A. Short Answer Questions. (1/2 point each blank except as marked.)

1. REVIEW QUESTION: Of the three types of nuclear radiation, the type that is negatively charged is ? while the type that was later found to be part of the electromagnetic spectrum is ?.

2. On Jan. 1, 2017, the high temperature was 40 deg F and the low temperature was 10 deg F. On Jan. 2, 2017, the high temperature was 10 deg F and the low temperature was -30 deg F. The number of degree days on Jan. 1 was ?, the number of degree days on Jan. 2 was ?, and the contribution for both days was ?.

3. For the short oral presentation yesterday, mercury was found to be a major problem in the larger fish due to (a) eagles (b) bioaccumulation (c) electrofishing (d) birth defects

4. Carry out the following using the rules for precision or significant figures correctly (whichever applies): Area = (9.32 m) X (0.55 m) = ?.

5. The thermal process which consists of adding hydrogen to the organic molecules of the biomass in order to produce an energy-rich oil or gas is called ?.

6. Chemical decomposition of biomass heated in the absence of oxygen is called ?.

7. In a biological process, bacteria that act upon biomass in the absence of oxygen are called ? bacteria.

8. What is produced by the bacteria in question #7?

9. Which of the following contains the least carbon atoms per molecule: coal, methane, oil?

10. The gas that is produced in septic tanks is nearly 100% pure methane. (True, False.)

11. A toxic form of alcohol is called ? and is made from ?.

12. A form of alcohol which is used in alcoholic beverages is called ? and is made from ?.

13. A 15% mixture of gasoline and 85% of ? is called ?.

14. TEXT QUESTION: The use of the difference in temperature of the ocean in order to produce electrical energy is called ?. The hot ocean water is found at the surface while the cold ocean water is found deeper below.

15. A measure of the degree of acidity of a lake is called the ? and has a value of ? for neutral and about ? for normal rainwater.

16. Two emissions, given off by automobiles, which contribute to photochemical smog are ? and ?.
17. A temperature inversion occurs whenever (a) temperature increases with altitude or (b) temperature decreases with altitude or (c) temperature is constant as altitude increases. (Choose one)

18. Ozone has two sides to its character in that at surface altitudes it hurts us because it ? while at very high altitudes it helps us because it ?.

19. REVIEW QUESTION: Water in either the PWR or the BWR performs two functions: It ? and it ?.

20. A colorless, tasteless gas that is given off by incomplete combustion in automobiles and that is toxic at high concentrations is called ?.

21. The amount of solar energy which the earth receives at the top of the earth's atmosphere is about ? watts/m² while at the earth's surface only about ? watts/m² is received.

22. What fluid serves as a heat transfer agent that is pumped into the typical MN flat plate collector in an active solar system? (If you don't remember the name of the fluid, describe it for full credit.)

23. The girl scout home in St. Paul discussed in class receives about ? of its heat from solar energy.

24. Small slabs of silicon, about 2 inches in diameter which convert solar radiation into electricity are called ?.

25. A general type of heat transfer which refers to heat carried by the actual motion of a fluid (water or air) is called ?; this heat transfer as applied to a home where heat is lost out through the cracks and other openings of a house is called ?.

26. A general type of heat transfer which refers to energy emitted by a hot object in the form of electromagnetic rays is called ?; this heat gain resulting from sunlight shining in through the windows of a home is called ?.

27. REVIEW QUESTION: A general type of heat transfer which refers to heat passing through a substance without a change in shape of the object is called ?.

28. Resistance to heat transfer of the type mentioned in question # 27 is called the ? for the material.

29. Which is better: a low evaluating factor or a high evaluating factor?

30. The average evaluating factor for a MN home is about ?. (Include units)

31. State one example of a large centralized solar power installation.

32. In our short oral presentation yesterday, the Canadian CANDU reactors differ from the light water reactors in the US in that ? is used as a heat transfer agent.

