MEA 130 - EXAM 1(A)

February 12, 2002

Using a #2 pencil **only**, fill in your name (last name first, first name last) and student number on the answer sheet. Indicate your answer by completely filling in the appropriate bubble. Indicate, near the two black boxes ( ) on side one of the op-scan sheet which test version (**A** or **B or C**) you have. *Keep this copy of the exam to use as a study guide for the final exam.*

1. Meteorology is defined as the:
   a. mean conditions of the atmosphere over a long period of time
   b. study of the atmosphere and its phenomena
   c. specific conditions of the atmosphere at a specific place and time
   d. all of the above

2. In the earth's atmosphere, _____ can occupy between 0 and 4% of the volume.
   a. ozone (O_3)
   b. water vapor (H_2O)
   c. oxygen (O_2)
   d. nitrogen (N_2)

3. Which of the following gases is considered permanent in the earth's atmosphere?
   a. argon (Ar)
   b. nitrogen (N_2)
   c. oxygen (O_2)
   d. all of the above

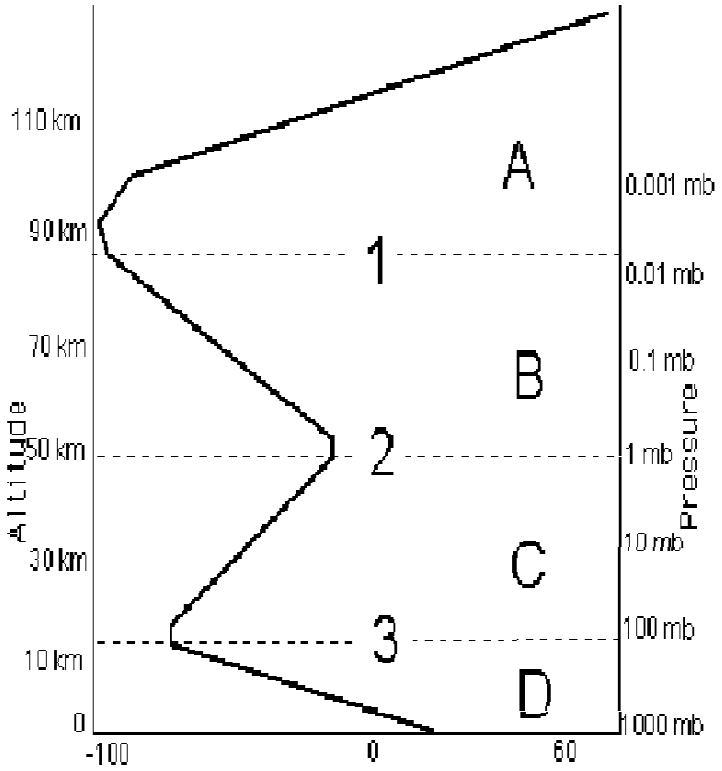
4. Which of the following gases is considered variable in the earth's atmosphere?
   a. water vapor (H_2O)
   b. carbon dioxide (CO_2)
   c. ozone (O_3)
   d. all of the above

5. Which of the following is considered a trace gas in the earth's atmosphere?
   a. ozone (O_3)
   b. water vapor (H_2O)
   c. argon (Ar)
   d. all of the above

6. Nearly 99% of the atmosphere's mass lies within ____of the surface.
   a. 3 km
   b. 30 km
   c. 300 km
   d. 3000 km

7. Water vapor:
   a. is a permanent gas
   b. is a "Greenhouse Gas"
   c. is visible
   d. none of the above

Questions 8 - 11 refer to the adjacent figure.



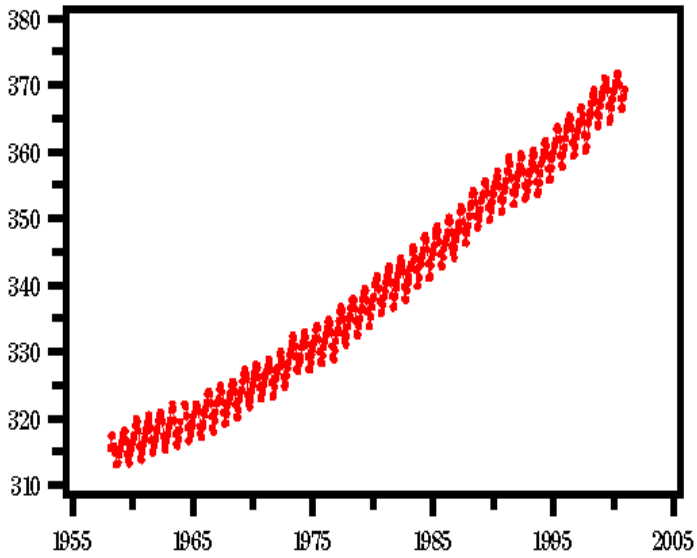
8. The mesosphere is identified by letter:
   a. A
   b. B
   c. C
   d. D

