**.**

**PRESSURE IN SOLIDS**

1. Define pressure and state its SI units
2. Ploughing tractors have very wide tyres. Explain why. **(2mk)**
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. (2mk)
5. A block of dimension **0.2m** by **0.1m** by **5cm** has a mass of **500g** and rests on a flat surface. Determine the least pressure that can be exerted by the block on the surface.
6. A box of mass **720kg** is placed on a table. If the area of contact in the table is **1.8m2**. Calculate the pressure it exerts on the table.
7. A metallic block of mass **50kg** exerts a pressure of **10N/m2** on the surface.

 Determine the area of contact between the block and the surface.

1. A block measuring **20cm** by **10cm** by **4cm** rests on a flat surface. The block has a weight of **6N**. Determine:

 **i)** The minimum pressure it exerts on the surface. (2 mk)

 **ii)** The density of the block in kg/m3  (3mk)

1. A block of mass **60kg** measures **6cm** by **5cm** by **4cm**. Calculate
2. The maximum pressure it can exert.
3. The minimum pressure.
4. A man of mass **80kg** exerts a pressure of **200,000Pa** on the ground while standing on both feet.
5. Calculate the area of each foot.

1. How much pressure would be exert if he stands on one foot.
2. a) A woman wearing shoes with sharp pointed heels exerts more pressure

 than an elephant. Explain? (1mks)

b) If the weight of the woman is 600N and her heel have an area of 1.0cm2 each and the elephant has a weight of 30,500N and each feet has an area of 730cm2, Calculate by how much more the woman exerts pressure on the ground than the elephant

1. A pick – up carrying stones weighs **20,000N**. The weight is evenly spread across the four tyres. The area of contact of each tire with the ground is **0.025m2**. Calculate the pressure exerted by each tire on the ground.
2. A pickup of mass **2000kg** has **four** similar tyres. If the pressure exerted by each tyre on the ground is **500,000N/m2**, calculate the area of each tyre in contact with the ground.
3. The total weight of a car with passengers is **30,000N**. The area of contact of each of the FOUR tyres with the ground is **0.015m2**. Determine the minimum car tyre pressure.

**10cm**

**60cm**

**30cm**

The figure below shows a box of mass **360kg** that measures **60cm by 30cm by 10cm**.

 **(i)** Calculate the Maximum pressure it can exert. (**3mk)**

 **(ii)** Minimum pressure it can exert. (**3mk)**

1. The figure below shows a block of wood plank of mass **600kg** and dimension **0.5m** by **0.2m** by **0.3m**

**0.3m**

**0.2m**

**0.5m**

Calculate

* 1. The density of the plank. **(3mk)**
	2. The weight of the plank.  **(1mk**
	3. The minimum pressure it can exert.  **(3mk)**

 **PRESSURE IN LIQUIDS**

1. Name **two** factors that affect pressure in fluids. (**2mks)**

1. State **two** true facts about pressure in liquids. **(2mk)**
2. Other than the density and the depth, state any other factor that affects the pressure of a fluid. (1mk)
3. Water is filled in a tall container with holes **A**, **B** and **C** first closed. Indicate on the diagram how the water jets out from the respective holes when the holes are opened. (2mk)

**A**

**B**

**C**

1. With an appropriate reason, Identify the suitable cross- sectional shape of a dam wall (2mk)

**Water**

**Water**

**Wall**

**(A)**

**(B)**

 Wall:……………………………………………………………………………………………

 Reason:……………………………………………………………………………………………

1. With an appropriate reason, Identify the suitable cross- sectional shape of a dam wall 2mks)

**(A)**

**(B)**

 Wall:

 ……………………………………………………………………………………………

 Reason:

 ……………………………………………………………………………………………

1. Which of the points **A** and **B** in the figure below will experience the greatest pressure given that the height of the liquid in the two containers is the same? Explain (2mk)

***h***

**A**

 **B**

**Pressure**

 **h**

**Water**

**Thistle funnel.**

The diagram below shows a set up used by a student to show variation of pressure in a liquid.

