Instructions: This Test has the same format as before. Part A consists of short answer questions where you are to pick the best word, phrase, or choice which best answers or, in some cases, defines the statement. Part B consists of longer answer questions. Make your answers clear and concise. If you need more room turn over the test paper and continue on the back but please indicate "over" on front. So for this, the fourth energy test of the term, Good Luck!

Equations & conversions factors:
\[ \frac{Q}{t} = \frac{Area \times (T_H - T_C)}{R} \]
\[ \frac{Q}{t} = \frac{(airchange \times (Volume)) \times (Btu/ft^2 \cdot F) \times (T_H - T_C)}{HeatedArea \times DD} \]
\[ KE = \frac{1}{2}mv^2 \]
\[ DD = 65 - T_{ave} \]
\[ T_{ave} = \frac{T_{high} + T_{low}}{2} \]
\[ 1\text{HP} = \frac{550 \text{ft} \cdot \text{lb}}{s} \]
\[ t_F = \frac{9}{5}t_C + 32 \]
\[ t_C = \frac{5}{9}(t_F - 32) \]

A. Short Answer Questions

1. REVIEW QUESTION: 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 through the windows of a home is called ___.

2. REVIEW QUESTION: 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 ___.

3. REVIEW QUESTION: A general type of heat transfer which refers to heat transmitted through a substance without a change in shape of the object is called ___. A measure of the "resistance" to heat flow by this type of heat transfer is called ___.

4. REVIEW QUESTION: Which is better: a low evaluating factor or a high evaluating factor?

5. REVIEW QUESTION: The average evaluating factor for a MN home is about ___. (Include units)

6. REVIEW QUESTION: The number of air changes per hour in an average MN house is ___. However, if the number of air changes per hour is less than a "threshold" limit of ___, then the condition is dangerous since a person can suffocate!

7. List two advantages of hydroelectric dams and _____________.

8. The largest hydroelectric dam in the United States is the ___ dam and has a power output of ___. (Be sure to include units.)

9. The largest hydroelectric dam in the world is the ___ dam located in ___, and has a power output of ___. (Be sure to include units.)

10. If the rate at which new plants (biomass) remove carbon from the atmosphere equals, on average, the rate of carbon emission from burning the biomass, then the biomass is said to be (a) expensive, (b) non-productive (c) unusable (d) carbon neutral

11. One major advantage that results from the use of wind is ___.
12. (1) In a biological process, bacteria which act upon biomass in the absence of oxygen are called ? bacteria.

13. (1) What is produced by the bacteria in the previous question?

For the following questions 14 through 18, choose from the list of biomass processes discussed in class—i.e. fermentation, pyrolysis, hydrogenation, direct mass burning, and methane production

14. (1) Chemical decomposition of biomass heated in the absence of oxygen is called ?.

15. (1) 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 ?.

16. (1 ½) Which three of the above processes can be used to produce energy in a liquid form?

17. (1 ½) Which three of the above processes can be used to produce energy in a solid form?

18. (1 ½) Which three of the above processes can be used to produce energy in a gaseous form?

19. (1) Which of the following contains the greatest number of hydrogen atoms per molecule: coal, methane, oil?

20. (1) The gas that is produced in septic tanks contains an amount of methane CH₄ gas that is closest to (a) 10% (b) 25% (c) 55% (d) 80% (e) 100%

21. (1) A form of alcohol (“spirits”) which is used in alcoholic beverages is called ? and is made from ?.

22. (1) A toxic form of alcohol is called ? and is made from ?.

23. (1) At our local Holiday filling station down the street, E85 is a mixture of 85% of ?, and 15% of ?.

24. (2) The difference in temperature between the freezing point temperature and the boiling point temperature in Fahrenheit degrees is ?? while the difference between the freezing point temperature and the boiling point temperature in Celsius is ?.

25. (2) “Room temperature” at 68 °F is equal to ? on the Celsius scale.

26. (1) Of the three types of heat transfer, select all those that are proportional to the fourth power of the Kelvin absolute temperature. Choose from (a) Conduction (b) Convection (c) Radiation

27. (1) Of the three types of heat transfer, select all those that are proportional to the difference in temperature. Choose from (a) Conduction (b) Convection (c) Radiation

28. (1) The radiation energy given off by the sun is (a) high energy, small wavelength (b) high energy, large wavelength (c) low energy, small wavelength (d) low energy, large wavelength
The albedo is (a) the percentage of sunlight reflected by the earth (b) the percentage of sunlight absorbed by the earth (c) a measure of the amount of ice in kg that we lose each year (d) the percentage of infrared energy given off by the earth.

The current value for the albedo for the earth is closest to (a) 20% (b) 30% (c) 40% (d) 50% (e) 60% (f) 70% (g) 100%

The power per square meter entering the top of the earth's atmosphere that is facing the sun is called the “solar constant” and has a numerical value that is closest to (a) 2800 W/m² (b) 2000 W/m² (c) 1400 W/m² (d) 766 W/m² (e) 239 W/m²

Should the global atmospheric concentration of CO₂ increase to the point where the “tipping point” occurs resulting in the loss of ice of Greenland, Siberia, the Arctic, and the Antarctic regions, the earth’s albedo would (a) increase (b) decrease (c) remain unchanged

Our atmosphere currently consists of 78% ? and 21% ?. (Order is important here.)

