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PHYSOL_*The solution for learning Physics*

Question Bank

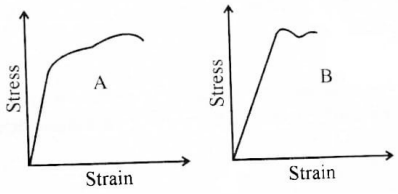
Mechanical Properties of Solids

Each question scores One

1	Name the law relating stress and strain. Ans: Hooke's law.
2	"Strain has no unit and dimension" -True/false. Ans: True.
3	Stress has the same dimension as that of ---------- Ans: Pressure.
4	Modulus of elasticity for a rigid body is ---------- Ans: Infinity.
5	For ductile materials , ultimate stress point and fracture points are ----------(very close/far apart) Ans: Far apart.
6	For brittle materials , ultimate stress point and fracutre points are ----------(very close/ far apart) Ans: Very close.
7	Slope of stress strain graph will give..... Ans. Modulus of elasticity.
8	Unit of stress is..... Ans: N/m^2
9	The maximum value of elasticity is called..... Ans. Elastic limit.
10	Glass is a..... Material. (Brittle/Ductile) Ans. Brittle.
11	Aorta is a ..... Material Ans. Elastomer

Each question scores Two

1	Rope of cranes is made of a number of thin wires braided together. Why? Ans: If we use a number of thin wires braided together instead of a thick one, flexibility can be increased. OR Stress= Force/area When we braid the thin wires together, area of cross section increases. Then the stress reduces. So we can save it from breaking.
2	When a spring balances are continuously used for long time, they show wrong reading. Explain Why? Ans: This is due to elastic fatigue.
3	Why are girders for supporting roofs or bridges formed in the shape of I? Ans: This is because this section provides a large load bearing surface and enough depth to prevent bending. This shape reduces the weight of the beam without sacrificing the strength and hence reduces the cost.

4	A cable is replaced by another one of the same length and material but of twice the diameter. Find the maximum load that the new wire can support without exceeding the elastic limit, as compared to the load that the original wire could support. Ans: Four times as that of original wire. Here area of cross-section of the new cable is four times the original cable. Ultimate tensile stress is same for both wires. Stress = Force / Area.
6	Distinguish between elasticity and plasticity. Ans: The property of a body, by virtue of which it tends to regain its original size and shape when the applied deforming force is removed, is known as elasticity. The inability of a body to regain its original size and shape when the applied deforming force is removed, is known as plasticity.
7	What is meant by elastic fatigue? Ans: The elastic fatigue may be defined as the loss of strength of the material caused due to repeated alternating strains to which the material is subjected.
8	A heavy wire is suspended from a roof but no weight is attached to its lower end. Is it under stress? Justify your answer. Ans: A heavy wire (even when no weight is attached to it) is under stress, when it is suspended from a roof. It is because , the weight of the heavy wire acts as the deforming force.
9	What is the limitation of Hooke's law? Ans: Its holds good , when a wire is loaded within its elastic limit.
10	What is an elastomer? Give examples. Ans: Materials for which stress-strain graph is not a straight line within elastic limit. Do not obey Hooke's law. The elastic region is very large. No plastic region. Examples: Rubber, the elastic tissue of aorta.
11	What is a deforming force? Ans: A force that produces a change in shape or size of a body is called the deforming force
12	Why are bridges declared unsafe after long use? Ans: A bridge undergoes continuous a large number of alternating strains everyday, which results in the loss of its elastic strength which may lead to the collapse of the bridge.
13	Why do spring balance show wrong readings after they have been used for a long time? Ans: When a spring balance has been used for a long time, the spring in the balance gets fatigued and there is a loss of the strength of the spring. So spring balance show wrong readings after they have been used for a long time.
14	The Stress-Strain graph of two materials A and B are shown below. (a)State the law which relates stress with strain. (b)Which of the two materials is more ductile? Ans:(a) It states that "within the elastic limit stress is directly proportional to strain". (b) material A. 
15	A steel wire of length 1.5 m and diameter 25 cm is loaded with a force of 98 N. The increase in the length of the wire is 1.5×10^{-4} m. Calculate the tensile stress and the fractional change in length of the wire.