State and explain the effect on the height, **h,** when the thistle funnel is moved upwards towards the surface of the liquid. (2mk)

1. Water dams are built with thicker walls at the bottom than at the top. Explain why. (2mk)
2. Water tanks in houses are erected as high as possible. Explain. (1 mk)
3. Explain why a hole in a ship near the surface is less dangerous than one near the bottom.
4. A drum which is **2m** high contains water to a depth of **0.5 m** and oil of density **0.5g/cm3** extends to the top. Find the pressure exerted at the bottom of drum by the two liquids.
5. The reading of mercury barometer is at **70.0cm**. what is the pressure at the place in N/m2. {Assume density of mercury is **1.36 x 104 kg/m3**} (3mk)
6. A submarine is **30m** below sea water of density **1g/cm3**. if the atmospheric pressure at the place is equivalent to **760mmHg**. Find the total pressure acting on the submarine (Take density of mercury **=13600kg/m3**) **(4mk)**
7. A submarine is **40m** below sea water of density **1020 kg/m3**. If the atmospheric pressure at the place is **103,000Pa**, calculate the total pressure acting on the submarine. (**4mk)**
8. A submarine is **20m** below sea water of density **1000 kg/m3**. If the atmospheric pressure at the place is **102,000Pa**, calculate the total pressure acting on the submarine.
9. A boy is swimming **25m** below water level of density **1g/cm3**. The atmospheric pressure at this place is equivalent to **72cmHg**. Calculate the total pressure on his body in **N/m2** (take **ρ** for mercury = **13600kg)**
10. A water tank of height **4.8m** 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 **2cm2**. The density of water is **1000kg/m3** and the atmospheric pressure =**104,000 Pa**
11. A water tank of height **6m** is 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 **0.5m2**. Take acceleration due to gravity, g = **10m/s2**, the density of water to be **1000kg/m3** and the atmospheric pressure **P=100,000 Pa** (3mks)
12. The height of mercury column in a barometer is found to be **76cm** at a certain place. What would be the height on a water barometer in the same place? (Density of water is **1000kg/m3** and density of mercury is **13600kg/m3**).

1. The height of mercury column in a barometer, at a place is **64cm**. What would be the height of a column of paraffin in the barometer at the same place? (take density of mercury =**13600kgm-3 and** density of paraffin = **800 kg /m3**).
2. A hole of diameter **1.0mm** is made in the side of a water pipe. If the pressure of the flow is maintained at **3.0 x 106 Nm-2**, calculate the force with which the water jets out of the hole. (3mk)
3. A hole of area **200mm2** at the bottom of a tank **4.0m** deep is closed with a cork. Determine the force due to water (Density of water is **1000kg/m3**, and acceleration due to gravity is **10m/s2**
4. The figure below shows a conical flask 15cm high, filled with a liquid of

density 1200kg/m3. The atmospheric pressure of the surrounding is 84,000Pa. determine the pressure at the point marked X at the bottom of the flask. (4mk)

**Point X**

**15 cm**

1. A cube of side 12cm is completely immersed in a liquid of density 800kgm-3 so that the top surface of the cube is horizontal and 20cm below the surface of the liquid as shown in the figure below.

**20cm**

**12cm**

 Calculate the pressure due to the liquid on the cube.

 i) At a depth of 20cm (2mks)

 ii) At a depth of 32cm (2mks)

 iii) Hence calculate the force due to the pressure difference between the top

surface and the bottom of the cube (3mk)

**2.8m**

**Hole**

The figure below shows a cylindrical can filled with a liquid of density **0.8 gcm-3**. A hole of diameter **2.0 cm** is drilled at a depth of **2.8 m** from the top of the can.

 Determine:

  **(i)** The cross-sectional area of the hole. (2mks)

 **(ii)**  The maximum pressure exerted by the liquid at the hole. (2mks)

 **(iii)** The maximum force exerted on a jet of liquid through the hole. (2mks)

1. The figure below shows a tank of height **5m** filled with water and oil which are immiscible. Water has a height of **2m** and a density of **1000kg/m3** while oil has a height of **3m** and a density of **600kg/m3** as shown below. If the atm pressure at the place is **100,000Pa**, calculate the total pressure exerted at the base of the tank.

**2m**

**3m**

**Oil**

**Water**

1. The figure below shows a tank of height **7m** filled with ethanol and oil which are immiscible. Ethanol has a height of **4m** and a density of **0.8g/cm3** while oil has a density of **0.6g/cm3** as shown below. Calculate the pressure exerted at the base of the tank by the two liquids

**4m**

**Oil**

**Ethanol**

 **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. (1mk)
4. Explain why brakes fail in a hydraulic brake system when air gets in to the system. (2mk)
5. Explain why a liquid and not a gas must be used as the ‘fluid’ in a hydraulic

 machine. **(1mk)**

1. The area of larger piston of a hydraulic press is **4m2** and that of the other piston is

 **0.05m2**. A force of **100m** is applied on the smaller piston. How much force is

produced on the larger piston?

