

NCEES Fundamentals of Engineering (FE) Mechanical Practice Exam (Sample)

Study Guide



Everything you need from our exam experts!

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SAMPLE

Questions

- 1. What does a phase change refer to?**
 - A. The reaction of solids to heat**
 - B. The transition of a substance between solid, liquid, and gas phases**
 - C. Changing the temperature of a material**
 - D. The mixing of different states of matter**
- 2. Which of the following is a characteristic of turbulent flow?**
 - A. The flow is smooth and regular**
 - B. The flow occurs at low velocities**
 - C. The flow exhibits chaotic and irregular movement**
 - D. The flow is steady and predictable**
- 3. What does "yield strength" indicate about a material?**
 - A. It is the maximum stress before complete failure**
 - B. It is the stress where permanent deformation begins**
 - C. It is the stress within the elastic limit**
 - D. It represents the maximum tensile strength**
- 4. What is the difference between an ideal gas and a real gas?**
 - A. Ideal gas behaves perfectly under all conditions, real gas does not**
 - B. Real gas follows gas laws perfectly, while ideal gas does not**
 - C. Ideal gas has a higher density than real gas**
 - D. Real gas can be compressed more than ideal gas**
- 5. Why is aerodynamics important in engineering?**
 - A. It helps in the measurement of thermal efficiency**
 - B. It optimizes objects for motion through the air**
 - C. It reduces the effects of friction on surfaces**
 - D. It improves the fluidity of gases**
- 6. Which type of welding uses coated electrodes?**
 - A. SMAW**
 - B. TIG**
 - C. MIG**
 - D. GMAW**

- 7. In dynamics, what does the term "momentum" refer to?**
- A. The rate of change of velocity**
 - B. The product of an object's mass and its velocity**
 - C. The force applied to an object**
 - D. The energy of an object in motion**
- 8. What does the term "vibration" refer to in mechanical systems?**
- A. A steady motion of components**
 - B. Oscillating motion around an equilibrium position**
 - C. A complete stop of moving parts**
 - D. The slow deformation of materials under stress**
- 9. What is the preferred fluid in hydrostatic testing of boilers and pressure vessels?**
- A. Nitrogen**
 - B. Compressed air**
 - C. Water**
 - D. Hydraulic oil**
- 10. How is work quantified in physics?**
- A. As force multiplied by velocity**
 - B. As the product of force and distance**
 - C. As energy divided by time**
 - D. As distance divided by the angle of force applied**

Answers

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1. B
2. C
3. B
4. A
5. B
6. A
7. B
8. B
9. C
10. B

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Explanations

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1. What does a phase change refer to?

- A. The reaction of solids to heat
- B. The transition of a substance between solid, liquid, and gas phases**
- C. Changing the temperature of a material
- D. The mixing of different states of matter

A phase change refers to the transition of a substance between solid, liquid, and gas phases. This occurs when a substance absorbs or releases energy, primarily in the form of heat, which alters its temperature and structure, allowing it to change from one state to another. For example, when ice (solid) is heated, it can melt into water (liquid); conversely, when water is cooled, it can freeze into ice. Similarly, water can evaporate into steam (gas) when heated, and steam can condense back into water when cooled. Understanding these transitions is essential in thermodynamics, as they involve changes in energy associated with the interactions between molecules in different states of matter. While the other options touch on related concepts, they do not encompass the full definition of a phase change. The reaction of solids to heat may imply a change in temperature but does not specify the transition between states. Changing the temperature of a material is a process that can lead to a phase change but is not the phase change itself. The mixing of different states of matter describes a mixture rather than a singular transition of a material from one phase to another.

2. Which of the following is a characteristic of turbulent flow?

- A. The flow is smooth and regular
- B. The flow occurs at low velocities
- C. The flow exhibits chaotic and irregular movement**
- D. The flow is steady and predictable

Turbulent flow is characterized by chaotic and irregular movement of fluid particles. In this type of flow, the velocity and pressure of the fluid can vary drastically at different points within the flow field. This randomness leads to vortices and eddies, contributing to a complex flow pattern that is distinctly different from laminar flow, which is smooth and orderly. In contrast to turbulent flow, laminar flow typically occurs at lower velocities, where the flow remains uniform and predictable. The other characteristics mentioned—smooth and regular flow, low velocities, and steady and predictable behavior—are commonly associated with laminar flow rather than turbulent flow. Understanding that turbulent flow incorporates these chaotic behaviors is crucial for various applications in engineering, such as in the design of piping systems, aircraft aerodynamics, and environmental fluid dynamics, where predicting fluid behavior plays a significant role in system performance and efficiency.

