

Advanced Nuclear Energy Principles

Nuclear Physics And Engineering · Answer Key · 10 Questions

1. In a pressurized water reactor (PWR), what is the primary purpose of the boric acid dissolved in the primary coolant?

- A) To prevent corrosion of the stainless steel pipes
- B) To act as a neutron poison to control reactivity**
- C) To increase the thermal conductivity of the water
- D) To prevent the accumulation of hydrogen gas

2. Which isotope is primarily produced by neutron capture in U-238 within a nuclear reactor and subsequently decays into Plutonium-239?

- A) Uranium-235
- B) Thorium-232
- C) Neptunium-239**
- D) Protactinium-233

3. What is the specific role of a 'moderator' in a thermal nuclear fission reactor?

- A) To absorb excess heat generated by the fuel rods
- B) To slow down fast neutrons to increase the probability of fission**
- C) To prevent the release of radioactive gases into the atmosphere
- D) To increase the kinetic energy of neutrons to sustain the chain reaction

4. Which phenomenon describes why nuclear binding energy per nucleon is highest in the region of Iron-56, limiting the energy yield of fusion or fission processes?

- A) The mass defect principle
- B) The nuclear strong force saturation**
- C) The Pauli exclusion principle
- D) The electrostatic repulsion limit

5. In the context of nuclear waste management, what is the process of 'transmutation'?

- A) Converting liquid waste into stable solid glass (vitrification)
- B) Using neutron bombardment to convert long-lived isotopes into shorter-lived ones**
- C) The extraction of reusable plutonium from spent fuel rods
- D) The natural decay of radioactive isotopes over geological timescales

6. Which part of a nuclear reactor is specifically designed to minimize neutron leakage by reflecting them back into the core?

- A) Control rods
- B) Containment dome
- C) Beryllium reflector**
- D) Zircaloy cladding

7. Why does 'delayed neutron emission' play a critical role in the safety and control of nuclear reactors?

- A) It creates a surplus of heat energy during shutdown
- B) It allows the chain reaction to be controlled on a timescale of seconds rather than microseconds**
- C) It prevents the formation of Xenon-135 pits
- D) It reduces the amount of enrichment needed for fuel

8. What defines the 'critical mass' of a fissile material such as Uranium-235?

- A) The maximum amount of fuel a reactor can hold before melting
- B) The minimum amount of mass required to maintain a self-sustaining chain reaction**
- C) The total mass of radioactive waste produced annually
- D) The density required to trigger spontaneous fusion

9. Which gas is commonly used as a coolant in Advanced Gas-cooled Reactors (AGR) due to its chemical inertness?

- A) Helium
- B) Neon
- C) Carbon Dioxide**
- D) Argon

10. The 'CANDU' reactor design is distinct from most Western reactors primarily because it uses which of the following?

- A) Natural uranium and heavy water**
- B) Enriched uranium and light water
- C) Thorium fuel cycles exclusively
- D) Liquid sodium coolant