



### Alternative Energy Sources

1. What is the main difference between a battery and a fuel cell?
2. What are the by-products produced by a fuel cell?
  - a.  $\text{H}_2\text{O}$  and heat
  - b. Hydrogen and heat
  - c. Hydrogen and Oxygen
  - d. Oxygen heat
3. The electrodes in a fuel cell are porous so that gases can flow through them.
  - a. True
  - b. False
4. In a fuel cell, hydrogen is supplied to the
  - a. Anode
  - b. Cathode
  - c. Electrolyte
  - d. External load
5. The cathode is the \_\_\_\_\_ terminal of the cell.
  - a. Negative
  - b. Positive
6. In a fuel cell, the membrane electrolyte is coated with a/an
  - a. Catalyst
  - b. Inhibitor
  - c. Plastic
  - d. Polymer
7. What happens in a fuel cell reaction?
8. Pure oxygen and hydrogen are
  - a. Easily stored
  - b. Easy to transport
  - c. Expensive to produce
  - d. Inexpensive to produce



9. A direct methanol fuel cell get its oxygen from
  - a. Oxygen found in methanol
  - b. Oxygen found in the membrane
  - c. Oxygen in the air
  - d. Supply of pure oxygen
10. A liquid mixture of methanol and water provide the direct methanol fuel cell with
  - a. Carbon dioxide
  - b. Electrons
  - c. Hydrogen
  - d. Oxygen
11. Another name for methanol is
  - a. Ethyl alcohol
  - b. Isopropyl alcohol
  - c. Rubbing alcohol
  - d. Wood alcohol
12. Fuel cells used today can be as big as a
  - a. Desktop PC
  - b. Kitchen trash bin
  - c. Refrigerator
  - d. Small house
13. Name three current uses for fuel cells.
14. The best way to test a battery is
  - a. Across a large load resistor
  - b. To take an output current measurement
  - c. Under normal operating conditions
  - d. With no load (open circuit)
15. What is another name for a solar cell?
16. When sunlight hits a solar cell, a voltage is produced in the range of
  - a. 0.3 to 1.5 volts
  - b. 2.1 to 4.8 volts
  - c. 5.2 to 10.5 volts
  - d. 20 to 40 volts
17. The amount of voltage produced by a solar cell is dependant on both the \_\_\_\_\_ of the cell and the \_\_\_\_\_ hitting the cell.



18. Solar cells are usually connected in groups called array due to the
- Fragile nature of each cell
  - Low output voltage produced by one cell
  - Safety concerns
  - Small dimension of each cell
19. Most solar cells are made with
- Germanium
  - Phosphorus
  - Selenium
  - Silicon
20. The structure of a solar cells is a PN junction with the N-type material forming the
- Negative terminal
  - Positive terminal
21. When light is absent, the PN junction in a solar cell act as a/an
- Biased diode
  - Closed switch
  - Conductor of electrons
  - Unbiased diode
22. Name the four light characteristics
23. Light intensity is a measure of
- How far away the light source is
  - How far into the cell the light travels
  - How long the cell is exposed to light
  - How much light is reaching the cell
24. The light intensity of sunlight is approximately
- 100 fc
  - 2000 fc
  - 5000 fc
  - 20,000 fc
25. Another unit of measure for light intensity in solar cells is
- Air mass units
  - Amperes
  - Lumens
  - Watts



26. Since light frequencies are so high, \_\_\_\_\_ is typically used to define the light frequency or color.
- Cycles
  - Distance
  - Length
  - Wavelength
27. The most common measure for wavelength is
- Angstroms
  - Centimeters
  - Microns
  - Nanometers
28. The range of wavelengths that are visible to the human eye is
- 100 to 400 nm
  - 400 to 700 nm
  - 700 to 1000 nm
  - Anything above 1000 nm
29. Wavelengths in the infrared range are \_\_\_\_\_
- Below 400 nm
  - 400 to 500 nm
  - 500 to 700 nm
  - Above approximately 800 nm
30. The maximum current in a solar cell is the typically \_\_\_\_\_ per square centimeter under full sunlight.
- 10 mA
  - 20 mA
  - 40 mA
  - 50 mA
31. Will the solar cell be damaged if it is shorted to test for maximum current?
- Yes
  - No
32. In solar cells, as the light intensity decreases, the \_\_\_\_\_ remains relatively constant but the \_\_\_\_\_ drops significantly.
- Current, power
  - Current, voltage
  - Voltage, current
  - Voltage, power



33. What is the internal resistance of a solar cell with an open circuit voltage of 0.5V and a short circuit current of 250 mA?
- 2 ohms
  - 12.5 ohm
  - 5 ohms
  - 50 ohms
34. Name three common applications for solar cells.
35. A 12-volt battery with a recharging voltage of 15 volts would require a solar panel with \_\_\_\_\_ cells.
- 12
  - 15
  - 24
  - 32
36. In a recharging circuit, the solar panel is connected in \_\_\_\_\_ with the battery and a \_\_\_\_\_ diode.
- Parallel, PN junction
  - Series, blocking
  - Series, light emitting
  - Series, Zener
37. A large solar panel can keep a keep a set of storage batteries
- At room temperature
  - From charging
  - From leaking
  - Fully charged
38. The storage batteries usually supply power to one or more
- Homes
  - Inverter units
  - Offices
  - Portable device
39. One disadvantage of the solar panels is that
- An external power source is required
  - Each solar cell has a short life span
  - Solar panels are limited to 50 cells
  - They are not economical unless sufficient sunlight is always available
40. When testing a solar cell, the cell must be fully illuminated and two quantities measured. Name them.



41. Since the position of the sun moves, sophisticated solar arrays are optimized by
  - a. Adding an external light source
  - b. Positioning the cells in various fixed positions
  - c. Positioning the cells perpendicular to the sun at high noon
  - d. Using motors to change the position of the array automatically
42. In most practical applications, the solar cells are placed in a fixed position facing
  - a. North with a  $15^\circ$  tilt
  - b. North with a tilt equal to the latitude of the location
  - c. South with a  $15^\circ$  tilt
  - d. South with a tilt equal to the latitude of the location
43. An ultra-capacitor stores large amounts of energy which can
  - a. Supply a constant voltage over a long period of time
  - b. Supply a small capacitance to a load
  - c. Supply long term current to a load
  - d. Supply short term peak current to a load
44. Ultracapacitors are also known as
  - a. Ceramic capacitors
  - b. Electrolytic capacitors
  - c. Mega capacitors
  - d. Super capacitors
45. Ultracapacitors have a typical capacitance value of
  - a. 4 to 6 Farads
  - b. 4 to 6 milliFarads
  - c. 4 to 6 microFarads
  - d. 4 to 6 nanoFarads
46. If ultracapacitors are put in parallel, you can increase the
  - a. Capacitance value
  - b. Internal resistance
  - c. Temperature rating
  - d. Voltage rating
47. Ultracapacitors are usually used
  - a. Alone in a circuit
  - b. With a DC power source
  - c. With an AC power source
  - d. With other ultracapacitors



48. The main application of ultracapacitors is to
- a. Eliminate the need for a DC power supply
  - b. Provide additional voltage to a DC power supply
  - c. Recharge a DC power supply
  - d. Temporarily assist a DC power supply during peak loads
49. Why can't batteries be used in place of ultracapacitors?
50. Name three uses for ultracapacitors.