POSTAL Study Package 2019

Mechanical Engineering

Objective Practice Sets

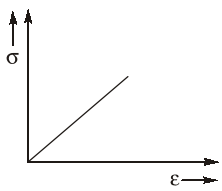
Strength of Materials

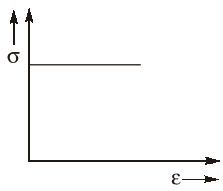
Contents

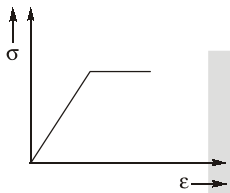
MADE EASY Publications

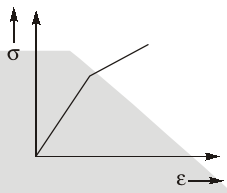
1 CHAPTER
Properties of Materials

Q.1 The stress-strain curve of an ideal elastic strain hardening material will be as:

(a) 

(b) 

(c) 

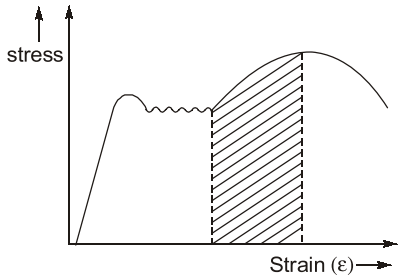
(d) 

Q.2 The stress below which a material has a high probability of not failing under reversal of stress is known as:
(a) tolerance limit
(b) elastic limit
(c) proportional limit
(d) endurance limit

Q.3 Which of the following stages of creep are characterised by a high strain rate which slows with increasing time?
(a) Primary (b) Secondary
(c) Tertiary (d) All

Q.4 Modulus of Toughness is:
(a) Area under stress-strain curve upto yield point
(b) Area under stress-strain curve upto elastic limit
(c) Area under stress-strain curve upto fracture point
(d) Area under stress-strain curve upto ultimate point

Q.5 For the stress-strain curve of steel shown below, the shaded region represents:



(a) Elastic region
(b) Necking
(c) Yielding
(d) Strain Hardening

Q.6 Lueder's lines on steel specimen under simple tension test is a direct indication of yielding of material due to slip along the plane
(a) of maximum principal stress
(b) of maximum shear
(c) of loading
(d) perpendicular to direction of loading

Q.7 A fatigue crack in a sound and smooth specimen takes
(a) longer time in initiation than propagation
(b) longer time in propagation than initiation
(c) equal time in initiation & propagation
(d) no time in propagation

Q.8 At any stage during steady state the strain is
(a) totally plastic
(b) totally elastic
(c) elastic and plastic
(d) elastic or plastic depending upon the modulus of elasticity of material

Q.9 For metallic minerals creep becomes an important consideration at

Direction : The **Q. 21** & **Q.22** items consists of two statements; one labelled as **'Assertion (A)'** and the other as **'Reason (R)'**. You are to examine these two statements carefully and select the answers to these items using the codes given below:

(a) Both A and R are true and R is a correct explanation of A.
(b) Both A and R are true but R is not a correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Q.21 **Assertion (A):** For a ductile material, stress-strain curve is a straight line upto yield point.
Reason (R): The material follows Hooke's law upto the point of proportionality. **[IAS-2003]**

Q.22 **Assertion (A):** Stress-strain curves for Brittle Material do not exhibit yield point.
Reason (R): Brittle Material fail without yielding. **[IAS-1996]**

Answers Properties of Materials

1. (d)	**2.** (d)	**3.** (a)	**4.** (c)	**5.** (d)	**6.** (b)	**7.** (a)	**8.** (c)	**9.** (c)	**10.** (a)
11. (b)	**12.** (c)	**13.** (c)	**14.** (a)	**15.** (a)	**16.** (a)	**17.** (a)	**18.** (203.17)		
19. (4712.39 N)		**20.** (0.75)		**21.** (d)	**22.** (a)				

Explanations Properties of Materials

1. (d)

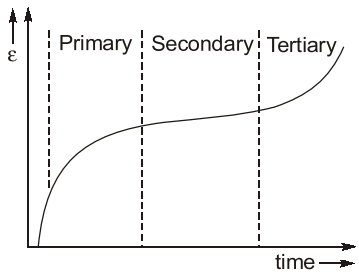
Due to strain hardening, with increase in strain, the stress required to deform the material increases.

2. (d)

Endurance limit is the maximum value of completely, reversed bending stress that a material can withstand for an infinite number of cycles, before first crack appears.

3. (a)

For initial stage, the strain rate is relatively high, but slows with increasing time due to work hardening.