1. The areas of the piston of the smaller and larger pistons of a Hydraulic press are **4cm2** and **480cm2**. Calculate the force applied on the smaller piston to raise a load of **8400N** on the larger piston.
2. In a hydraulic machine, the pistons of two connected cylinders have radius of **10cm** and **100cm** respectively. A force of **400N** is applied on the smaller piston. Calculate the force on the larger piston.
3. Figure shows a hydraulic press system. A force of **200N** is applied at the small piston.

**Liquid**

**Area = 180cm2**

**2**

**A Bale**

 **200 N**

**50 cm2**

1. State the principle on which the system operates.
2. Calculate the weight of the Bale supported by the large piston (3mks)
3. Figure shows a hydraulic press system. A force of **60N** is applied at the

**Liquid**

**Area = 300cm2**

**2**

**A Bale**

 **60 N**

**10 cm2**

small piston. Calculate the weight of the Bale supported by the large piston. (3mk)

1. The figure below shows a hydraulic brake system of a car**.** When a force of **200N** is applied on the master cylinder the slave piston experience a force of **8000N**. Calculate the area of the master cylinder.

**Master piston**

**Brake pedal**

**Slave piston**

**400 cm2**

1. The figure below shows two cylinders of different cross-sectional areas

 connected with a tube. The cylinders contain an incompressible fluid and

 are fitted with pistons of cross-sectional areas **4cm2** and **24cm2**.

**Area = 4cm2**

**P**

**Area = 24cm2**

**Q**

**Incompressible fluid**

Opposing forces **P** and **Q** are applied to the pistons such that the pistons do not move. If the pressure of the smaller piston is **5 N cm-2**. Determine force **Q**.(3mk)

1. The figure below shows a hydraulic brake system of a car. When a force of **400N** is applied on the master cylinder the slave piston experience a force of **35,000N**. The master piston has an area of **8cm2**

**Master piston**

**Brake pedal**

**Slave piston**

 Calculate

1. The area of the slave piston. (3mk)
2. The pressure exerted on the master piston. (3mk)
3. Name **two** reasons why **oil** is preferred to **water** as a hydraulic fluid
4. State the principle on which the system operates. (1 mk)

 **(2mk)**

 **U-TUBE**

1. The U-tube below is filled with water and paraffin as shown. If the density of water is **1g/cm3.**

**40 cm**

 **50cm**

**Water**

**Paraffin**

**B**

**A**

 **(i)** What can you say about the pressure at point **A** and **B**.? **(1mk)**

 **(ii)** Calculate the density of paraffin

1. The figure below show a U-tube filled with two liquids**, X** and **Y**. Liquid **X** has a density of **800Kg/m3** while **Y** has a density of **1200Kg/m3**. Determine the height h of liquid.

***h***

**30 cm**

**X**

**Y**

1. The U – tube below is filled with two liquids **A** and **B**. Liquid **B** has a density of **1.6g/cm3**. Calculate the density of liquid **A**.

**50cm**

**20cm**

**A**

**B**

1. The U – tube below is filled with ethanol and mercury. Ethanol has a density of **0.8g/cm3**. Calculate the density of liquid mercury.

**4cm**

**68 cm**

**Ethanol**

**Mercury**

**Mercury**

**80cm**

**h**

**Oil**

**Water**

The figure below show a U-tube filled with water and oil of densities **1000Kg/m3** and **600Kg/m3** respectively. Determine the height **h** of liquid.

**40 cm**

**X**

**Blew here**

Mutunga blew in to one end of a **U-tube** manometer as shown below and the liquid **X** rose up on the other end by **40cm**. If the atmospheric pressure at the place is **103,000 Pa** and the density of liquid **X** is **1200kg/m3**, calculate the pressure of his lungs

1. The figure below shows a u – tube containing two liquids **L1** and **L2** of densities **0.8g/cm3** and **1.8g/cm3** respectively in equilibrium. Given that **h2= 16cm** determine **h1**  (4mk)

**L2**

 **L1**

***h2***

***h1***

1. The figure below shows an open-ended manometer connected to a gas supply.

**Mercury**

**Gas supply**

 **100mm**

 If the mercury barometer reads **760mm**, calculate the pressure of gas in the cylinder (density of water = **1g/cm3**, density of mercury = **13.6g/cm3**) (3mks)

1. The figure below shows a water manometer used to measure the pressure of a cooking gas. Calculate the pressure of the gas? (atm pressure = **1.0 x 105 Pa** Density of liquid **L** = **900g/cm³).**  (3mk)

**Gas supply**

**Liquid L**

**60cm**

1. The figure below shows a mercury manometer of density **13,600kg/m3**.

**Mercury**

**Gas supply**

 **40mm**

If the atm pressure is **760mmHg,**calculate.

