Q.1 State the kinetic molecular model of matter?
A. The main points of kinetic molecular model are:
   (i) Every matter is composed of extremely small particles called atoms or molecules.
   (ii) These atoms or molecules in a substance are hold together by the intermolecular attractive forces.
   (iii) The atoms or molecules of the matter are in continuous motion and possess kinetic energy.
   (iv) The motion of atoms or molecules of the matter may be translation, rotation or vibrational.

Q.2 Write the distinct properties of each of the three states of matter?
A. According to the kinetic molecular model, the three states of matter can be explained as;
   **Solids**
   (1) The molecules of the solids are very close to each other.
   (2) The molecules of the solids can slightly vibrate.
   (3) The attractive forces between the molecules of a solid are stronger.
   (4) Solids have definite shape and definite volume.
   **Liquids**
   (1) The molecules of the liquids are close to each other.
   (2) The molecules of the liquids can translate and vibrate.
   (3) The attractive forces between the molecules of the liquids are strong.
   (4) Liquids have definite volume and variable shape.
   **Gases**
   (1) The molecules of the gases are at larger distance from each other.
   (2) The molecules of the gases can move randomly.
   (3) The attractive forces between the molecules of the gases are negligible.
   (4) Gases have variable volume and variable shape.

Q.3 Define density and explain it?
A. **Density**
   It can be define as "Mass per unit volume of a body is called density." It is denoted by a Greek letter Rho “ρ”. It is a scalar quantity.
   **Explaination**
   Consider a body of mass “m” has a volume “v”. Then density can be defined as;
The SI unit of density is kg/m³.

Table of some common materials and their densities.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Density in (Kg/m³)</th>
<th>Materials</th>
<th>Density in (Kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>1.21</td>
<td>Water</td>
<td>1000</td>
</tr>
<tr>
<td>Ice</td>
<td>920</td>
<td>Cork</td>
<td>250</td>
</tr>
<tr>
<td>Wood</td>
<td>650</td>
<td>Steel</td>
<td>7900</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2700</td>
<td>Copper</td>
<td>8940</td>
</tr>
<tr>
<td>Lead</td>
<td>11350</td>
<td>Gold</td>
<td>19320</td>
</tr>
<tr>
<td>Oil</td>
<td>880</td>
<td>Mercury</td>
<td>13600</td>
</tr>
</tbody>
</table>

Q.4 Define pressure and its unit?

A. **Pressure**
   The normal force applied per unit area is called pressure. It is denoted by “P”. Mathematically
   \[
P = \frac{F}{A}
   \]
   The SI unit of pressure is called Pascal (pa).

**Pascal**
It can be define as “when one Newton force acts on a body of area one meter square, then the pressure is one Pascal.” Mathematically
\[
1Pa = \frac{1N}{1m^2}
\]

Q.5 Write a note on atmospheric pressure?

A. **Atmospheric pressure**
A thick layer of gases (air) surrounds the earth, which is called atmosphere. We live at the bottom of a deep ocean of gases, which exert a great pressure on our bodies. This pressure is called atmospheric pressure which is approximately equal to 10⁵Pa. this atmospheric pressure is called one atmosphere or one bar. Mathematically
\[
1\text{Atmosphere} = 1\text{bar} = 10^5\text{Pa}
\]
Q.6 What is Barometer? Describe a simple Mercury Barometer.

A. **Barometer**
   A device used to measure the atmospheric pressure is called Barometer.

**Simple Mercury Barometer**
It consists of a long glass tube sealed at one end. The open end of the tube is dipped in a dish of Mercury. The atmospheric pressure on the Mercury in the dish keeps the column up in the tube. The sea level atmospheric pressure is 760mm or 76cm of Mercury column. Greater the pressure greater will be the column and vice versa.

(FIGURE)

Q.7 What is Pascal’s principle? Describe its one practical application.

A. **Pascal’s principle**
   This principle states that “whenever an external pressure is applied on a liquid, the pressure is transmitted equally to every point of the liquid in all directions.”

