

WIND POWER TEST

Team Name _____

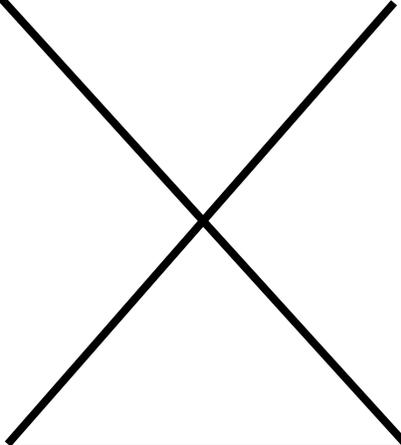
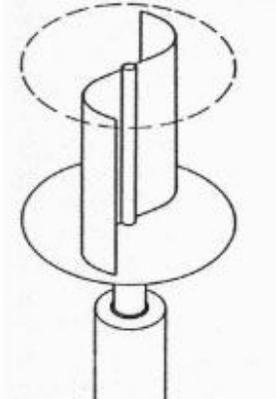
Team Number _____

Competitors' Names _____

1. FINAL ANSWERS MUST BE WRITTEN ON THE LINES PROVIDED.
2. Write Team Name, Team Number and competitor names on 1st page, and team number at the top of all other pages.
3. You may separate the exam pages, but you must clip / staple them together before turning them in.
4. Turn in all exam materials at the end of the event.
5. Each answer is worth one point unless otherwise indicated.
6. When time is up, the time is up. Continuing to write after the time is up risks immediate disqualification.
7. You will be notified when it is your turn to do device testing. When notified, please move as quietly as possible to not disturb other teams.
8. Cell phones must be put away. Notify supervisor of any emergency needs.

Total _____ / 55

For #1-3, name the type of windmill and classify it as a Horizontal Axis Wind Turbine (HAWT) or Vertical Axis Wind Turbine (VAWT)

Windmill example	Is this an example of a VAWT or a HAWT?	Specific name given for the example
<p>1</p> 	<p>1</p>	
<p>2</p> 	<p>2</p>	<p>2</p>
<p>3</p> 	<p>3</p>	<p>3</p>

For #4-9, refer to the diagrams in #1-3, then match each characteristic with the correct windmill (1,2,or 3). Choose only the single best answer for each description.

- 4. Tip speed ratios of 1 or below _____
- 5. Ideal for areas with turbulent or variable winds, but efficiency is low— 15% _____
- 6. High efficiency, but often requires an external power source or a second rotor to initiate movement _____
- 7. Must be turned to face into the winds _____
- 8. Turns slowly with very high torque, so this design is better suited for work like pumping water than generating electricity. _____
- 9. This design operates similarly to a cup anemometer. _____

For questions 10-16, match these choices to the descriptions. Each choice may be used once, more than once, or not at all. When indicated, more than one choice is required.

- a. Biomass
- b. Geothermal
- c. Hydroelectric
- d. Nuclear
- e. Wind
- f. Hydrogen
- g. Solar

- 10. Which is not a renewable source of energy? _____
- 11. What **TWO** sources of energy for electrical generation rely on release of thermal energy from radioactive decay? _____
- 12. Which includes methane produced by some methanogen bacteria? _____
- 13. For which **TWO** resources is electricity generation most disruptive of animal migrations? _____
- 14. Which **THREE** of these resources employ heated water for moving electrical turbines? _____

15. Which **TWO** energy sources can be used to generate electricity without use of turbines? _____

16. In 2016, 2% of new jobs in the U.S. were associated with which resource? _____

For questions 17-22, match the form of energy storage with its example or description. Each choice may be used once, more than once, or not at all.

