PRESSURE

PRESSURE
PRESSURE CHANGES

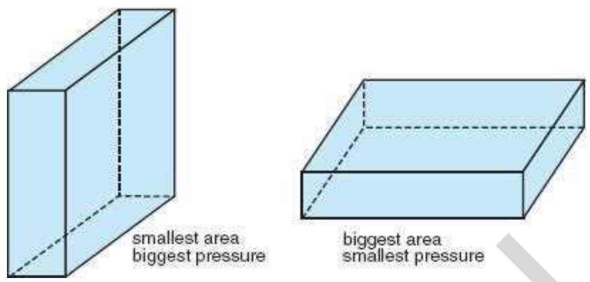
PRESSURE

Define the term pressure in terms of force and area, and do calculations using the equation pressure = force/area.

- **Pressure** is the force per unit area

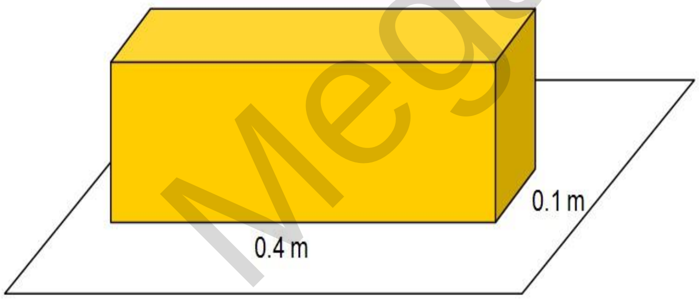
$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} \qquad P = \frac{F}{A}$$

- The SI unit of pressure is Newton per square meter (N/m2). This unit is also called the **Pascal (Pa)**.
- For a solid block resting on the floor, the pressure acting on the floor is highest when the block is resting on its smaller surface.



Problem Solving

1. **Diagram below shows a cuboid of 2 kg on a table. Calculate the pressure exerted on the table by the cuboid.**



2. **A 6000 kg elephant standing on one of its feet exerts a pressure of 600 000 Pa on the ground.**

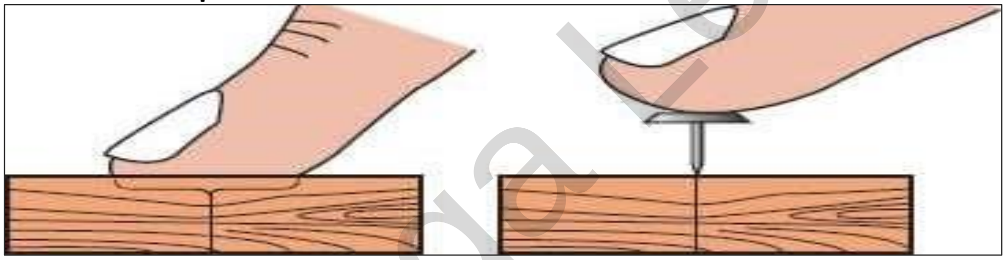
a) What is the area of its foot?

b) If its feet are the same size, what pressure would it exert standing on all four feet?

3. **A weight of a brick is 30 N. If its dimension is 20 cm by 30 cm by 30 cm, find the maximum and minimum pressure its exerted?**
4. **A boy and a sled have a combined mass of 38 kg. The runners of the sled are 1.60 m long and 1.2 m wide. Find the pressure exerted on the snow.**

5. **A block of metal of dimensions 0.5 m x 0.6 m x 1.0 m has a mass of 300 kg. Calculate the maximum and minimum pressure acting on the ground.**
6. **A force of 200 N acts on an area of 4 m^2.**
a) What pressure is produced?
b) What would the pressure be if the same force acted on half the area?
7. **A rectangular block of mass 30 kg measure 0.1 m by 0.4 m by 1.5 m.**
a) Calculate the weight of the block.
b) Calculate the maximum and minimum pressure exerted by the block.
8. **What pressure is exerted on the snow by a 180 N skier if his skis are 183 cm long and 13 cm wide?**
9. **Soft snow can be compressed by about 3000 Pascals of pressure. What is the smallest area that a pair of snowshoes must have if they will enable a 70 kg person to walk over the snow without sinking in? Take g = 10 m/s^2.**
10. **A student pressing a thumbtack into a piece of wood with a force of 20 N. The surface area of the head of the thumbtack is 1 m^2 and the cross-sectional area of the tip of the thumbtack is 0.01 m^2. Calculate:**
a) the pressure exerted by the student's thumb on the head of the thumbtack
b) the pressure of the tip of the thumbtack on the wood.
c) What conclusion can be drawn from your answers to (a) and (b)?

Explain how pressure varies with force and area in the context of everyday examples.
Pressure Example



Intensity of pressures exerted by a thumb and a drawing pin into a piece of wood

Increasing the pressure by reducing the area

A sharp knife has a very small surface area on its cutting edge so that high pressure can be exerted to cut the onion.

The high pressure on surface of the ice so that the ice melts and allowing the ice skater to glide smoothly

When a force is applied to the head of a nail, the pressure will drive its sharp end into a piece of wood easily

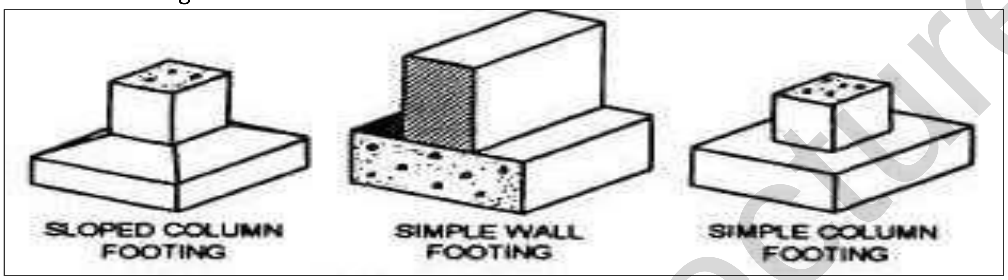
The pressure under the studs is high enough for them to sink into the ground, which gives extra grip

Rally need very high air pressure inside the tyres, because the narrow tyres have a very small contact area with the icy road.

Reducing the pressure by increasing the area

Skis have a large area to reduce the pressure on the snow so that they do not sink in too far.

Wall foundations have a large horizontal area. This reduces the pressure underneath so that the walls do not sink further into the ground.

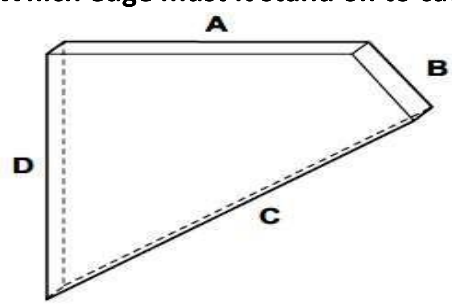


A load-spreading washer ensures that the nut is not pulled into the wood when tightened up.

A tractor moving on soft ground has wide tires to reduce the pressure on the ground so that they will not sink into the ground.

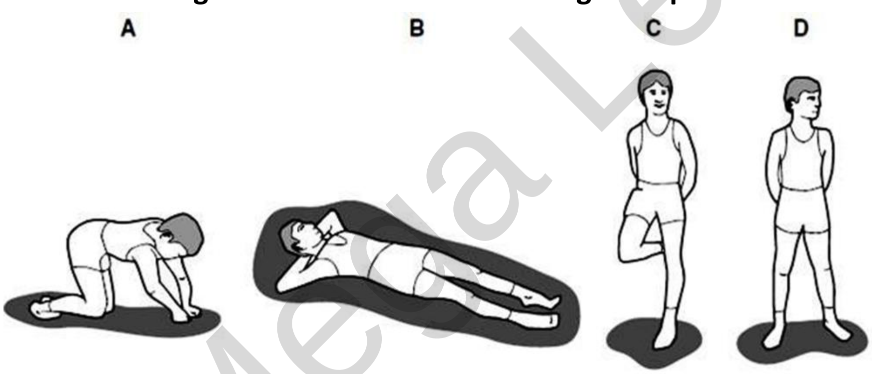
A wide shoulder pad of a heavy bag will reduce the pressure exerted on the shoulder of the person carrying the bag.

1. **The diagram shows a thick sheet of glass.**
   Which edge must it stand on to cause the greatest pressure?



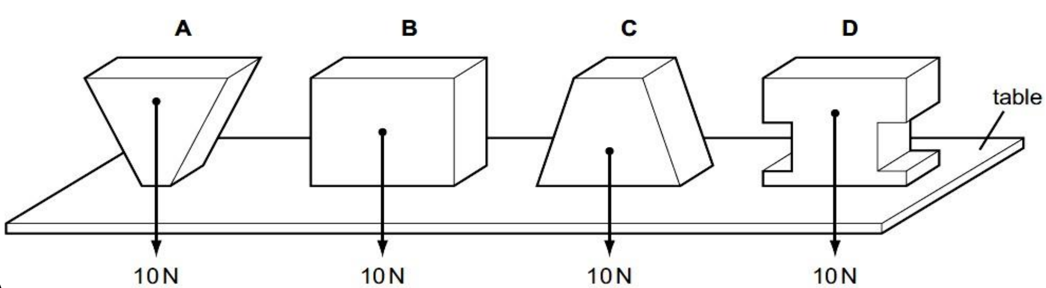
B

2. **Which diagram shows the child exerting least pressure on the ground?**



B

3. **Four blocks, each weighing 10 N, rest on a horizontal table.**
   Which block applies the greatest pressure on the table?

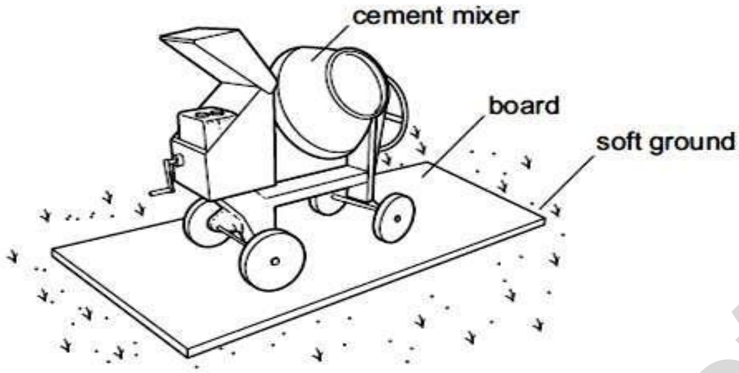


A

4. Which would be the least likely to sink into soft ground?

A. a loaded lorry with four wheels
B. a loaded lorry with six wheels
C. an empty lorry with four wheels
D. an empty lorry with six wheels

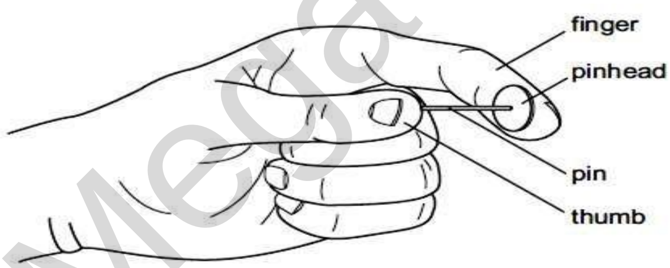
5. To prevent a cement mixer sinking into soft ground, the mixer is placed on a large flat board.



Why does this prevent the mixer sinking?

A. the large area decreases the pressure on the ground.
B. The large area increases the pressure on the ground.
C. The large area decreases the weight on the ground.
D. The large area increases the weight on the ground.

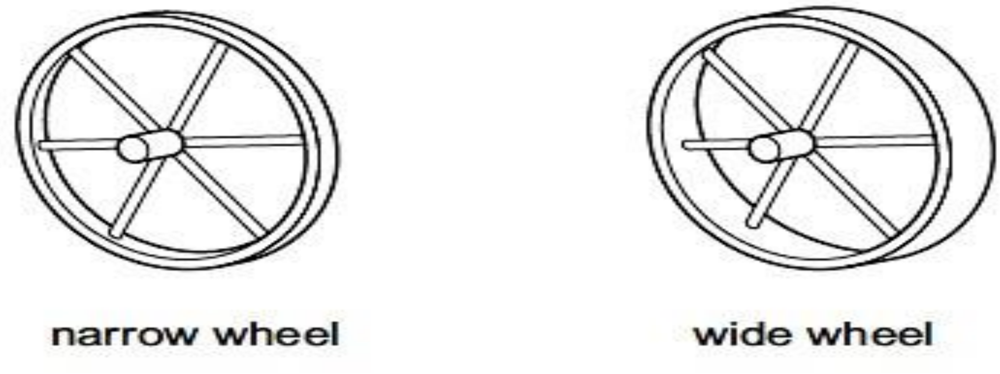
6. A pin is squeezed between finger and thumb.



