Chapter 2 - Warming the Earth and the Atmosphere

1 Which of the following provides a measure of the average speed of the atoms and molecules in air?

- pressure
- temperature
- density
- evaporation

2 The freezing of pure water is 32° on the ____ scale.

- Kelvin
- Fahrenheit
- Celsius
- absolute

3 The transfer of heat from molecule to molecule within a substance is called ____.

- conduction
- convection
- radiation
- latent energy

4 The heat energy released when water vapor changes to a liquid is called ____.

- latent heat of evaporation
- latent heat of sublimation
- latent heat of vaporization
- latent heat of condensation

5 Which of the following is the poorest conductor of heat?

- still air
- water
- ice
- soil

6 What is responsible for the cold feeling that you experience after leaving a swimming pool on a hot, dry summer day?

- heat transport by conduction
- heat transport by convection

- heat transport by radiation
- heat transport by latent heat

7 The movement of smoke in the atmosphere from one area to another by wind is an example of ____.

- advection
- radiation
- conduction
- reflection

8 In the lower atmosphere, any air that rises will ____ and cool.

- expand
- evaporate
- compress
- vaporize

9 During atmospheric convection, rising air bubbles are called ____.

- wind
- vapors
- thermals
- clouds

10 A heat transfer process in the atmosphere that depends upon the movement of air is ____.

- conduction
- reflection
- convection
- radiation

11 Radiation is made of discrete packets of energy called ____.

- thermals
- convective cells
- photons
- microns

12 The wavelength of radiation is ____ proportional to the energy carried per wave.

- directly
- not
- slightly
- inversely

13 Which region of the sun's electromagnetic spectrum is most responsible for human skin cancer?

- infrared
- (•) ultraviolet
- visible
- near infrared

14 Energy transferred by electromagnetic waves is called ____.

- magnetism
- convection
- conduction
- (•) radiation

15 The proper order from shortest to longest wavelength is ____.

- ultraviolet, infrared, and visible
- infrared, visible, and ultraviolet
- (•) ultraviolet, visible, and infrared
- visible, ultraviolet, and infrared

16 Electromagnetic radiation with wavelengths between 0.4 and 0.7 micrometers is called ____.

- ultraviolet light
- (•) visible light
- infrared light
- microwaves

17 The earth's radiation is often referred to as ____ radiation, while the sun's radiation is often referred to as ____ radiation.

- shortwave; longwave
- shortwave; shortwave
- (•) longwave; shortwave
- longwave; longwave

18 The earth emits radiation with greatest intensity at ____.

- (•) infrared wavelengths
- radio wavelengths
- visible wavelengths
- ultraviolet wavelengths

19

The wavelengths of radiation that an object emits depend primarily on the object's ____.

- (•) temperature
- ( ) photons
- ( ) density
- ( ) reflective surfaces

20 As the temperature of an object ____, the intensity of the radiation emitted by the object ____.

- (•) increases; increases
- ( ) increases; decreases
- ( ) decreases; stays the same
- ( ) decreases; increases

21 The atmospheric greenhouse effect is due primarily to the fact that ___.

- ( ) oxygen and ozone absorb ultraviolet radiation
- ( ) nitrogen and oxygen transmit visible radiation
- ( ) cloud formation releases latent heat energy
- (•) carbon dioxide and water vapor absorb infrared radiation

22 Without the atmospheric greenhouse effect, the average surface temperature of the earth would be ___.

- ( ) higher than at present
- (•) lower than at present
- ( ) the same as it is now
- ( ) much more variable than it is now

23 An object at radiative equilibrium temperature is behaving as a ____.

- ( ) selective absorber
- (•) blackbody
- ( ) light reflector
- ( ) greenhouse gas

24 The earth emits infrared radiation ____.

- ( ) only at night
- ( ) only during the day
- ( ) at variable times
- (•) continuously

25 Which of the following has a higher albedo than thin clouds?

- the moon
- snow
- ice
- water

26 Although water vapor accounts for about 60% of the atmospheric greenhouse effect, it is the increase of ____ in the atmosphere that appears to be the main cause of global warming.

- carbon monoxide
- ozone
- carbon dioxide
- argon

27 The albedo of the earth's surface is only about 4%, yet the combined albedo of the earth and the atmosphere is about 30%. Which set of conditions below best explains why this is so?

- high albedo of clouds; low albedo of water
- high albedo of clouds; high albedo of water
- low albedo of clouds; low albedo of water
- low albedo of clouds; high albedo of water

28 The earth's surface receives about twice as much energy from the atmosphere than from the sun as a result of ____.

- the release of latent heat during condensation
- conduction of heat upward from the surface
- convection
- absorbed infrared energy radiated back to earth
- direct absorption of sunlight by the atmosphere

29 Which process accounts for the sky's blue color?

- light reflection
- light scattering
- albedo
- thermal convection

30 An object that radiates more energy than it absorbs will ____.

- become colder
- become warmer
- maintain the same temperature
- reach radiative equilibrium

31

During the summer months at the North Pole, the sun does not set for ____.

