Crystalline solids: - A crystalline solid is that in which there is regular and repeated arrangement of atoms or molecules in 3 dimensions.

Amorphous Solids: - Am amorphous solid is that which has random but rigid arrangement of atoms.

Elasticity: - The property of a body by virtue of which it regains its original shape or size when the deforming forces acting on it are removed, is called elasticity.

Plasticity: - The inability of a body to return to its original shape and size, when the deforming forces are removed, is called plasticity.

Stress (σ): - The restoring force acting per unit are of the surface when a deforming force is applied is called stress. The unit is Nm^{-2}.

Strain: - The fraction change produced in the body as a result of deforming force is called strain.

Hooke's Law: - Within the elastic limit the strain produced in a body id directly proportional to stress acting on it.

Mathematically,

Stress $\propto$ strain

$$\frac{Stress}{Strain} = Cons\tan t$$

Young's Modulus: - The ratio of stress to the longitudinal strain is called Young's modulus of elasticity (Y).

$$Y = \frac{Fl}{a\Delta l}$$

Bulk Modulus: - The ratio of hydrostatic stress to volume strain is called Bulk Modulus of elasticity (B).

$$B = -\frac{\Delta PV}{\Delta V}$$

Rigidity Modulus: - The ratio of stearing stress to stearing strain Is called rigidity modulus (η)

$$\eta = \frac{F}{a\theta}$$

Elastic Limit: - The maximum value of stress when permanent deformation begins to occur is called elastic limit.

Ductile materials: - Those material in which there is a large gap between the elastic limit and the breaking point are called ductile limit.

Brittle materials: - Those materials in which the breaking point is very close to the elastic limits are called brittle limits.

Elastomers: - The materials which can be pulled to several times their original length and still return to their original value after the removal of deforming force are called elastomers.
Elastic Fatigue: - The loss of elastic strength of the material due to repeated alternating stress to which the material is objected is called elastic fatigue.

Fluid: - The term fluid refers to a substance that can flow and does not have shape of its own e.g: liquid and gases.

Mathematically:

$$\text{Pressure} = \frac{Force}{Area}$$

In S.I, the unit of pressure is Nm^{-2} or Pascals (Pa).

Pascal's Law: - Pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and the walls of the containing vessel.

Atmospheric Pressure: - Air has weight owing to its weight, the atmosphere exerts a pressure at the surface of earth of approximately $100,00Nm^{-2}$
(or 100kPa)

Archimedes's Principle: - When a body is immersed in a fluid, the fluid exerts an upward force on the body equal to the weight of the fluid that is displaced.

Law of floatation: - It states that a body will float, if the weight of liquid displaced by the immersed part is atleast equal or greater than the weight of the body.

Surface Tension (T): - The property of a liquid at rest by virtue of which its free surface behave like a stretched membrane with a tendency to contract to a minimum area is called surface tension.
Surface Tension may be defined as the force acting per unit length on either side of imaginary line drawn on the liquid surface .Units: - In S.I., the unit is Nm^{-1}.

Force of cohesion: -The force of attraction between the molecules of the same substance is called force of cohesion.

Force of adhesion: - The force of attraction between the molecules of the different substance is called force of adhesion.

Surface energy: - The amount of work done per unit area in increasing the surface area of a liquid film is called surface energy.

Angle of contact: - The angle, which the tangent to the liquid surface at the point of contact makes with the solid surface inside the liquid is called angle of contact.

Excess pressure inside a liquid drop (or air bubble in a liquid): - It is given by

$$p_t - p_0 = 2T/R$$

Excess pressure inside a liquid bubble (or soap bubble): - It Is given by

$$p_t - p_0 = 4T/r$$

Capillarity: - The phenomenon of the rise and fall of liquid in a capillary tube is called capillarity.
Effect of temperature on surface tension: - Surface tension decreases with increase in temperature of liquid.

Viscosity: - The property of fluid by virtue of which an opposing force (internal friction) comes into play, whenever there is a relative motion in between the different layers of the fluid is called viscosity.

Velocity gradient: - The change of velocity of a liquid layer with distance from the solid surface is called velocity gradient.

Coefficient of viscosity: - Coefficient of viscosity of a liquid is defined as the viscous dragging force, which maintains a unit velocity gradient between 2 parallel layers each of unit area.

