

Advanced Mechanical Engineering Concepts

Mechanical Engineering · Answer Key · 25 Questions

1. What is the specific value of the adiabatic index (gamma) for a monatomic ideal gas?

- A) 1.33
- B) 1.40
- C) 1.67**
- D) 1.29

2. In the context of beam deflection, what does the term 'flexural rigidity' specifically represent?

- A) EI**
- B) E/I
- C) I/E
- D) GL

3. Which dimensionless number represents the ratio of inertial forces to viscous forces in fluid dynamics?

- A) Nusselt number
- B) Reynolds number**
- C) Prandtl number
- D) Grashof number

4. According to the Mohr-Coulomb failure criterion, what does the yield surface represent in the principal stress space?

- A) A sphere
- B) An ellipsoid
- C) A hexagonal prism**
- D) A cylinder

5. What is the primary function of a 'desuperheater' in a steam power cycle?

- A) To increase pressure
- B) To reduce steam temperature**
- C) To remove moisture
- D) To increase kinetic energy

6. Which material property is defined as the energy absorbed per unit volume up to the point of fracture?

- A) Resilience
- B) Ductility
- C) Toughness**
- D) Malleability

7. In a four-bar linkage mechanism, what condition must be met for at least one link to perform a full revolution (Grashof's Law)?

- A) $s + l \leq p + q$**
- B) $s + l > p + q$
- C) $s + p = l + q$
- D) $s + q > l + p$

8. What is the name of the phenomenon where a metal gains strength through plastic deformation at temperatures below its recrystallization temperature?

- A) Annealing
- B) Work hardening**
- C) Tempering
- D) Quenching

9. The 'Stanton number' is a dimensionless quantity that relates heat transfer coefficient to what?

- A) Thermal conductivity
- B) Mass flux and heat capacity**
- C) Dynamic viscosity
- D) Surface tension

10. In thermodynamics, what is the 'Clausius inequality' used to determine?

- A) Energy conservation
- B) Entropy production**
- C) Enthalpy change
- D) Work potential

11. What is the relationship between the shear modulus (G), Young's modulus (E), and Poisson's ratio (ν) for an isotropic material?

- A) $G = E / (2(1+\nu))$**
- B) $G = E / (1+\nu)$
- C) $G = E * (1+\nu)$
- D) $G = E / (2(1-\nu))$

12. Which type of heat exchanger is most efficient for high-temperature and high-pressure applications?

- A) Shell and tube**
- B) Plate and frame
- C) Double pipe
- D) Regenerative rotary

13. What is the critical speed of a rotating shaft dependent upon?

- A) Its natural frequency**
- B) Its angular momentum
- C) Its surface finish
- D) The fluid density

14. In gear terminology, what is the 'addendum' defined as?

- A) Depth below the pitch circle
- B) Distance from pitch circle to top of tooth**
- C) Width of the gear tooth
- D) Circular thickness of the gear

15. The 'Peltier effect' is most directly associated with which technology?

- A) Gas turbines
- B) Thermoelectric cooling**
- C) Internal combustion
- D) Solar thermal

16. Which law states that the mass flow rate of a fluid through a pipe is constant if the density is constant?

- A) Bernoulli's principle
- B) Continuity equation**
- C) Navier-Stokes equation
- D) Darcy-Weisbach law

17. What is the Miller index notation (1 1 1) in crystallography referring to?

- A) A specific atom
- B) A crystal plane**
- C) A dislocation line
- D) A grain boundary

18. Which cycle is the ideal theoretical cycle for a gas turbine engine?

- A) Otto cycle
- B) Diesel cycle
- C) Brayton cycle**
- D) Rankine cycle

19. What is the unit of 'Dynamic Viscosity' in the SI system?

- A) Pascal-second**
- B) Newton-meter
- C) Poise
- D) Stokes

20. In fracture mechanics, what is the stress intensity factor (K) typically proportional to?

- A) Square root of crack length**
- B) Crack length squared
- C) Inverse of crack length
- D) Crack volume

21. What does a 'Pitot tube' measure in a fluid flow?

- A) Static pressure
- B) Stagnation pressure**
- C) Dynamic viscosity
- D) Flow rate

22. What is the 'Biot number' used to characterize?

- A) Fluid convection
- B) Internal vs external thermal resistance**
- C) Radiation heat loss
- D) Latent heat transfer

23. Which of these manufacturing processes involves the use of a high-energy electron beam?

- A) MIG welding
- B) EBW**
- C) TIG welding
- D) Plasma arc cutting

24. What is the purpose of 'doping' in material science?

- A) Increasing surface area
- B) Altering electrical properties**
- C) Reducing melting point
- D) Increasing density

25. In a bolted joint, what is the 'pre-load' intended to do?

- A) Increase joint stiffness**
- B) Decrease friction
- C) Lubricate the threads
- D) Prevent fastener vibration