CHAPTER 3

SOLAR AND TERRESTRIAL RADIATION

MULTIPLE CHOICE QUESTIONS

1. The frequency of an electromagnetic wave is ______ proportional to its wavelength.
a. directly
*b. inversely

2. ______ is the distance between successive troughs and crests.
a. Frequency
*b. Wavelength

3. All of the following types of electromagnetic radiation have wavelengths longer than that of visible light with the exception of
a. infrared radiation.
b. microwaves.
c. radio waves.
*d. ultraviolet radiation.
e. None of these is correct.

4. All of the following types of electromagnetic radiation have wavelengths shorter than that of visible light with the exception of
a. gamma rays.
b. ultraviolet radiation.
c. radio waves.
*d. X-rays.
e. None of these is correct.

5. Violet has the ______ wavelength in the visible electromagnetic spectrum.
a. longest
*b. shortest

6. Ultraviolet radiation, gamma rays, and X-rays have frequencies ______ that of visible light and infrared radiation.
*a. higher than
b. lower than
c. equal to

7. Solar radiation that reaches Earth's surface consists of
a. infrared radiation.
b. visible radiation.
c. ultraviolet radiation.
8. ______ is (are) partially blocked by ozone in the stratosphere.
   *a. Ultraviolet radiation
   b. Microwaves
   c. X-rays

9. According to Wien's displacement law, which one of the following objects emits its most intense electromagnetic energy at the shortest wavelength?
   a. an ice cube
   b. your hand
   c. the atmosphere
   *d. the Sun
   e. your desk

10. Generally, as the temperature of a radiating surface decreases,
   a. the rate of electromagnetic radiation emitted by the surface will increase.
   *b. the wavelength at which radiation from the surface is most intense will lengthen.
   c. Both of the above are correct.
   d. None of the above is correct.

11. If the temperature of the Sun were to ______, the wavelength at which solar radiation is most intense would decrease.
   a. remain the same.
   *b. increase.
   c. decrease.

12. Solar radiation
   *a. is most intense at a shorter wavelength than terrestrial infrared radiation.
   b. does not interact with components of the atmosphere.
   c. heats the atmosphere which, in turn, heats Earth's surface.
   d. that reaches the outer atmosphere consists of mostly microwaves.
   e. None of the above is correct.

13. The ultimate source of solar radiation is
   a. convection.
   b. nuclear fission.
   *c. nuclear fusion in the Sun.
   d. sunspots.
   e. solar tides.

14. Today, the solar altitude is at a maximum around
   a. sunrise.
   b. 6 pm.
   *c. noon.
   d. 9 am.
15. Earth is closest to the Sun during the
   *a. Northern Hemisphere winter.
   b. Northern Hemisphere summer.
   c. Southern Hemisphere spring.
   d. Southern Hemisphere fall.
   e. Southern Hemisphere winter.

16. Earth is closest to the Sun in
   b. July.
   c. March.
   d. September.

17. During summer in the Northern Hemisphere, the number of hours of daylight is ______ the number of hours of darkness.
   a. equal to
   *b. greater than
   c. less than

18. During winter in the ______ Hemisphere, the number of hours of daylight is less then the number of hours of darkness.
   a. Northern
   *b. Southern

19. Exactly one-half of the surface area of the Earth is in sunlight during
   a. either equinox only.
   b. the winter solstice only.
   c. the summer solstice only.
   *d. any day of the year.
   e. 1 January

20. Earth's rotational axis is oriented perpendicular to the Sun's rays on the first day of
   *a. spring.
   b. summer.
   c. winter.
   d. None of the above is correct.

21. On the first day of summer in the Southern Hemisphere, the noon Sun has an altitude of 90 degrees where?
   a. Tropic of Cancer
   b. Arctic Circle
   *c. Tropic of Capricorn
   d. Antarctic Circle
   e. the equator
22. Except right at the poles, nights are everywhere about 12 hours long when?
   *a. equinoxes  
   b. solstices  
   c. aphelion  
   d. perihelion  
   e. 21 December

23. At the equinoxes, the noon Sun has an altitude of 90 degrees at the
   a. north pole.  
   *b. equator.  
   c. Tropic of Capricorn.  
   d. Arctic Circle.  
   e. Tropic of Cancer.

24. The period of daylight at any point along the equator
   a. ranges from about 9 to 15 hours over the period of a year.  
   b. ranges from about 11 to 13 hours over the period of a year.  
   *c. is essentially the same throughout the year.  
   d. None of the above is correct.

