3. PRESSURE

1. Define pressure and state its SI units.
2. Ploughing tractors have very wide tyres. Explain why.
3. What is the reason why a trailer carrying heavy loads have many wheels?
4. A student wearing sharp pointed heeled stiletto shoes is likely to damage a soft wooden floor. Explain.
5. A block of dimension **0.2 m** by **0.1 m** by **5 cm** has a mass of **500 g** and rests on a flat surface. Determine the least pressure that can be exerted by the block on the surface. *ANS 1×10^{4} Nm $^{-2}$*
6. A box of mass **720 kg** is placed on a table. If the area of contact in the table is **1.8 m^2**. Calculate the pressure it exerts on the tab***le.*** *ANS 4000*
7. A metallic block of mass **50 kg** exerts a pressure of **10 N/m^2** on the surface. Determine the area of contact between the block and the surface.
8. A block measuring **20cm** by **10 cm** by **4 cm** rests on a flat surface. The block has a weight of **6 N**. Determine:
   i) The minimum pressure it exerts on the surface. *ANS 300 Nm $^{-2}$*
   ii) The density of the block in kg/m^3 *ANS 750 kg/m^3*
9. A block of mass **60 kg** measures **6 cm** by **5cm** by **4 cm**. Calculate
   a) The maximum pressure it can exert. *ANS 300 000 Nm $^{-2}$*
   b) The minimum pressure. *ANS 200 000 Nm $^{-2}$*
10. A man of mass **80 kg** exerts a pressure of **200,000 Pa** on the ground while standing on both feet.
    a)Calculate the area of each foot. *ANS 0.002 m ^{2}*
    b) How much pressure would be exert if he stands on one foot. *ANS 400 000 Nm $^{-2}$*
11. A woman wearing shoes with sharp pointed heels exerts more pressure than an elephant. Explain?
12. If the weight of the woman is 600 N and her heel have an area of 1.0 cm^2 each and the elephant has a weight of 30,500 N and each feet has an area of 730 cm^2, Calculate by how much more the woman exerts pressure on the ground than the elephant *ANS 2 895 548 Pa*
13. A pick – up carrying stones weighs **20,000 N**. The weight is evenly spread across the four tyres. The area of contact of each tire with the ground is **0.025 m^2**. Calculate the pressure exerted by each tire on the ground. *ANS 800 000 Nm $^{-2}$*
14. A pickup of mass **2000 kg** has **four** similar tyres. If the pressure exerted by each tyre on the ground is **500,000 N/m^2**, calculate the area of each tyre in contact with the ground. *ANS 0.04 m^2*
15. The total weight of a car with passengers is **30,000 N**. The area of contact of each of the FOUR tyres with the ground is **0.015 m^2**. Determine the minimum car tyre pressure. *ANS 500 000 Pa*
16. The figure below shows a box of mass **360 kg** that measures **60 cm by 30 cm by 10 cm**.
    (i) Calculate the Maximum pressure it can exert. *ANS 120 000 Pa*
    (ii) Calculate Minimum pressure it can exert. *ANS 20 000 Pa*
17. The figure below shows a block of wood plank of mass **600 kg** and dimension **0.5 m** by **0.2 m** by **0.3 m.** Calculate
    a) The density of the plank. *ANS 20 000 kg/m^3*
    b) The weight of the plank. *ANS 6000 N*
    c) The minimum pressure it can exert. *ANS 40 000 Pa*