Stoke's Law: - The backwards dragging force acting on a small sphere of radius r moving with a uniform velocity v through a medium of coefficient of viscosity η is given by

$F = 6\pi\eta rv.$

Streamline Flow: -The flow of liquid in which each particle of the liquid follows the path of its proceeding particles with exactly the same velocity is called streamline flow.

Turbulent Flow: - The flow of a liquid in which all the particles of the fluid crossing a given point is not same is called Turbulent flow.

Reynolds's number: - If a liquid of density ρ, coefficient of viscosity η and flowing through a tube of diameter D, then Reynold's number is given by, $v_c = \frac{N_R \eta}{\rho D}$

Ideal Liquid: - A liquid which is incompressible, non-viscous and isotropic is called an ideal point.
Equation of continuity: - It expresses the law of conservation of mass in fluid dynamics. It states that if there is no source or sink of the fluid along the length of the pipe, the mass of the fluid crossing any section of the pipe per second is always constant.

Bernoulli's Theorem: - It states that for an ideal fluid having streamline flow the sum of pressure energy, kinetic energy and potential energy is always constant.

Mathematically : $P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$

Or

$P_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$

Thermal expansion

Coefficient of linear expansion: -it is defines as the increase in length per unit rise in temperature of the body. $\beta = \frac{\Delta S}{S(\Delta T)}$

Coefficient of volume expansion: - It is defined as the increase in surface per unit area of a body of 1 degree rise in temperature. $\gamma = \frac{\Delta V}{V(\Delta T)}$

Coefficient of volume expansion: - It is defined as the increase in volume per unit volume of a body of 1degree rise in temperature. $\gamma = \frac{\Delta V}{V(\Delta T)}$

.

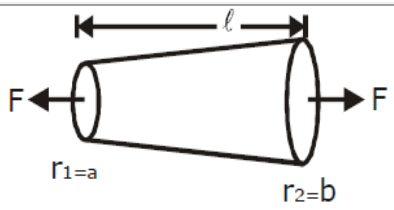
S.No.	Question Details		Marks
	MCQ		
1.	Stress is		**1**
	(a) total applied force	(b) force per unit length	
	(c) restoring force per unit area	(d) three-point average of forces	
2.	Elasticity is the property of a body, by virtue of which		**1**
	(a) it is distorted or stretches without the application of force	(b) it changes size and shape when the force is applied and stays in that shape when applied force is removed	
	(c) it remains in original size and shape when the force is applied	(d) it tends to regain its original size and shape when the applied force is removed	
3.	According to Hooke's law		**1**
	a) For small deformations the stress and strain are proportional to each other	b) For small deformations the stress is proportional to square of strain	
	c) For small deformations the stress and strain are inversely proportional to each other	d) For large deformations the stress and strain are proportional to each other.	
4.	At large flow velocities the flow of a fluid becomes		**1**
	(a) viscous	(b) turbulent	
	(b) compressible	(d) laminar	
5.	In a hydraulic lift the force applied on the smaller cylinder of area A_1 is F_1. If the area of the larger cylinder is A_2 the maximum weight that can be lifted is		**1**
	(a) F_1	(b) $\frac{A1}{A2}\ F1$	
	(c) F1A2	(d) $\frac{A2}{A1}\ F1$	
6.	Which one of the following statements is correct for a fluid passing through the narrow part of nonuniform pipe?		**1**
	(a) its velocity decreases but its pressure increases	(b) its velocity and pressure both increase	
	(c) its velocity increases but its pressure Decreases.	(d) its velocity and pressure both decrease	
7.	A capillary tube remains dipped in a water container, so that loss in weight of the capillary tube is		**1**
	(a) half of the buoyant force	(b) less than the upward buoyant force	