Which statement is correct?

A. The force of the pin is larger on the finger than on the thumb.
B. The force of the pin is larger on the thumb than on the finger.
C. The pressure of the pin is larger on the finger than on the thumb.
D. The pressure of the pin is larger on the thumb than on the finger.

7. A farmer has two carts. The carts have the same weight, but one has four narrow wheels and the other has four wide wheels.



In rainy weather, which cart sinks less into soft ground and why?

	cart wheels	why
A	narrow	greater pressure on the ground
B	narrow	less pressure on the ground
C	wide	greater pressure on the ground
D	wide	less pressure on the ground

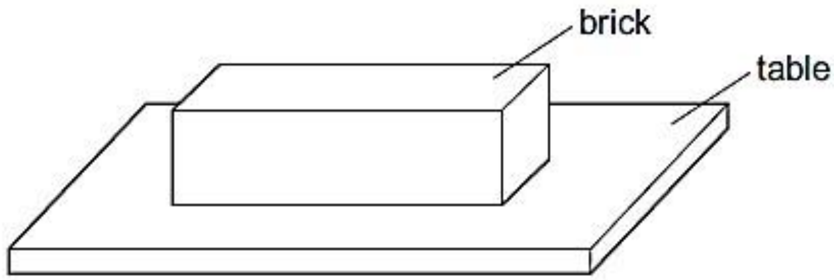
D

8. Two boys X and Y each have the same total weight and are standing on soft ground.

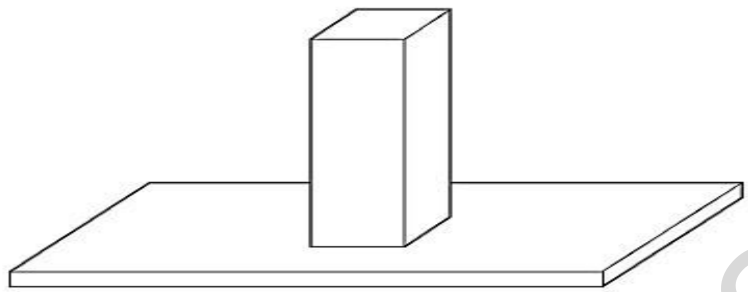
Which boy is more likely to sink into the soft ground and why?

	boy more likely to sink	pressure on soft ground
A	X	larger than Y
B	X	smaller than Y
C	Y	larger than X
D	Y	smaller than X

9. A brick with rectangular sides rests on a table.



The brick is now turned so that it rests on the table on its smallest face.

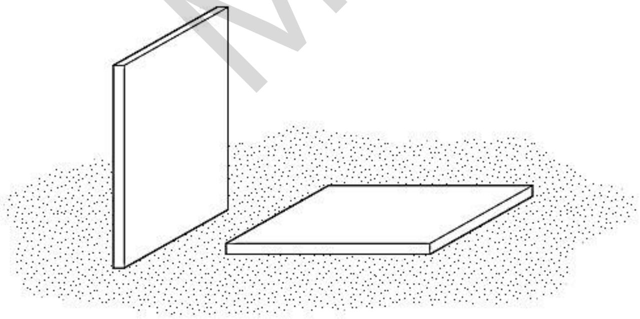


How has this change affected the force and the pressure exerted by the brick on the table?

	force	pressure
A	unchanged	unchanged
B	increased	unchanged
C	unchanged	increased
D	increased	increased

C

10. A builder leaves two identical, heavy, stone tiles resting on soft earth. One is vertical and the other is horizontal.

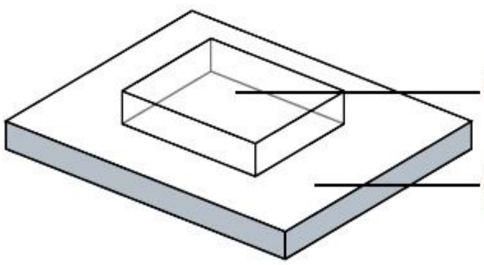


After a few hours, the vertical tile has started to sink into the soft earth, but the horizontal one has not.
Which row correctly compares the forces and the pressures that the tiles exert on the earth?

	forces	pressures
A	different	different
B	different	same
C	same	different
D	same	same

C

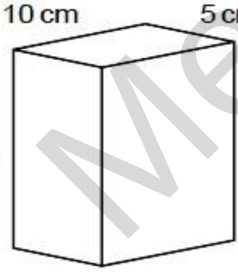
11. The diagram shows a glass block resting on a table top.



The area of the block in contact with the table is X and the area of the table top is Y.
The weight of the block is P and the weight of the table is Q.
Which expression gives the pressure exerted on the table by the block?

A $\frac{P}{X}$ **B** $\frac{P}{Y}$ **C** $\frac{Q}{X}$ **D** $\frac{Q}{Y}$ **A**

12. A brick of weight 80 N stands upright on the ground as shown



What is the pressure it exerts on the ground?

A $\frac{80}{20 \times 10}$ N/cm^2

B $\frac{20 \times 10}{80}$ N/cm^2

C $\frac{80}{10 \times 5}$ N/cm^2

D $\frac{10 \times 5}{80}$ N/cm^2

C

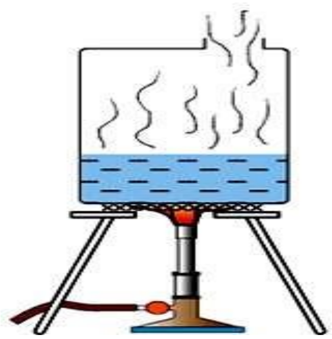
13. A small table weighing 40 N stands on four legs, each having an area of 0.001 m^2. What is the pressure of the table on the floor?

A. 400 N/m^2
B. 1000 N/m^2
C. 10 000 N/m^2
D. 40 000 N/m^2

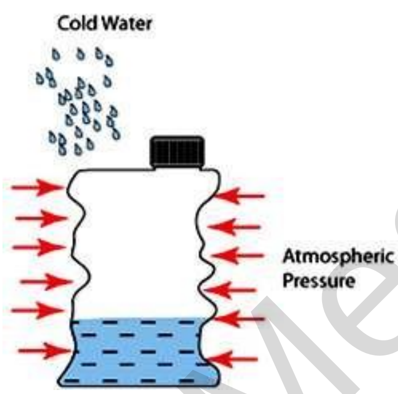
PRESSURE

Describe how the height of a liquid column may be used to measure the atmospheric pressure.

Crushing Can



Water can is heated

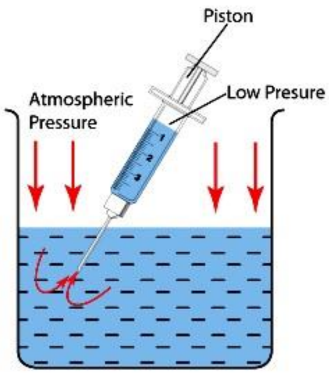


- When the air inside the can is cooled, its pressure decreases.
- The high atmospheric pressure outside exerts a great force on the can and causes it crashes.

Atmospheric Pressure

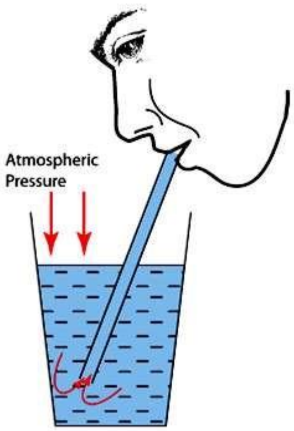
- The atmosphere is the layer of air enveloping the Earth. It extends up to 1000 km above the surface and has a total mass of 4.5 × 1018 kg.
- The weight of air exerts a pressure on the surface of the Earth called the atmospheric pressure. At sea level it is about 105 Pa (100 000 Pa).
- The pressure inside our bodies is almost the same as the external pressure and so balances it.

Syringe



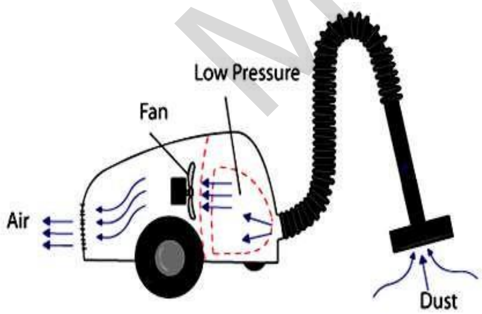
- When the piston is pulled up, the atmospheric pressure inside the cylinder will decrease.
- The atmospheric pressure outside pushes the liquid up into the syringe.

Straw



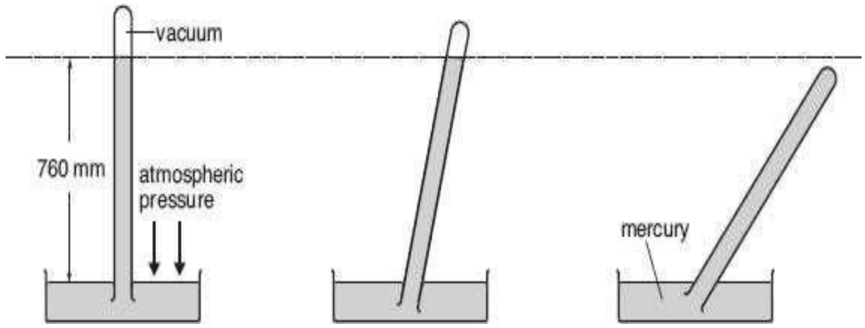
- When a person suck through the straw, the pressure in the straw become low.
- The atmospheric pressure outside which is higher will force the water into the straw and consequently into the mouth.

Vacuum Cleaner



- When a vacuum cleaner is switched on, it sucks out the air inside the cleaner, causes the pressure inside the cleaner become low.
- The atmospheric pressure which is higher in magnitude, forces the air and duct particles into the cleaner.

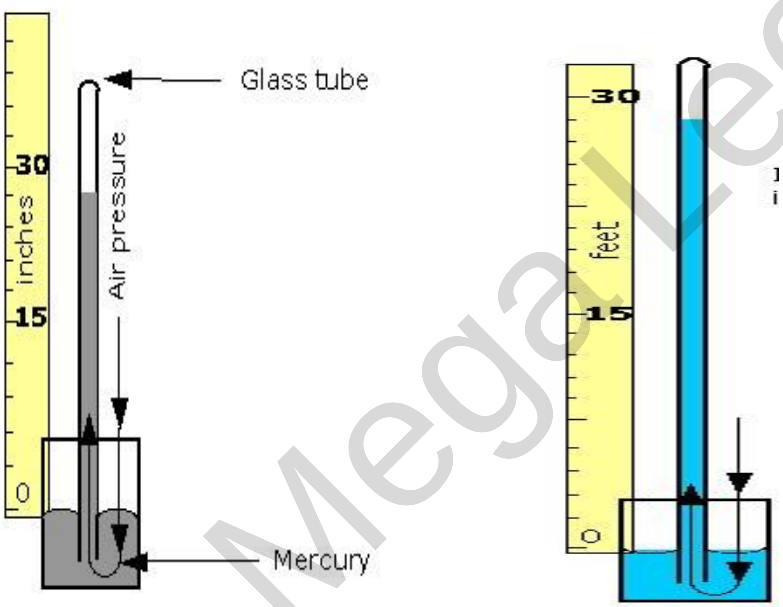
Simple Mercury Barometer

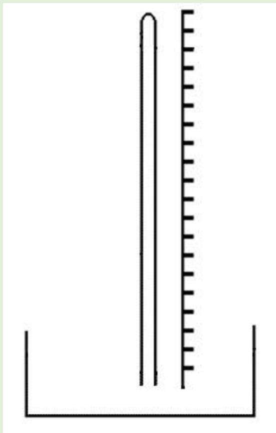
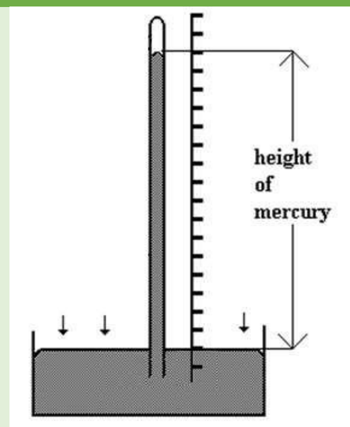
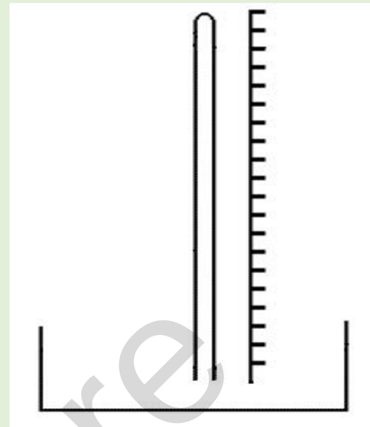


- Atmospheric pressure can be measure using a simple mercury barometer.
- The atmospheric pressure act on the surface of the mercury in the trough and support the vertical mercury column.
- The atmospheric pressure is 760 mm Hg (millimeters of mercury) at sea level (equivalent to 105 Pa or 100000 Pa).

