# Unit 6 - Week 4



## Assignment 4

**The due date for submitting this assignment has passed.**
**As per our records you have not submitted this assignment.**

**Due on 2020-10-14, 23:59 IST.**

1) For a linear, isotropic elastic material, identify the correct relation(s). *1 point*

- $E = 2G(1+\nu)$.
- $G = 2E(1+\nu)$.
- $E = 3K(1-2\nu)$.
- $E = 3K(1+\nu)$.

No, the answer is incorrect.
Score: 0
Accepted Answers:
$E = 2G(1+\nu)$.
$E = 3K(1-2\nu)$.

2) Identify all the correct statements *2 points*

- In general, polycrystalline metals are stronger than their single-crystal equivalents.
- The geometric constraints imposed on the grains by the neighbouring grains during deformation are relatively higher in polycrystalline materials.
- Cross slip occurs easily in metals with low stacking fault energy.
- Polycrystals have a greater tendency to exhibit easy glide plastic deformation.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*In general, polycrystalline metals are stronger than their single-crystal equivalents.*
*The geometric constraints imposed on the grains by the neighbouring grains during deformation are relatively higher in polycrystalline materials.*

3) Identify the mechanisms that can cause materials to undergo softening during plastic deformation *2 points*

- Damage accumulation.
- Rotation of individual grains towards the crystallographic orientations, thereby increasing the Schmid factor.
- Hall-Petch effect.
- Thermal softening.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*Damage accumulation.*
*Rotation of individual grains towards the crystallographic orientations, thereby increasing the Schmid factor.*
*Thermal softening.*

4) Identify all the correct statements *1 point*

- During elastic deformation, stress is proportional to strain.
- The modulus of elasticity is a measure of stiffness of the material.
- The modulus of elasticity is not significantly affected by heat treatment or alloying.
- An external force acting on a polymer material produces an instantaneous elastic strain which remains constant as long as the stress is constant.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*The modulus of elasticity is a measure of stiffness of the material.*
*The modulus of elasticity is not significantly affected by heat treatment or alloying.*

5) The number of material constants required to characterize the behavior of linear isotropic elastic materials is _____.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*(Type: Numeric) 2*

*1 point*

6) Identify all the correct statements *1 point*

- Resilience is computed as the area under the stress-strain curve in the elastic regime.
- Toughness is computed as the area under the stress-strain curve until fracture.
- The relations between the true stress, engineering stress, true strain and engineering strain given by, $\sigma_T = \sigma(1+\varepsilon)$ and $\varepsilon_T = ln(1+\varepsilon)$, are valid only until the onset of necking.
- The deformation of a ductile material is homogeneous until fracture.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*Resilience is computed as the area under the stress-strain curve in the elastic regime.*
*Toughness is computed as the area under the stress-strain curve until fracture.*
*The relations between the true stress, engineering stress, true strain and engineering strain given by, $\sigma_T = \sigma(1+\varepsilon)$ and $\varepsilon_T = ln(1+\varepsilon)$, are valid only until the onset of necking.*

**Q.7-9: Refer to Table 1.**

Table 1 describes the tension test data on a AISI 1020 hot-rolled steel specimen with an initial diameter of 9.11 mm. For strain, the extensometer gage length was $L_i$ = 50.8 mm. In addition, minimum diameters were measured manually with a micrometer in the necked region at several interval points during the test. After fracture, the broken halves were reassembled, and the following measurements were made:

• Points originally 25.4 mm apart and on opposite sides of the necked region were 38.6 mm apart.
• The final diameter in the necked region is 5.28 mm.

Table 1: Tension test data for AISI 1020 steel specimen

| Force (kN) | Engg. Strain | Diameter (mm) |
|---|---|---|
| 0 | 0 | 9.11 |
| 6.67 | 0.0005 | – |
| 13.34 | 0.00102 | – |
| 19.13 | 0.00146 | – |
| 17.79 | 0.0023 | – |
| 17.21 | 0.0031 | – |
| 17.53 | 0.005 | – |
| 17.44 | 0.007 | – |
| 17.21 | 0.01 | – |
| 20.77 | 0.049 | 8.89 |
| 24.25 | 0.125 | – |
| 25.71 | 0.218 | 8.26 |
| 25.75 | 0.234 | – |
| 25.04 | 0.306 | 7.62 |
| 23.49 | 0.33 | 6.99 |
| 21.35 | 0.348 | 6.35 |
| 18.9 | 0.36 | 5.72 |
| 17.39 | 0.366 | 5.28 |

Answer the questions 7-9 based on the given data.

7) The yield strength (in MPa) based on the 0.2% offset method is *1 point*

- 268.34
- 272.2
- 253.56
- 264.5

No, the answer is incorrect.
Score: 0
Accepted Answers:
*264.5*

8) The percentage reduction in area is *1 point*

- 66.4
- 75
- 58.6
- 33.2

No, the answer is incorrect.
Score: 0
Accepted Answers:
*66.4*

9) By assuming that the test was interrupted upon reaching a strain of 0.007, and the specimen unloaded to zero force, what would be the new length (in mm) of the original 50.8 mm gage section? *2 points*

- 51.35
- 51.72
- 51.09
- 51.99

No, the answer is incorrect.
Score: 0
Accepted Answers:
*51.09*

10) The true stress-strain curve for a material is given by $\sigma = 1200\varepsilon^{0.25}$, where the stress is in MPa. The ultimate tensile strength of the material (rounded to nearest integer) is

No, the answer is incorrect.
Score: 0
Accepted Answers:
*(Type: Range) 658,662*

*2 points*

11) Identify all the correct statements *1 point*

- BHN depends on the load applied.
- VHN is independent of the load applied.
- The ultimate strength of a material whose BHN is 65 kgf/mm$^2$ is 221 MPa.
- A square based diamond pyramid indenter is used in the Brinell hardness test.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*BHN depends on the load applied.*
*VHN is independent of the load applied.*
*The ultimate strength of a material whose BHN is 65 kgf/mm$^2$ is 221 MPa.*