Fundamentals of Renewable Energy Science

Renewable Energy · Answer Key · 25 Questions

1. What is the primary physical process that converts sunlight directly into electricity in a photovoltaic cell?

A) The thermal expansion effect
B) The photoelectric effect
C) The piezoelectric effect
D) The thermionic emission effect

2. Which component in a wind turbine is responsible for converting the rotational mechanical energy into electrical energy?

A) Gearbox
B) Generator
C) Anemometer
D) Nacelle

3. In geothermal energy systems, what is the primary medium typically used to transport heat from the Earth's crust to the surface?

A) Molten iron
B) Water or steam
C) Natural gas
D) Liquid nitrogen

4. What is the maximum theoretical efficiency limit of a wind turbine, known as the Betz Limit?

A) 59.3%
B) 75.0%
C) 42.5%
D) 33.3%

5. Which type of solar technology uses mirrors to concentrate sunlight onto a receiver to produce high-temperature heat?

A) Photovoltaic cells
B) Concentrated Solar Power (CSP)
C) Solar thermal panels
D) Passive solar design

6. In a hydroelectric power plant, what determines the maximum potential energy of the water stored in a reservoir?

A) The flow rate only
B) The head height and water mass
C) The salinity of the water
D) The water temperature

7. What is the main chemical component of biogas produced by the anaerobic digestion of organic matter?

A) Methane
B) Hydrogen sulfide
C) Oxygen
D) Carbon monoxide

8. Which gas is commonly used as a storage medium for hydrogen fuel cells due to its high energy density per unit mass?

A) Helium
B) Neon
C) Hydrogen
D) Argon

9. What is the term for the ratio of the actual energy output of a power plant over a period of time to the theoretical maximum output?

A) Capacity factor
B) Efficiency ratio
C) Load demand
D) Energy density

10. Which law of thermodynamics dictates that energy cannot be created or destroyed, only transformed?

A) First Law
B) Second Law
C) Third Law
D) Zeroth Law

11. What type of ocean energy relies on the gravitational pull of the moon and sun?

A) Wave energy
B) Tidal energy
C) Ocean thermal energy conversion
D) Salinity gradient energy

12. Which semiconductor material is most commonly used in the manufacturing of commercial solar photovoltaic cells?

A) Gallium arsenide
B) Silicon
C) Cadmium telluride
D) Copper indium gallium selenide

13. What is the primary purpose of an inverter in a solar energy system?

A) To increase voltage
B) To store electricity
C) To convert DC to AC electricity
D) To track the sun's movement

14. In a pumped-storage hydroelectric plant, what is the function of the secondary reservoir?

A) To filter the water
B) To provide a place to store water during low electricity demand
C) To increase the water temperature
D) To act as a backup for tidal flow

15. Which layer of the Earth is the primary heat source for geothermal energy?

A) The crust
B) The inner core
C) The mantle
D) The atmosphere

16. What defines 'base load' power in an energy grid?

A) The minimum level of demand on an electrical grid over 24 hours
B) The maximum demand reached during peak summer
C) The energy provided only by fossil fuels
D) The total capacity of all connected wind turbines

17. What is the effect of increased temperature on the efficiency of a typical silicon solar cell?

A) Efficiency increases
B) Efficiency decreases
C) Efficiency remains constant
D) Efficiency becomes zero

18. Which substance is removed from flue gases in biomass plants to mitigate acid rain?

A) Nitrogen oxides
B) Sulfur dioxide
C) Noble gases
D) Water vapor

19. What is the primary mechanism that generates electricity in ocean thermal energy conversion (OTEC)?

A) Tidal currents
B) Temperature difference between deep and surface water
C) Wave height
D) Marine biomass

20. What is the main advantage of using a variable-speed drive in wind turbine operations?

A) It stops the turbine in high winds
B) It optimizes aerodynamic efficiency across different wind speeds
C) It eliminates the need for a gearbox
D) It prevents the nacelle from rotating

21. Which of the following is considered a 'dispatchable' renewable energy source?

A) Solar PV
B) Wind power
C) Biomass
D) Run-of-river hydro

22. What is the purpose of 'feed-in tariffs' in renewable energy policy?

A) To tax fossil fuels
B) To provide long-term contracts for renewable energy producers
C) To limit the size of solar panels
D) To control the price of residential electricity

23. Which physical property of hydrogen makes it difficult to store and transport compared to natural gas?

A) Low atomic mass
B) High boiling point
C) Low volumetric energy density
D) High reactivity with steel

24. What is the 'band gap' in the context of photovoltaic materials?

A) The energy required to move an electron from the valence band to the conduction band

B) The thickness of the silicon wafer

C) The distance between two solar panels

D) The speed of light through the cell

25. Which process converts biomass into liquid fuel such as ethanol?

A) Combustion

B) Fermentation

C) Pyrolysis

D) Gasification