3. What does "yield strength" indicate about a material?

- A. It is the maximum stress before complete failure
- B. It is the stress where permanent deformation begins**
- C. It is the stress within the elastic limit
- D. It represents the maximum tensile strength

Yield strength is a critical property of materials that signifies the stress level at which a material begins to deform plastically. This means that when the applied stress exceeds the yield strength, the material will undergo permanent deformation; it will not return to its original shape even if the load is removed. In engineering terms, understanding yield strength is essential for designing components that need to withstand certain loads without changing shape or function. It is a key indicator of how much stress a material can handle before it starts to exhibit inelastic behavior. The other choices represent different material properties: the maximum stress before complete failure describes ultimate tensile strength; stress within the elastic limit pertains to elastic modulus behavior; and maximum tensile strength refers to the peak stress a material can tolerate before failure. These definitions highlight the different stages of a material's response to stress and emphasize why yield strength specifically marks the threshold for permanent deformation.

4. What is the difference between an ideal gas and a real gas?

- A. Ideal gas behaves perfectly under all conditions, real gas does not**
- B. Real gas follows gas laws perfectly, while ideal gas does not
- C. Ideal gas has a higher density than real gas
- D. Real gas can be compressed more than ideal gas

The distinction between an ideal gas and a real gas is fundamentally rooted in the assumptions that define ideal gases as opposed to the behavior of real gases under various conditions. An ideal gas is a theoretical construct that follows the ideal gas laws perfectly, meaning it adheres to the equations of state without deviation regardless of pressure and temperature. It is characterized by assumptions such as negligible molecular volume and no intermolecular forces acting between the gas particles. In contrast, real gases deviate from this perfect behavior, especially at high pressures and low temperatures where interactions between molecules become significant, and their individual volumes can no longer be ignored. Real gases do not behave according to the ideal gas law under all conditions, leading to variations in pressure, volume, and temperature that are not predicted by the ideal model. While the other options do touch on aspects of gas behavior, they don't accurately capture the core difference inherent in the question. Real gases exhibit non-ideal behavior especially at certain conditions, which is the key point of distinction that is recognized by the statement of ideal gas behavior versus real gas behavior.

5. Why is aerodynamics important in engineering?

- A. It helps in the measurement of thermal efficiency
- B. It optimizes objects for motion through the air**
- C. It reduces the effects of friction on surfaces
- D. It improves the fluidity of gases

Aerodynamics is crucial in engineering primarily because it optimizes objects for motion through the air. This discipline involves analyzing the behavior of air as it interacts with solid objects, especially those designed for travel, such as aircraft, automobiles, and submarines. An understanding of aerodynamic principles allows engineers to minimize drag forces, enhance stability, and improve overall efficiency in motion through the atmosphere. When designing vehicles or structures that move through the air, engineers focus on shaping those objects to ensure that they can cut through air smoothly, reducing turbulence and drag. This optimization ultimately leads to better performance, reduced fuel consumption, and improved speed. The principles of aerodynamics are fundamental to ensuring that designs are not only functional but also competitive in terms of speed and efficiency. Other options, while related to aspects of engineering and the behavior of materials or fluids, do not capture the primary role of aerodynamics in optimizing designs for air movement.

6. Which type of welding uses coated electrodes?

- A. SMAW**
- B. TIG
- C. MIG
- D. GMAW

The process that uses coated electrodes is Shielded Metal Arc Welding (SMAW). In SMAW, also known as stick welding, a consumable electrode composed of a metal core surrounded by a flux coating is used to create the weld. When the electrode is heated and struck against the workpiece, an electric arc is established. The heat from the arc melts the electrode and the work surface, allowing the metal to fuse together. The flux coating serves multiple purposes: it generates gas that protects the weld pool from atmospheric contamination, creates a slag that helps protect the weld as it cools, and adds alloying elements to the molten weld metal which can enhance its properties. This combination of factors makes SMAW versatile and widely used in various applications, particularly in field and repair work. In contrast, the other mentioned welding processes—TIG (Tungsten Inert Gas), MIG (Metal Inert Gas), and GMAW (Gas Metal Arc Welding)—do not utilize coated electrodes. TIG welding relies on a non-consumable tungsten electrode, while MIG and GMAW use a continuously fed solid wire as the electrode with gas shielding to protect the weld, eliminating the need for coatings.