Mercury Vs Water

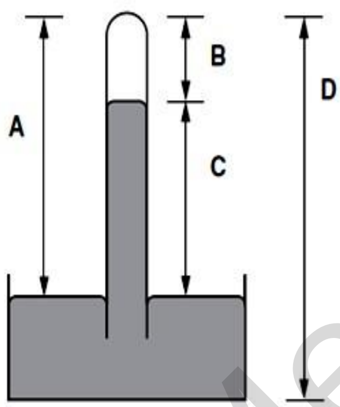
Mercury is more dense than water



At High Altitude	At Sea Level	At Low Altitude
		
Low Pressure	760 mmHg	High Pressure

1. The diagram shows a simple mercury barometer.

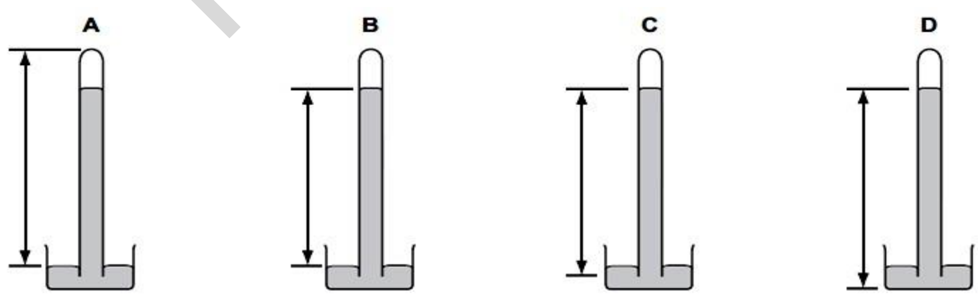
Which height is a measure of the atmospheric pressure?



C

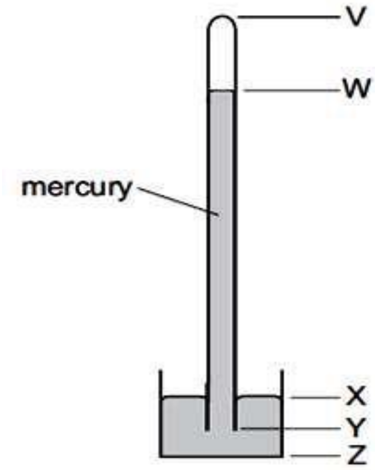
2. The diagrams show a simple mercury barometer.

Which diagram shows the distance to be measured to find atmospheric pressure?



B

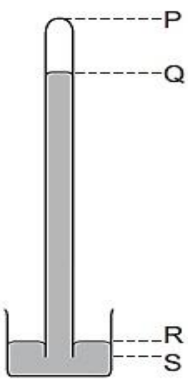
3. **The diagram shows a simple mercury barometer.**



The atmospheric pressure increases. Which distance increases?

A. **VW**
B. **WY**
C. **XY**
D. **XZ**

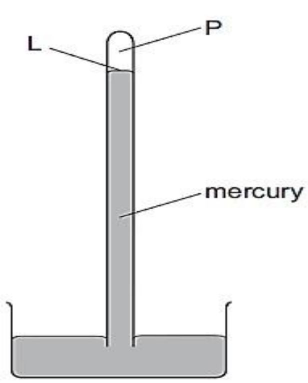
4. **A long tube full of mercury is inverted in a small dish of mercury.**



The mercury level in the tube falls, leaving a vacuum at the top.
When the atmospheric pressure falls, which length decreases?

A PQ   B PS   C QR   D RS   **C**

5. **The diagram shows a simple mercury barometer, used to measure atmospheric pressure.**

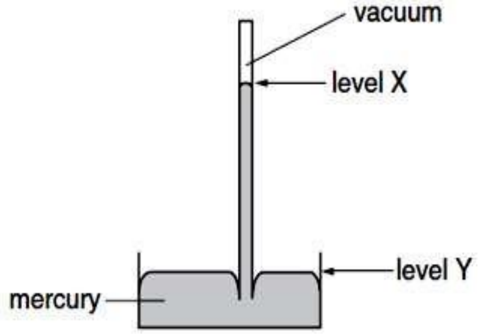


Atmospheric pressure increases.
What happens to the level L and to the pressure at P?

	level L	pressure at P
A	falls	increases
B	falls	stays the same
C	rises	increases
D	rises	stays the same

D

6. **The diagram shows a simple mercury barometer.**

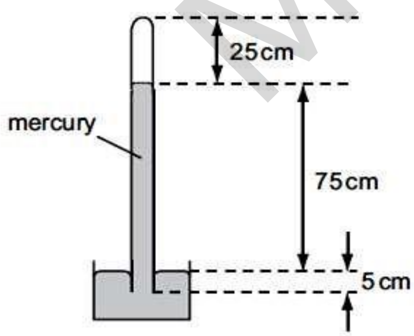


If atmospheric pressure increases, what happens to level X and to level Y?

	level X	level Y
A	goes down	goes down
B	goes down	goes up
C	goes up	goes down
D	goes up	goes up

C

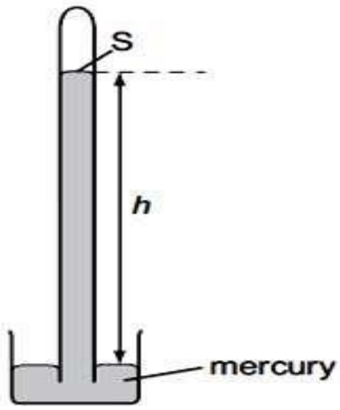
7. **The diagram shows a mercury barometer.**



Which distance is used to calculate the pressure of the atmosphere?

A. 25 cm
B. 75 cm
C. 80 cm
D. 100 cm

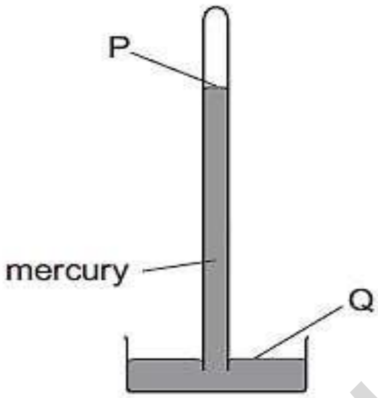
8. The diagram shows a simple mercury barometer. The barometer reading is hcm of mercury.



What is the pressure at S?

A. approximately zero
B. atmospheric pressure
C. atmospheric pressure + h cm of mercury
D. h cm of mercury

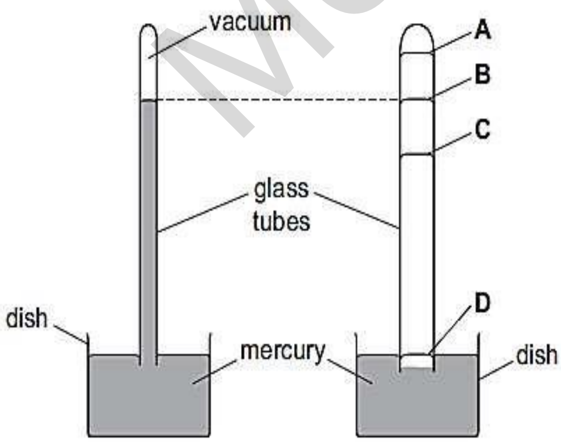
9. The diagram shows a simple mercury barometer used to measure atmospheric pressure.



Which statement is correct?

A. The pressure at P is atmospheric pressure.
B. The pressure at P is nearly zero.
C. The pressure at Q is lower than the pressure at P.
D. The pressure at Q is nearly zero.

10. The diagrams show two mercury barometers standing side by side. The right-hand diagram shows a tube of bigger diameter, but the diagram is incomplete. There is a vacuum above the mercury in both tubes.

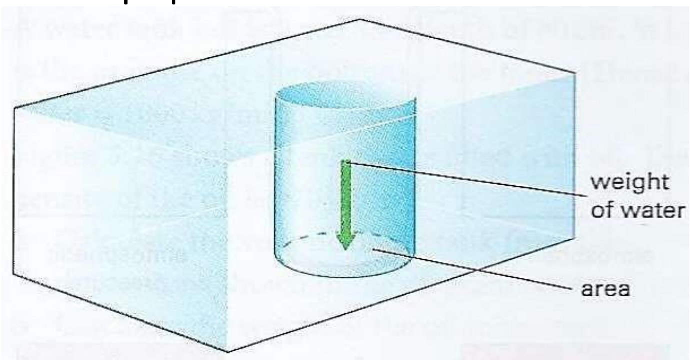


Which labelled position on the right-hand tube could show the mercury level in that tube?

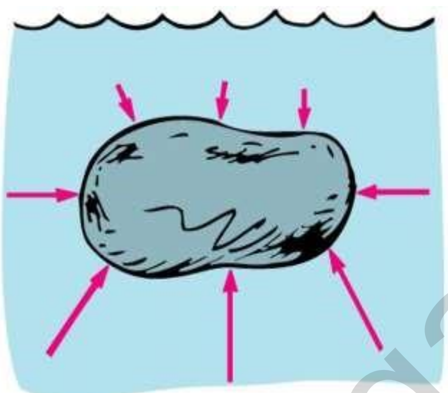
B

Explain quantitatively how the pressure beneath a liquid surface changes with depth and density of the liquid in appropriate examples.

