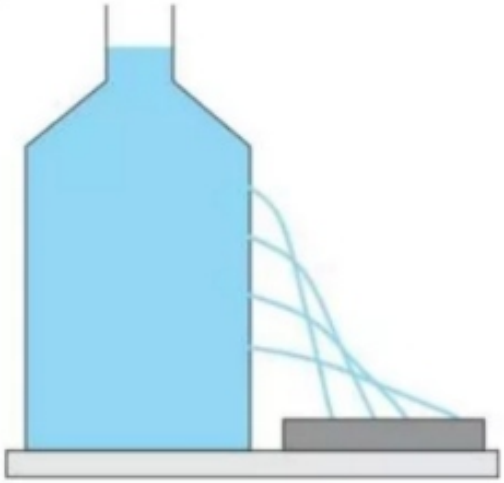
Due to its weight, a fluid exerts pressure in all directions; the pressure exerted by the fluid is called fluid pressure.

Solution 13S.

A solid exerts pressure only on the surface on which it is placed, i.e. at its bottom, but a fluid exerts pressure at all points in all directions.

Solution 14S.

Take a can or large plastic bottle filled with water. Place it on a horizontal surface. Make a series of holes in the wall of the vessel anywhere below the free surface of the liquid. The water spurts out through each hole. This shows that the liquid exerts pressure at each point on the wall of the bottle.



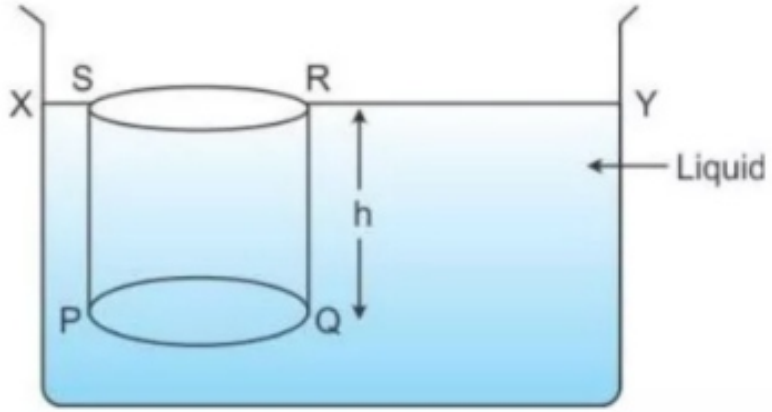
Liquid exerts pressure at all points in all directions

Solution 16S.

$P = P_o + h\rho g$
Here, P = Pressure exerted at a point in the liquid
P_o = Atmospheric pressure
h = Depth of the point below the free surface
ρ = Density of the liquid
g = Acceleration due to gravity

Solution 17S.

Consider a vessel containing a liquid of density ρ. Let the liquid be stationary. In order to calculate pressure at a depth, consider a horizontal circular surface PQ of area A at a depth h below the free surface XY of the liquid. The pressure on the surface PQ will be due to the thrust of the liquid contained in cylinder PQRS of height h with PQ as its base and top face RS lying on the frees surface XY of the liquid.



Total thrust exerted on the surface PQ
= Weight of the liquid column PQRS
= Volume of liquid column PQRS x density x g
= (Area of base PQ x height) x density x g
= (A x h) x ρ x g

This thrust is exerted on the surface PQ of area A. Therefore, pressure is given as shown below.
P = Thrust on surface / Area of surface
P = Ah ρg / A = hρg
Thus, Pressure = depth x density of liquid x acceleration due to gravity

Solution 18S.

Due to dissolved salts, density of sea water is more than the density of river water, so pressure at a certain depth in sea water is more than that at the same depth in river water.

Solution 19S.

(a) $P_2 = P_1 + h \rho g$,
(b) $P_2 > P_1$

Solution 20S.

The reason is that when the bubble is at the bottom of the lake, total pressure exerted on it is the atmospheric pressure plus the pressure due to water column. As the gas bubble rises, due to decrease in depth the pressure due to water column decreases. By Boyle's law, PV = constant, so the volume of bubble increases due to decrease in pressure, i.e., the bubble grows in size.

Solution 21S.

The pressure exerted by a liquid increases with its depth. Thus as depth increases, more and more pressure is exerted by water on wall of the dam. A thicker wall is required to withstand greater pressure, therefore, the thickness of the wall of dam increases towards the bottom.

Solution 22S.

The sea divers need special protective suit to wear because in deep sea, the total pressure exerted on the diver's body is much more than his blood pressure. To withstand it, he needs to wear a special protective suit.

Solution 23S.

Laws of liquid pressure:

1. Pressure at a point inside the liquid increases with the depth from its free surface.
2. In a stationary liquid, pressure is same at all points on a horizontal plane.
3. Pressure is same in all directions about a point in the liquid.
4. Pressure at same depth is different in different liquids. It increases with the increase in the density of liquid.
5. A liquid seeks its own level.

Solution 24S.

The liquid from hole B reaches a greater distance on the horizontal surface than that from hole A.
This explains that liquid pressure at a point increases with the depth of point from the free surface.

Solution 25S.

(i) As the diver moves to a greater depth, pressure exerted by sea water on him also increases.
(ii) When the diver moves horizontally, his depth from the free surface remains constant and hence the pressure on him remains unchanged.