1. The pressure of gas in **mmHg.** (2mk)
2. The pressure of gas in **N/m2.** (3mk)
3. Use the Fig below to answer the questions that follow.

**Gas in**

**Mercury**

**56mm**

**A**

**B**

 i) What pressure is acting on point **A**? (1mk)

 ii) What is the value of pressure difference in the instrument reading.

 (1mk)

 iii) If the atmospheric pressure is **760mmHg**. What is the value of gas pressure?

 (2mks)

1. The figure below shows a water manometer used to measure the pressure of a cooking gas. By how much is pressure of the gas above atmosphere pressure? (Density of mercury = 13.6g / cm³). (3mk)

**Gas supply**

**Mercury**

**60cm**

**40cm**

1. The fig below shows air trapped in a J shaped tube. What is the pressure exerted on the trapped air? ( Density of mercury **13600Kg/m3** atmospheric pressure is **1.0 x 105 pa**) Give your answer in Pascal(2mks)

**Mercury**

**80cm**

**Trapped air**

**13.** The figure below shows some air trapped by mercury in a glass tube. The tube is inverted in a dish containing mercury.

**Trapped air**

**Mercury**

**600 mmHg**

Given that the atmospheric pressure is **760 mmHg** and the height of mercury column in the tube is **600mm**, determine the pressure of the trapped air

1. The pressure of the trapped air in **mmHg.**
2. The pressure of the trapped air in **Pascal**
3. If the atmospheric pressure is 760mmHg. Calculate the pressure in Pascal’s of the trapped air in the tube shown below. (Density of mercury = 13.6g / cm³). (3mk)

**Mercury**

**300mm**

**60mm**

**Trapped air**

1. The figure below shows an open and closed tube manometer connected at different times, to same gas cylinder. Assuming no loss in pressure from the gas cylinder, **calculate** the value of h **(Take atmospheric pressure =1.0×105Pa , density of mercury =13600kg/m3 and acceleration due to gravity =10N/kg )**  (3mks)

**20cm**

**Open manometer**

**Gas cylinder**

**Closed manometer**

**Gas cylinder**

***h***

**Vacuum**

1. The figure below shows Hare’s apparatus used for comparing liquid densities.

**Suck**

**Water**

**30cm**

**25 cm**

**Liquid X**

Calculate the density of liquid **X** given that density of water is **1000kgm-3**.(2mk)

**Tap**

**Liquid A**

**24cm**

**20 cm**

**Liquid B**

**Figure 3** shows the levels of two liquids **A** and **B** after some air has been sucked out of the tubes through the tap. If the density of liquid **B** is **1.2g/cm3**, find the density of liquid **A**

1. The figure below shows a u – tube containing two liquids **L1** and **L2** of densities **0.8g/cm3** and **0.5g/cm3** respectively floating on a water surface. If the system is in equilibrium, determine the ratio **h1: h2**  (3mks)

**L2**

**L1**

**Water**

***h2***

***h1***

**HEIGHT OF MOUNTAIN**

1. The barometric height in a town is 65cmHg. Given that the standard atmospheric
pressure is 76cmHg and the density of mercury is 13600kg/m3, determine the altitude of
the town. (Take density of air = 1.25kg/m3) (3mks
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 750mmHg and

520mmHg respectively. Given that the density of air between the bottom and top

of the mountain is uniform and equal to 1.25 Kg/m3, estimate the height of the mountain. (Take the density of mercury to be 1.36 x 104 Kg/m3) (3mk)

1. The height of mercury column in a barometer is found to be **67cm** at a certain place. What would be the height on a water barometer in the same place. (Density of water is **1000kg/m3** and density of mercury is **13600kg/m3**). ( 3mk)
2. The height of mercury column in a barometer density 13600kg/ m-3, at a place is 64cm. What would be the height of a column of paraffin in barometer at the same place. (Density of paraffin = **8.0 x 102** kg /m3). (3mks)
3. The barometric height at sea level is **76cm** of mercury while that at a point on a highland is **74cm** of mercury. What is the altitude of the point? *Take g =* ***10m/s2****, density of mercury =* ***13600 Kg/m3*** *and density of air as* ***1.25Kg/m3****.*

(3mk)

**ATM PRESSURE**

1. Define the term **atmospheric** pressure and give its **SI** units (2mk)
2. Explain why it may not be possible to suck a liquid into your mouth using drinking straw on the surface of the moon. (1mk)
3. A barometer was taken from Mount Kenya to Mombasa .**Explain** the change in mercury level in the barometer. (2mk)
4. A glass is filled with water to the brim and a cardboard placed on top. The glass is then inverted as shown.

