UNIT-V -MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS

PART-A

1. **Define slip.**

   Plastic deformation as the resultof dislocation motion; also, theshear displacement of two adjacentplanes of atoms.

2. **Define twinning.**

   A twin boundary is a special type of grain boundary across which there is a specific mirror lattice symmetry; that is, atoms on one side of the boundary are located in mirror image positions of the atoms on the other side

3. **What is a fracture?**

   Simple fracture is the separation of a body into two or more pieces in response to an imposed stress that is static (i.e., constant or slowly changing with time) and at temperatures that are low relative to the melting temperature of the material.

4. **Write types of fractures.**
   - Ductile Fracture
   - Brittle Fracture
   - Fatigue fracture and
   - Creep fracture.

5. **What is fatigue fracture?**

   Materials subjected to extended cyclic loading may result in delayed fracture called fatigue fracture.

6. **What is creep?**

   Under the influence of a constant applied stress many materials continue to deform indefinitely. This process is called creep.

7. **What is brittle fracture?**

   The failure of a material without apartment plastic deformation is called brittle fracture.

8. **What are transgranular and intergranular fracture?**

   In many brittle crystalline materials, crack propagation occurs along specific crystallographic planes; such a process is termed cleavage. This type of fracture is said to be transgranular in tragranular fracture because fracture cracks pass through grains. The fractured surface looks grainy or granular. In some alloys, crack propagation along grain boundaries is also possible; this is termed Intergranular fracture. This yields a relatively shiny and smooth fracture surface.

9. **What are creep and creep resistance**

   Creep is the property of a material by which it deforms continuously under a steady load (yielding). The deformation during creep is no recoverable. The creep can produce fracture or rupture even though the applied stress is lower than the Ultimate stress. So the creep in materials should be avoided, particularly at high temperatures.

   Creep resistance is the property of the material by which the continuation of creepIs stopped.

10. What are the two types of Deformation in metals?

- Elastic deformation
- plastic deformation

11. What is plastic deformation?

Deformation that is permanent or non recoverable after release of the applied load. It is accompanied by permanent atomic displacements.

12. What is Elastic deformation?

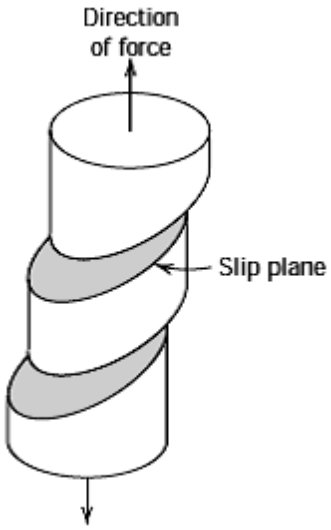
Deformation that is nonpermanent, that is, totally recovered upon release of an applied stress.

PART-B

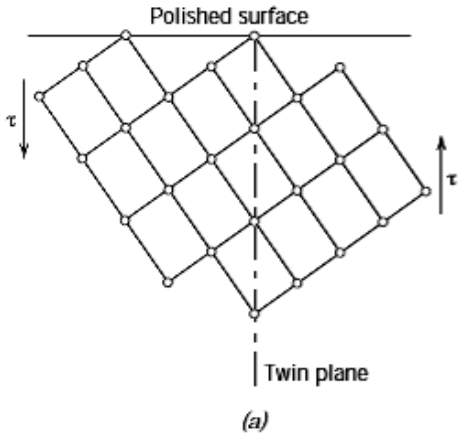
1. What are slip and twinning? What are their characteristics?