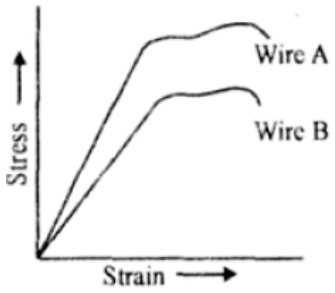
	(c) equal to the upward buoyant force	**(d)** more than the upward buoyant force	
8.	A boy is carrying a bucket of water in one hand with a 0.05 kg cork piece in it. After some time he takes out the cork piece and holds it in the other hand. The boy will carry		**1**
	(a) Same load as before	(b) Less load than before	
	(c) More load than before	(d) Either less or more load depending on the density of plastic	
9.	The Celsius temperature at absolute zero is equal to		**1**
	a) 273^oC	b) - 273^oC	
	c) - 100^oC	d) 100^0C	
10.	In general, when a solid is heated, it		**1**
	a) contracts proportionally to the change in temperature	b) contracts inversely proportionally to the change in temperature	
	c) expands inversely proportionally to the change in temperature	d) expands proportionally to the change in temperature.	
11.	When the adhesive force in the case of liquid and glass is greater than the cohesive forces between the liquid molecules, the shape of the meniscus of liquid in a capillary tube is?		**1**
	(a) Plane	(b) Circular	
	c) Convex	d) Concave	
12.	In laminar flow		**1**
	a) adjacent layers of fluid move in circle crossing each other each other and the flow is steady	b) adjacent layers of fluid do not slide smoothly past each other and the flow is unsteady	
	c) adjacent layers of fluid slide smoothly past each other and the flow is steady	d) adjacent layers of fluid slide smoothly past each other and the flow is unsteady	
13.	A body cools from 80^oC to 50^oC in 5 minutes. Calculate the time it takes to cool from 60^oC to 30^oC. The temperature of the surroundings is 20^0C.		**1**
	(a) 12 min	(b) 9 min	
	(c) 15 min	(d) 6 min	
14.	A washer consists of a 3.00 cm diameter circle of sheet metal with a 1.00 cm diameter circular hole in the middle. If the metal washer is heated until the diameter of the washer is 3.03 cm, then the diameter of the hole will be		**1**

	a) 1.01 cm	b) 0.97 cm	
	c) 0.98 cm	d) 1.00 cm	
15	The unit of surface tension in S.I units is given by		**1**
	a) dynes per cm	b) dynes per cm^2	
	c) Newtons per $meter^2$	d) Newton per meter	
16	Assertion (A) : Lead is more elastic than rubber. Reason (R) : If the same load is attached to lead and rubber wires of the same cross-sectional area, the strain of lead is very much less than that of rubber.		**1**
	a. Assertion is correct, reason is correct; reason is a correct explanation for assertion.	b. Assertion is correct, reason is correct; reason is not a correct explanation for assertion	
	c. Assertion is correct, reason is incorrect	d. Assertion is incorrect, reason is correct.	
17	Assertion: The temperature at which Centigrade and Fahrenheit thermometers read the same is – 40° Reason: There is no relation between Fahrenheit and Centigrade temperature.		**1**
	a. Assertion is correct, reason is correct; reason is a correct explanation for assertion.	b. Assertion is correct, reason is correct; reason is not a correct explanation for assertion	
	c. Assertion is correct, reason is incorrect	d. Assertion is incorrect, reason is correct.	
18	Assertion: It is better to wash the clothes in cold soap solution. Reason: The surface tension of cold solution is less than the surface tension of hot solution.		**1**
	a. Assertion is correct, reason is correct; reason is a correct explanation for assertion.	b. Assertion is correct, reason is correct; reason is not a correct explanation for assertion	
	c. Assertion is correct, reason is incorrect	d. Assertion is incorrect, reason is correct.	
19	Assertion: A large soap bubble expands while a small bubble shrinks, when they are connected to each other by a capillary tube. Reason: The excess pressure inside bubble (or drop) is inversely proportional to the radius.		**1**

