Eastside Invitational
Jan 28, 2017
Wind Power Div C - Part 2

Team Information

Team Name and number:_____

Name of Students: _____ and _____

Instructions

Wind Power is a combination of hands on activities and written test portion. 50% of the points will be for the written test portion and 50% for the device demonstration.

The teams will be interrupted from the written portion of the test to test their blade assembly.

The teams will be rotated to test on the Low Speed Fan and on the High Speed Fan

You may not finish the test in the allotted time. Therefore, you are encouraged to complete the questions in any order that you choose.

The test may be separated and split between the two team members as long as all the papers are placed back in the proper order.

Answer all questions on the answer sheet. **Only** answers written on the answer sheet will be graded. You may write on the test packet. If you need more room, you may also attach extra paper.

Unless otherwise stated, there is only one answer to each question. Where there is more than one answer, the question will include "Check all that Apply".

Tie breaker questions are labeled with asterisk (*) next to the question

Test Score: _____ / 50

Science Olympiad
January 28, 2017

Eastside Invitational
Wind Power Test

Team Name _____ Team Number _____

Record your answers her
Only this page will be graded

Answer Sheet (Questions 1-21: 1 point each; 21-34: 2 points each; 35: 3 points)**:**

1. _____	11. _____	21._____	31._____
2. _____	12. _____	22._____	32._____
3. _____	13. _____	23._____	33._____
4. _____	14._____	24._____ _	34._____
5. _____	15._____	25._____	35._____
6._____	16._____	26._____	
7. _____	17._____	27._____	
8. _____	18. _____	28._____	
9. _____	19._____	29._____	
10. _____	20._____	30._____	

Test Score:_____ / 50 ___

Questions 1 to 21: 1 point each

1. In ancient Babylon, the first true windmill, a machine with vanes attached to an axis to produce circular motion, may have been built as early as _____.

a. 900 B.C.
b. 1200 B.C.
c. 1500 B.C.
d. 2000 B.C.

2. The first windmill to be used for the production of electricity was in which country?

a. Egypt
b. Scotland
c. Holland
d. China

3. The wind speed will increase considerably in a mountain pass due to the inverse relationship between speed and pressure. What explain this effect?

a. Pascal's principle
b. Archimedes' principle
c. Bernoulli's principle
d. Newton's principle

4. A wind turbine generator converts the wind's _____ energy to _____ energy

a. Solar/Kinetic
b. Kinetic/Chemical
c. Electrical/Mechanical
d. Kinetic/Electrical

5. When charging a battery, _____ energy is being converted to _____ energy.

a. Kinetic/Electrical
b. Chemical/Electrical
c. Electrical/Chemical
d. Electrical/Kinetic

6. Which modern vertical axis design is optimal for low-speed, high-torque use?

a) Savonius b) Darlington c) Broom d) Darrieus e) Maxwell

7. How is electricity utilization measured? Choose one.

a. Kilowatt hour
b. Meter
c. Horsepower
d. Pound

8, The ratio between the number of turns on the secondary to the turns on the primary of a transformer is known as

a. Power factor ¨
b. Winding factor
c. Efficiency

d. Turns ratio

9. Core losses in a trans former are caused by
a. Hysteresis loss
b. Eddy current loss
c. Both a and b
d. None of the above

10. What are the important conditions one should consider before transformers are connected in parallel
a. Voltage ratio ¨
b. Phase sequence
c. Polarity ¨
d. All of the above

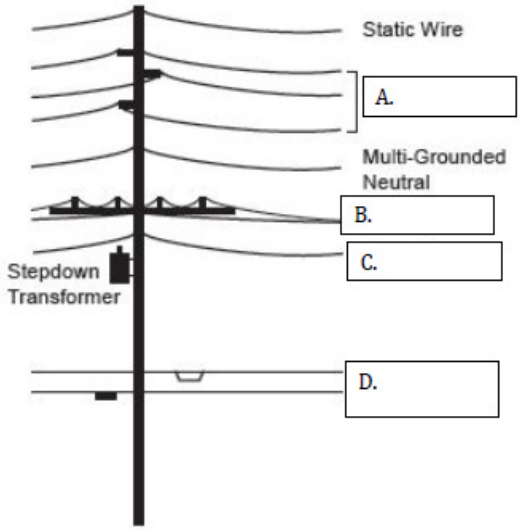
11. An inverter does this:
a. Converts AC to DC
b. Converts DC to AC
c. Decreases the voltage
d. Increases the amps