Solution 26S.

Pascal's law states that the pressure exerted anywhere in a confined liquid is transmitted equally and undiminished in all directions throughout the liquid.

Solution 27S.

Two applications of Pascal's law:

1. Hydraulic press
2. Hydraulic jack

Solution 28S.

The principle of a hydraulic machine is that a small force applied on a smaller piston is transmitted to produce a large force on the bigger piston.
Hydraulic press and hydraulic brakes work on this principle.

Solution 29S.

Hydraulic press works on principle of hydraulic machine.
It states that a small force applied on a smaller piston is transmitted to produce a large force on the bigger piston.
Use: It is used for squeezing oil out of linseed and cotton seeds.

Solution 30S.

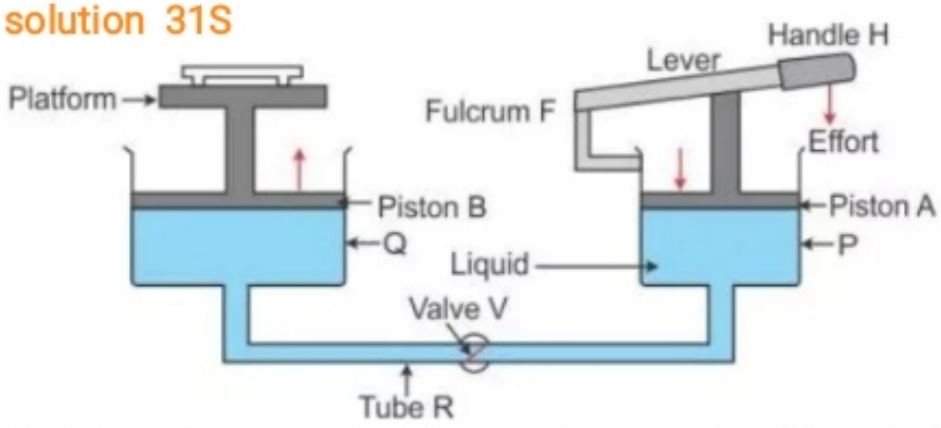
(i) X : Press Plunger; Y: Pump Plunger

(ii) When the lever is moved down, valve B closes and valve A opens, so the water from cylinder P is forced into the cylinder Q.

(iii) Valve B closes due to an increase in pressure in cylinder P. This pressure is transmitted to the connecting pipe and when the pressure in connecting pipe becomes greater than the pressure in the cylinder Q, valve A opens up.

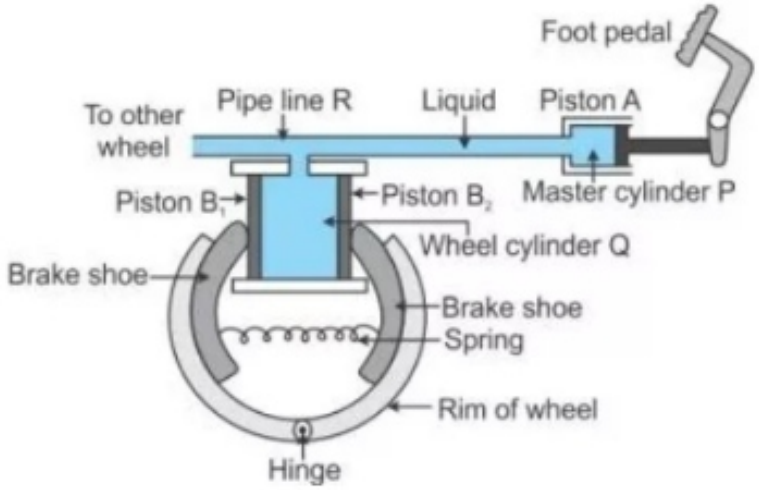
(iv) When the release valve is opened, the ram (or press) plunger Q gets lowered and water of the cylinder Q runs out in the reservoir.

solution 31S



Working: When handle H of the lever is pressed down by applying an effort, the valve V opens because of increase in pressure in cylinder P. The liquid runs out from the cylinder P to the cylinder Q. As a result, the piston B rises up and it raises the car placed on the platform. When the car reaches the desired height, the handle H of the lever is no longer pressed. The valve V gets closed (since the pressure on the either side of the valve becomes same) so that the liquid may not run back from the cylinder Q to cylinder P.

Solution 32S.



Working: To apply brakes, the foot pedal is pressed due to which pressure is exerted on the liquid in the master cylinder P, so liquid runs out from the master cylinder P to the wheel cylinder Q. As a result, the pressure is transmitted equally and undiminished through the liquid to the pistons $B_1$and B_2 of the wheel cylinder. Therefore, the pistons B_1 and B_2 get pushed outwards and brake shoes get pressed against the rim of the wheel due to which the motion of the vehicle retards. Due to transmission of pressure through the liquid, equal pressure is exerted on all the wheels of the vehicle connected to the pipe line R.

On releasing the pressure on the pedal, the liquid runs back from the wheel cylinder Q to the master cylinder P and the spring pulls the break shoes to their original position and forces the pistons B_1 and B_2 to return back into the wheel cylinder Q. Thus, the brakes get released.