**Practical applications of Pascal’s principle are:**
(i) Hydraulic lift  (ii) Hydraulic brake  (iii) Hydraulic press

**Hydraulic lift system**
It consists of a narrow cylinder “A” connected to a larger cylinder “B” filled with an incompressible liquid. When pressure is applied on the piston of cylinder "A", this pressure is transmitted to cylinder "B" equally by Pascal's principle and piston of cylinder “B” moves upward. A platform is made at
Q.8  **State and explain pressure in liquids?**

A. **Pressure**

The normal force applied per unit area is called pressure. Mathematically

\[ P = \frac{F}{A} \]  

(1)

Consider we have a liquid of mass “m”, density “\( \rho \)”, and volume “V” in a container. The liquid exert a normal force on the bottom of the container equal to its weight. The height of the liquid in the container is “h”.

\[ F = mg \]  

(1)

Putting the value of “F” in equation (1) we get

\[ P = \frac{mg}{A} \]  

(2)

We also know that

\[ \rho = \frac{m}{V} \]

\[ m = \rho V \]

Putting the value of “m” in equation (2) we get

\[ P = \frac{\rho V g}{A} \]

Since \( V = A \times h \)

\[ P = \frac{\rho A h g}{A} \]

\[ P = \rho g h \]

Q.9  **State and explain Archimedes principle?**

A. **Archimedes principle**

This principle state that "whenever a body is immersed wholly or partially in a fluid, the body will experiences an upward buoyant force (Upthrust) equal to the weight of fluid displaced." Mathematically
\[ F_b = \text{weight of fluid displaced} \]
\[ F_b = W \]

**Explanation**

When we immersed a body in a fluid (liquid), then two forces acts on the body i.e. weight of the body "W" acting vertically downward and the upward buoyant force "\( F_b \)". If \( F_b < W \) then the body will sink, if \( F_b \geq W \) then the body will float on the surface of the liquid.

**Q.10** Define elasticity with an example?

**A. Elasticity**
The property of a body due to which it resist deformation or regains its original shape after the removal of deforming force.

**For example**
When we stretch a rubber band, its size increases but after the removal of force, the rubber band get their original shape.

**Q.11** State and explain Hook’s law?

**A. Hook’s law**
This law states that “Under elastic limit the extension or compression produce in a spring is directly proportional to the applied force.”

**Explanation**
Consider that a spring is connected with a firm support at its one end. A force “\( F \)”is applied on the other end of the spring to produce an extension “\( x \)”. Mathematically

\[ F \propto x \]
\[ F = \text{constant (x)} \]
\[ F = kx \]

Where \( k \) is constant of proportionality and is known as spring constant. Its unit is Nm\(^{-1}\) (N/m). \( k \) depends upon the nature of the spring.

**Q.12** Define stress and strain?

**A. STRESS**
The applied force per unit area that produces deformation in a body is called stress. It is denoted by a Greek letter “\( \sigma \)”. Mathematically

\[ \text{Stress} = \frac{\text{Force}}{\text{Area}} \]
\[ \sigma = \frac{F}{A} \]

The SI unit of stress is N/m\(^2\) OR (Nm\(^{-2}\)).
STRAIN
The deformation produced in a body due to stress is called strain.
Consider a wire has an initial length “L". After the applied deforming force, the length of the wire change to an amount “ΔL". Then the linear strain can be defined as “the change in length per unit original length is called linear strain". It is denoted by a Greek letter Epsilon “ε". Mathematically

\[ \varepsilon = \frac{\Delta L}{L} \]

Strain has no unit, because it is the ratio of two similar quantities.

Q.13 What is meant by Young’s Modulus or Modulus of elasticity?
A. Young’s Modulus
The ratio of the tensile stress to the linear strain is called young’s modulus or modulus of elasticity. Mathematically

\[ \text{Young's modulus} = \frac{\text{Stress}}{\text{Strain}} \]

\[ Y = \frac{\sigma}{\varepsilon} \]

\[ Y = \frac{FL}{A\Delta L} \]

The SI unit of Young’s modulus is N/m^2 OR (Nm^{-2}).