PRESSURE IN FLUIDS

1. Name **two** factors that affect pressure in fluids.
2. State **two** true facts about pressure in liquids.
3. Other than the density and the depth, state any other factor that affects the pressure of a fluid.
4. Water dams are built with thicker walls at the bottom than at the top. Explain why.
5. Water tanks in houses are erected as high as possible. Explain.
6. Explain why a hole in a ship near the surface is less dangerous than one near the bottom.
7. A drum which is **2 m** high contains water to a depth of **0.5 m** and oil of density **0.5 g/cm^3** extends to the top. Find the pressure exerted at the bottom of drum by the two liquids. *ANS 12 500 Nm $^{-2}$*
8. The reading of mercury barometer is at **70.0 cm**. What is the pressure at the place in N/m^2. {Assume density of mercury is **1.36×10^4 kg/m^3**} *ANS 95 200 N/m ^{2}*
9. A submarine is **30 m** below sea water of density **1 g/cm^3**. if the atmospheric pressure at the place is equivalent to **760 mmHg**. Find the total pressure acting on the submarine (Take density of mercury **=13600 kg/m^3**) *ANS 403 360 Nm $^{-2}$*
10. A submarine is **40 m** below sea water of density **1020 kg/m^3**. If the atmospheric pressure at the place is **103,000 Pa**, calculate the total pressure acting on the submarine**.** *ANS 511 000 Nm $^{-2}$*
11. A submarine is **20 m** below sea water of density **1000 kg/m^3**. If the atmospheric pressure at the place is **102,000 Pa**, calculate the total pressure acting on the submarine. *ANS 302 000 Nm $^{-2}$*
12. A boy is swimming **25 m** below water level of density **1 g/cm^3**. The atmospheric pressure at this place is equivalent to **72 cmHg**. Calculate the total pressure on his body in **N/m^2** (take **ρ** for mercury = **13600 kg)** *ANS 347 920 Nm $^{-2}$*
13. A water tank of height **4.8 m** is ¾ full. Determine the force exerted on a thin metal plate resting flat at the bottom of the bottom of the tank if the plate has an area of **2 cm^2**. The density of water is **1000 kg/m^3** and the atmospheric pressure =**104,000 Pa** *ANS 28 N*
14. A water tank of height **6 m** is $\frac{4}{5}$ full. Determine the force exerted on a thin metal plate resting flat at the bottom of the bottom of the tank if the plate has an area of **0.5 m^2**. Take acceleration due to gravity, g = **10 m/s ^{2}**, the density of water to be **1000 kg/m^3** and the atmospheric pressure **P=100,000 Pa** *ANS 74 000 N*
15. The height of mercury column in a barometer is found to be **76 cm** at a certain place. What would be the height on a water barometer in the same place? (Density of water is **1000 kg/m^3** and density of mercury is **13600 kg/m^3**). *ANS 10.336 m*
16. The height of mercury column in a barometer, at a place is **64 cm**. What would be the height of a column of paraffin in the barometer at the same place? (take density of mercury =**13600 kgm^{-3} and** density of paraffin = **800 kg /m^3**). *ANS 10.88 m*
17. A hole of diameter **1.0 mm** is made in the side of a water pipe. If the pressure of the flow is maintained at **3.0×10^6 Nm^{-2}**, calculate the force with which the water jets out of the hole. *ANS 2.3571 N*
18. A hole of area **200 mm^2** at the bottom of a tank **4.0 m** deep is closed with a cork. Determine the force due to water (Density of water is **1000 kg/m^3**, and acceleration due to gravity is **10 m/s ^{2}** *ANS 80 N*

HYDRAULIC MACHINES

1. State the Pascal's principle.
2. Name two properties of a suitable hydraulic fluid
3. Give a reason why air is not commonly used as the fluid in a hydraulic lift.
4. Explain why brakes fail in a hydraulic brake system when air gets in to the system.
5. Explain why a liquid and not a gas must be used as the 'fluid' in a hydraulic machine.
6. The area of larger piston of a hydraulic press is **4 m²** and that of the other piston is **0.05 m²**. A force of **100 m** is applied on the smaller piston. How much force is produced on the larger piston? ***ANS 8000 N***
7. The areas of the piston of the smaller and larger pistons of a Hydraulic press are **4 cm²** and **480 cm²**. Calculate the force applied on the smaller piston to raise a load of **8400 N** on the larger piston. ***ANS 70 N***
8. In a hydraulic machine, the pistons of two connected cylinders have radius of **10 cm** and **100 cm** respectively. A force of **400 N** is applied on the smaller piston. Calculate the force on the larger piston. ***ANS 40000 N***
9. The figure 1 below shows a mass of 6 kg on piston B balanced by force F acting on piston A.