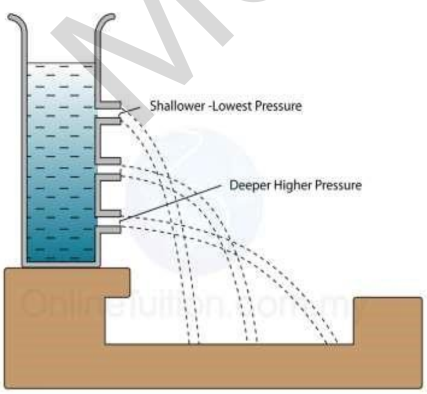
- **A liquid exerts pressure because of its weight.**
  Liquid pressure



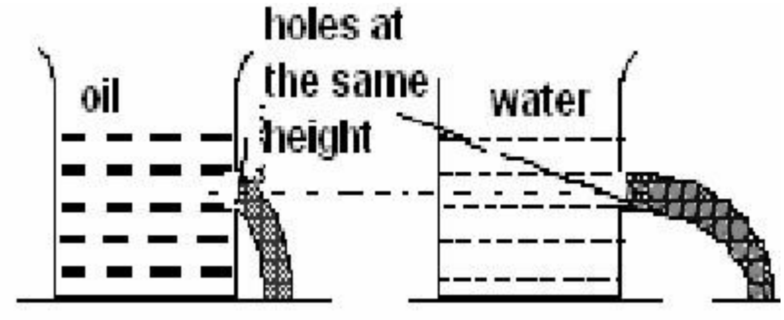
- **The liquid pushes on every surface in contact with it, no matter which way the surface is facing.**
  Pressure acts in all direction



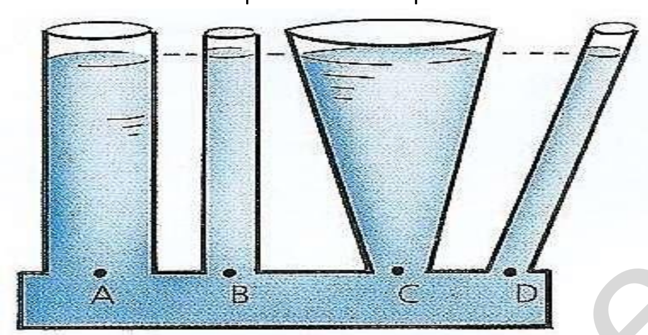
- **The deeper into a liquid you go, the greater the weight of liquid above and the higher pressure.**
  Pressure increase with depth



- **The more dense the liquid, the higher the pressure at any particular depth. Pressure depends on the density of the liquid**



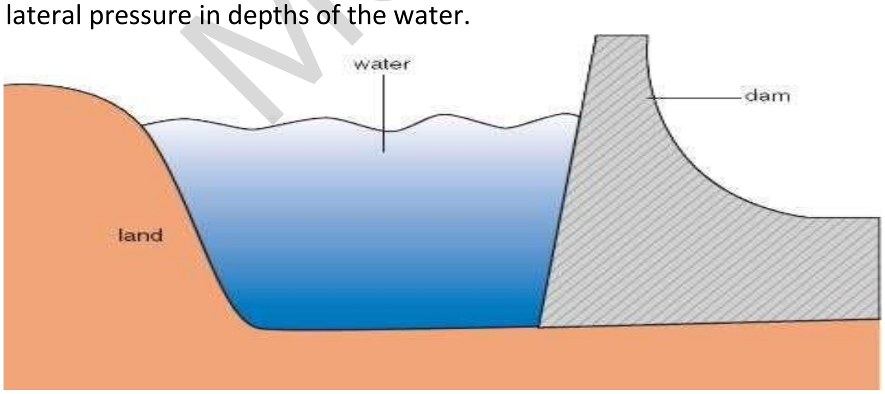
- Whatever the shape or width, the pressure at any particular depth is the same.
- Pressure doesn't depend of the shape of container



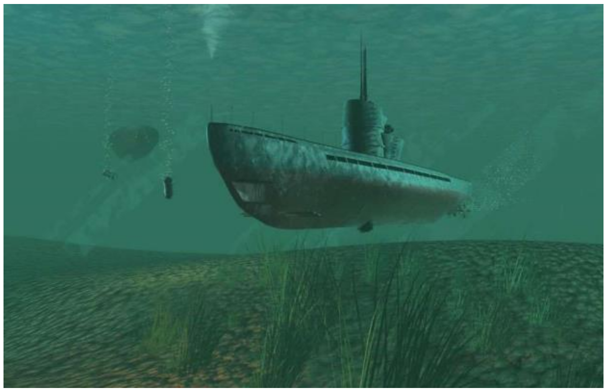
Pressure Below Liquid

- The pressure below the surface of a fluid can be calculated by the following equation:
  pressure = height × density × gravitational field strength
  p = h × p× g
- where p is pressure difference in pascals
  h = height in metres
  p= density in kilogram per cubic metre
  g = gravitational field strength in N/kg

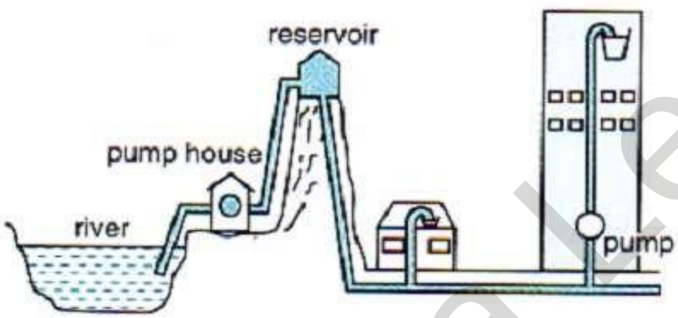
The wall of a dam is much thicker at the bottom than at the top because it must withstand the increased lateral pressure in depths of the water.



Submarine is built with thick wall so as to withstand enormous pressure at greater depth.



Normally a water tank is placed at higher level so as to supply water at greater pressure.



A patient receiving intravenous drips of a certain fluid from a bottle. In order for the fluid to flow into the vein, the bottle must be placed at a height above the injection site, so it has sufficient pressure to flow into the veins of the patient.

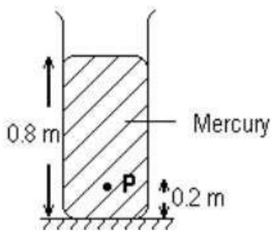
Examples

Given that density of water is 1000 kg/m3, 1 atmosphere = 105 Pa and g = 10 N/kg.

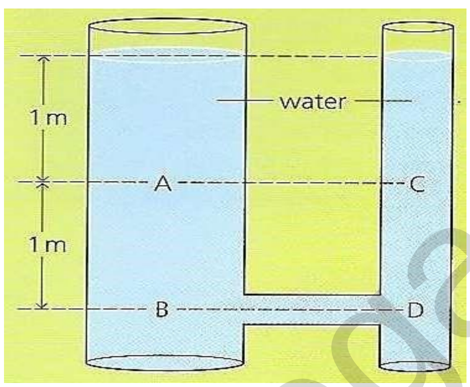
1. What is the pressure at a depth of 23 m in water?

2. Through what vertical distance does a diver mover to increase the pressure of herself by 1 atmosphere.
3. A large tank holds a salad oil, density 0.9 × 103 kg/m3, to a depth of 6 m. What is the pressure at the bottom of the tank?
4. A dam is to be made to hold back an artificial lake 110 m deep. Find the pressure that the bottom of the dam must withstand.
5. If the density of sea water is 1150 kg/m3, calculate the pressure below 40 m of sea water due to the water alone.
6. The figure shows a cylinder containing liquid mercury.

What is the pressure caused by the liquid mercury at the point P? [Density of liquid mercury is 1.36×10^5 kg/m^3]



7. Calculate the increase in pressure as you dive from the surface of a lake to a depth of 8 m
8. What is the pressure difference at 100 m below sea level? (Density of sea water = 1030 kg/m^3)
9. What is the total pressure at the bottom of a column of mercury of height 15 cm? (Density of mercury = 13600 kg/m^3)
10. In the diagram below;



a) How does the pressure at A compare with the pressure at B?
b) How does the pressure at B compare with the pressure at D?
c) How does the pressure at A compare with the pressure at C?
d) Calculate the pressure at B due to the water.
e) If the water system were replace with paraffin, how would this affect the pressure at B?

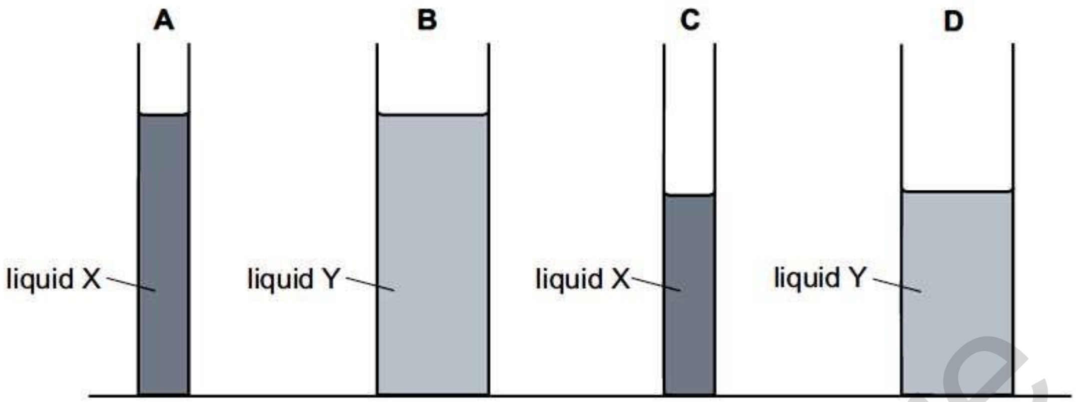
1. What does not affect the pressure at a point beneath the surface of a liquid?

A. area of the liquid surface
B. density of the liquid
C. depth of the point below the surface
D. strength of the gravitational field

2. Which statement about the pressure in a column of liquid is correct?

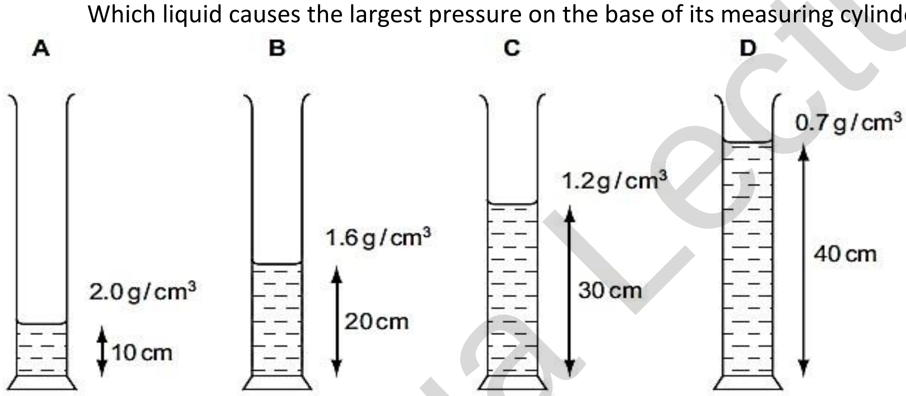
A. It acts only vertically downwards.
B. It increases if the column width increases.
C. It increases with depth in the column.
D. It is uniform throughout the column.

3. **Liquid X has a density of 1010 kg/m3. Liquid Y has a density of 950 kg/m3.**
The liquids are poured into tubes as shown.
Which tube has the greatest pressure on its base?



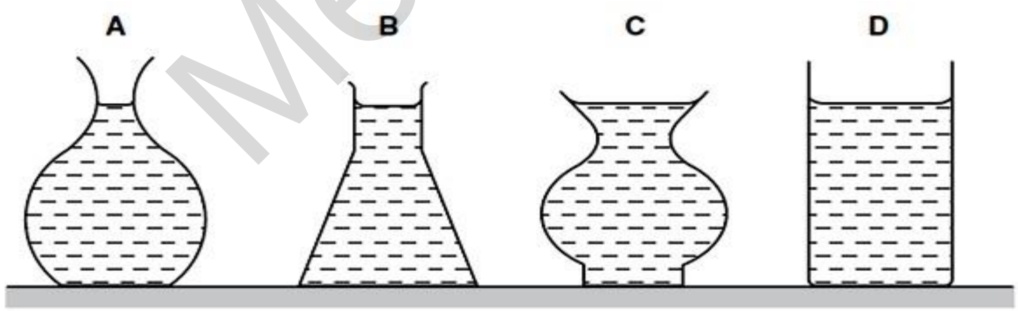
A

4. **Four different liquids are poured into identical measuring cylinders. The diagrams show the depths of the liquids and their densities.**
Which liquid causes the largest pressure on the base of its measuring cylinder?



C

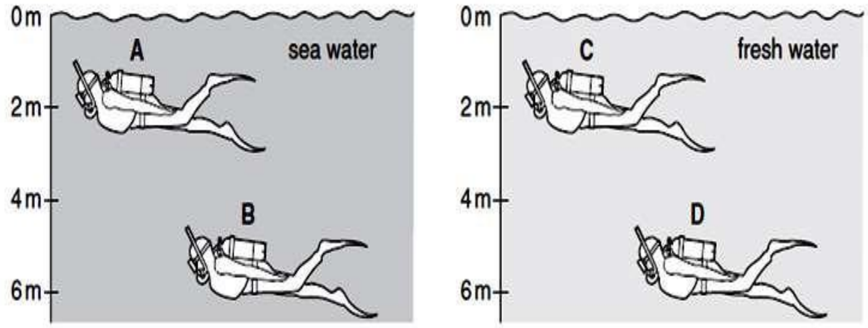
5. **Four flower vases have circular bases. They are filled with water so that they all have the same weight.**
Which vase exerts the greatest pressure on its base?