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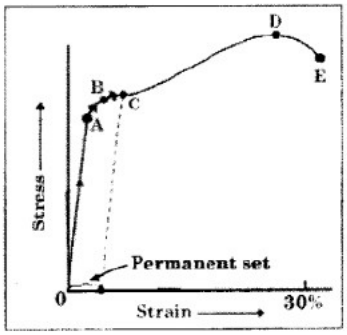
Ans: Tensile stress = $\frac{F}{A}=\frac{F}{\pi r^2}$

Thus Tensile stress = $\frac{98}{3.14\,x\,(12.5\,x\,10^{-2})^2}=1.99\,x\,10^{7}\,Nm^{-2}$

Fractional change in length = $\frac{\Delta L}{L}=\frac{1.5\,x\,10^{-4}}{1.5}=10^{-4}$

16 A typical stress-strain graph of a metallic wire is shown below.



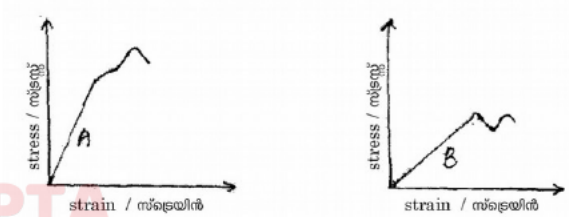
(a) Write the name of the point B labelled in the graph.

(b) For materials like copper, the points D and E are ..... (close/far apart).

Ans: (a) Elastic limit.

(b) Far apart.

17 The stress-strain curve of two bodies A and B are given in the figure.



Which of the two materials is preferable to be used as a rope in a crane? Substantiate your answers.

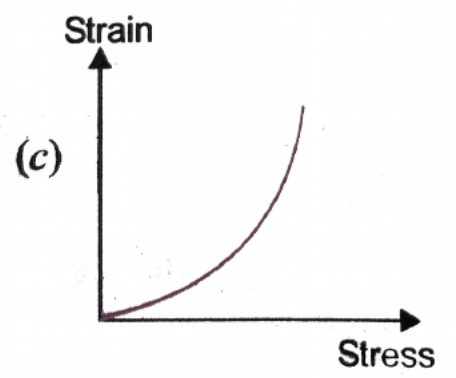
Ans: Material A is preferred. Ultimate stress for 'A' is greater than that of 'B'.

18 A rubber band can be pulled to several items its original length.

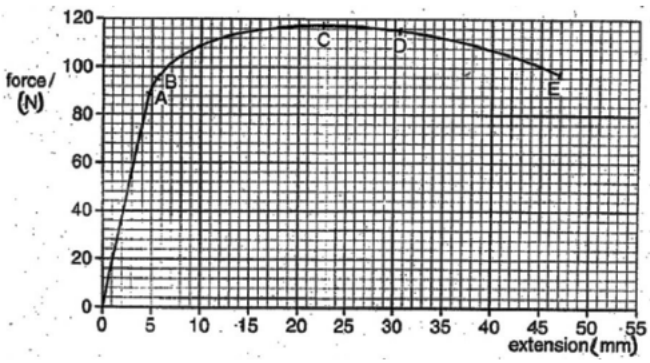
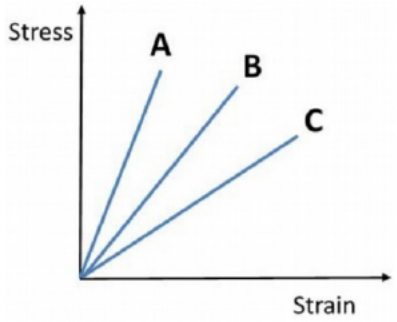
a) Draw the stress-strain graph of a rubber band.

b) Rope of cranes is made of a number of thin wires braided together. Why?

Ans: (a)



(b) To reduce stress.

19	The graph below shows how the force applied to a metal wire is related to the extent ion of the wire.  Write the letter that corresponds to: i) Elastic limit ii) Fracture point Ans: (i) B (ii) E
20	Which is more elastic A, B or C? Justify your answer.  Ans:'A'. Small strain for large stress.
21	Which is more elastic, steel or rubber? Why? Ans: Steel. For a given stress , strain is small for steel.
22	State Hooke's law. Ans: It states that "With in the elastic limit stress is directly proportional to strain". i.e. Stress α Strain.
23	Define stress? Ans. Deforming force per unit area is called stress.
24	Define strain? Ans. It is the ratio of change in dimension to the original dimension.
25	Name the stresses produced when a spring is elongated? Ans. Linear stress and shearing stress.
26	Define linear strain and volume strain? Ans. Linear strain is the ratio of change in length to original length. Volume strain is the ratio of change in volume to original volume.
27	State the Units and dimensions of Stress. Ans: Units of stress: Nm^{-2} or Pascal Dimensions of stress: $[ML^{-1}T^{-2}]$

