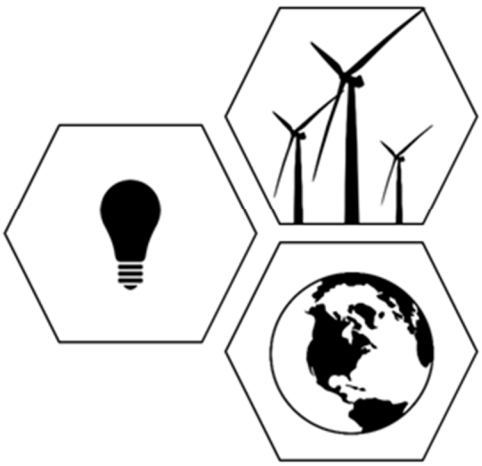
2017 Chinook Invitational
Division B

Wind Power Written Test

Team Number: _____
School/Team: _____
Participant Names: _____ & _____

Instructions:

- Sheets may be double sided, check both sides.
- Circle the correct answer, if it is unclear which answer has been selected, points may not be given.
- Calculators are allowed.
- This packet may be unstapled and divided, but if you chose to do this, make sure each page has your team information.



Final Score __/25 Scorer Initials: ____

Team Number: ____ School/Team: _____

1. The theoretical limit for the efficiency of a wind turbine is 59.3%, what is this ceiling called?

   A. Ohm's Limit, or Ohm's Law
   B. Joule's Limit, or Joule's Law
   C. Edison's Limit, or Edison's Law
   D. Betz's Limit, or Betz's Law
   E. Murphy's Limit, or Murphy's Law

2. Identify the type of wind turbine pictured below:

   A. Giromill
   B. Darius
   C. Savorious
   D. Saphonian
   E. Piezoelectric

3. What kind of energy do wind turbines convert into electromagnetic energy?
   A. Potential
   B. Chemical
   C. Thermal
   D. Gravitational
   E. Kinetic

4. What's the most aerodynamically efficient number of blades for a practical wind turbine?
   A. 1
   B. 2
   C. 3
   D. 4
   E. 5

5. How much power is available in the wind with a wind speed of 78.2m/s and an air density of 0.408Kg/m^3, and a turbine sweep area of 1330m^2?
   A. 40 MW
   B. 70 MW
   C. 100 MW
   D. 130 MW
   E. 160 MW

6. What is the effect of temperature on power transmission?
   A. Lower losses, because as metal's temperature increases, its resistance decreases.

B. Lower losses, because as metal's temperature increases, so does its conductivity.
C. Greater losses, because the higher temperature requires a lower current to avoid melting the line.
D. Greater losses, because as metal's temperature increases so does its resistance.
E. No effect.

7. Identify the equation for power loss
   A. $P_L = I/R^2$
   B. $P_L = I^2R$
   C. $P_L = IR$
   D. $P_L = IR^2$
   E. $P_L = R/I^2$

8. Which of the following is the SI unit of resistance?
   A. Amps
   B. Farads
   C. Ohms
   D. Coulombs
   E. Hertz

9. What's the most commonly-used conductor metal for overhead power lines?
   A. Copper
   B. Silver
   C. Gold
   D. Zinc
   E. Aluminum

10. What is the primary disadvantage of HVDC over AC for long distance power transmission.
   A. Greater construction cost
   B. High power loss in transmission
   C. Danger to birds
   D. Difficulty to integrate with renewable energy sources
   E. Expensive conversion stations

11. If coal with an energy density of 24MJ/kg is burned in a power plant with an overall conversion efficiency of 33%, how much coal per second will be needed to produce 100MW of electricity?
   A. 4 kg/s
   B. 13 kg/s
   C. 15 kg/s
   D. 25 kg/s
   E. 55 kg/s

12. Assuming an efficiency of 100%, using $9.81 m/s^2$ as an approximation for gravity, for a dam producing 1MW of electricity with a flow rate of 10000 L/s what is the required head?
   A. 1 m
   B. 10 m
   C. 50 m
   D. 100 m

E. 1000 m

13. What is the ultimately the source of all “renewable energy”?
    A. Fission
    B. Fusion
    C. Earth’s Gravity
    D. Earth’s Core
    E. A Giant Battery

14. Which of the following is not a nuclear reactor accident?
    A. Three Mile Island Accident
    B. Chernobyl Disaster
    C. Fukushima Disaster
    D. Tunguska Incident
    E. K-19 Accident

15. Hydroelectric power plants convert _____ energy and _____ energy into electromagnetic energy?
    A. Potential, Kinetic
    B. Chemical, Thermal
    C. Potential, Thermal
    D. Thermal, Kinetic
    E. Chemical, Kinetic

16. Which of the following energy transfer chains best represents pumped-storage hydroelectricity.
    A. Potential > Kinetic > Thermal > Electromagnetic
    B. Potential > Kinetic > Electromagnetic
    C. Electromagnetic > Kinetic > Potential >Kinetic > Electromagnetic
    D. Electromagnetic > Thermal > Kinetic > Electromagnetic
    E. Electromagnetic > Chemical > Thermal > Kinetic > Electromagnetic

17. Which of the following types of batteries is non-rechargeable?
    A. Nickel-cadmium
    B. Nickel-metal hydride
    C. Zinc-carbon
    D. Lithium-ion
    E. Lead-acid

18. What’s the main source of energy loss for flywheel storage?
    A. Inertia
    B. Friction
    C. Temperature
    D. Flux-Capacitation
    E. Resistance

19. Which of the following has the lowest specific energy density?

A. Silicon
B. Hydrazine
C. Glucose
D. Methanol
E. Butanol

20. Worldwide, the largest-capacity form of grid energy storage is
    A. Lithium-ion Batteries
    B. Thermal Storage
    C. Flywheels
    D. Pumped Storage Hydroelectricity
    E. Hydrogen Storage

21. Washington's largest wind farm, Windy Point Wind Farm, is located in
    A. Klickitat County
    B. King County
    C. Walla Walla County
    D. Columbia County
    E. Snohomish County

22. The number of wind-powered mills peaked around
    A. 1820
    B. 1830
    C. 1840
    D. 1850
    E. 1860

23. Which state generates the most electricity from wind power?
    A. California
    B. Texas
    C. New Mexico
    D. Washington
    E. Nebraska

24. What was approximately the cumulative global wind power installed capacity in 2016?
    A. 275 GW
    B. 335 GW
    C. 375 GW
    D. 435 GW
    E. 475 GW

25. Windmills began to appear in Europe in which century?
    A. Eleventh
    B. Twelfth
    C. Thirteenth

D. Fourteenth
E. Fifteenth