Our earth heats up and gives off radiation energy called ? radiation which consists of (a) high energy, small wavelength (b) high energy, large wavelength (c) low energy, small wavelength (d) low energy, large wavelength (Note: There are two blanks to be filled in.)

Greenhouse gases are transparent to (a) high energy, small wavelength (b) high energy, large wavelength (c) low energy, small wavelength (d) low energy, large wavelength but instead absorb (a) high energy, small wavelength (b) high energy, large wavelength (c) low energy, small wavelength (d) low energy, large wavelength (Order is important here.)

Of all the planets in our solar system, the one that has an atmosphere that is mainly CO₂ and that has a surface temperature that exceeds 500 °C is the planet ?. (Severe global warming!)

Of all the planets in our solar system, the one that has an atmosphere that is mainly CO₂ and that has a surface temperature that is around 0 °C is the planet ?. (Also global warming!)

Of all the greenhouse gases in our atmosphere, the one that has a lifetime of about 1000 years before disintegrating or being removed (absorbed) from our atmosphere is (a) CH₄ (b) CO₂ (c) NOX (d) SOX (e) H₂O vapor (f) halocarbons

Of all the graphs in our text, the one that is typically shown the most is the one that illustrates the concentration of atmospheric CO₂ versus time. The preindustrial concentration of CO₂ is closest to ? and the current concentration of CO₂ is closest to ?. (a) 280 ppm (b) 320 ppm (c) 360 ppm (d) 410 ppm (e) 280 ppb (f) 320 ppb (g) 360 ppb (h) 410 ppb (i) 440 ppb

Any abrupt change to the earth’s energy balance such as an increase in solar luminosity, an increase in greenhouse gases, a change in the surface albedo, a volcanic explosion that dumps particulate matter into the atmosphere is referred to as (a) a catastrophe (b) an anthropogenic event (c) a climate forcing (d) a feedback (e) a natural event

Climate (a) is the same thing as weather (b) describes immediate local conditions (c) describes the average conditions that prevail in Earth’s atmosphere—temperature, humidity, cloudiness, and so forth.

Of all the greenhouse gases, the one that has the greatest global warming potential—namely, the greatest effect at absorbing the earth’s heat energy and not allowing it to escape is (a) CH₄ (b) CO₂ (c) NOX (d) SOX (e) H₂O vapor (f) halocarbons
43. (1) Stratospheric Ozone (O₃) has the important property in that it protects us from ___.

44. (2) The so-called Ozone “hole” originally was found over ___ and was actually a depletion in the amount of ozone closest to (a) 100%  (b) 70% (c) 40% (d) 10% (e) 0%  (Note 2 blanks!)

45. (1) A remarkable global agreement occurred in 1987 when almost all countries of the world (including the United States!) agreed to cut back on the use of ___ which was found to be destroying the ozone layer. Choose from (a) HFCs  (b) CFCs (c) CO₂  (d) CH₄

46. (2) In the previous question, this international agreement of 1987 was called the ___. It was later found the phase-out of the harmful chemicals (that hopefully you mentioned above) was not fast enough, so a second agreement called the ___ was later signed that called for a total phase-out of these harmful chemicals of the previous question by 1995. (Note: As mentioned in class, this is a “success” story that occurs when many global nations work together for the common good.)

47. (2) Volcanic eruptions cause the global temperature to immediately (increase, decrease) (Choose one.) because of _______________________.

48. (2) REVIEW QUESTION: However, in the long term the global temperature that results from volcanic eruptions will (increase, decrease) (Choose one.) because of _______________________.

49. (1) From our short oral presentation Thursday and from previous lecture material, current “throughput” results in a reduction of global resources that include (a) minerals  (b) oil  (c) coal (d) natural gas (CH₄)  (e) timber  (f) all of these (g) none of these.

50. (1) From our short oral presentation Thursday, the goal of American Imperialism & the Energy Trade is to (a) increase “throughput” (b) extract global mineral resources (c) exploit native resources  (d) maximize profit (e) none of these (f) all of these

51. (1) Inflation occurs when (a) “throughput” decreases  (b) “throughput” increases  (c) when there is a shortage of mineral resources  (d) when there is a excess of mineral resources  (e) both (a) and (c)  (f) both (b) and (c) (g) both (b) and (d)

B. Longer Answer Questions

1. (5) (a) What is an “electrical grid?”
   (b) How many are there in North America?
   (c) Where are the boundaries of these grids?
   (d) How many are there in Europe?
   (e) Compare the voltage and frequency of the grids in North America versus Europe.

2. (3) List and three of the many techniques to expand “throughput” using “supply side” economics.
3. (5) (a) (1) How is an active solar energy system different from a passive solar system? (b) (2) Draw a diagram of and *explain* the operation of an active solar energy system. (c) (2) 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.

4. (3) List *three* specific examples of a passive heating system.

5. (4) List four of the many consequences discussed in class from global warming.
6. 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

7. (10) Define and briefly discuss from the viewpoint of the text the following three terms:

Inverter

Power tower

Thermal mass

Ocean thermal energy conversion (OTEC)

Smart grid