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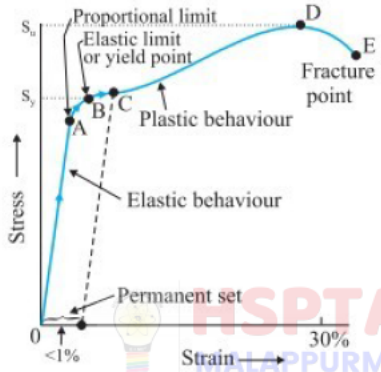
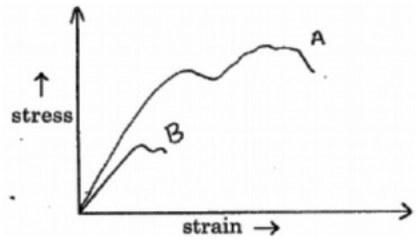
28	Give example of nearly perfectly elastic and plastic bodies. Ans: Nearly perfectly elastic body: Quartz fibre. Nearly perfectly elastic body: Clay, wax.
29	A copper wire of 1 mm diameter is stretched by applying a force of 10 N. Find the stress in the wire? Ans: Stress=Force/Area Stress= $\frac{F}{\pi r^2}=\frac{10}{3.14\times(.5\times10^{-3})^2}=1.273\times10^7\,N\,m^{-2}$

Each question scores Three

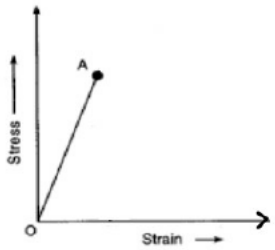
1	Hooke's law states that stress α strain. a) What is the necessary condition for the above law to be valid? b) Explain with the help of a graph, the relation between stress and strain for a given solid material under increasing tensile stress. Ans: (a) The law is valid only for small deformation and it is obeyed only with in the elastic limit. (b)  Fig. 2
2	The stress-strain graph for wires of two materials A and B are given below.  a) Which material is more ductile? b) When a spring balances are continuously used for long time, they show wrong reading. Explain why. Ans: (a) Material 'A' (b) Due to elastic fatigue the spring temporarily losses its elasticity and the balance shows wrong reading.
3	Ultimate stress of rock is $3x10^8 N/m^2$. Find the maximum height possible for a mountain? Given density of rock is $3x10^3$ kg/m^3. Ans: Stress = pressure Stress= hρg $3x10^8=hx3x10^3x10$

	h=10000m h=10km
4	Show that elastic average energy density = $\frac{1}{2}\times Stress\times Strain$ Ans. Stress=Force/area $Strain=\frac{\Delta l}{l}$ $\frac{1}{2}\times Stress\times Strain = \frac{1}{2}\times\frac{Force}{Area}\times\frac{\Delta l}{l} = \frac{1}{2}\times\frac{Energy}{Volume}$ $= \frac{Energy\ Density}{2}$ =Average energy density

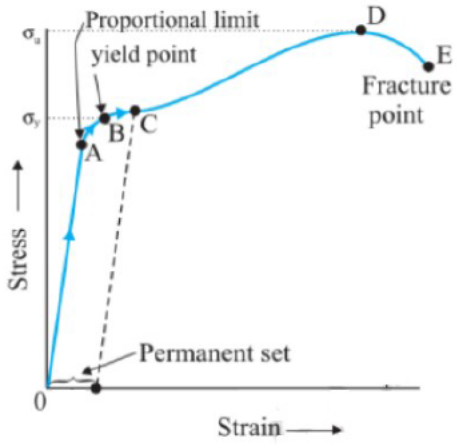
Each question scores Five

1 a)State and explain Hooke's law.
b)A wire is fixed at one end is subjected to increasing load at the other end. Draw a curve between Stress and Strain and with the help of the curve, explain the terms
a)proportional limit b)yield point c) permanent set d)fracture point
c)How does this curve may be used to distinguish between ductile and brittle substances?

Ans: a)Hooke's law states that within the elastic limit stress is directly proportional to strain.
Stress α Strain
Stress = K x Strain
Where K is known as modulus of elasticity.
If a material obey Hooke's law, the graph connecting stress and strain will be a straight line.



b)



c) If the points D and E are very close to each other the material is brittle and if they are far apart, the material is ductile.