	a. Assertion is correct, reason is correct; reason is a correct explanation for assertion.	b. Assertion is correct, reason is correct; reason is not a correct explanation for assertion	
	c. Assertion is correct, reason is incorrect	d. Assertion is incorrect, reason is correct.	
20	Assertion: When a capillary tube is dipped into mercury, the mercury level in the tube falls. Reason: Mercury is a very viscous liquid		**1**
	a. Assertion is correct, reason is correct; reason is a correct explanation for assertion.	b. Assertion is correct, reason is correct; reason is not a correct explanation for assertion	
	c. Assertion is correct, reason is incorrect	d. Assertion is incorrect, reason is correct.	
21.	What does the slope of stress versus strain graph indicate?		**1**
22.	Why soap bubble bursts after some time?		**1**
23.	How a raincoat become waterproof?		**1**
24.	Three vessels have the same base area and different neck area. An equal volume of liquid is poured into them, which will possess more pressure at the base?		**1**
25.	On what factors does the critical speed of fluid flow depend?		**1**
26.	Two thermos flasks are of the same height and same capacity. One has a circular cross-section while the other has a square cross-section. Which of the two is better?		**1**
27.	Black body radiation is white. Comment		**1**
28.	Railway tracks are laid on large-sized Wooden sleepers. Why?		**1**
29.	Why is any metallic part of a machinery never subjected to a stress beyond the elastic limit of the material?		**1**
30.	Pendulum clocks generally go fast in winter and slow in summer. Why?		**1**
31.	Two thermometers are constructed in the same way except that one has a spherical bulb and the other a cylindrical bulb. Which will respond more quickly to temperature changes?		**1**
32.	Iceberg floats in water with part of it submerged. What is the fraction of the volume of iceberg submerged if the density of ice is $0.917 g/cm^3$.		**1**
33.	A 20 kg load is hung from the end of a spring. The spring then stretches 10 cm. If instead a 40 kg load is hung from the spring, how much will the spring stretch?		**2**

34.	A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force f, its length increases by *l*. Another wire of the same material of length 2L and radius 2r, is pulled by a force 2f. Find the increase in length of this wire.	**2**
35.	A wire suspended vertically from one of its ends is stretched by attaching a weight of 200N to the lower end. The weight stretches the wire by 1mm. find the elastic energy stored in the wire.	**2**
36.	If S is stress and Y is young's modulus of material of a wire, find the energy stored in the wire per unit volume in terms of S and Y.	**2**
37.	How the fishes can survive in the extreme winter, when ponds and lakes are frozen?	**2**
38.	A composite wire of diameter 1 cm consisting of copper and steel wire of lengths 2.2 m and 2.0m respectively. Total extension of the wire, when stretched by a force is 1.2 mm. Calculate the force given that young's modulus for copper is 1.1×10^{11} Pa and for steel is 2.0×10^{11}Pa.	**2**
47.	The free surface of oil in a tanker, at rest, is horizontal. If the tanker starts accelerating the free surface will be titled by an angle θ. If the acceleration is a ms^{-2}, what will be the slope of the free surface?	**2**
48.	A sphere, a cube and a thin circular disc, all made of the same material and having the same mass and initially heated to 200°C. Which of these objects will cool fastest and which one slowest, when left in air at room temperature? Give reason	**2**
49.	Explain what happens when length of a tube is less than the height up to which a liquid my rise in it.	**2**
50.	Two mercury droplets of radii 0.1 cm. and 0.2 cm. collapse into one single drop. What amount of energy is released? The surface tension of mercury T= 435.5×10^{-3} N m^{-1}.	**2**
51.	The sap in trees, which consists mainly of water in summer, rises in a system of capillaries of radius r = 2.5×10^{-5} m. The surface tension of sap is T = 7.28×10^{-2} Nm^{-1} and the angle of contact is 0°. Does surface tension alone account for the supply of water to the top of all trees?	**2**
52.	The pressure of a medium is changed from 1.01×10^5Pa to 1.165×10^5Pa and change in volume is 10% keeping temperature constant. Find the bulk modulus of the medium.	**3**
53.	A Slightly tapering wire of length l and end radii a and b is subjected to the stretching forces F and F as shown in figure. If Y us the Young's modulus of the wire, calculate the extension produced in the wire.	**3**