**Glass**

**Cardboard**

**Water**

 Explain why the cardboard does not fall down.

1. The figure shows a rubber sucker.

**Rubber sucker**

**Smooth surface**

 Explain why the sucker sticks on a smooth clean surface (2mk

1. Explain why a partially inflated balloon released at sea level would become fully inflated at a higher altitude
2. Explain how a drinking straw is used to suck a liquid (3mk)
3. Give a reason why water is not a suitable liquid for use in a barometer **(1mk)**
4. State one applications of atmospheric pressure. (1mk)
5. Explain why high flying aircraft need to be airtight and have pressurized cabins for people.
6. 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. (2mks)
7. 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. (1mk)

 (ii) State the reason the bottle gets deformed (2mk)

 (iii) Explain your answer in e (ii) (2mk)

**Trapped air**

**Trapped water**

**Plastic bottle**

**AIR**

The figure shows an inverted test tube which floats in water enclosed in a plastic bottle.

When the sides of the plastic bottle are squeezed, explain what would be observed. (3 mks)

1. A simple barometer is steadily slanted from vertical position. What happens if there is little air in the space above the mercury? (1mk)

**A**

**Mercury**

**760mm**

The **figure** below represents a mercury barometer at sea level..

 (i) **What** is the name of the part labelled **A**? (1mk)

 (ii) **What** will happen to the barometric height if the barometer is taken to a place of higher altitude.? (1mk)

 (iii) **Give** a reason for your answer in (ii) above. (1mk)

1. Explain why a ball point cover has a small hole
2. The liquid to be transferred has to be at a higher level than the other container where it is being emptied.
3. Three identical tubes containing mercury were inverted as shown.

**X**

**Mercury**

**760cm**

**A**

**B**

**C**

 **(i)** Indicate on the diagram above the levels of mercury in tube B and C.(1 mk)

 **(ii)** Explain the effect on the level of mercury in tube A if region X is filled with some air.

1. The figure below shows petrol being siphoned from container (**a)** to **(b)**

**(b)**

**(a)**

**Tube**

**Water**

 State when the liquid will stop flowing through the pipe. Explain your answer.

1. (i) Indicate on the figure below, the direction of flow of the liquid. (1mk)

**A**

**B**

ii) Explain what would happen to the flow of the system in the figure above if it was put in a vacuum (2mks)

1. One of the applications of pressure in liquids and gases is the lift pump. The pump is more effective in pumping water if the well is less than 10m at sea level. Explain. (2mks)
2. Explain why;

(i) It is difficult to remove the lid from a preserving jar which was closed when the space above the food was full of steam (2 mks)

(ii) A force pump must be used instead of a lift pump to raise water from a deep well over 10m (2 mks)

1. The figure below shows a lift pump used to draw water from a borehole

**Storage tank**

**Water**

**Piston**

**Barrel**

**Valve2**

**Valve1**

 **(i)** Describe briefly how the lift pump works in order to lift water from the borehole

 **(4mk)**

 **(ii)** State two advantages of a force pump over a lift pump (**2mks)**

1. The figure below shows a force pump used to draw water from a borehole

**Chamber C**

**Water**

**Piston**

**Barrel**

**Valve2**

**Valve1**

**Pa**

**Pa**

 **(i)** Describe briefly how the force pump works in order to draw water from the borehole **(4mk)**

 **(ii)** State two advantages of a force pump over a lift pump

1. The figure below shows a force pump

 **100mm**

**Piston**

**Water**

**Valve V1**

**Valve V2**

 **Explain** how the water gets past valve V2  (2mks)

1. The table below shows valves of pressure P in fresh water at different depth.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pressure P (kPa)** | **110** | **140** | **180** | **200** | **220** |
| **Depth h (m)** | **1** | **4** | **8** | **10** | **12.2** |

 (i) On the grid provided, plot a graph of pressure (y-axis) against depth (x-axis) (5mk)

 (ii) Given that the **equation P = Pa + pgh**, determine from the graph.

 (iii) The value of **Pa** (1 mk)

 ***SCHEEM***

1. The figure shows an inverted test tube which floats in water enclosed in a plastic bottle.

**Trapped air**

**Trapped water**

**Plastic bottle**

**AIR**

When the sides of the plastic bottle are squeezed, explain what would be observed. (3 mks)

***ANS Test tube sink ;Pressure is increased on squeezing ; forcing more water into the test tube the weight of the test tube and water exceeds upthrust and sink ;***