25. Earth's solar constant
   *a. is actually variable.  
   b. refers to the intensity of solar radiation that actually reaches Earth's surface.  
   c. is about 0.5 calories per square centimeter per minute.  
   d. must be measured at perihelion.  
   e. must be measured at aphelion.

26. As solar radiation travels through the atmosphere, a portion of that radiation is
   a. absorbed by gases.  
   b. reflected by clouds.  
   c. scattered by dust particles and molecules.  
   *d. All of the above are correct.  
   e. None of the above is correct.

27. Through absorption, solar radiation is
   *a. converted to heat energy.  
   b. scattered to space.  
   c. reflected to space.  
   d. destroyed.  
   e. None of the above is correct.

28. The layer of the atmosphere that contains the ozone shield is the
   *a. stratosphere.  
   b. mesosphere.  
   c. troposphere
29. The principal threat to the ozone shield is (are)
a. aircraft exhaust.
b. burning of fossil fuels.
*c. chlorofluorocarbons (CFCs).
d. volcanic eruptions.
e. global warming.

30. A thinner ozone shield would likely mean
a. more intense UV radiation received at the Earth's surface.
b. greater incidence of skin cancer.
c. greater incidence of cataracts and other eye damage.
*d. All of the above are correct.
e. None of the above is correct.

31. Formation and dissociation of ozone in Earth's atmosphere is related to the
a. atmospheric absorption of ultraviolet radiation from the Sun.
b. formation and maintenance of the "warm layer" in the stratosphere.
*c. Both of the above are correct.
d. None of the above is correct.

32. Which one of the following surfaces has the lowest albedo for visible solar radiation?
*a. black asphalt
b. green grass
c. fresh snow
d. old snow
e. white beach sand

33. Which one of the following surfaces has the highest albedo for visible solar radiation?
a. ocean water
b. black asphalt
*c. fresh snow
d. green grass
e. old snow

34. Which one of the following surfaces absorbs the highest percentage of incident solar radiation at noon?
a. fresh snow
b. clouds
c. land
*d. the ocean
e. green grass

35. The average albedo of the ocean is
a. greater than that of clouds.
b. greater than Earth's planetary albedo.
c. less than 10 percent.
d. about 30 percent.
e. more than 60 percent.

36. On a clear day, the albedo of the sea surface is lowest
a. at sunrise.
b. at noon.
c. at sunset.

37. The Moon’s planetary albedo is __________ the albedo of the Earth.
a. about the same as
b. less than
c. greater than

38. The surface of Earth is absorbing solar radiation. If more solar radiation is absorbed than emitted, then the temperature of Earth’s surface will
a. rise
b. fall.
c. not change.

39. The principal absorber(s) of the solar radiation that is intercepted by the Earth-atmosphere system is (are)
a. clouds.
b. land.
c. ocean water.
d. aerosols.

40. Earth's planetary albedo is about ______ percent.
a. 31
b. 70
c. 23
d. 46
e. 8

41. Earth's surface and atmosphere emit primarily what type of electromagnetic radiation?
a. visible
b. microwaves
c. gamma rays
d. infrared
*e. ultraviolet

42. The greenhouse effect is primarily the consequence of atmospheric
a. carbon dioxide.
b. water vapor.
c. oxygen.
d. ozone.
e. methane.

43. At night, air temperatures near Earth’s surface tend to be lowest when the sky is
a. completely cloud covered.
b. mostly cloudy.
c. partly cloudy.
d. overcast with high thin clouds.
*e. clear.

44. Clouds, carbon dioxide, water vapor, and methane strongly ______ infrared radiation.
a. reflect
*b. absorb

45. The chief reason for the upward trend in atmospheric carbon dioxide since the mid-1800s is
(are)
*a. burning of fossil fuels.
b. deforestation.
c. less photosynthesis worldwide.
d. volcanic eruptions.
e. CFCs.

46. A greenhouse gas:
a. methane
b. nitrous oxide
c. ozone
d. carbon dioxide
*e. All of the above are correct.

47. According to projections by global climate models, sea-level rise is expected to accompany
global warming because
a. heating sea-water causes it to expand.
b. higher temperatures at high latitudes may partially melt the polar ice caps.
*c. Both of the above contribute.

48. A doubling of the absolute temperature of the Sun's surface would cause the amount of solar
energy reaching the Earth to be
a. one-half the amount it now receives.
b. twice the amount it now receives.
*c. sixteen times the amount it now receives.
d. None of the above is correct.

49. Compared to the rest of the 20th century, the global mean annual temperature during the
decade of the 1990s was relatively
*a. high.
b. low.
50. An infrared radiometer flown onboard a weather satellite is used to measure
*a. cloud surface temperatures.
b. the solar wind.
c. the solar constant.