

Invitational test:

1. Power in the Wind

$$P = \frac{1}{2} \rho A V^3$$

$$\text{Power} = \frac{1}{2} \times \text{AIR DENSITY} \times \text{BLADE AREA} \times \text{WIND VELOCITY}^3$$

From this equation, which variable seems to determine the power produced by a fan blade the most?

Wind velocity b/c it is cubed

2. Why do wind turbines spin slowly, only 12-20 rpms?

--quieter, and more aesthetic

3. What is one problem that results must be overcome to compensate for these slow turbines?

must use an expensive heavy duty gear box

4. Modern turbines can produce wind when the wind speed is over

a. 5 mph b. **7 mph** c. 10 mph d. 15 mph

5. What is yawing used for in turbines?

a. improve aerodynamics of the blades

b. increase the gear ratio

c. rotate the turbine into the wind

d. decrease the lift of the turbine

6. a 7MW turbine can power 3,000 homes in Germany, but only 2,000 homes in the USA, why is this?

We use so much more electricity per household

7. Most modern wind turbines have _____ blades

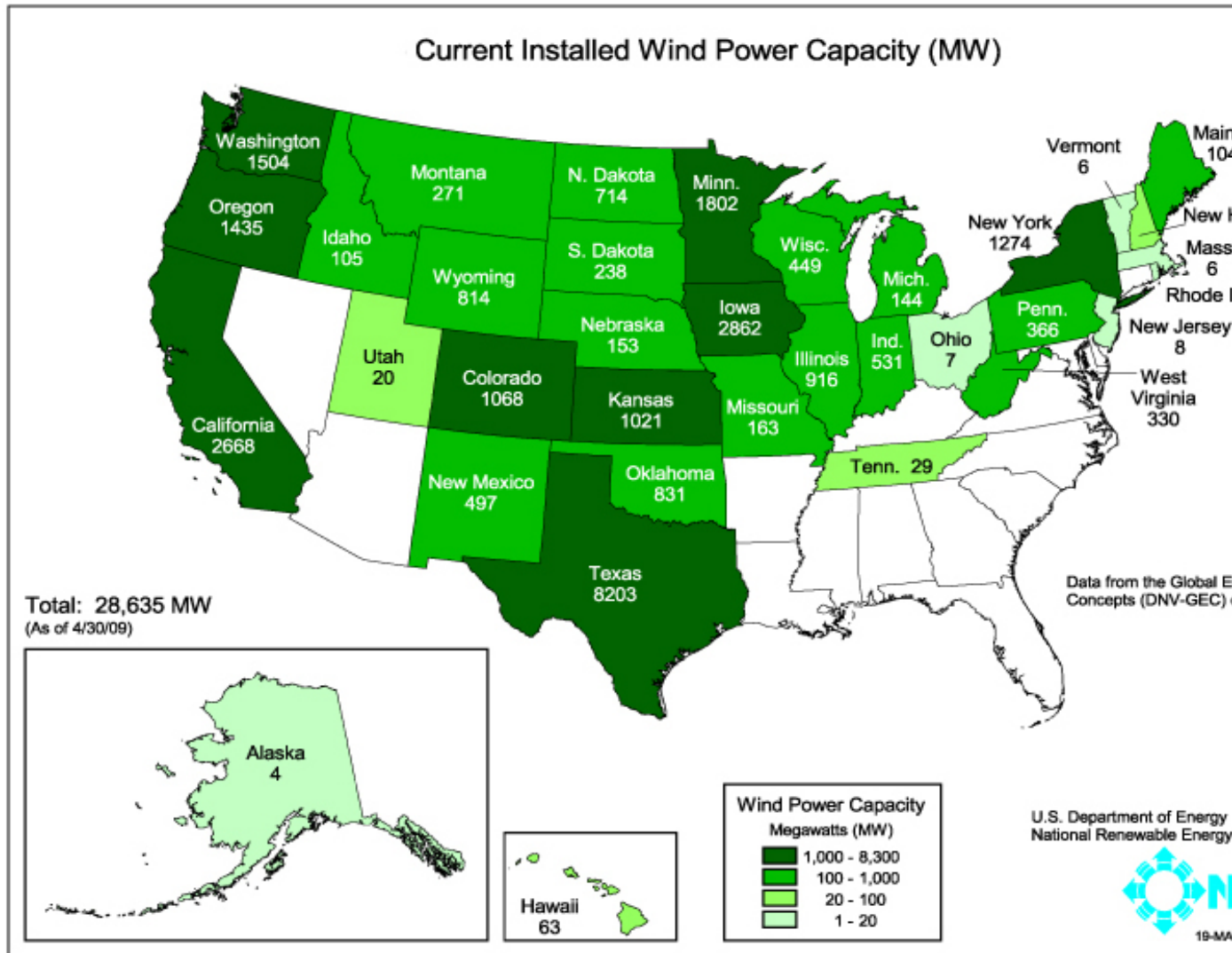
a. 1 b. 2 **c. 3** d. 4

8. Label the parts of the turbine below.



9. Using the map on the next page, list the 5 states with the most wind power capacity from highest to lowest.

TX, CA, IA, MN, WA



10. All renewable [energy](#) (except tidal and geothermal power), and even the energy in fossil fuels, ultimately comes from the _____.

sun

11. What creates the wind that drives any wind turbine?

1. **uneven warming of the earth's surface (equator gets more sun than poles)**
2. **warm moves faster and rises creating convection currents**

12. What is the biggest advantage of wind power?

--clean energy, except (renewable or energy independence for 1/2 credit)

13. A wind turbine located at spot averaging 12 mph will produce _____ times as much energy as a similar turbine located at a spot averaging 6 mph.

- a. 2 b. 4 c. 6 **d. 8**

14. What are 2 reasons for the lack of wind turbines in some states?

--not enough wind

--cost of electricity is cheap compared to price for wind power

--land is too expensive or unavailable for development

15. An average wind speed of at least _____ mph is needed to efficiently produce electricity.

a. 4 b. 6 c. 8 d. 10 **e. 12**

16. In the US, wind power generates around _____ of our energy.

a. 1% b. 3% c. 5% d. 15%

17. In general, wind turbines rated below _____ are used to power houses or small businesses.

a. 10 KW b. 50 KW **c. 100 KW** d. 1MW

18. The majority of energy sources require the use of a turbine to create power except

a. solar b. nuclear c. wind d. hydroelectric

II. Heat

1. From the list below, record the letters which are good insulators (**there may be more than one answer**)

a. wood b. wool c. copper **d. glass** e. aluminum foil **f. air**

a,b, d, f

2. When a fluid is heated it _____ becomes _____ dense and _____.

a. expands; less ; rises c. expands; less, sinks
b. shrinks; more; rises d. shrinks; more; sinks
e. expands; more; rises f. shrinks; less; sinks

3. Draw a convection current.

4. Land heats _____.

a. faster than water. b. slower than water. c. at the same rate as water.

5. By which method of heating does the Sun heat the Earth _____.

Radiation

6. Why can you hold your finger 1 cm away from the side of a lit candle flame, but not 1 cm above the same candle flame?

Convection causes hot air to rise, not go sideways. The sideways heat would only be by radiation and the air is too good of an insulator for such a small amount of heat.

7. If you stick a metal rod in a snowbank, the end in your hand will soon become cold. Does energy flow from the snow to your hand?

No (1pt), Through conduction (1pt) energy flows from hand to snow via rod. Metal is such a good conductor (1pt)