Name: _____

1. Energy is neither created nor destroyed, only transformed. This statement corresponds to the principle of:
A) Conservation of mass
B) Second law of thermodynamics
C) Conservation of energy
D) Inertia.

2. Which of the following options represents a renewable primary energy source?
A) Natural gas
B) Coal
C) Solar radiation
D) Nuclear energy

3. What is the approximate average daily solar radiation in Guayaquil?
A) 1.5 kWh/m²
B) 2.5 kWh/m²
C) 5.5 kWh/m²
D) 8.5 kWh/m²

4. In Guayaquil, theoretically, what is the best cardinal orientation to install fixed solar panels to maximize annual production?
A) North
B) South
C) East
D) West

5. The unit of energy in the International System (SI) is:
A) Watt
B) Joule
C) Voltage
D) Newton

6. What is the fundamental physical principle behind photovoltaic generation?
A) Ohm's Law
B) Thermoelectric effect
C) Photoelectric effect
D) Joule's Law

7. The "Ampere-hours" (Ah) of a battery represent:
A) The maximum voltage it can deliver
B) The charge capacity it can supply over time
C) The number of charge cycles
D) The instantaneous system power

8. What is direct radiation?
A) Radiation reaching the ground after being scattered by the atmosphere
B) Radiation reflected by nearby objects
C) Solar radiation reaching the surface in a straight line without deviation
D) Radiation emitted by the Earth's surface at night.

9. What happens when a solar panel is partially shaded?
A) Its voltage increases
B) It heats up less
C) It produces more energy
D) Its production decreases

10. What does it mean when a solar panel has 18% efficiency?
A) It converts 18% of solar heat into electricity
B) It converts 18% of the received solar energy into electricity
C) It loses 18% of the generated energy
D) It achieves 18% efficiency over voltage

11. What type of energy is transformed in a hydroelectric power plant?
A) Chemical to electrical
B) Wind to mechanical
C) Potential to electrical
D) Solar to kinetic

12. The height between the reservoir and the turbine is known as:
A) Static level
B) Suction pressure
C) Gross head
D) Nominal flow rate

13. Which of the following turbines is an impulse (action) turbine?
A) Kaplan
B) Francis
C) Pelton
D) Propeller

14. Which of the following is an environmental disadvantage of large hydroelectric dams?
A) Low efficiency
B) They produce CO_2
C) Disruption of aquatic ecosystems
D) Use of fossil fuels

15. What is the function of the spillway in a hydroelectric plant?
A) Increase the flow rate
B) Generate additional energy
C) Store water
D) Release excess water to prevent overflow

16. Which variable directly determines the power generated in a hydroelectric system?
A) Applied voltage
B) Water temperature
C) Flow rate and head
D) Channel length

17. The average conversion efficiency of a hydroelectric power plant is approximately:
    A) 30%
    B) 50%
    C) 90%
    D) 15%

18. What occurs in the Southern Hemisphere on June 21?
    A) Autumn equinox
    B) Spring equinox
    C) Summer solstice
    D) Winter solstice

19. What is the approximate tilt angle of the Earth's axis?
    A) 23.5°
    B) 25°
    C) 20°
    D) 22.5°

20. Which of the following is NOT a renewable energy source?
    A) Hydroelectric
    B) Coal
    C) Biomass
    D) Wind

21. What does "Voc" mean in a solar panel?
    A) Open-circuit voltage
    B) Short-circuit current
    C) Operating voltage
    D) Maximum allowable voltage

22. Which component of a photovoltaic system converts DC into AC?
    A) Solar panel
    B) Charge controller
    C) Inverter
    D) Battery

23. The typical efficiency of a commercial monocrystalline solar panel is:
    A) 1–5%
    B) 10–15%
    C) 16–25%
    D) 35–45%

24. Which of the following turbines does NOT have cavitation problems?
    A) Francis
    B) Kaplan
    C) Pelton
    D) Propeller

25. What does the term "tilt angle β" indicate in a photovoltaic system?
    A) Angle between sunlight and the horizontal
    B) Angle between the panel and the horizontal
    C) Angle of the Sun projected on the surface
    D) Angle between the panel and the north-south direction

26. A land area of 5 hectares is available. Each solar panel measures 2 × 1.5 m (useful area) and has 500 Wp with 18% efficiency. The average solar radiation is 4.5 kWh/m²/day, inverter efficiency is 80%, transformer efficiency is 90%, and only 80% of the land can be used for panels.
    Calculate the installed capacity and the annual delivered energy.

Installed Capacity (kWp): _____
Annual Energy (kWh/year): _____

27. Four batteries are connected in series, each rated at 12 V and 5 A. Calculate the total voltage and the current at the output terminals.
    Total Voltage (V): _____
    Current (A): _____

28. A house has the following appliances:

Appliance	Qty	Power (W)	Hours/day
Light bulbs	10	20	4
Refrigerator	1	500	4
Iron	1	1000	0.1
Television	1	250	8

Calculate:
Total Power: _____
Total Daily Energy: _____

29. A hydroelectric project has a design flow rate of 20 m³/s and generates 15 MW. With an overall efficiency of 85%, calculate the gross head required for the system.
    Gross Head (m): _____

30. Determine the number of solar panels needed to supply the house described in exercise 28, considering:
- Minimum daily solar radiation: 3.8 kWh/m²
- Inverter efficiency: 90%
- Maximum panel power: 500 Wp
  Number of panels: _____

$$P = \rho \cdot g \cdot H_B \cdot Q \cdot \eta_{total}$$

$$Eac\ ' = Eac\ /\ \eta_{inv}$$

$$E_{DEMANDA} = 1.25^{*}(Eac' + Edc)$$

$$P_{max} = (E_D\ /\ E_{Disponible})^{*}1kW/m^2\ )^{*}\ FS$$

$$N_{paneles} = 1.1^{*}\ Pmax\ /\ C$$

$$FS = 0.95$$