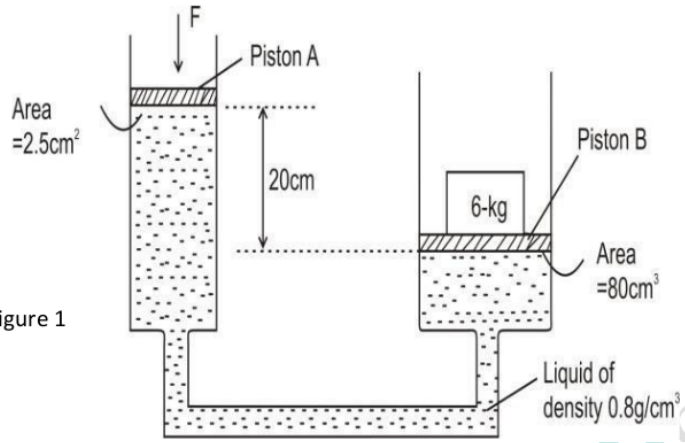
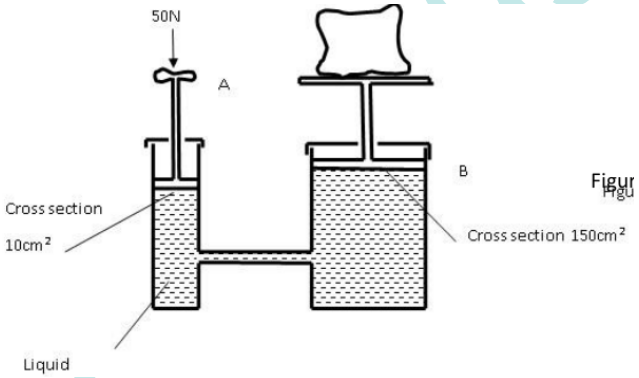


Figure 1

Determine the value of the force F. ***ANS 1.475 N***

11. (a) Figure shows one form of hydraulic lifting device. The force A causes a pressure in a liquid. The pressure moves the piston B.



Figur

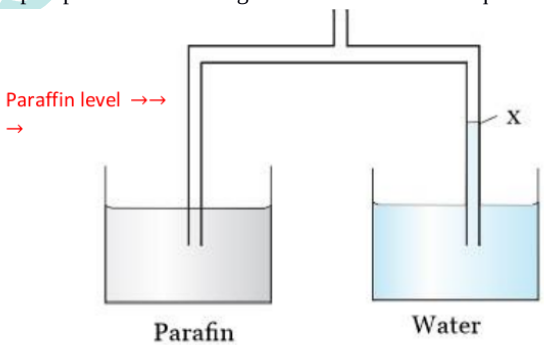
Determine;

i. The pressure in the liquid. ***ANS 50000 Pa***
ii. The force pushing up on B. ***ANS 750 N***
iii. Suggest with a reason what would happen if the liquid was replaced with

(b) State principal of transmission of pressure in liquids.

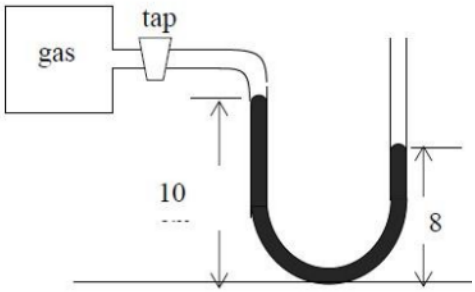
U - TUBE

1. A vacuum pump was used to pump out air from the glass tube immersed in liquids as shown in figure 1 below.



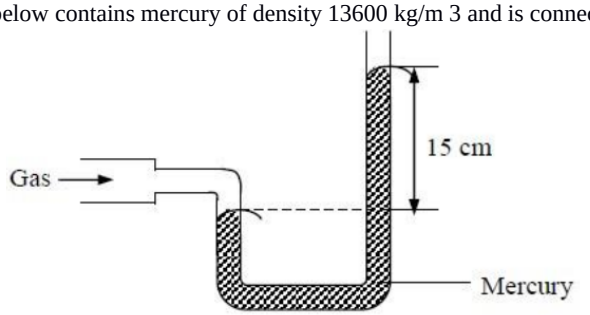
After sometime the level of water rose to position X. Mark Y the corresponding position for the paraffin level. Give a reason for your answer.

2. A U-tube containing mercury is used as a manometer to measure the pressure of a gas in a container. When the manometer has been connected and the tap opened, the mercury in the U-tube settles as shown in the diagram below. *ANS 10064 Pa*



If the atmospheric pressure is 760 mmHg and the density of mercury is 13 600 kg/m^3, calculate the pressure of the gas in Pascals.