Q.14 Write a note on vacuum cleaner?
A. Vacuum cleaner
It is a device used to clean a carpet or room from dust particles. When a vacuum cleaner is switch on, the fans in it start rotation. The fan force air forward to the exhaust part. When the air particles are driven forward the density of particles increases which increase pressure in front of the fan. But the pressure behind the fan drops as a result the dust particles move from high pressure to low pressure in the vacuum cleaner. In this way dust is removed from the carpet.
Conceptual questions

1. **Why is the cutting edges of the knife made very thin?**
   A. The cutting edges of the knife are made thin to decrease area. When the area decreases for a given pressure, its force for cutting things increases and vice versa.

2. **State two applications of atmospheric pressure used at home.**
   A. The two applications of atmospheric pressure used at home are:
   (i) **Sucking through a straw**
       The atmospheric pressure acting on the surface of the liquid is greater than the pressure in the mouth. Therefore it is forced to raised in the straw into the mouth.
   (ii) **Syringe**
       It is used to draw liquid. The piston of the syringe is drawn back upward to decrease pressure within the cylinder. Atmospheric pressure acting on the surface of the liquid drives it into the cylinder.

3. **Why we can not use water instead of mercury in a barometer?**
   A. Mercury is used in barometer because
   (i) It does not stick with the glass walls of the tube while water stick.
   (ii) The expansion produce in mercury due to pressure is uniform where that of water is not uniform.

4. **What is the unit for the pressure in weather maps?**
   A. The unit of pressure in weather maps is milli bar. Mathematically
   
   \[ 1000 \text{ milli bar} = 1 \text{bar} \]

5. **Why miners in mines face breathing problems?**
   A. Mines are present at great depth. Therefore miners face breathing problems in mines due to high pressure.

6. **What is the basic principle of hydraulic press?**
   A. A hydraulic press works on the principle of Pascal's law. It state that "whenever an external pressure is applied on a liquid, the pressure is transmitted equally to every point of the liquid in all directions."

7. **Why water tanks are constructed at the highest level in our houses?**
   A. The velocity gained by the water falling under the action of gravity depends upon the height. Therefore the water tanks are constructed at the highest level in our houses, so that the water flows faster to washroom etc.
8. Why a small needle sinks in water and a huge ship travel easily in water without sinking?
A. The upthrust acting on the needle is less than the weight of the needle. While the upthrust acting on the ship is greater than the weight of the ship. Therefore a small needle sinks in water but a huge ship floats.

9. Which material is more elastic, steel or rubber and why?
A. Steel is more elastic than rubber. Because steel produce more resistance against the deformation than rubber. So more deforming force is required to deform steel. While rubber can be easily deform.

10. Walnuts can be broken in the hand by squeezing two together but not one. Why?
A. When two walnuts are placed in hand, the area of the palm of hand is greater than the area of surfaces of walnuts in contact. When pressure is provided to squeeze these walnuts together, the pressure between the surfaces in contact increases which causes the walnuts to break.

11. Explain how and why camels have adapted to allow them to walk more easily in desert conditions?
A. The camel is called ship of the desert. It has a hump for storing food and long powerful legs to carry load for long distances in the desert. It can move faster on sand due to its large surface area of its toe which exert less pressure on sand and do not sink in sand.

**Numerical questions**

1. The atmospheric pressure is 100kPa. What is the force exerted by the atmosphere on a rectangular surface that measure 0.5m to 0.4m?

   **Given data**
   \[ P = 100 \text{kPa} = 100 \times 10^3 \text{Pa} \]
   \[ L = 0.5 \text{m} \]
   \[ B = 0.4 \text{m} \]
   \[ F = ? \]

   **We know that**
   \[ P = \frac{F}{A} \]
   \[ F = PA \]

   **As**
   \[ A = L \times B = 0.5 \times 0.4 = 0.20 \text{m}^2 \]
   \[ F = 100 \times 10^3 \times 0.20 \]
   \[ F = 20 \times 10^3 \text{N} \]
   \[ F = 20 \text{kN} \]
2. What is the height of a column of turpentine oil that would exert the same pressure as 5cm of mercury? Density of mercury is 13600Kg/m³ and the density of turpentine oil is 840Kg/m³.