		
54.	What is the density of water in a lake at a depth, where the pressure is 24atm, given that its density at the surface is 10^3 kg m^{-3}? Compressibility of water 45.5x 10^{-11} $Pa^{-1.}$ Given that 1atm =1.01x10^5 Pa.	**3**
55.	Water stands at a depth 'H' in a tank whose side walls are vertical. A hole is made on one of the walls at a depth 'h' below the water surface. (a) What is the velocity of efflux? (b) At what distance R from the foot of the wall does the emerging stream of water strike the floor? (c) For what value of 'h' this range is maximum?	**3**
56.	Two metal plates are held together by two rivets width radii of 0.2cm if the maximum shear stress a single rivet can withstand is 5x10^8 N m^{-2}, how much force must be applied parallel to the plates to shear off both the rivets?	**3**
57.	A square lead slab of slide 50 cm and thickness 5.0cm is subjected to a shearing force (on its narrow face) of magnitude 9.0x10^4N. The lower edge is riveted to the floor. How much is the upper edge displaced, if the shear modulus of lead is 5.6x$10^9 Pa$?	**3**
58.	Two mercury droplets of radii 0.1 cm. and 0.2 cm. collapse into one single drop. What amount of energy is released? The surface tension of mercury T= 435.5 × 10^{-3} N m^{-1}.	**3**
59.	If a drop of liquid breaks into smaller droplets, it results in lowering of temperature of the droplets. Let a drop of radius R, break into N small droplets each of radius r. Estimate the drop in Temperature.	**3**
60.	A liquid contained in a calorimeter cool from 80°C to 60°C in 10s. If the temperature of the surroundings is 30°C, calculate the time it will take to cool further to 45°C. [13.565s]	**3**
61.	An aluminum can of mass 100g contains 200g of water. Both initially at 15°C are placed in a freezer at -5°C. Calculate the amount of heat that has to be removed from the water and the can for their temperatures to fall to -5°C. (shc of Al- 0.9J/g°C, shc of water 4.29J/g°C, sp.latent heat of ice – 340J/g)	**3**
62.	Derive the relation between surface energy and surface tension	**3**
63.	The surface tension and vapour pressure of water at 20°C is 7.28 × 10^{-2} Nm^{-1} and 2.33×10^3 Pa respectively. What is the radius of the smallest spherical water droplet which can form without evaporating at 20°C?	**3**
64.	Derive an expression for rise of liquid in a capillary tube.	**5**
65.	Derive an expression for the terminal velocity of a small sphere falling through a viscous medium.	**5**
66.	State and prove Bernoulli's theorem.	**5**

67.	The stress versus strain graphs for wires of two materials A and B are as Shown in Fig. (a) Which material has greater value of Young's modulus? (b) Which material is more ductile? (c) Which material is more brittle? (d) Which of the two is the stronger material?  	**5**
68.	A light rod of length 2m is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One of the wires is made of steel and is of cross section 10^{-3} m^{-2} and the other is of brass of cross section $2x10^{-3}$ m^2 find out the position which a weight may be hung to produce (a) equal stresses in both the wires.(b) equal strains in both wires. Young's modulus for brass= 10^{11} N m^{-2} and young's modulus for steel =$2x10^{11}$ N m^{-2}	**5**
69	**Case Study: Read the following paragraph and answer the questions.** A solid has definite shape and size. To change (**or deform)** the shape or size of a body, a force is required. If you stretch a helical spring by gently pulling its ends, the length of the spring increases slightly. When you leave the ends of the spring, it regains its original size and shape. The property of a body, by virtue of which it tends to regain its original size and shape when the applied force is removed, is known as e**lasticity** and the deformation caused is known as elastic deformation. However, if you apply force to a lump of putty or mud, they have no gross tendency to regain their previous shape, and they get permanently deformed. Such substances are called **plastic** and this property is called **plasticity**. Putty and mud are close to ideal plastics. (i)A wire is stretched to double its length. What is the value of longitudinal strain? (ii) What is the bulk modulus of a perfectly rigid body? (iii) Which one of these is more elastic, steel or rubber? Why? OR (iii) Why is a spring made of steel, not of copper?	**4**
70	**Case Study: Read the following paragraph and answer the questions.** The cohesive forces between molecules in a liquid are shared with all neighboring molecules. Those on the surface have no neighboring molecules above and, thus, exhibit stronger attractive forces upon their nearest neighbors on and below the surface. Surface tension could be defined as the property of the surface of a liquid that allows it to resist an external force, due to the cohesive nature of the water molecules. Due to the surface tension, small objects will "float" on the surface of a fluid, as long as the object cannot break through and separate the top layer of water molecules. When an object is on the surface of the fluid, the surface under tension will behave like an elastic membrane.	**4**

	(i) An air bubble of radius `r` in water is at a depth `h` below the water surface at some instant. If `P` is atmospheric pressure, `d` and `T` are density and surface tension of water respectively . What is the pressure inside the bubble? (ii) What is the value of angle of contact of a liquid does not wet the surface of a solid? (iii) The work done in blowing a soap bubble of radius R is W_1 and that to a radius 3R is W_2. What is the ratio of their work done? OR (iii)Calculate the energy evolved when 8 droplets of water of radius 0.5mm each combine into one(S=0.072N/m) .	