3. The U tube shown below contains mercury of density 13600 kg/m 3 and is connected to a laboratory gas supply.

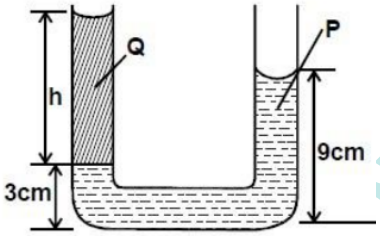


If the atmospheric pressure is 75 cmHg, what is the pressure of the gas in:

i. cmHg *ANS 90 cmHg*

ii. Pascal (Take g = 10 N/kg) *ANS 122 400 Pa*

4. In the figure 2, below, U-tube contains two immiscible liquids P and Q.



If the density of Q is 900 kg/m^3 and that of P is 1200 kg / m^3. Calculate the height of liquid Q. *ANS 0.09 m*

HEIGHT OF MOUNTAIN

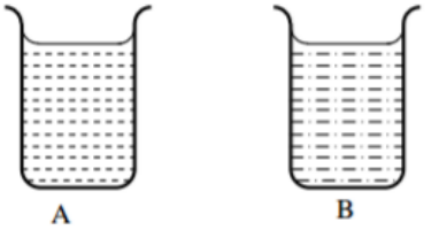
1. The barometric height in a town is 65 cmHg. Given that the standard atmospheric pressure is 76 cmHg and the density of mercury is 13600 kg/m^3, determine the altitude of the town. (Take density of air = 1.25 kg/m^3) *ANS 1196.8 m*
2. A mountain climber with a mercury barometer discovered that the readings of the barometer at the bottom and top of a certain mountain were 750 mmHg and 520 mmHg respectively. Given that the density of air between the bottom and top of the mountain is uniform and equal t 1.25 Kg/m^3, estimate the height of the mountain. (Take the density of mercury to be 1.36 x 10^4 Kg/m^3) *ANS 2502.4 m*
3. The height of mercury column in a barometer is found to be **67 cm** at a certain place. What would be the height on a water barometer in the same place. (Density of water is **1000 kg/m^3** and density of mercury is **13600 kg/m^3**). *Ans 9.112 m*
4. The height of mercury column in a barometer density 13600 kg/ m^{-3}, at a place is 64 cm. What would be the height of a column of paraffin in barometer at the same place. (Density of paraffin = **8.0 x 10^2** kg /m^3). *ANS 10.88 m*
5. The barometric height at sea level is **76 cm** of mercury while that at a point on a highland is **74 cm** of mercury. What is the altitude of the point? *Take g = **10 m/s^2**, density of mercury = **13600 kg/m^3** and density of air as **1.25 kg/m^3**.* *ANS 217.6 m*

ATM PRESSURE

1. Define the term **atmospheric** pressure and give its **SI** units .
2. Explain why it may not be possible to suck a liquid into your mouth using drinking straw on the surface of the moon.
3. A barometer was taken from Mount Kenya to Mombasa .**Explain** the change in mercury level in the barometer.
4. Explain why the sucker sticks on a smooth clean surface.
5. Explain why a partially inflated balloon released at sea level would become fully inflated at a higher altitude.
6. Explain how a drinking straw is used to suck a liquid.
7. Give a reason why water is not a suitable liquid for use in a barometer.
8. State one applications of atmospheric pressure.
9. Explain why high flying aircraft need to be airtight and have pressurized cabins for people.
10. A tin-can is partially filled with water and heated so that the water boils for some time. Explain what happens to the can when closed tightly and allowed to cool.
11. In an experiment to demonstrate atmospheric pressure, a plastic bottle is partially filled with hot water and the bottle is then tightly corked. After some time the bottle starts to get deformed.
    (i) State the purpose of the hot water.
    (ii) State the reason the bottle gets deformed.
12. Explain why a ball point cover has a small hole.