C

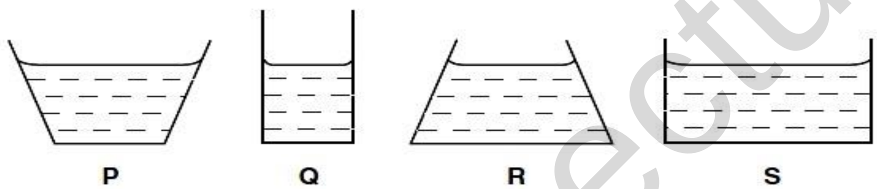
6. The diagrams show two divers swimming in the sea and two divers swimming in fresh water. Sea water is more dense than fresh water.

On which diver is there the greatest pressure?



B

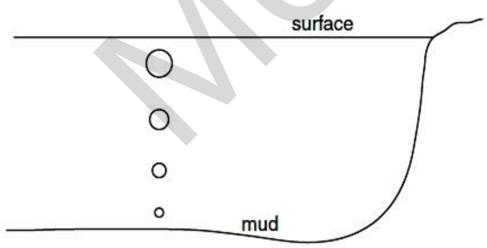
7. The diagrams show, to the same scale, the vertical sections of a set of circular vessels, each containing the same depth of water.



Which one of the following statements is correct?

A. The water exerts the greatest pressure on the base of vessel P.
B. The water exerts the greatest pressure on the base of vessel S.
C. The water exerts the same force on the base of each vessel.
D. The water exerts the same pressure on the base of each vessel.

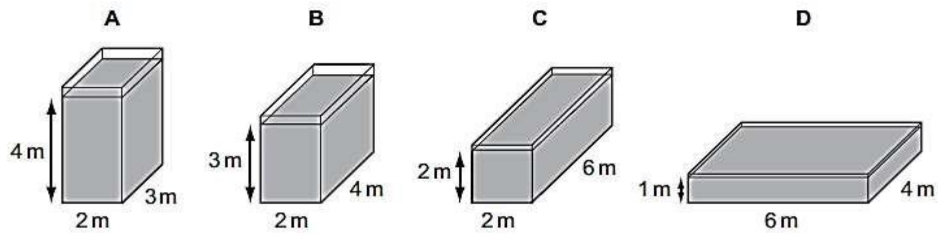
8. Bubbles of gas, escaping from the mud at the bottom of a deep lake, rise to the surface.



As the bubbles rise they get larger.
Why is this?

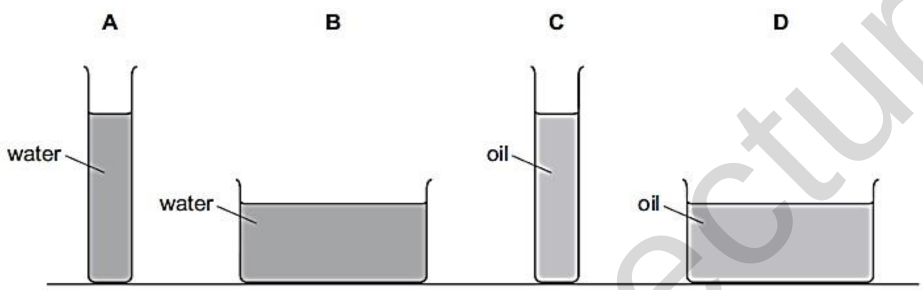
A. Atmospheric pressure on the bubbles decreases.
B. Atmospheric pressure on the bubbles increases.
C. Water pressure on the bubbles decreases.
D. Water pressure on the bubbles increases.

9. **Four glass tanks contain water.**
   In which tank is the pressure of the water on the base greatest?



A

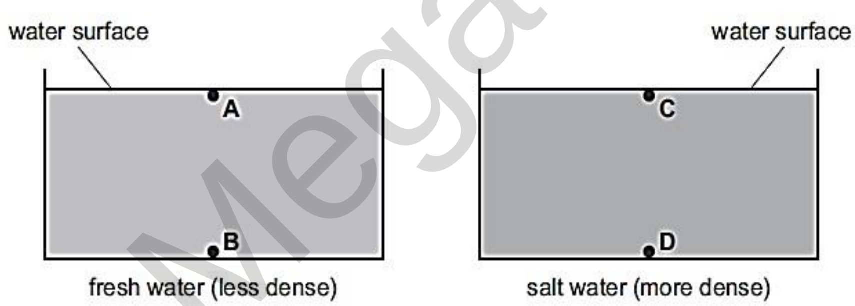
10. **A student fills two containers with water (density 1.0 g/cm³) and two with oil (density 0.8 g/cm³), as shown in the diagrams.**
    In which container is the pressure on the base the greatest?



A

11. **The diagrams show two swimming pools. One contains fresh water and the other contains salt water. Salt water is more dense than fresh water.**

- At which labelled point is the pressure the greatest?

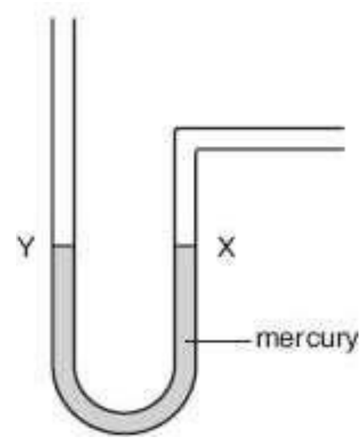


D

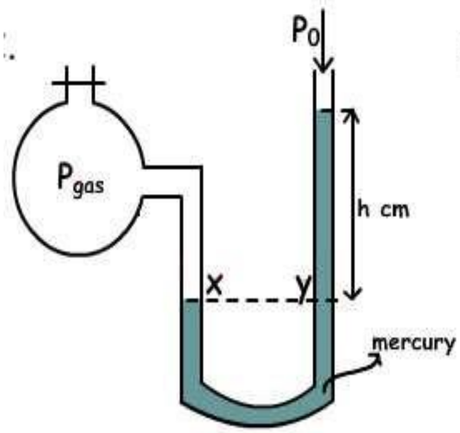
PRESSURE CHANGES

Describe the use of a manometer in the measurement of pressure difference.

- A manometer consists of a U-tube containing a liquid (either mercury or water).
- It is used to measure gas pressure.
- When one arm is connected to a gas supply, the level of two surfaces of the liquid will indicate the strength of the pressure

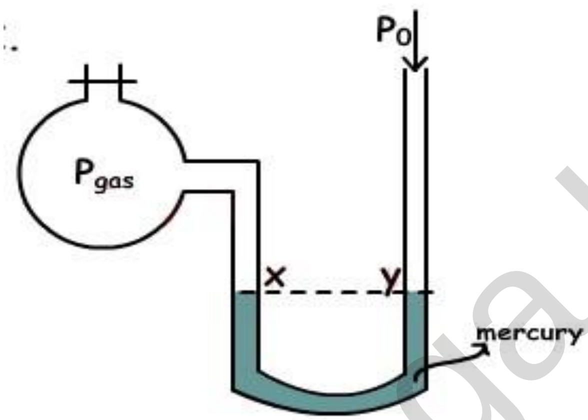


Manometer CASE 1



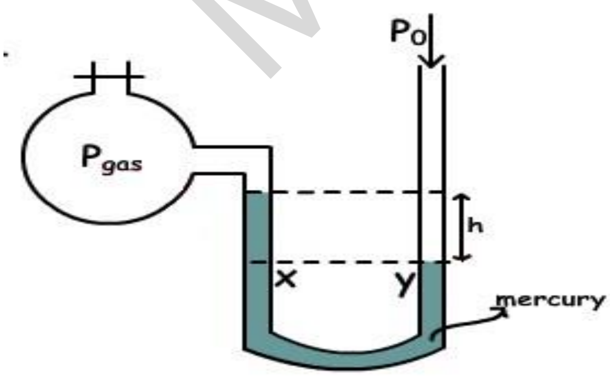
$P_{gas} = P_O + h$

CASE 2



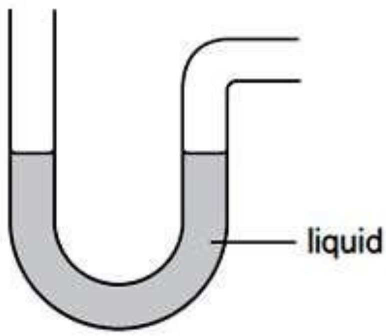
P_{gas} = PO

CASE 3



$P_{gas} = P_O - h$

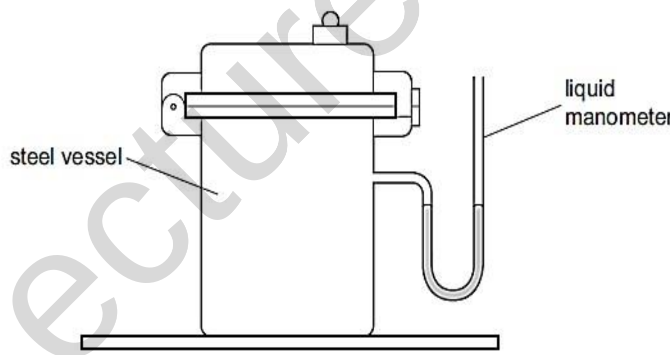
1. **The diagram shows an instrument used to measure gas pressure.**
   What is the instrument called?



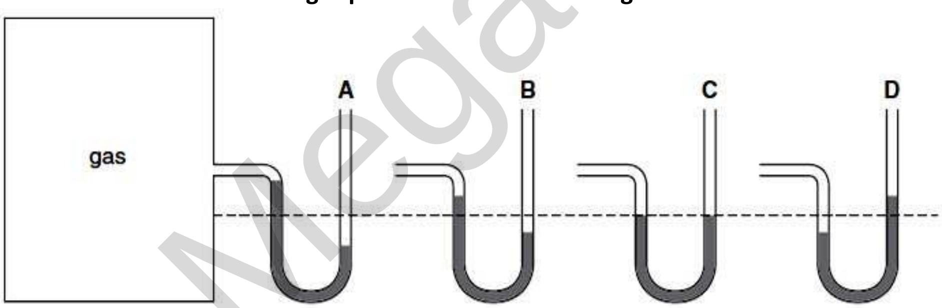
A. ammeter
B. barometer
C. manometer
D. thermometer

2. **A manometer is used to indicate the pressure in a steel vessel, as shown in the diagram.**
   What value does the liquid manometer give for the pressure in the vessel?

A. It is zero.
B. It is between zero and atmospheric pressure.
C. It is equal to atmospheric pressure.
D. It is greater than atmospheric pressure.

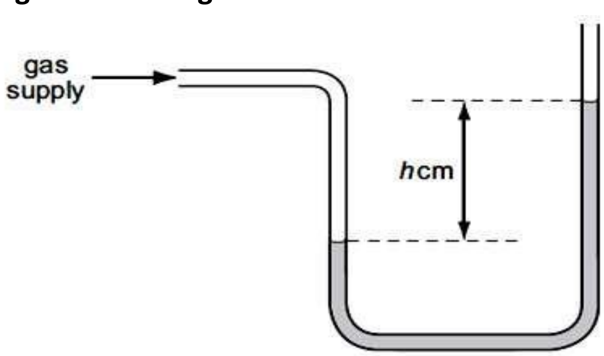


3. **A manometer is being used to measure the pressure of the gas inside a tank. A, B, C and D show the manometer at different times.**
   At which time is the gas pressure inside the tank greatest?



D

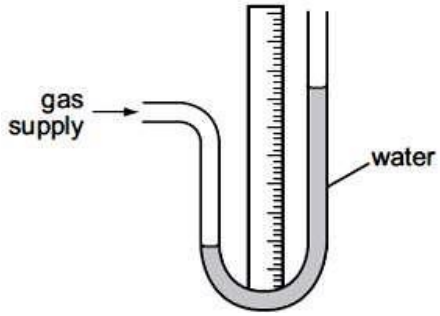
4. **A water manometer is used to measure the pressure of a gas supply to a house. It gives a reading of h cm of water.**



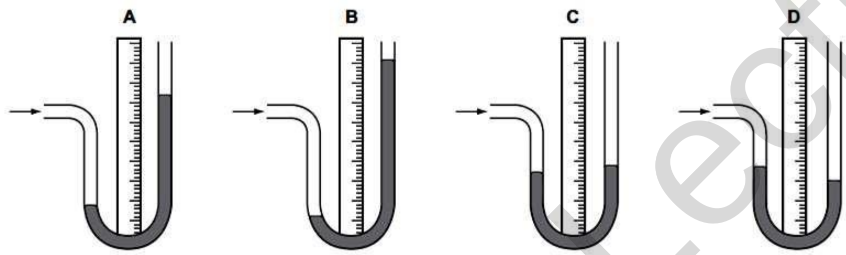
Why is it better to use water rather than mercury in this manometer?