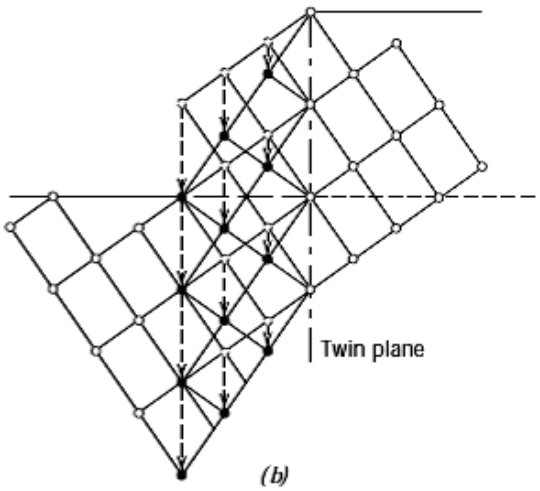
Hints:

- Plastic deformation as the result of dislocation motion; also, the shear displacement of two adjacent planes of atoms.

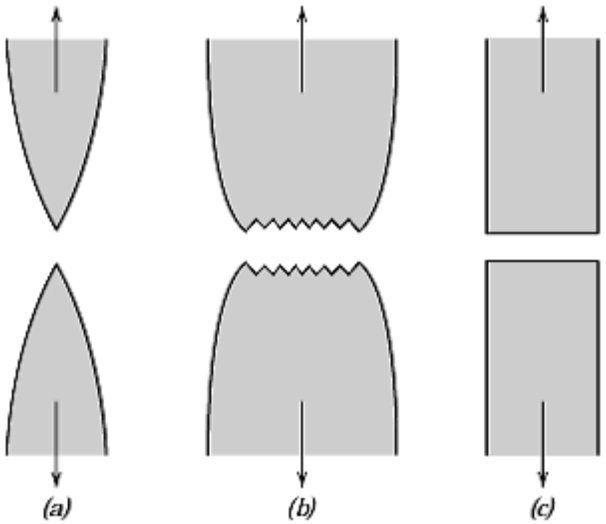


- A twin boundary is a special type of grain boundary across which there is a specific mirror lattice symmetry;

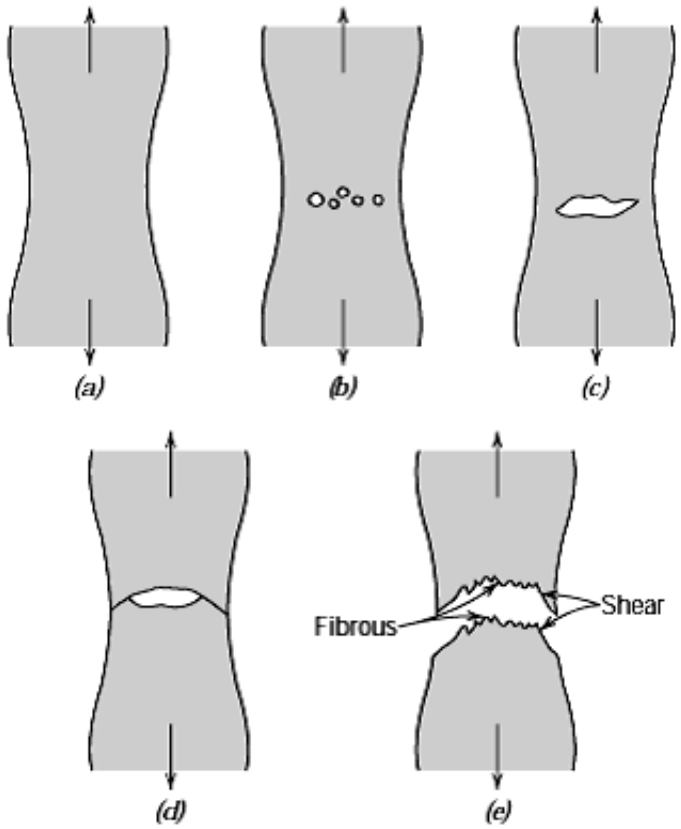




2. **Discuss characteristics of ductile fracture and brittle fracture.**
   Hints:

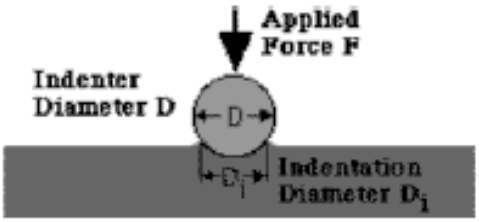


- Ductile fracture surfaces will have their own distinctive features on both macroscopic and microscopic levels.
- These highly ductile materials neck down to a point fracture, showing virtually 100% reduction in area.
- Brittle fracture takes place without any appreciable deformation, and by rapid crack propagation.
- The direction of crack motion is very nearly perpendicular to the direction of the applied tensile stress and yields a relatively flat fracture surface, as indicated



3. **Explain the testing procedure for determining the following properties.**
   I. **Brinell hardness testing**

Hints:



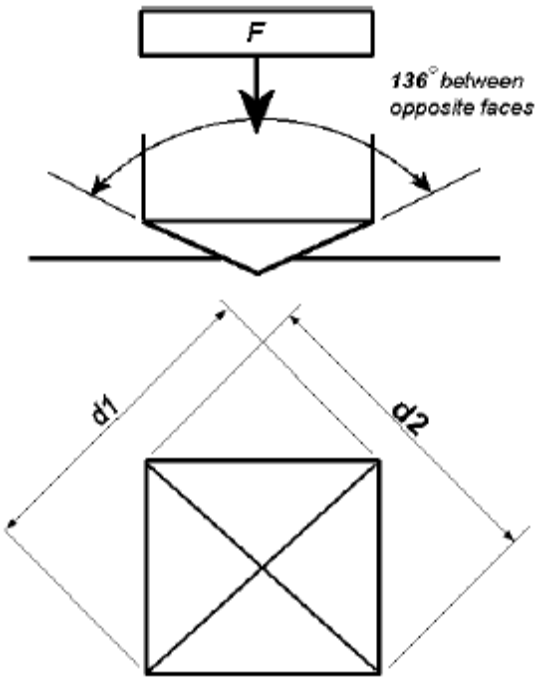
$$BHN = \frac{F}{\frac{\pi}{2} D \left(D - \sqrt{D^2 - D_i^2}\right)}$$

- In Brinell tests, as in Rockwell measurements, a hard, spherical indenter is forcedinto the surface of the metal to be tested.
- The diameter of the hardened steel (ortungsten carbide) indenter is 10.00 mm (0.394 in.). Standard loads range between500 and 3000 kg in 500-kg increments
- Maximum specimen thickness as well as indentation position (relative to specimen edges) and minimum indentation spacing requirements are the same as for Rockwell tests.

4. **Explain the testing procedure of Vickers hardness test**

Hints:

The facility to convert the hardness measured on one scale to that of another ismost desirable. However, since hardness is not a well-defined material property,and because of the experimental dissimilarities among the various techniques, acomprehensive conversion scheme has not been devised. Hardness conversion datahave been determined experimentally and found to be dependent on material typeand characteristics.

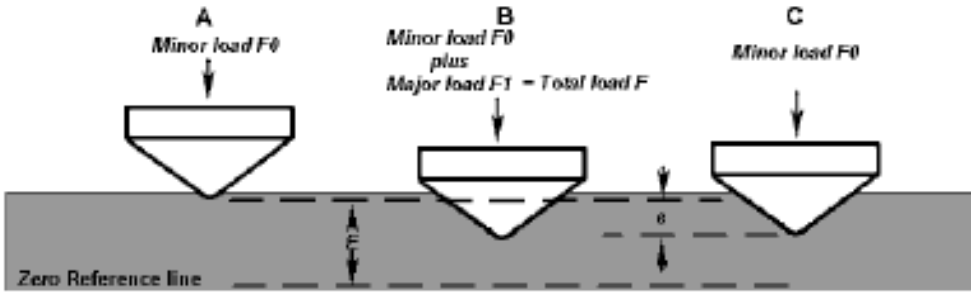


5. **Explain the testing procedure of Rockwell hardness test**

Hints:

The Rockwell tests constitute the most common method used to measure hardness because they are so simple to perform and require no special skills.

With this system, a hardness number is determined by the difference in depth of penetration resulting from the application of an initial minor load followed by a larger major load; utilization of a minor load enhances test accuracy.