33. In our short oral presentation yesterday, we found out that the Canadian CANDU reactors have about the same 1st Law efficiency as our US Light water reactors—i.e. 28 to 30%. (true, false)

34. According to our short oral presentation yesterday, the overwhelming solution to solving our climate crises is to (a) increase conservation (b) increase electric vehicles (c) increase recycling efforts (d) decrease population
B. Longer Answer Questions

1. (4) REVIEW QUESTION: Discuss a graphite reactor: (a) Where is it found? (b) Is it a light water reactor or a breeder reactor? (c) In what ways does it differ from the pressurized water reactor? (d) What can be conveniently produced by a graphite reactor rather than using a BWR or a PWR?

2. (5) REVIEW QUESTION: Draw as best as you can and explain the operation of a boiling-water reactor. Be sure to include in your diagram the fuel rods, control rods, pumps, turbine and generator. Also be sure to indicate how the control rods can be used to adjust the power output of the reactor.

3. (5) Describe and list four specific examples of a passive heating system. Also define "thermal mass" and mention why it is so important.

4. (3) Draw a diagram of and explain how a Trombe Wall works.
5. (6) Draw a diagram of and explain the operation of an active solar energy system; Explain how this system can be used to heat a home using a "forced-air" heating system and how it can also be used to heat water.

6. (3) LAB QUESTION: How much does it cost to operate 18 40-watt incandescent bulbs for 8.00 hours if electricity costs 8.25 cents per KWH?

7. (4) LAB QUESTION: If the initial temperature of 250.0 g unknown material is 95.4 deg C, calculate its specific heat if, upon insertion, it causes the temperature of water and calorimeter to rise from 18.4 deg C to 25.4 deg C. The mass of that water is 500.0 g (specific heat: 1.000 cal/g C deg) and the mass of the calorimeter is 200.0 g (specific heat: 0.100 cal/g C deg). Neglect heat loss to atmosphere.

8. PLEASE USE THE BLANK PAGE PROVIDED TO ANSWER THIS PROBLEM. LAB QUESTION: A strange wooden house was constructed with one 3.0 ft by 5.0 ft south-facing \((R_T=1.00)\) window and 8.0 inch thick softwood having an \(R\)-value of 1.25 per inch. The house was placed in the backyard on stilts with the 8.0 inch softwood placed on the floor, ceiling, and all four walls. The structure measured 6.0 ft by 8.0 ft for the floor (and ceiling) and the walls are 7.0 ft high. The 6.0 by 7.0 wall is facing south, and use 1630 BTU's per ft\(^2\) insolation for the entire day. If the structure was maintained at 70 deg F inside and the outside temperature at 15 deg F for the entire day, and there were 1.4 air changes per hour, determine:

(a)(4) The heat lost by conduction for the day.
(b)(1) The heat lost by infiltration for the day.
(c)(3) The heat gain from insolation, net heat lost, and the evaluating factor for the structure.
9. (6) It's becoming more and more clear that climate change is real and anthropogenic (caused by human activity). Specifically, (a) (3) List at least three greenhouse gases and mention how these influence the earth’s temperature? (b) (3) List three pieces of evidence for rapid climate change that is given by the NASA web-site discussed in class.

10. (3) How can biomass be used in order to produce energy in the
(a) solid form by a thermal process:

(b) liquid form by a biological process:

(c) gaseous form by a biological process:

11. From class in our discussion of the “Energy Menu”, we discussed both a “front-end” process and a “back-end” process for the use of “clean coal”
(a) (3) Discuss the “front-end” process and mention three problems that remain.

(b) (1) Define and discuss what is meant by the “back-end” process

14. (a) (1) Draw a graph of altitude versus temperature as it should occur normally. (b) (1) What then is a thermal inversion? (c) (2) Distinguish between a high pressure subsidence inversion and a photochemical radiative thermal inversion. (d) (1) Which of these inversions is common to Los Angeles and why?
15. (9) TEXT QUESTIONS: Define and briefly discuss the following:

- Geothermal gradient
- “Ring of Fire”
- Coefficient of Performance (COP)
- The peak power output and location of the largest tidal plant; compare this power output to a nuclear power plant or a coal-fired power plant
- Insolation
- Carbon neutral
- Thermosiphon
- Power Tower
- Hydropower

GOOD LUCK EVERYONE, AND HAVE A GREAT REMAINING SUMMER!