A. h would be too large if mercury were used.
B. h would be too small if mercury were used.
C. The tube would need to be narrower if mercury were used.
D. The tube would need to be wider if mercury were used.

5. A water manometer is connected to a gas supply. The diagram shows the water levels.

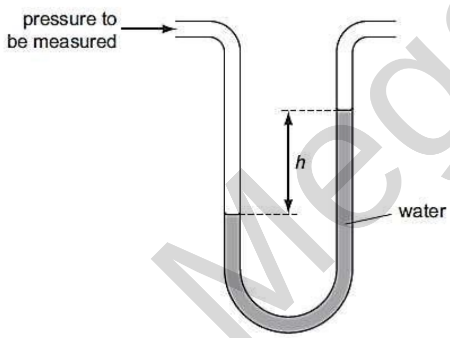


The water is replaced by mercury, which is more dense than water.
Which diagram shows the mercury levels when the manometer is connected to the same gas supply?



C

6. A pressure is measured using a manometer as shown in the diagram.



The water in the manometer is replaced with a liquid which is more dense.
How does the value of h change?

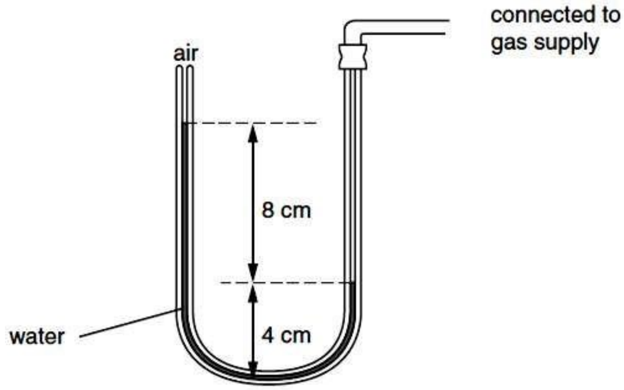
A. It becomes zero.
B. It decreases, but not to zero.
C. It stays the same.
D. It increases.

7. A manometer is connected to a gas supply.

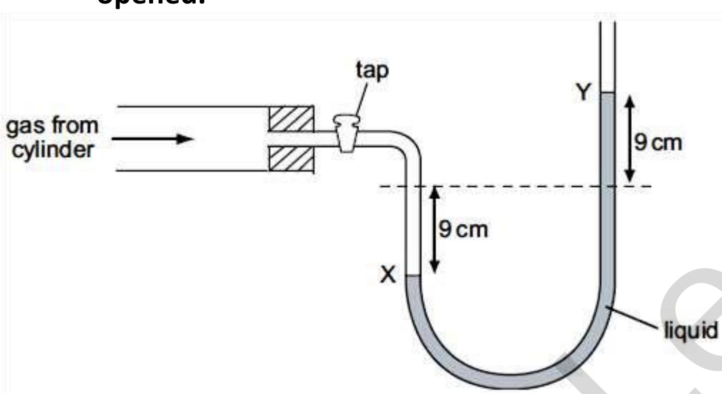
Pressure can be measured in cm of water.

What is the pressure of the gas?

A. 8 cm of water more than atmospheric pressure
B. 12 cm of water more than atmospheric pressure
C. 8 cm of water less than atmospheric pressure
D. 12 cm of water less than atmospheric pressure



8. The diagram shows the levels X and Y in a liquid manometer when the gas tap is opened.



What is the pressure of the gas in the cylinder?

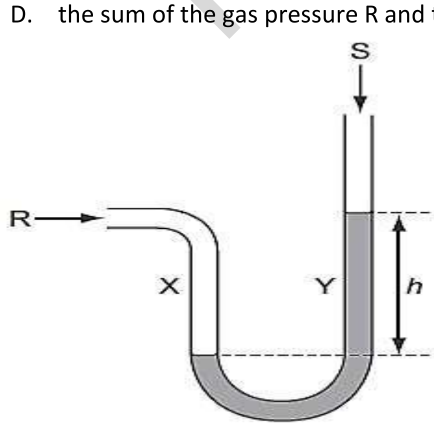
A. 18 cm of liquid below atmospheric pressure
B. 9 cm of liquid below atmospheric pressure
C. 9 cm of liquid above atmospheric pressure
D. 18 cm of liquid above atmospheric pressure

9. The diagram shows a simple manometer.

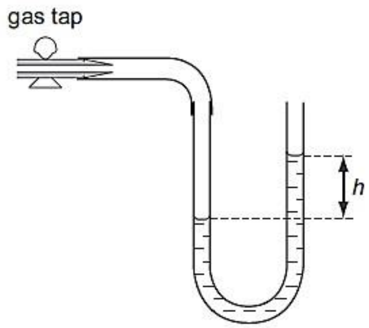
Side X is connected to a gas supply. Side Y is open to the atmosphere.

What pressure is the length h used to measure?

A. the atmospheric pressure S
B. the difference between the gas pressure R and the atmospheric pressure S
C. the gas pressure R
D. the sum of the gas pressure R and the atmospheric pressure S



10. A water manometer is connected to a gas supply. One end of the manometer is open to the atmosphere.



Which statement about the pressure of the gas supply is true?

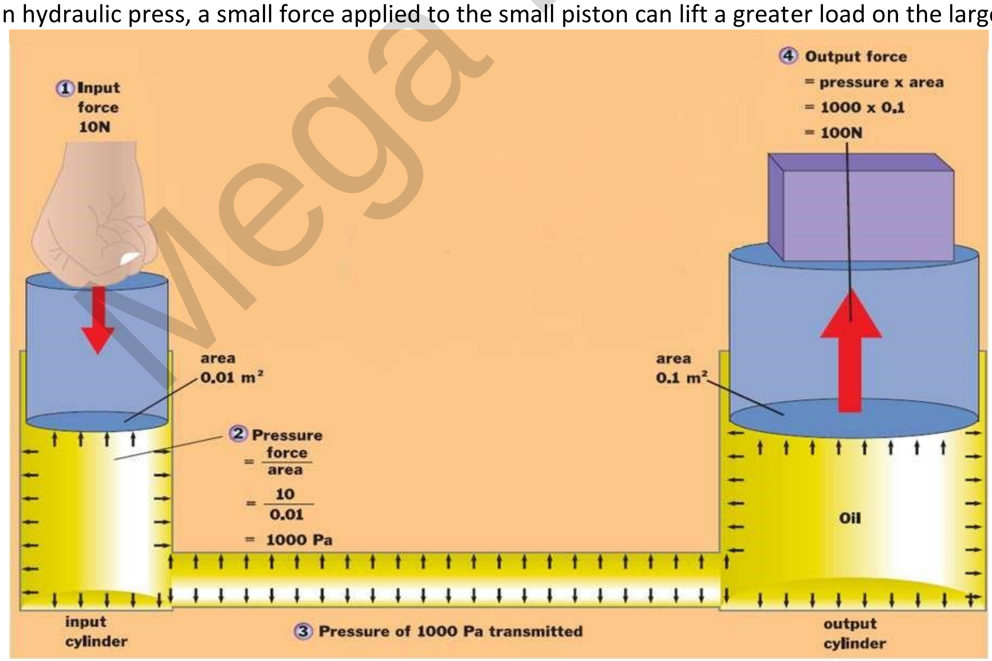
A. The pressure is h cm of water.
B. The pressure is h cm of water below atmospheric pressure.
C. The pressure is the same as atmospheric pressure.
D. The pressure is h cm of water above atmospheric pressure.

PRESSURE CHANGES

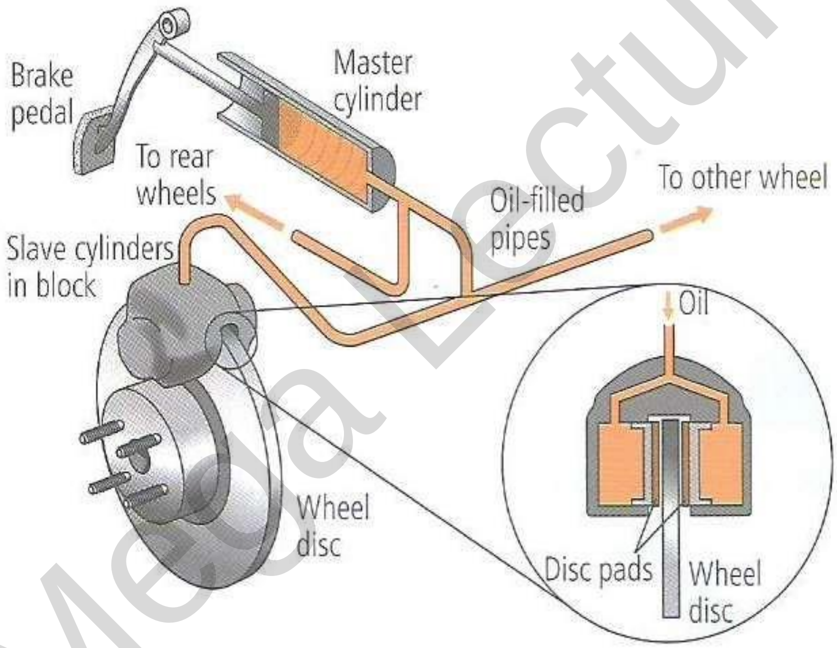
Describe and explain the transmission of pressure in hydraulic systems with particular reference to the hydraulic press and hydraulic brakes on vehicles.

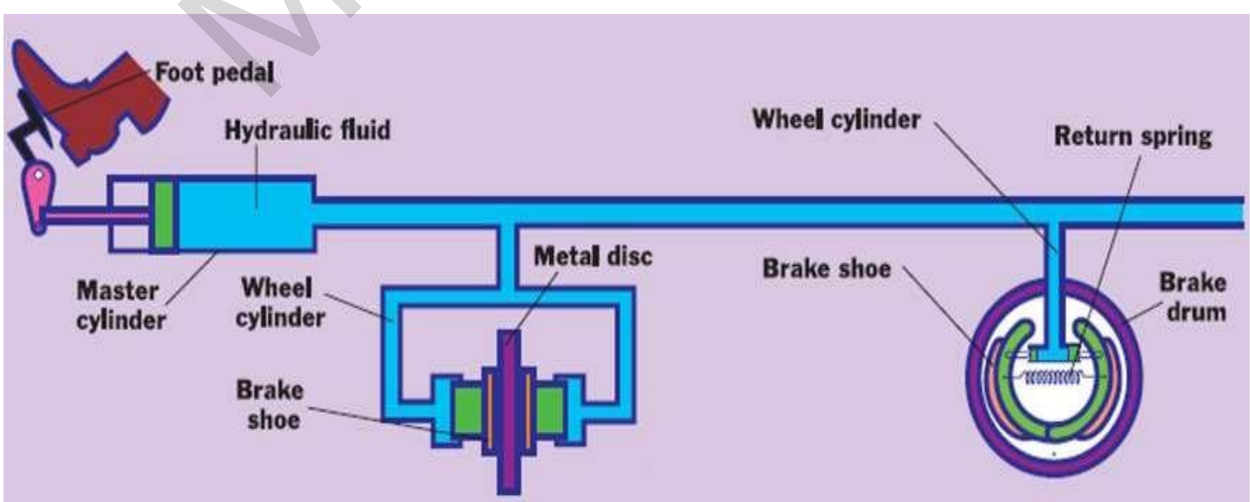
Hydraulic system

- Hydraulic systems work by using liquids under pressure. They make use of two properties of liquids:
  - Liquids are incompressible.
  - If pressure is applied to an enclosed, the pressure is transmitted to all parts of the liquid.
- In hydraulic press, a small force applied to the small piston can lift a greater load on the large piston.