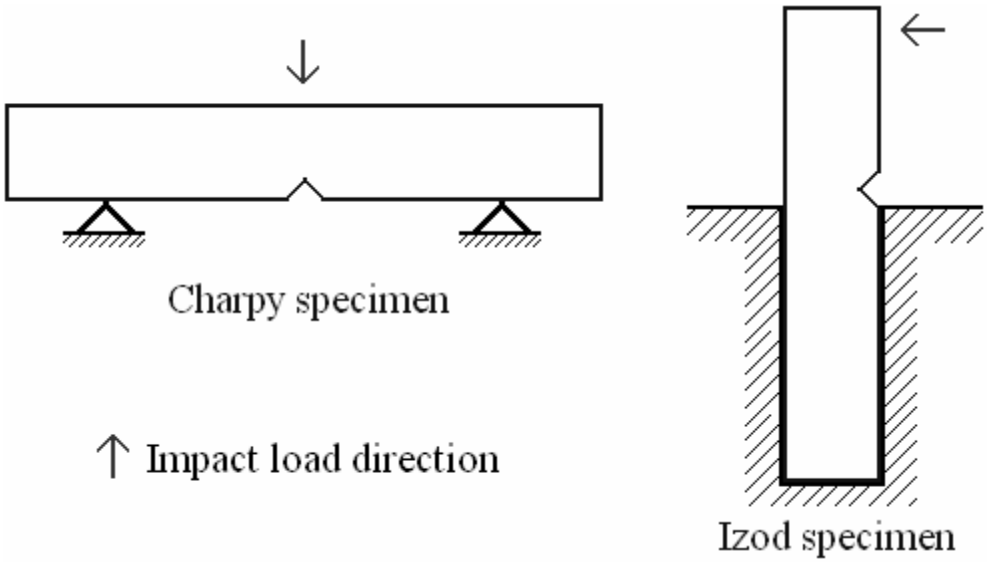


6. **Compare charpy and izod impact test.**

Hints:

A material's susceptibility to different kinds of fracture is measured using notched specimen subjected to impact load. Further study involves examining the fracture surfaces, and calculation of ductility.

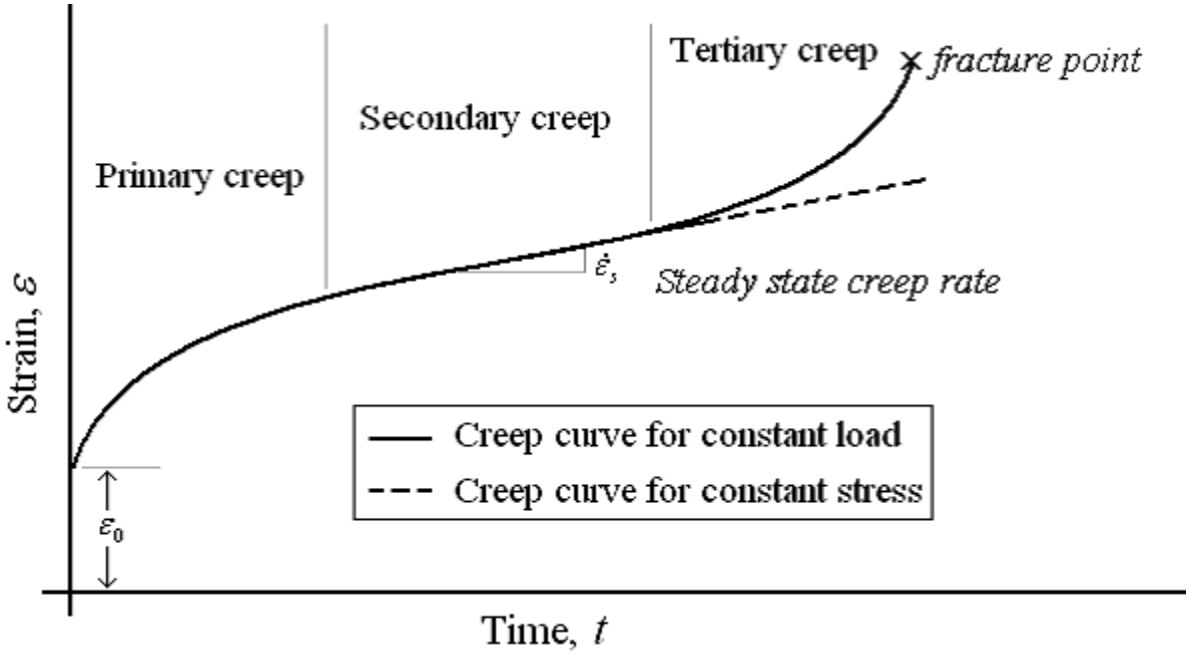
Two kind of specimen configurations & loading directions:



7. **Draw a typical creep curve and brief on the mechanism**

Hints:

- Deformation that occurs under constant load/stress and elevated temperatures which is time-dependent is known as creep.
- Creep deformation (constant stress) is possible at all temperatures above absolute zero. However, it is extremely sensitive to temperature.
- Hence, creep in usually considered important at elevated temperatures (temperatures greater than 0.4 Tm, Tm is absolute melting temperature).
- Creep test data is presented as a plot between time and strain known as creep curve.
- The slope ofthe creep curve is designated as creep rate.

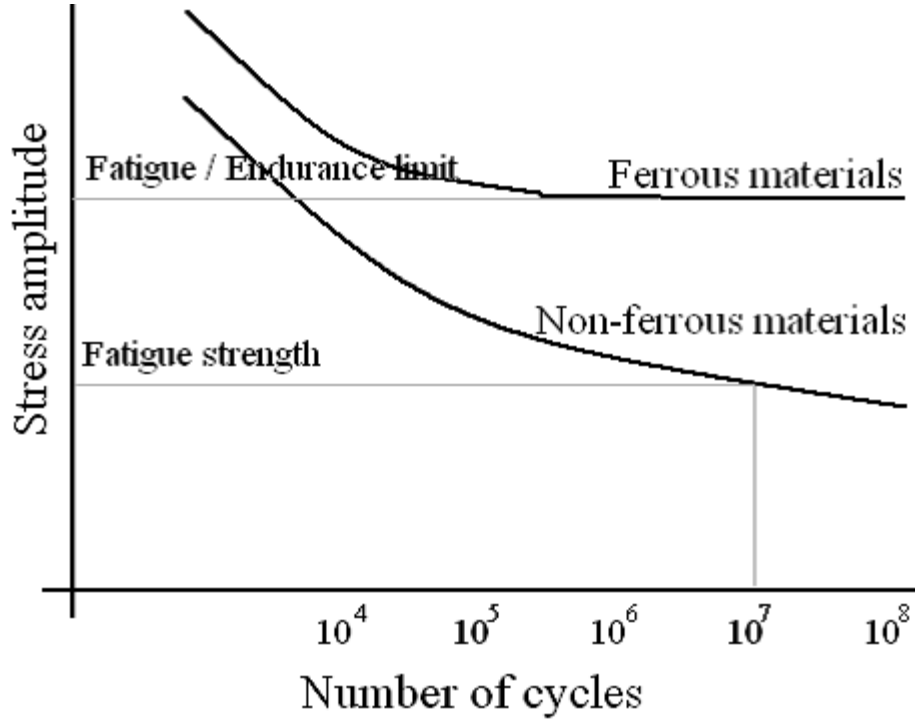


8. **Draw S-N curve for ferrous and non-ferrous metals and explain how endurance strength can be determined.**

Hints:

Fatigue test, usually, involves applying fluctuating loadcyclically.

- A specimen of rotating beam type is often used because of its simplicity.
- Fatigue data is usually presented by plotting maximum stress (*S*) against number of cycles to fracture (*N*), using a logarithmic scale for the latter variable.



Endurance ratio – ratio of fatigue stress to tensile stress ofa material. For most materials it is in the range of 0.4-0.5.