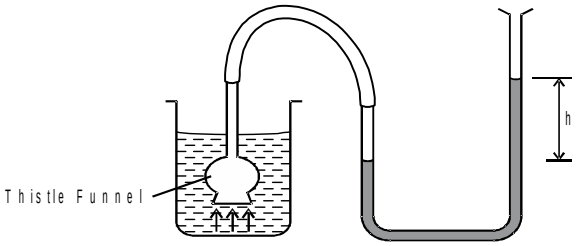
RANDOM QUESTIONS

1. The figure below shows two containers filled with two different liquids to the same height.



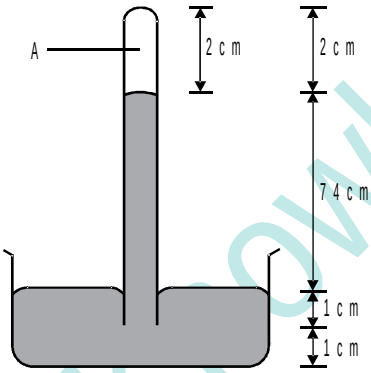
It was found that the pressure at the bottom of A is greater than that at B. Explain (1 Mark)

2. The diagram below shows a set up used by a student to show variation of pressure in a liquid. The thistle funnel is wrapped with an elastic membrane. Use it to answer the question that follow.



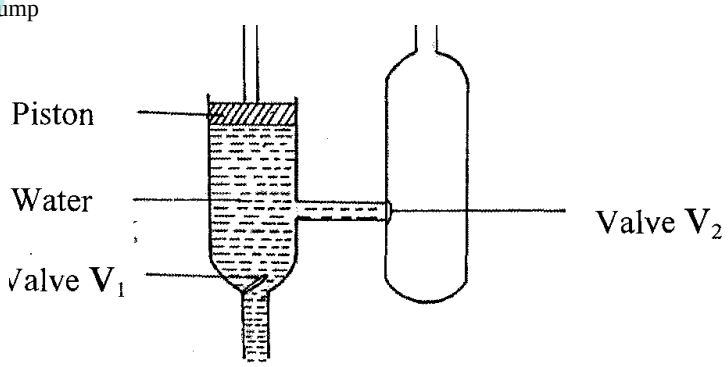
State and explain the effect on the height, h, when the thistle funnel is moved upwards towards the surface of the liquids.

3. Figure below shows a simple barometer.



i) What name is given to region A?
ii) What keeps the mercury in the tube?
iii) What is the value of the atmospheric pressure being shown by the barometer?
iv) What would happen to the reading if the barometer was taken up a high mountain.
v) Give a reason for (iv) above.

4. The figure below shows a force pump

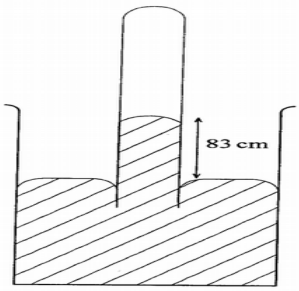


Explain how the water gets past valve V_2

5. State **one** reason why mercury is preferred as a barometric liquid and not water.
6. With the aid of a diagram, describe how a liquid may be siphoned from one container to another using a flexible tube.
7. Explain why a lift pump is unable to raise water from a borehole where the level of water is 20 m below the ground level.
8. For an enclosed system with a liquid, a force is applied at one point.

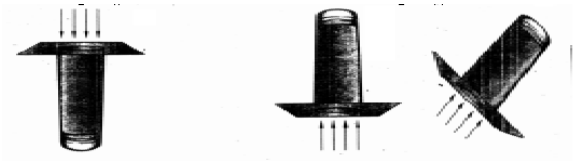
a) Briefly explain how force is transmitted to other parts of the system.
b) State one application of such a system.

9. Explain why it may be difficult to suck a liquid using a drinking straw on the surface of the moon.
10. The figure below shows an instrument used to measure atmospheric pressure.



State with a reason the modification that would be required in a similar set up if mercury were to be replaced with water.

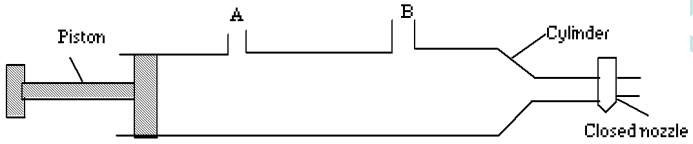
11. The figure below show a glass tumbler filled with water to the brim, a card made of manila paper is then placed on top of a glass tumbler as shown



(i) Tumbler filled with water (ii) Tumbler filled with water

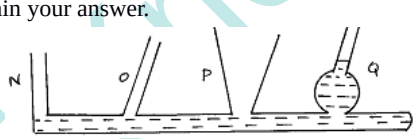
While supporting the card with one hand the glass tumbler is carefully inverted as shown in figure (ii). It is observed that the card remains in place without being support. Explain this observation.