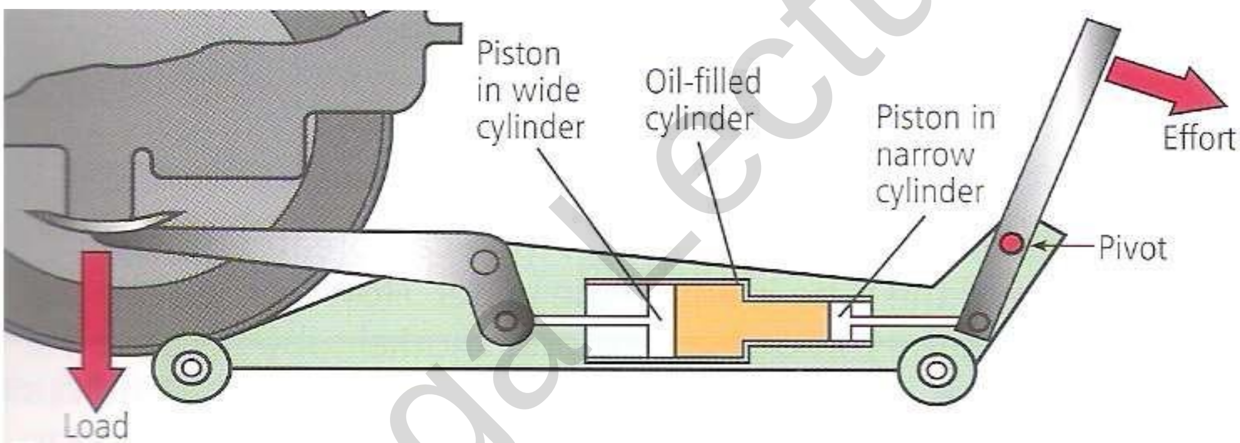
Hydraulic brakes





- When the driver presses on the brake pedal of the car, pressure is exerted on the brake fluid in the main cylinder.
- This pressure is transmitted along the brake pipes to wider cylinder at the wheels.
- The oil pressure forces the piston in each wheel cylinder to push the brake disc pads on to the wheel disc.

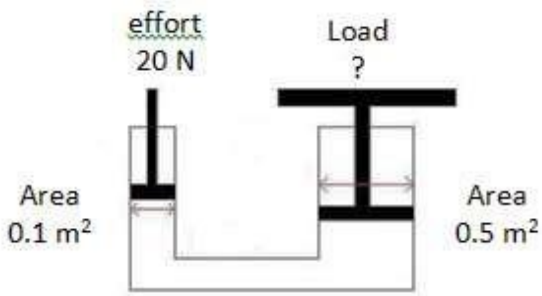
Hydraulic jack



- When the handle is pressed down, the piston in the narrow cylinder is forced into the oil-filled cylinder.
- Oil is forced out of this cylinder, through the pipe and into a wider cylinder.
- The pressure of the oil on the piston in the wider cylinder forces this piston outwards which forces the pivoted lever to raise the car.

Example

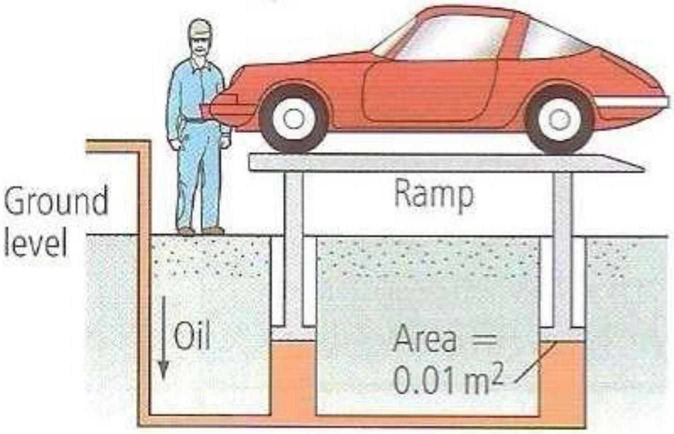
1. **Figure below shows a simple hydraulic jack. The load is just being lifted using an effort of 20 N.**



Calculate;

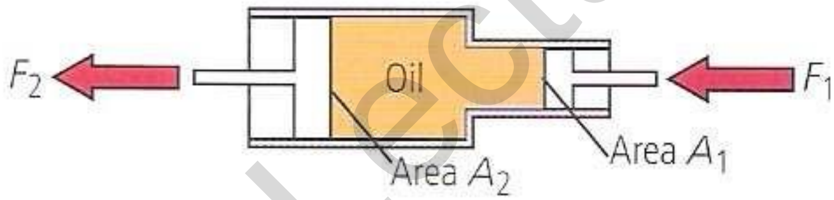
A. pressure at A,
B. pressure at B,
C. thrust acting on the piston C,
D. the load lifted?

2. The hydraulic lift below is used to raise a vehicle so its underside can be inspected.



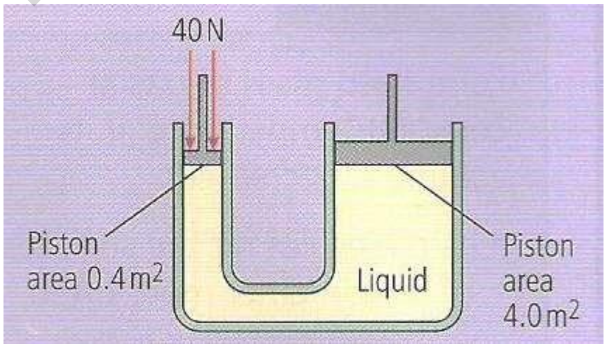
The lift has four pistons, each of area 0.01 m^2 to lift the platform. The pressure in the system must not be greater than 5.0×10^5 Pa. The platform weight is 2000 N. Calculate the maximum load that can be lifted on the platform.

3. A jack is projected to lift a bus which has a mass of 4 000 kg. If the large piston has an area of 1 m2, and the small piston on the other end of the circuit has an area of 0.05 m2, what is the minimum force that must be applied (to the little piston) in order to lift the bus?



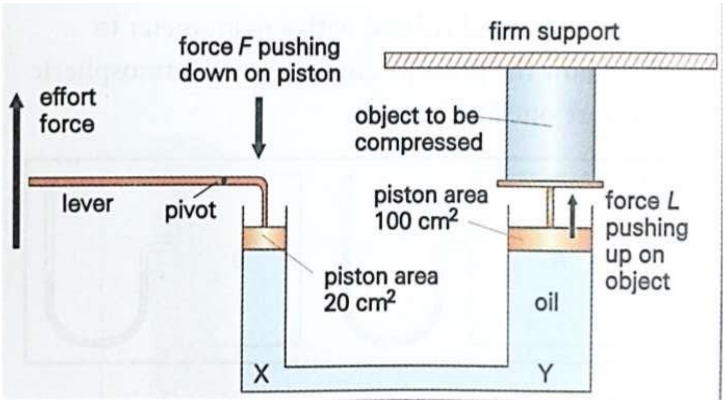
4. In a hydraulic machine force of 40 N is applied to piston of area 0.40 m^2. The area of the other piston is 4.0 m^2.

a) Calculate the pressure transmitted through the liquid.
b) Calculate the force on the other piston.



5. In figure below, the force L is 200 N and the large piston on the right rises 1.0 cm.

a) Calculate the force F.
b) Calculate the volume of oil that enters the cylinder on the right.
c) Use your answer to b to calculate the distance that the piston on the left falls.
d) Explain why the effort force is less than the force F



Solution

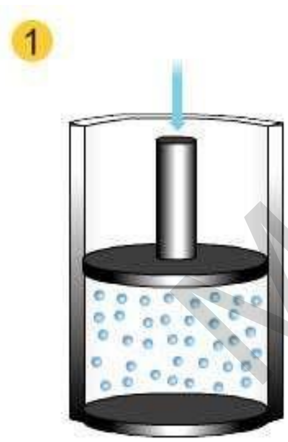
a) F = P.A = (200/100) × 20 = 40 N
b) Volume = length × area = 1 × 100 = 100 cm^3
c) Length = *V*/*A* = 100/20 = 5 cm
d) The effort force produces a pressure in the liquid.
This pressure is transferred through the oil to the right-hand piston.
The same pressure exerts a larger force because larger area of the piston.

PRESSURE CHANGES

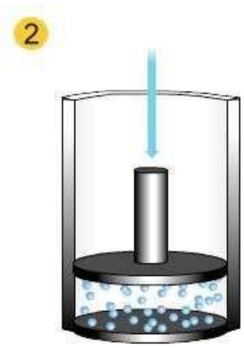
Describe how a change in volume of a fixed mass of gas at constant temperature is caused by a change in pressure applied to the gas. Do calculations using $p_1V_1 = p_2V_2$

Pressure & volume of gas

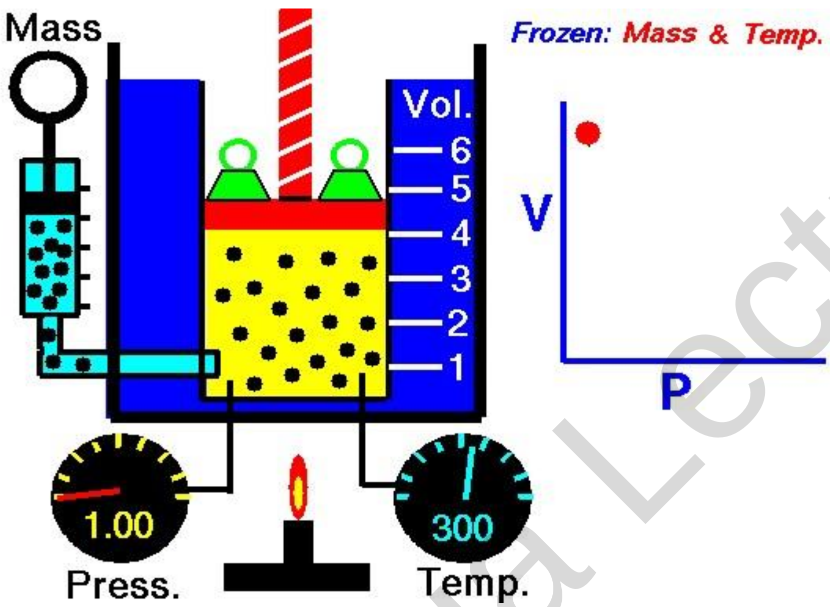
- Consider a gas is trapped in a cylinder by a piston.
- If the piston is pushed in, the gas particles will have less room to move as the volume the gas occupies has been decreased.



- Because there has been a decrease in volume the particles will collide more frequently with the walls of the container.
- Each time they collide with the walls, they exert a force on them.
- More collisions mean more force, so the pressure will increase.



- When the volume decreases the pressure increases.
- This shows that the pressure of a gas is inversely proportional to its volume.