9. The troposphere is identified by letter:
   a. A
   b. B
   c. C
   d. D

10. The tropopause is identified by number:
   a. 2
   b. 3
   c. 1
   d. none of the above

11. The “mean free path” is largest in the:
   a. A
   b. B
   c. C
   d. D

12. This well known figure, which depicts measurements made at Mauna Loa, Hawaii, shows concentrations of this gas.



   a. argon (Ar)
   b. ozone (O_3)
   c. water vapor (H_2O)
   d. carbon dioxide (CO_2)

13. The rapid increase in this gas's concentration is attributed to:
   a. fossil fuel burning
   b. deforestation
   c. release of CFCs
   d. both (a) and (b)

14. Which nation recently "pulled out" of *the Kyoto Protocol* agreement designed to reduce the emission of Greenhouse gases?
   a. Canada
   b. United States
   c. China
   d. Brazil

15. In the troposphere:
   a. most of what is considered "weather" occurs
   b. the air is generally well mixed
   c. temperature usually decreases with height
   d. all of the above

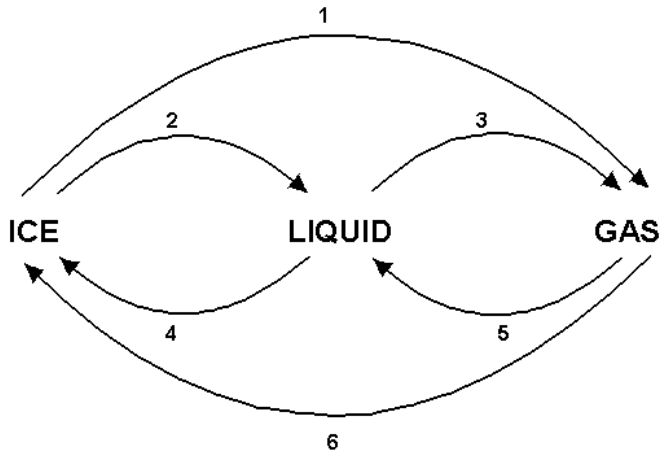
16. In the stratosphere:
   a. the air is well mixed
   b. warming is due to the absorption of ultraviolet radiation by ozone (O_3)
   c. temperature normally decreases with height
   d. all of the above

17. Within an <u>isothermal</u> layer, the temperature:
   a. decreases with respect to height
   b. does not change with respect to height
   c. increases with respect to height
   d. none of the above

18. Which of the following provides a measure of the "average speed" of air molecules:
   a. heat
   b. pressure
   c. density
   d. temperature

19. At a temperature of 0 K:
    a. it would be -273^{o} Celsius
    b. it would be -273^{o} Centigrade
    c. all molecular motion stops
    d. all of the above

Use the Figure below, which depicts the "Changes of State" involving water, to answer questions 20-22.



20. Through which processes shown above can latent heat energy be converted into sensible heat energy - thereby warming the air?
    a. 1, 5, 6
    b. 1, 2, 3
    c. 4, 5, 6
    d. 2, 3

21. The process of deposition is shown by:
    a. 6
    b. 1
    c. 4
    d. none of the above

22. The process of sublimation is shown by:
    a. 6
    b. 3
    c. 1
    d. none of the above

23. Which of the following is the <u>poorest</u> conductor of heat?
    a. water
    b. rock
    c. metal
    d. air

24. The Law that states: "Energy is always conserved, it can neither be created nor destroyed" is called:
    a. Stefan-Boltzmann Law
    b. Wien's Displacement Law
    c. Kirchhoff's Law
    d. The First Law of Thermodynamics