**Given data**
- Height of mercury = $h_1 = 5\text{cm}$
- Density of mercury = $\rho_1 = 13600\text{Kg/m}^3$
- Height of turpentine = $h_2 =$?
- Density of turpentine = $\rho_2 = 840\text{Kg/m}^3$
- Gravitation acceleration = $g = 9.8\text{m/s}^2$
- Pressure of mercury = pressure of turpentine

**Solution**

\[ \rho_1 gh_1 = \rho_2 gh_2 \]

\[ h_2 = \frac{\rho_1 h_1}{\rho_2} \]

\[ h_2 = \frac{13600 \times 5\text{cm}}{840} \]

\[ h_2 = 80.95\text{cm} \]

3. A rectangular glass block of dimensions 30cm by 5cm by 10cm weighs 37.5N. Calculate the least and the greatest pressure it can exert when resting on a horizontal table?

**Given data**
- Length = $L = 30\text{cm} = 0.30\text{m}$
- Width = $B = 10\text{cm} = 0.10\text{m}$
- Thickness = $h = 5\text{cm} = 0.05\text{cm}$
- Weight = $W = 37.5\text{N}$

**Solution**

We know that

\[ P = \frac{F}{A} \quad \text{----------- (1)} \]

Area for least pressure is given as;

\[ A = L \times B = 0.30 \times 0.10 = 0.03\text{m}^2 \]

To find least pressure

\[ P = \frac{W}{A} = \frac{37.5}{0.03} \]

\[ P = 1250\text{Pa} \]

Area for greatest pressure is given as;

\[ A = B \times h = 0.10 \times 0.5 = 0.005\text{m}^2 \]

To find the greatest pressure

\[ P = \frac{W}{A} = \frac{37.5}{0.005} \]

\[ P = 7500\text{Pa} \]
4. Calculate the pressure at a depth of 100m of water. Take g=10m/s^2

Given data
\[ h = 100m \]
\[ g = 10m/s^2 \]
\[ \rho = 1000Kg/m^3 \]
\[ P = ? \]
\[ P = \rho gh \]
\[ P = 1000 \times 10 \times 100 \]
\[ P = 1000000 \]
\[ P = 10^6 Pa \]

5. In hydraulic press, the area of the load piston is ten times the area of the effort piston. How much load can be lift with it by applying a force of 100N on effort piston?

Given data
Suppose area of effort piston = \( A_1 \)
So area of load piston = \( A_2 = 10A_1 \)
Force on effort piston = \( F_1 = 100N \)
Amount of load lifted = \( F_2 = ? \)

According to Pascal's principle

\[ F_1 = F_2 \]
\[ \frac{F_1}{A_1} = \frac{F_2}{A_2} \]
\[ F_2 = \frac{F_1A_2}{A_1} \]
\[ F_2 = \frac{100 \times 10A_1}{A_1} \]
\[ F_2 = 1000N \]

6. Calculate the extension in wire of force constant 2000N/m, when a force of 200N is applied on it with in elastic limit.

Given data
\[ F = 200N \]
\[ K = 2000N/m \]
\[ x = ? \]

According to Hooks law;

\[ F = Kx \]
\[ x = \frac{F}{K} \]
\[ x = \frac{200}{2000} \]
\[ x = 0.1m \]
7. An elastic wire of length 2m and cross-sectional area 0.02m$^2$ is stretched 0.10m by a 300N force. Calculate the young’s modulus of the material.

**Given data**
- $L = 2m$
- $A = 0.02m^2$
- $\Delta L = 0.10m$
- $F = 300N$
- $Y = ?$

**We know that**

$$Y = \frac{FL}{A\Delta L}$$

$$Y = \frac{300 \times 2}{0.02 \times 0.10}$$

$$Y = 300000$$

$$Y = 3 \times 10^5 \text{ N/m}^2$$