

**MatE 115 – Diagnostic Quiz
SOLUTIONS**

Please answer ALL questions. Circle the answer that you think is correct.

1. The electronic configuration of manganese ($Z=25$) is:

- (a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$
- (b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ ✓**
- (c) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
- (d) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$

2. Which of the following statements is true for pure iron:

- (a) Fe melts over a range of temperatures
- (b) Fe is isomorphic
- (c) The ductile to brittle transition does not occur in Fe
- (d) The melting of iron is an invariant reaction. ✓**

3. In general, a hardened, plain carbon steel is tempered to:

- (a) Increase the yield strength
- (b) Decrease the ductility
- (c) Increase the impact resistance/toughness ✓**
- (d) Increase the ultimate tensile strength

4. In CsCl (cesium chloride) the cesium ions are:

- (a) Are negatively charged
- (b) Are positively charged ✓**
- (c) Are neutral, having no charge
- (d) Can be either positively or negatively charged, depending upon the situation

For **Questions 5 through 8**: An aluminum plate is rolled to reduce its thickness from 5 mm to 3 mm.

5. The hardness of the aluminum plate will:

- (a) Increase ✓
- (b) Decrease
- (c) Remain the same
- (d) Aluminum is naturally soft

6. The ductility of the aluminum plate will:

- (a) Increase
- (b) Decrease ✓
- (c) Remain the same
- (d) Aluminum is naturally ductile

7. The electrical conductivity of the aluminum plate will:

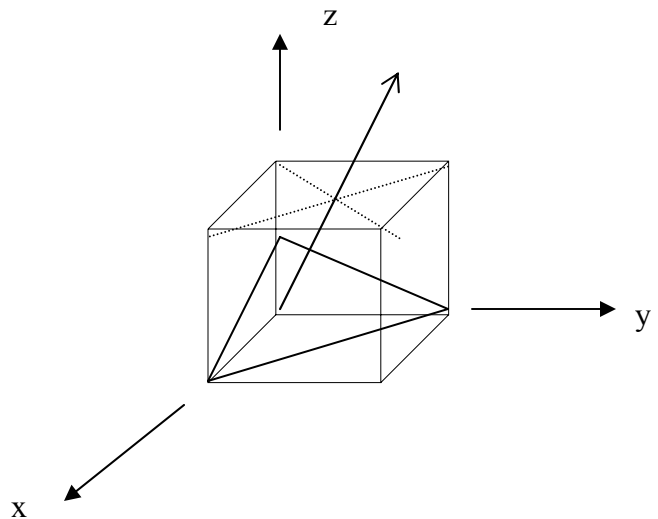
- (a) Increase
- (b) Decrease ✓
- (c) Remain the same
- (d) Aluminum is naturally conductive

8. The elastic modulus of the aluminum plate will:

- (a) Increase
- (b) Decrease
- (c) Remain the same ✓
- (d) Aluminum is naturally elastic

9. In the figure on the right sketch the (112) plane

10. In the figure on the right sketch the [112] direction



11. The resistivity of conductors increases with increasing temperatures because:

- (a) Atoms move faster
- (b) More vacancies are created
- (c) The mean free path of electrons decreases ✓
- (d) Resistivity of conductors drops with increasing temperature

12. The driving force for diffusion to occur is:

- (a) The concentration gradient ✓
- (b) The temperature gradient
- (c) The force gradient
- (d) Diffusion does not require a driving force

13. The conductivity of semiconductors decreases with increasing temperature because:

- (a) Electrons move faster
- (b) Electrons move slower
- (c) More vacancies are created
- (d) The conductivity of semiconductors does not decrease with increasing temperature ✓

14. Which of the following defects will not affect the resistivity of a conductor:

- (a) Vacancies
- (b) Interstitials
- (c) Dislocations
- (d) Defects always affect the resistivity ✓

15. Which of the following statements is not in accordance with Fick's First Law?

- (a) The rate of diffusion is directly proportional to the concentration gradient
- (b) The rate of diffusion is directly proportional to the diffusion coefficient
- (c) The diffusion coefficient is independent of concentration
- (d) The rate of diffusion varies with time. ✓

16. Ductility is:

- (a) The amount of deformation that a material can withstand without breaking ✓
- (b) The amount of elastic deformation that a material can withstand
- (c) The maximum load that a material can withstand
- (d) The maximum impact loading a material can withstand

17. Toughness is a measure of:

- (a) The energy required to cause plastic deformation
- (b) The energy required to cause necking
- (c) The energy required to cause fracture ✓
- (d) The energy required to cause elastic yielding

18. The term “cold working” means:

- (a) Deforming a material at room temperature
- (b) Deforming a material at 0°C or below
- (c) Deforming a material at less than 0.3 of its melting point ✓
- (d) Deforming a material at temperatures below red heat

19. Which of the following types of polymers (plastics) can be recycled?

- (a) Thermoset polymers
- (b) Crosslinked polymers
- (c) Thermoplastic polymers ✓
- (d) All polymers can be recycled

20. In a material which is a single crystal, e.g., silicon single crystal, the properties such as strength, electrical resistivity and elastic modulus will be:

- (a) The same in all directions, i.e., isotropic
- (b) Different in different directions, i.e., anisotropic ✓
- (c) The same in all directions, but different in different planes
- (d) Properties such as strength and elastic modulus are not relevant for single crystals

21. Thermoset polymers tend to be rigid because:

- (a) The linear polymeric chains are held together rigidly by electrostatic bonds
- (b) Crosslinking between polymeric chains prevent their motion** ✓
- (c) Polymeric chains are made up of interatomic bonds which are very rigid
- (d) Thermoset polymers are not rigid

22. In the Mg-Pb system, which of the following reactions represents a eutectic reaction:

- (a) $\alpha + L \rightarrow \alpha + \text{Mg}_2\text{Pb}$
- (b) $L + \text{Mg}_2\text{Pb} \rightarrow \alpha + \text{Mg}_2\text{Pb}$
- (c) $L \rightarrow \alpha + \text{Mg}_2\text{Pb}$** ✓
- (d) $\alpha \rightarrow \alpha + \text{Mg}_2\text{Pb}$

23. Strain hardening occurs when a metal is:

- (a) Quenched
- (b) Plastically deformed** ✓
- (c) Elastically deformed
- (d) Annealed

24. The yield strength is the stress at which:

- (e) The maximum in the stress-strain curve occurs.
- (f) The material or sample fractures.
- (g) The material begins non-uniform elongation.
- (h) Plastic deformation begins.** ✓

25. The Ultimate Tensile Strength represents the stress at which:

- (i) The plastic strain is equal to the elastic strain.
- (j) Non-uniform elastic deformation begins.
- (k) Non-uniform plastic deformation begins.** ✓
- (l) The strength reaches its ultimate.