25. Which Law states that "Gases that are good absorbers of a particular wavelength of radiation are likely to be good emitters of that wavelength"?
    a. Stefan-Boltzmann Law
    b. Wien's Displacement Law
    c. Kirchhoff's Law
    d. First Law of Thermodynamics

26. Which of the following statements is <u>true</u> about conduction?
    a. air is a poor conductor
    b. most solids are good conductors
    c. the larger the temperature difference, the greater the conduction
    d. all of the above

27. Which of the following statements is <u>true</u> about radiation?
    a. it requires no medium in which to propagate
    b. it travels at the speed of light (3×10^8 m/s)
    c. it releases its energy only when striking an object
    d. all of the above

28. The heat transfer process in the atmosphere that depends upon the <u>vertical</u> mass movement of air is called:
    a. radiation
    b. conduction
    c. convection
    d. advection

29. The sun emits a maximum amount of radiation at wavelengths near ___, while the earth emits maximum radiation near wavelengths of ___.
    a. 0.5 μ , 10.0 μ
    b. 1.0 μ, 10.0 μ
    c. 10.0μ , 30.0 μ
    d. 0.5 μ, 30.0 μ

30. According to Stefan-Boltzmann's Law, if the temperature of an object were to double, the amount of energy emitted by that object would _____.
    a. decrease by a factor of 16
    b. increase by a factor of 4
    c. increase by a factor of 16
    d. cannot tell from available information

31. If the earth's average temperature does indeed increase in response to "Global Warming", Wien's Displacement Law tells us that the wavelength of maximum emission (8_{max}) would _____ .
    a. become longer
    b. become shorter
    c. remain the same
    d. none of the above

32. Which Law allows us to refer to solar radiation as "short wave" radiation and terrestrial radiation as "long wave" radiation?
    a. Stefan-Boltzmann Law
    b. First Law of Thermodynamics
    c. Kirchhoff's Law
    d. Wien's Displacement Law

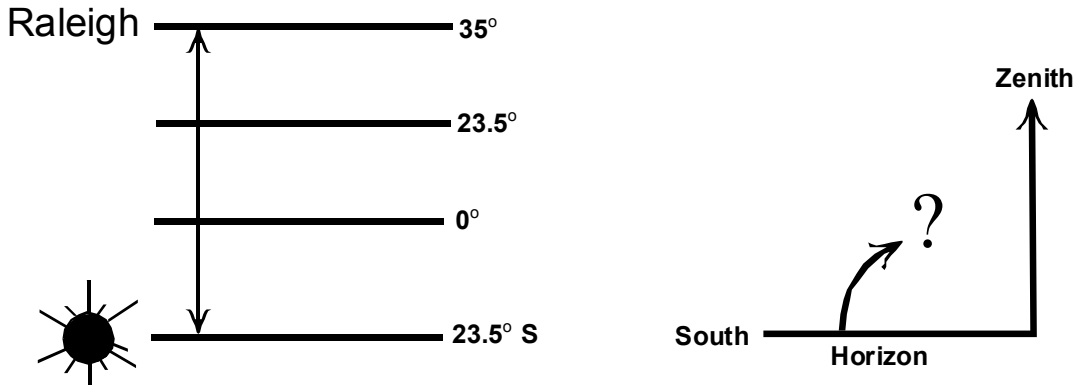
33. A Blackbody is a body (or an object) that:
    a. absorbs all of the radiation that strikes it (perfect absorber)
    b. emits the maximum amount of radiation possible (perfect emitter)
    c. selectively absorbs and emits radiation as a function of 8
    d. both (a) and (b)

34. Which of the following acts like a "Blackbody".
    a. earth
    b. sun
    c. atmosphere
    d. both (a) and (b)

35. The figure below, which we discussed in class, depicts day/night characteristics for which time of year?
    a. Winter Solstice
    b. Summer Solstice
    c. Autumnal Equinox
    d. Vernal Equinox

Per the examples in class, the diagram below depicts the relationship between the latitude of Raleigh and the latitude at which the sun is directly overhead at local noon. Given this information answer questions 36 - 38 below.