12. The figure below shows a spring full of water. It has two identical holes A and B - drilled along its cylinder. The cylinder's nozzle is closed

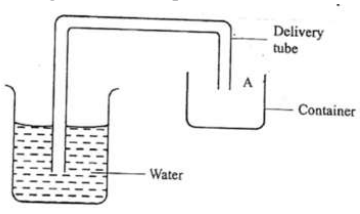


State with a reason how the speed of the jets of water from A and B compared when the piston is pushed into the cylinder

13. The figure below shows water level in limb Q of a glass tube. Indicate the corresponding water levels in limb N, O and P. Explain your answer.

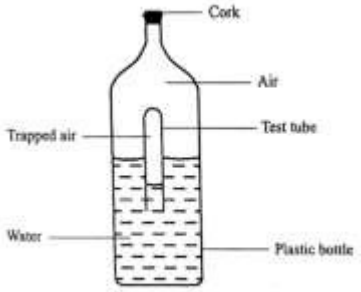


14. a) Figure below shows a setup used by a student to investigate how a siphon works.



(i) State what would be observed when the student sucks the tube at point A and releases it.
(ii) Explain the observation in (a)(i)

b) Figure below shows a test-tube inverted and floating inside a plastic bottle containing some water. The bottle is the sealed.



It is observed that when the sides of the bottle are squeezed, the test-tube sinks. Explain this observation.

15. Figure below shows the scale of a measuring instrument.

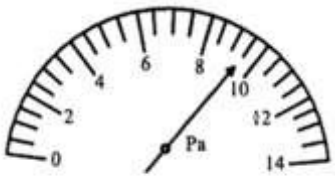


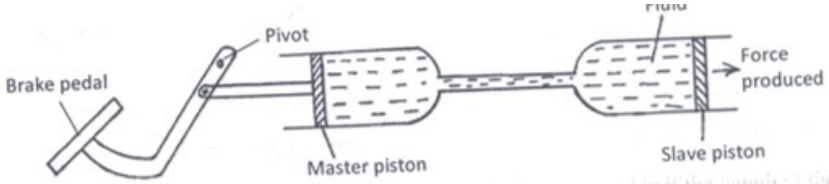
Figure 2

(a) Determine the reading indicated.

(b) State the physical quantity measured by this instrument.

16. State one advantage of hydraulic brakes over mechanical brakes. (1 Mark)

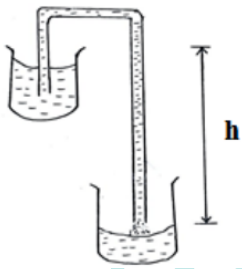
17. Use the information in the figure below which represents hydraulic braking system to answer questions a and b



a) State one property that the fluid should have.

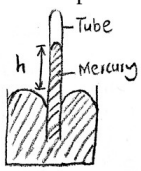
b) Explain briefly how the system operates.

18. Figure below shows a liquid being siphoned from one container to another.



State and give reason what would happen to the flow if the system is placed in a vacuum.

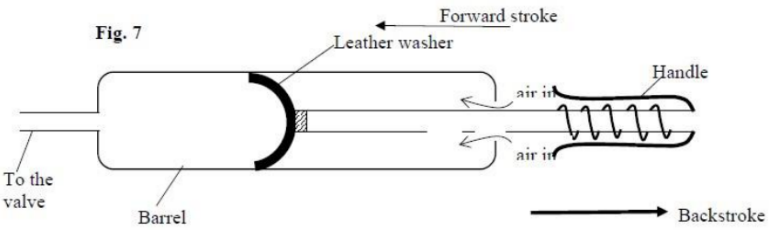
19. a) The figure below shows a simple mercury barometer



i) when the tube was tilted mercury did not fill the tube completely. Give a reason for the observation.

ii) give a reason why mercury is preferred as a liquid in a glass barometer.

20. The bicycle pump shown in Figure 7 below is one of the applications of pressure in gases.



Explain how the leather washer functions during;

(a) Backstroke

(b) Forward stroke

21. State one advantage of force pump over lift pump.

22. Explain how continuous flow of water is maintained in the force pump.