- A. Capacitor
- B. Battery
- C. Flywheel
- D. Pumped hydroelectric storage
- E. Compressed Gas

17. These **TWO** energy storage methods move matter to storage areas during periods when electricity demand is low, then release the matter and use it to spin electricity generating turbines during periods of higher demand. _____

18. This type of energy storage device is made of two conductive plates that can become oppositely charged, separated by an insulating material _____

19. Chemical reactions release electric current from this energy storing device. _____

20. During a thunderstorm, a cloud serves as a natural version of this device. _____

21. This type of energy storage requires two height separated reservoirs. _____

22. This is sometimes called an electromechanical storage device. _____

23. Electricity is transmitted over long distances at very high voltage for two reasons:

i. _____

ii. _____

24. (3 pts) What percent of energy will be lost during transmission of 130 watts of electricity if it is transmitted with a current of 1.3 amp over a conductive wire having a resistance of 12 ohms?

25. (3 pts) How much electrical power is available from a current of 15.4 amps at a voltage of 30.36 volts? _____

26. Which of these two metals would comprise a transmission wire having lower tensile strength? A) Copper B) Aluminum _____

27. Which of these two metals would comprise a transmission wire having lower conductivity? A) Copper B) Aluminum _____

28. Which of these two metals would comprise a transmission wire having lower weight? A) Copper B) Aluminum _____

29. Which of these two metals would comprise a transmission wire having lower cost per meter? A) Copper B) Aluminum _____

30. What part of a wind power generator is show below?

A) Turbine B) Gearbox C) Yaw controller D) Capacitor _____



31. Voltage is the measure of: _____

- A. the amount of work done per group of charge
- B. the amount of charge per unit of work
- C. the number of Coulombs per Joule
- D. the amount of work per unit energy
- E. the number of Joules per electron

32. Voltage is analogous to: _____

- A. energy
- B. Joules
- C. Pressure
- D. Charge
- E. Coulombs

33. Power is a measure of how much: _____
A. energy is used over a period of time
B. resistance a device has over time
C. current passes through a device over time
D. energy is used by a resistance
E. voltage passes through a device over time

34. If you connect a capacitor to a battery, what will happen? _____
A. The battery will charge up.
B. The capacitor will discharge and release energy.
C. Current will flow, and the capacitor will charge up, then release its energy.
D. Current will flow, and the capacitor will charge up.
E. Nothing will happen.

35. What is the benefit of using capacitors instead of batteries? _____
A. They can release charge (energy) more quickly and release energy repeatedly in bursts.
B. They are cheaper to make than batteries.
C. They can release charge (energy) more slowly than a battery and release energy repeatedly in bursts.
D. They are more efficient than batteries.
E. They release more energy than batteries.

36. Which of the following statements is true concerning high voltage, long-distance power transmission: _____
A. It is typically a single-phase, DC power system
B. It is typically a single-phase AC power system
C. It is typically a three-phase, DC power system
D. It is typically a three-phase AC power system

37. Earliest known windmills of any function were found in: _____
A. Egypt B. Iran C. Holland D. Denmark E. Scotland

38. Earliest known windmill used to generate electricity was built in 1860 in: _____
A. Egypt B. Iran C. Holland D. Denmark E. Scotland

39. The first electricity generating windmills having blades whose pitch could be adjusted and which could be turned to face the wind was built about: _____
A) 1860 B) 1880 C) 1900 D) 1920 E) 1940

40. Which of these was most important for stimulating the resurgence of United States interest in wind generated electricity during the late 1900's? _____
- A) The cold war raised concerns of Russian fossil fuel embargos
 - B) Concerns about greenhouse gas emissions causing climate change
 - C) The 1970's oil crisis raised concerns about national fuel dependence
 - D) The war with Iraq raised concerns about oil supply interruptions
 - E) The Environmental Protection Agency enforced tighter air pollution standards.
41. Electromagnetic induction was discovered by _____
- A) Alexander Graham Bell
 - B) Thomas Edison
 - C) Benjamin Franklin
 - D) Michael Faraday
 - E) Nikola Tesla
42. The first known offshore windfarm was built in 1991 off the coast of _____
- A) United States
 - B) Scotland
 - C) Denmark
 - D) United Kingdom