36. Calculate the noon solar angle (angle the sun is above the horizon) for Raleigh.
    a. 23.5^0
    b. 55.0^0
    c. 78.5^0
    d. 31.5^0



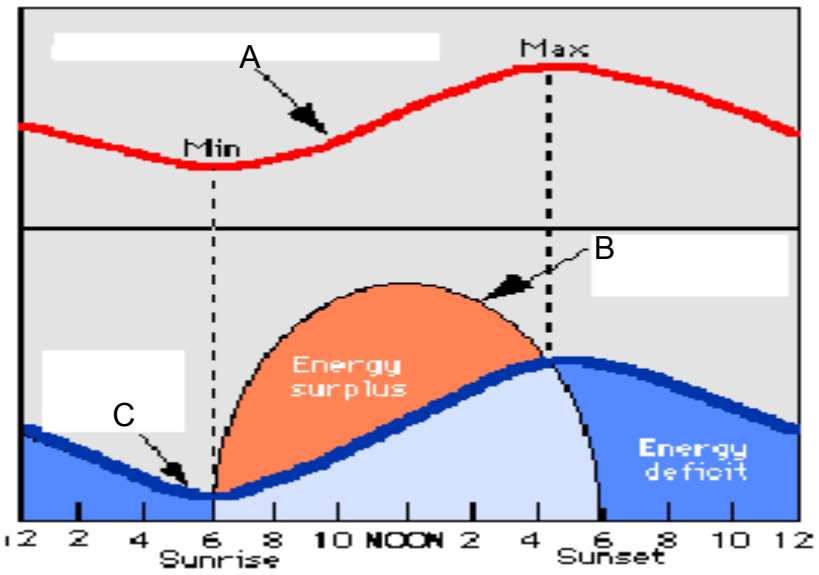
37. What astronomical event does this figure depict.
    a. Winter Solstice
    b. Summer Solstice
    c. Autumnal Equinox
    d. Vernal Equinox

38. What is the name given to the latitude 23.5^0 S?
    a. Equator
    b. Tropic of Cancer
    c. Antarctic Circle
    d. Tropic of Capricorn

39. When are days and nights equal in length (12 hours) over the entire globe?
    a. never
    b. Summer Solstice
    c. Winter Solstice
    d. Spring Equinox

40. Where are days and nights equal in length (12 hours) all year long?
    a. at 66.5°N
    b. at 0°
    c. at 23.5°S
    d. no where

Questions 41-43 refer to the figure below, which depicts the incoming solar radiation, outgoing terrestrial radiation and resulting temperature profiles for a day in Raleigh, NC



41. The daily temperature profile is depicted by line:
    a. A
    b. B
    c. C
    d. none of the above

42. The daily incoming solar radiation is depicted by line:
    a. A
    b. B
    c. C
    d. none of the above

43. What time of year could this picture depict?
    a. Summer Solstice
    b. Winter Solstice
    c. Autumnal Equinox
    d. none of the above

44. When compared to mid-continent regions, coastal areas tend to be during the summer and _____ during the winter.
    a. cooler, warmer
    b. warmer cooler
    c. cooler, cooler
    d. warmer, warmer

45. In the United States, one would expect to observe the <u>smallest</u> variation in temperature, both daily and seasonally in:
    a. Florida
    b. North Dakota
    c. North Carolina
    d. Louisiana

46. In North Carolina, one would expect to observe the <u>largest</u> variation in temperature, both daily and seasonally in:
    a. the Appalachian Mountains located in the western part of the state
    b. the Piedmont located in the central part of the state
    c. the Coastal Plains located in the eastern part of the state
    d. the islands of the Outer Banks

47. The _____ current that flows parallel to the east coast of the United States, keeps North Carolina _____ than it would otherwise be during the winter.
    a. Florida, warmer
    b. Gulf Stream, colder
    c. Gulf Stream, warmer
    d. Gulf Stream, drier

48. During the snowstorm on January 3rd of this year, the maximum temperature was 30^{o}F and the minimum was 20^{o}F. Calculate the number of HDD units for that day.
    a. 35
    b. 45
    c. 40
    d. None of the above

49. Which instrument is used on radiosondes (weather balloons) to obtain temperature?
    a. radiometer
    b. thermograph
    c. electrical thermometer
    d. liquid-in-glass thermometer

50. Satellites use radiometers and which “Law” in calculation of cloud temperatures?
    a. Wien’s Displacement Law
    b. First Law of Thermodynamics

c. Kirchhoff's Law
d. Stefan-Boltzmann Law