7. In dynamics, what does the term "momentum" refer to?

- A. The rate of change of velocity**
- B. The product of an object's mass and its velocity**
- C. The force applied to an object**
- D. The energy of an object in motion**

Momentum in dynamics refers to the quantity of motion that an object possesses. It is defined as the product of an object's mass and its velocity, which means that the greater the mass or the greater the velocity of an object, the more momentum it has. This concept is critical in analyzing how objects interact during collisions and in other dynamic scenarios, as momentum is conserved in isolated systems unless acted on by an external force. In essence, momentum encapsulates both how heavily an object weighs and how fast it is moving, providing a comprehensive measure of its motion. This relationship highlights why it is essential in the study of dynamics, as it helps predict how objects will behave when forces are applied, such as during impacts or when changes in motion occur. Understanding this fundamental definition allows for a deeper grasp of various mechanical principles and the behavior of moving objects, making it a vital concept in the field of engineering and physics.

8. What does the term "vibration" refer to in mechanical systems?

- A. A steady motion of components**
- B. Oscillating motion around an equilibrium position**
- C. A complete stop of moving parts**
- D. The slow deformation of materials under stress**

The term "vibration" in mechanical systems refers to oscillating motion around an equilibrium position. This definition captures the essence of how many mechanical systems operate. When a system experiences vibrations, it moves back and forth or oscillates around a central point, which is its equilibrium position. This phenomenon can occur in various contexts, such as in machinery, structures, and even in the dynamics of vehicles, where component parts may vibrate due to external forces or internal imbalances. The fundamental characteristic of vibration is that it involves a periodic or oscillatory movement. This oscillation can vary in frequency and amplitude, and it often plays a significant role in the analysis and design of mechanical systems, as excessive vibrations can lead to wear, noise, and failure of components. Understanding the nature of vibrations is critical for engineers to ensure the reliability and performance of mechanical systems. In contrast, steady motion involves constant velocity without oscillation, a complete stop of moving parts means no motion occurs, and slow deformation refers to the gradual changes in shape or size of materials under constant stress, rather than the rapid oscillation associated with vibration.

9. What is the preferred fluid in hydrostatic testing of boilers and pressure vessels?

- A. Nitrogen
- B. Compressed air
- C. Water**
- D. Hydraulic oil

Water is preferred in hydrostatic testing of boilers and pressure vessels primarily due to its availability, cost-effectiveness, and favorable physical properties. When conducting hydrostatic tests, the main goal is to ensure the integrity and strength of the equipment being tested. Water is incompressible, which means that its use can create a uniform pressure across the surface of the boiler or vessel, allowing for accurate detection of leaks or weaknesses. Additionally, using water allows for a safe test environment. In case of a failure during the testing process, water poses significantly less risk compared to gases, which can expand rapidly and cause violent ruptures or explosions. Water also has a high thermal capacity, making it suitable for applications involving temperature fluctuations. Other fluids like nitrogen or compressed air are gases that are more compressible and can lead to hazardous situations if a leak occurs. Hydraulic oils, while also incompressible, can pose environmental concerns and may impact testing results if contaminants are introduced. Overall, water remains the standard due to its balance of safety, effectiveness, and practicality in pressure testing applications.

10. How is work quantified in physics?

- A. As force multiplied by velocity
- B. As the product of force and distance**
- C. As energy divided by time
- D. As distance divided by the angle of force applied

Work in physics is defined as the energy transferred when a force acts upon an object to cause it to move a certain distance. The fundamental relationship that quantifies work is captured by the equation: $W = F \cdot d \cdot \cos(\theta)$ where (W) is work, (F) is the magnitude of the force applied, (d) is the displacement of the object, and (θ) is the angle between the direction of the force and the direction of motion. In a scenario where the force is applied in the same direction as the movement (i.e., $(\theta = 0^\circ)$), the equation simplifies to: $W = F \cdot d$ This shows that work is indeed quantified as the product of force and the distance over which that force is applied. Therefore, the correct choice accurately reflects this definition and formulation of work. The other options do not represent the concept of work correctly. For instance, force multiplied by velocity relates to power, which measures the rate of doing work over time. Additionally, energy divided by time is also related to power, and distance divided by the angle of force applied does not conform to any established