Wind Power Tryouts Key

1. 80% (1 pt)
2. The sun's heat drives the winds (1 pt), which causes the wind turbine's blades to rotate and allows the machine to convert mechanical energy to electrical energy (1 pt).
3. 20 (1 pt)
4. Answers may vary. Examples include: impact on landscape, noise pollution, blades can impact wildlife (1 pt for every correct disadvantage; 2 pts maximum)
5. Combustion (1 pt)
6. Electrical (1 pt); kinetic/rotational (1 pt)
7. Moment of inertia (1 pt); angular velocity (1 pt)
8. Oxidation (1 pt), reduction (1 pt)
9. Donates (1 pt), negative (1 pt)
10. Polarization (1 pt), hydrogen accumulates at the cathode (1 pt) and this reduces the effectiveness of the cell (1 pt)
11. 1866 (1 pt); ammonium chloride (1 pt); carbon (1 pt); zinc (1 pt)
12. zinc (Zn) (1 pt), copper (Cu) (1 pt), zinc (I) sulphate ($ZnSO_4$) (1 pt), copper (II) sulphate ($CuSO_4$) (a.k.a. cupric sulphate) (1 pt)
13. Rechargeable (1 pt)
14. Lead-acid (1 pt); oxygen and hydrogen (1 pt)
15. Wet cells use liquid electrolytes and dry cells use paste electrolytes. (1 pt) Dry cells can be used in any orientations, while wet cells cannot without spilling. (1 pt) The very first wet cells were very fragile. Wet cells came first. (1 pt) Wet cell: automobile batteries (1 pt); Dry cell: portable alkaline batteries. (1 pt)
16. Vertical (1 pt); Darrieus (1 pt)
17. Answers may vary, but may include:
    1. HAWT pro: able to produce more electricity from a given amount of wind (1 pt)
    2. HAWT con: heavier, does not produce well in turbulent conditions (1 pt)
    3. VAWT pro: produces well in tumultuous/inconsistent wind conditions, quieter, can be shorter, maintenance is easier (1 pt)
    4. VAWT con: not good with high wind speeds, more likely than HAWT to stall/stop working, fatigue-prone blades more likely to break (1 pt)
18. HAWTs (1 pt), because the blades always move perpendicularly to the wind (1 pt), so power is generated through the whole rotation (1 pt)
19. Savonius (1 pt)
20. A giromill is a type of Darrieus wind turbine (1 pt) that is comprised of straight vertical blades, as opposed to curved, "egg-beater" blades. (1 pt) They work well in turbulent wind conditions.
21. False (1 pt)
22. Types of wind farms

   1. Onshore (1 pt)
   2. Near shore (1 pt)
   3. Offshore (1 pt)

23. Answers may vary; advantages include less obtrusive than turbines on land, noise level mitigated by distance, average wind speed is higher over open water (1 pt); disadvantages include offshore installation is more expensive than installation onshore, offshore foundations are expensive to build, offshore saltwater environments raise maintenance costs by corroding the towers (1 pt)
24. Wind turbine efficiency is limited to 59.3% (2 pt). No wind turbine can convert more than 16/27 (59.3%) of the kinetic energy of the wind into mechanical energy turning a rotor.
25. reduce, reuse, recycle (must be in correct order, no partial credit, 2 pts)
26. Wyoming (1 pt)
27. B: 20000, 8000 (1 pt)
28. Ocean Thermal Energy Conversion (1 pt)
29. Evaporator (1 pt), ammonia (1 pt), turbine (1 pt)
30. Hawaii (2 pts) (1 pt if just USA is written)
31. amount of water flow (1 pt), height that the water falls (1 pt)
32. China (1 pt), Brazil (1 pt)
33. Steam (1 pt)
34. dry steam (1 pt), flash steam (1 pt), binary cycle (1 pt)
35. The Geysers Geothermal Complex (1 pt), California (1 pt)
36. Labeling:
    1. Foundation (1 pt): keeps the wind turbine on the ground (accept anything relating to keeping the turbine in place) (2 pts)
    2. [skipped]
    3. Tower (1 pt): raises the rotors above the ground, so that they encounter higher wind speeds and do not contact the ground. (2 pts)
    4. [skipped]
    5. Accept anything relating to "directional control" (1 pt): To keep the turbine facing the wind and producing the greatest amount of power. (2 pts)
    6. [skipped]
    7. Generator (1 pt): converts rotational motion into electrical energy. (2 pts)
    8. [skipped]
    9. Brake (1 pt): allows the rotor to stop (2 pts)
    10. Gearbox (1 pt): converts the speed of the rotors to a higher speed more suitable for the electrical generator (2 pts)
    11. Rotor blade (1 pt): converts the force of the wind into a rotational force on the hub. (2 pts)

12. [skipped]
13. Hub (1 pt): holds all the rotor blades in place and allows them to rotate. (2 pts)

37. 1 (2 pts, no partial); a purely resistive load
38. It is desirable because a power factor of less than one requires the utility to install excess capacity (in lines, transformers, generators, etc.) (2 pts) for the increased amount of reactive power in order to deliver the same amount of real power. (2 pts)
39. Brazil (2 pts, no partial)
40. a, c (0.5 pts each for marking a, c, 0.5 pts each for NOT marking b,d)
41. Grids don't have to be synchronized; decreased capacitive losses; more efficient usage of conductors (no skin effect), lower peak voltage resulting in less insulation usage, more time of the waveform is spent at peak current (in fact, all of the time is spent at peak current), permits easier isolation of two grids (1 pt each)
42. Higher (1 pt)
43. $P_{avail} = \frac{1}{2}\rho A v^3 C_p$ so 2.57 MW (1 pt for correct formula, 1 pt for correct use of Area=pi*r^2, 1 pt for showing work, 1 pt for correct answer)
44. Answers: For 8 point questions:2 points for correct answer, 3 points for correct setup of integral (or equivalent argument), 3 points for correct evaluation of integral
    1. V; there is no calculation to be done (2 pts for correct answer, no partial)
    2. V; avg. power delivered to a resistive load is the same as DC (4 pts, (2 pts for correct answer, 2 pts for correct explanation (integral/argument)) no partial)
    3. $V/\sqrt{3}$; the triangle wave spends an equal amount of time at each amplitude to the sawtooth wave; therefore, the RMS voltage is equivalent (8 pts)
    4. $V/\sqrt{3}$; integrate a single cycle (ranging from -V to V): The waveform is defined by t for -V to V (scaling in the time axis is irrelevant), so to find the RMS voltage: $\sqrt{\frac{\int_{-V}^{V} x^2}{2V}}$ (equivalent to Sqrt[Integrate[x^2, {x, -V, V}]/(2*V)]) (8 pts)
    5. $V/\sqrt{2}$; integrate a single cycle (ranging from -V to V): The waveform is defined by $V sin(t)$ (scaling in the time axis is irrelevant), so to find the RMS voltage: $\sqrt{\frac{\int_{-\pi}^{\pi} (V sin(x))^2}{2\pi}}$ (equivalent to Sqrt[Integrate[(V*Sin[x])^2, {x, -Pi, Pi}]/(2*Pi)]) (8 pts)