- **From this we can derive the equation:**
  $p_1V_1 = p_2V_2$
- ➢ p_1 is the starting pressure
- ➢ V_1 is the starting volume
- ➢ p_2 is the finishing pressure
- ➢ V_2 is the finishing volume

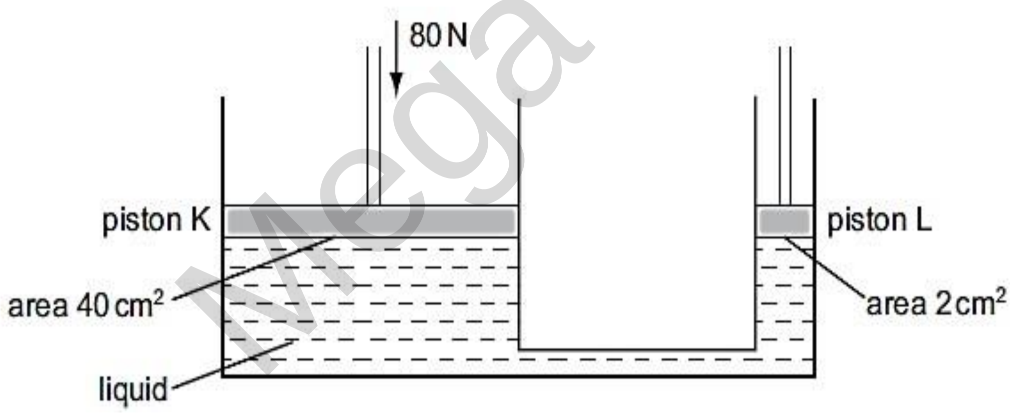
EXAMPLE

1. **Calculate the unknown quantity in each of the following changes involving a fixed mass of gas at constant temperature.**

	initial pressure / Pa	initial volume / m^3	final pressure / Pa	final volume / m^3
(a)	100	0.20	50	?
(b)	100	0.30	?	0.15
(c)	120	?	100	0.60
(d)	?	0.15	60	0.45

2. If a given mass of gas has a volume of 4.5×10^{-5} m^3 at a pressure of 30.0 kPa, what will be the volume of the gas if the pressure is increased to 50.0 kPa while the temperature is kept constant.
3. The volume of a gas at 760 mmHg is 1250 ml. What is its volume at 950 mmHg? Assume that there is no change in temperature.
4. A 600 cm^3 sample of gas is in a cylinder under a gauge pressure of 1.8 atm. What will the pressure gauge read if the sample is compressed to 180 cm^3 at constant temperature?
5. To compress nitrogen at 1 atm from 750 ml to 500 ml, what must the new pressure be if the temperature is kept constant?
6. The pressure on 6.0 L of a gas is 200 kPa. What will be the volume if the pressure is doubled, keeping the temperature constant?
7. A gas measuring 525 ml is collected at 104.66 kPa. What volume would this gas occupy at 99.33 kPa?
8. A container holds 600 liters of air at a pressure of 2 atmospheres. If the pressure on the gas is increased to 5 atmospheres, what will its volume become?
9. A gas cylinder has a volume of 0.4 m^3. It contains butane at a pressure of 100 kPa and a temperature of 20 °C. What pressure is needed to compress the gas to a volume of 0.05 m^3 at the same temperature
10. A bicycle pump contains 400 cm^3 of air at atmospheric pressure. The air is compressed slowly. What is the pressure when the volume of the air is compressed to 125 cm^3. (Atmospheric pressure = 100 kPa)

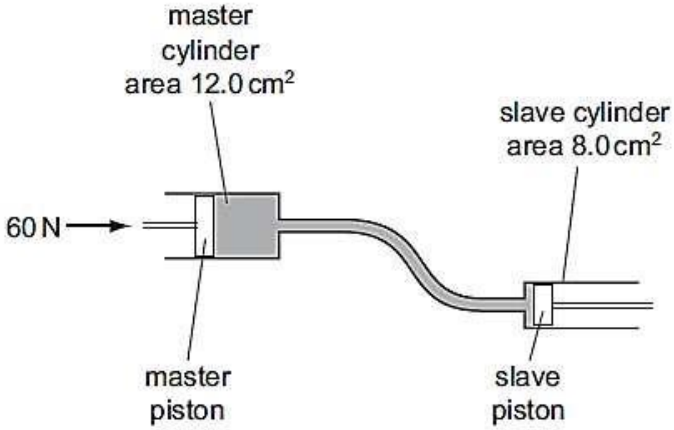
1. The system shown in the diagram contains a liquid.



A downward force of 80 N is exerted on piston K.
What will be the upward force exerted by the liquid on piston L?

A. 1 N
B. 4 N
C. 80 N
D. 1600 N

2. The diagram shows the principle of an hydraulic system.

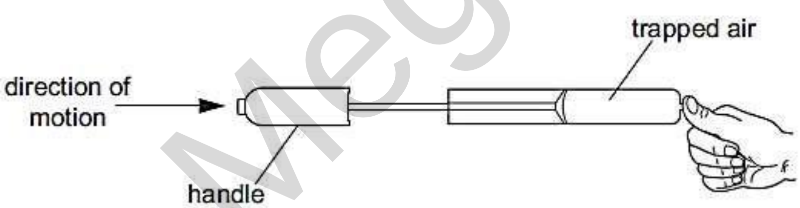


The cross-sectional area of the master cylinder is 12.0 cm2 and the cross-sectional area of the slave cylinder is 8.0 cm2. The force applied to the master piston is 60 N, producing a pressure of 5.0 N/cm2.
Which line in the table is correct?

	pressure at slave cylinder N/cm^2	force at slave cylinder N
A	3.3	40
B	3.3	90
C	5.0	40
D	5.0	90

C

3. A student places his thumb firmly on the outlet of a bicycle pump, to stop the air coming out.

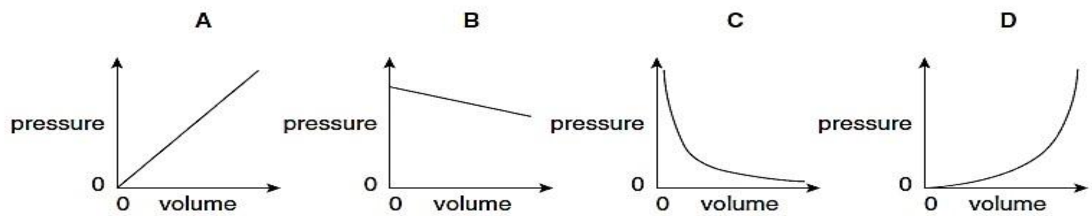


What happens to the pressure and to the volume of the trapped air as the pump handle is pushed in?

	pressure	volume
A	decreases	decreases
B	decreases	remains the same
C	increases	decreases
D	increases	remains the same

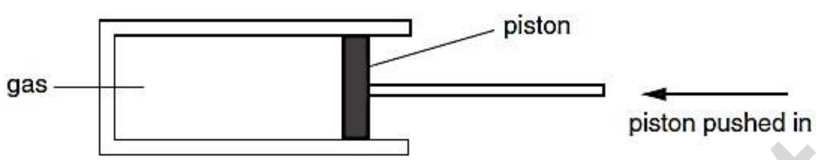
C

4. Which graph shows the relationship between the pressure and volume of a fixed mass of gas at constant temperature?



C

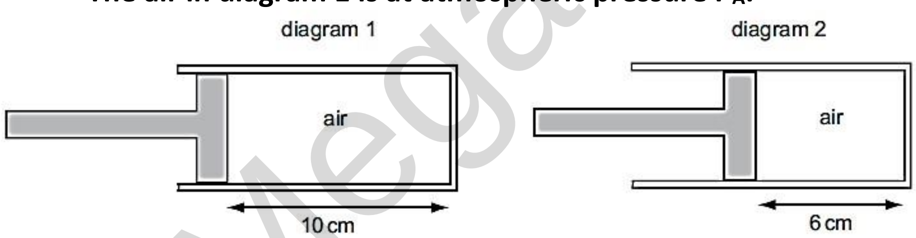
5. A measured mass of gas is placed in a cylinder at atmospheric pressure and is then slowly compressed.



If the temperature of the gas does not change, what happens to the pressure of the gas?

A. It drops to zero.
B. It decreases, but not to zero.
C. It stays the same.
D. It increases.

6. Diagram 1 shows some air trapped in a cylinder.
Diagram 2 shows the same air after the piston has been pushed in slowly.
The air in diagram 1 is at atmospheric pressure P_A.



What is the pressure of the air in diagram 2?

A $\frac{6}{10} \times P_A$

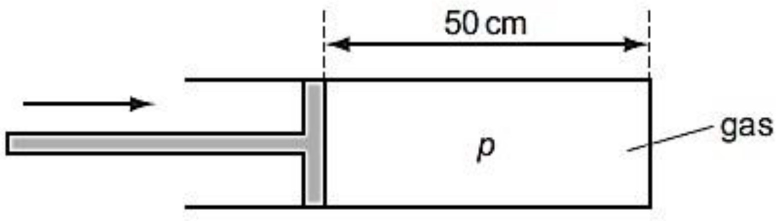
B P_A

C $\frac{10}{6} \times P_A$

D $60 \times P_A$

C

7. A gas is trapped inside a cylinder by a movable piston. The length of the gas column is 50 cm and the pressure inside the cylinder is p.



The piston is pushed in a distance of 30 cm, so that the length of the gas column is now 20 cm.
The temperature of the gas does not change.
What is the new pressure of the gas?

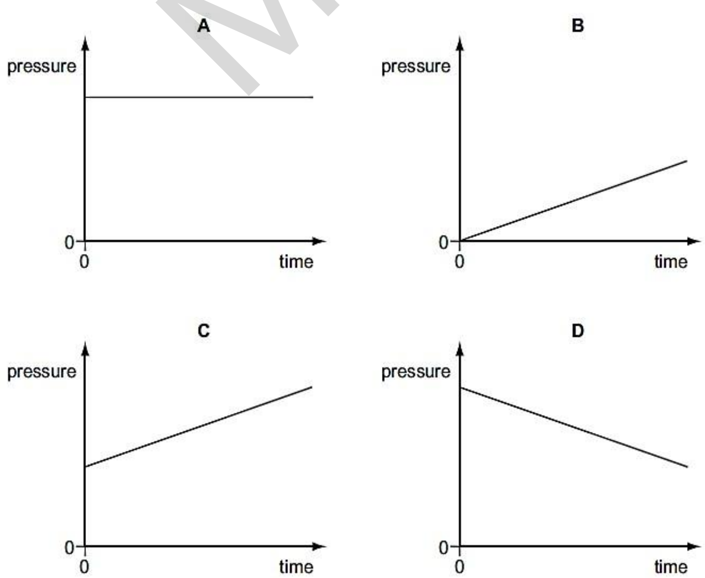
A. 0.4 p
B. 0.6 p
C. 1.5 p
D. 2.5 p

8. An airtight container holds a fixed quantity of gas. Its pressure and volume are measured on four occasions when the temperature is 20 °C.
The results are shown in the table.
Which set of readings is incorrect?

	pressure / kPa	volume / cm^3
A	120	36
B	100	48
C	80	60
D	60	80

A

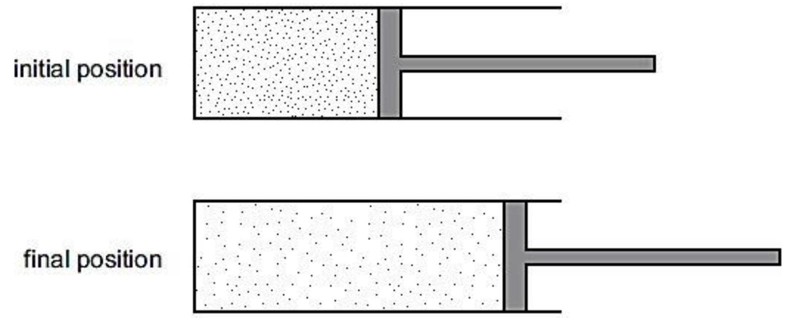
9. The pressure of a fixed mass of gas in a cylinder is measured. The volume of the gas in the cylinder is then slowly decreased.
Which graph could show the change of pressure of the gas during this process?



C

10. A piston traps a certain mass of gas inside a cylinder. Initially the piston is halfway along the length of the cylinder.

- The piston is now moved towards the open end of the cylinder. The temperature of the gas remains constant.

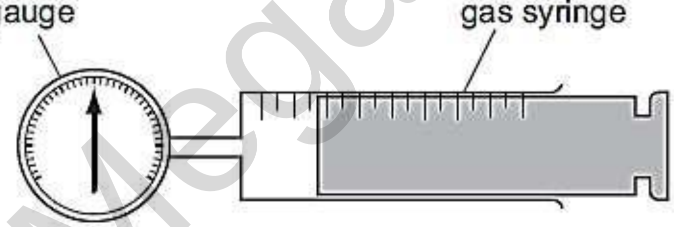


How are the density and the pressure of the gas affected by moving the piston?

	density	pressure
A	decreases	decreases
B	decreases	unchanged
C	increases	decreases
D	increases	unchanged

A

11. Some gas is trapped in a large syringe by a piston. The atmospheric pressure is 100 kPa.



The pressure gauge indicates that the gas pressure is 200 kPa above atmospheric pressure. The piston moves outwards and the volume of the trapped gas doubles. The temperature remains constant.
What is the new gas pressure?

A 100 kPa B 150 kPa C 200 kPa D 400 kPa

B