12. What's the difference between solar photovoltaic and solar thermal power?
a. Nothing, they're both ways of getting power from the sun
b. Solar thermal is for heating water; photovoltaics are for electricity
c. They both generate electricity but one uses solar panels, the other uses mirrors
d. None of the above

13. The NREL is the only federal laboratory dedicated to research, development, commercialization, and deployment of energy efficiency technologies. What does the acronym NREL stand for?

National Renewable Energy Laboratory

14-17. Below is a typical utility pole



14. What is A?
15. What is B?
16. What is C?
17. What is D?

18. What is Power Factor?
a. Power Factor is the cosine of the phase angle between current and voltage
b. Power Factor is the ratio of true power to apparent power
c. Power factor is the relationship (phase) of current and voltage in AC electrical distribution systems.
d. A and B
e. A, B, C
f. B and C

19. A quantity often useful in electric circuit analysis is _____, defined as the reciprocal of resistance:
a. Inductance
b. Conductance
c. Resistivity
d. Current

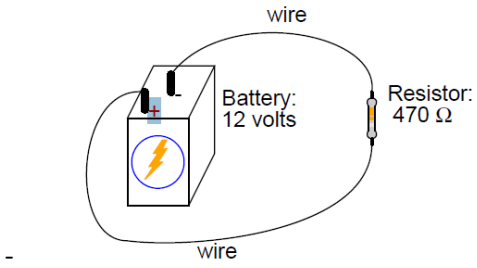
20. How much energy does an incandescent light bulb rated at 100 W use in one hour?
a. 36,000 J
b. 3600 J
c. 360,000 J
d. 360 J

21, A small motor does 4000J of work in 20 seconds. What is the power of the motor in watts?
a. 0.005 Watts
b. 80,000 Watts
c. 200 Watts
d. None of the Above

Questions 21 to 34: 2 points each

22. Suppose an electric current of 1.5 microamps (1.5 μA) were to go through a resistance of 2.3 mega-ohms (2.3 M). How much voltage would be "dropped" across this resistance?

23. Calculate the amount of current (I) that will go through the resistor in this circuit:



24. A device has the internal resistance of 300 ohms. If plugged into and outlet of 220 volts, how much power will it consume?

25. A factory has a peak demand of 12 MW and an average power demand of 9.86 MW. Find the load (demand) factor.

26. A piece of copper wire ($\rho = 1.724 \times 10^{-8}$ Ωm) has a diameter of 12.0 mm. If the wire has a length of 50.0 ft., what is the internal resistance of the wire?

27. A large cylindrical 1250 kg flywheel with radius of 6.50 m is being used to store energy. If it has a rotational speed of 95,500 RPM's, what is the rotational kinetic energy available to be converted back into electricity?

28. If the generator that is attached to the flywheel in the previous problem is 83.5% efficient, how much electrical energy could be produced?

29. A spherical water tank is placed on a tower that is 12.6 m tall is filled using energy from a wind turbine. If the tank has a radius of 15.3 m, and the water inside has an average density of 1.000 x 10^3 kg/m^3, what is the maximum stored energy of the tank?

30. A 36% efficient coal power plant burns 8.5 million kilograms of coal in a day. (Assume the heat of combustion of coal to be 31 MJ/kg) How many watts of power is produced per day?

31. Sunlight with intensity of 685 W/m^2 is captured with a solar panel that is 63.5% efficient. If during transmission and conversion 42.5% was lost and the panel was 525 cm by 242 cm, how much usable energy does the house receive?

32. A 1547 kW generator can produce how much energy during a 24 hour day? Assume wind speed remains constant at the ideal wind speed for that turbine.

33. If a new blade design has a radius that is double the radius of a previous design, what could be expected about the theoretical power output of the new design?

34. If the new design has double the radius and the wind speed in also double, what can now be expected about the theoretical power output of the new design?

Question 35: 3 points

35. A circuit has the following values:
    Applied voltage = 240;
    Current = 12 Amperes;
    Power factor = 0.83
    Find True power of the circuit