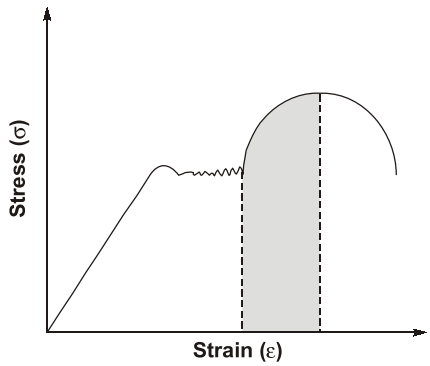


4. (c)

Modulus of Toughness is the strain energy absorbed per unit volume before fracture.

5. (d)

The shaded region represents strain hardening. After undergoing considerable plastic strain during yielding region, the material begins to strain hardened. Strain hardening is a process where material undergoes in change in atomic and crystal structure.



6. (b)

Leuder's lines are elongated surface markings or depressions, often visible to the unaided eye, that form along the length of a tension specimen at an angle of approximately 45° to the loading axis (i.e. the plane of maximum shear). It is caused by localized plastic deformation and result from discontinuous (in homogeneous) yielding. It is also known as Lueders bands or stretcher strains.

7. (a)

It takes more time for crack initiation during fatigue loading, and very less time for propagation once initiated.

8. (c)

At any stage during steady state, the strain is both elastic and plastic, as every material has some elastic recovery due to elastic strain.

9. (c)

The temperature at which the creep becomes an important consideration is called HOMOLOGOUS TEMPERATURE and this temperature is nearly half of the melting point temperature.

10. (a)

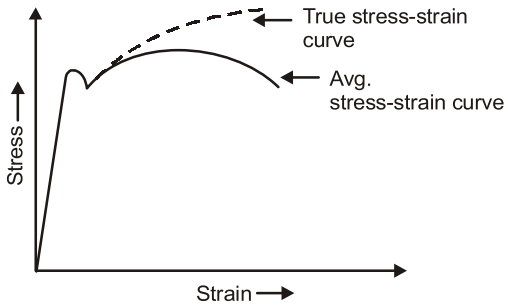
- Nominal stress = $\frac{\text{Load}}{\text{Original area}} = \frac{P}{A}$

  Nominal stress is also called engineering stress or average stress.

- Actual stress = $\frac{\text{Load}}{\text{Actual area}} = \frac{P}{A}$

  Actual area at instant of loading does not remain constant and increases with increase in elongation. Actual stress is also called true stress.

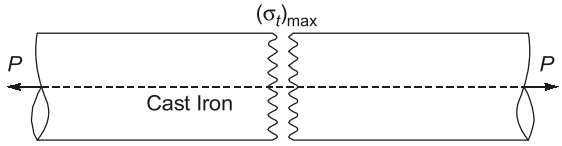
- Stress-strain curve for mild steel in Tension:



11. (b)

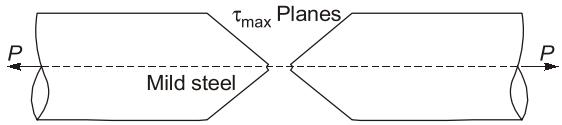
- Brittle material fails before yielding so C - 4.
- Mild steel undergoes strain hardening before fracture, hence A - 3
- Both Aluminium and Copper has FCC structure so B and D - 2
- Fig. 1 represents elastic - ideal plastic material, so none option matches with it.

12. (c)



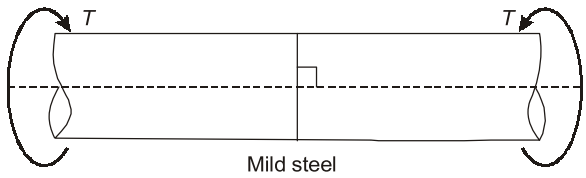
Granular transverse fracture

No permanent deformation (strain) before fracture



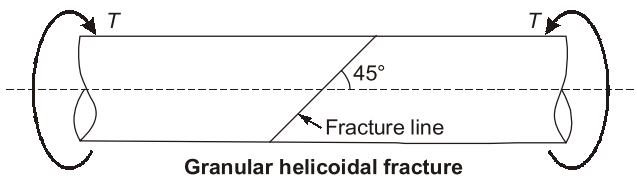
Cup and cone shape

Ductile material sets up some permanent deformation (strain) before fracture.



Plain (smooth) fracture on a transverse plane

Ductile material fails along maximum sheer stress plane during torsion test.



Granular helicoidal fracture

Brittle material during torsion test fail along $(\sigma_t)_{max}$ plane.