- 2 months
- 24 hours
- (•) 6 months
- 4 months

32 The auroras are caused by charged particles originating from ____.

- the earth’s atmosphere
- (•) solar wind
- the North Pole
- the South Pole

33 The earth is closest to the sun in ____.

- (•) January
- March
- July
- September

34 Seasons on earth are regulated by ___.

- only the length of daylight hours
- (•) both the length of daylight hours and the angle sunlight strikes the earth’s surface
- only the angle sunlight strikes the earth’s surface
- only the earth’s nearness to the sun

35 Between Christmas and January, at middle latitudes in the Northern Hemisphere, the length of the day ____.

- (•) increases
- decreases
- does not change
- is 12 hours long

36 On which date would the sun's rays be closest to being perpendicular to the earth's surface in the middle latitudes of the Northern Hemisphere?

- March 21
- (•) June 21
- September 22
- July 21

37 The average summer temperatures in the Southern Hemisphere are cooler than the average summer temperatures in the Northern Hemisphere because

___.

- the earth is closer to the sun in January
- the earth is farther from the sun in July
- (•) over 80% of the Southern Hemisphere is covered with water
- the sun's energy is less intense in the Southern Hemisphere

38 In the middle latitudes of the Northern Hemisphere, the day with the shortest number of daylight hours occurs on ____.

- June 21
- (•) December 21
- September 22
- January 1

39 When it is January and winter in the Northern Hemisphere, it is ____ in the Southern Hemisphere.

- (•) January and summer
- January and winter
- July and winter
- July and summer

40 For maximum winter warmth, in the Northern Hemisphere, large windows in a house should face ____.

- north
- (•) south
- east
- west

41 The formation of ice releases heat and warms the surroundings.

- (•) True
- False

42 Microwave radiation has a longer wavelength and carries more energy per wave than visible light.

- True
- (•) False

43

When an object emits and absorbs energy at equal rates, its temperature increases.

- ○ True
- ◉ False

44 The Southern Hemisphere has warmer summers and colder winters than the Northern Hemisphere.

- ○ True
- ◉ False

45 Airline routes are sometimes changed as a result of solar storms.

- ◉ True
- ○ False

46 **Instructions:** Choose one answer from each pair of selections.

If you could somehow see the random motions of atoms and molecules in air, would they all be moving at the SAME or at DIFFERENT speeds?

Answer:

DIFFERENT

47 **Instructions:** Choose one answer from each pair of selections.

Air is a GOOD | POOR conductor of heat.

Answer:

POOR

48 **Instructions:** Choose one answer from each pair of selections.

The longest wavelengths of visible light correspond to the color RED | VIOLET.

Answer:

RED

49 **Instructions:** Choose one answer from each pair of selections.

At a UV index of 10, a person should take EXTRA | MODERATE precautions when exposed to sunlight.

Answer:

EXTRA

50 **Instructions:** Choose one answer from each pair of selections.

Overcast skies usually result in cooler daytime temperatures because clouds are good REFLECTORS | ABSORBERS of sunlight.

Answer:

REFLECTORS

51 **Instructions:** Choose one answer from each pair of selections.

The earth's atmosphere SELECTIVELY | CONTINUOUSLY absorbs radiation.

Answer:

SELECTIVELY

52 **Instructions:** Choose one answer from each pair of selections.

Which is a better reflector of solar energy, WATER or ICE?

Answer:

ICE

53 **Instructions:** Choose one answer from each pair of selections.

To see the aurora australis, you have to travel to the NORTHERN | SOUTHERN Hemisphere.

Answer:

SOUTHERN

54 **Instructions:** Choose one answer from each pair of selections.

Compared to Phoenix (30°N latitude), Minneapolis (45°N) will have shorter days in the winter and LONGER | SHORTER days in the summer.

Answer:

LONGER

55 **Instructions:** Choose one answer from each pair of selections.

In the middle latitudes of the Northern Hemisphere, the sun's position can affect vegetation. Would you expect a SOUTH- or a NORTH-facing hill to receive more sunlight during a year?

Answer:

SOUTH

56 What provides a measure of the average speed or kinetic energy of the atoms and molecules in air?

Answer:

temperature

57 What mechanism always transfers heat by flowing from warmer to colder regions?

Answer:

conduction

58 In some situations, light behaves as if it were composed of particles rather than having a wavelike nature. What is the name given to light "particles?"

Answer:

photons

59 Which atmospheric gas is responsible for the largest percentage of the greenhouse effect?

Answer:

water vapor

60 During cloud droplet formation, condensation causes the release of what kind of heat into the environment?

Answer:

LATENT

61 Using the concept of latent heat, explain why perspiration is an effective way of reducing a person's body temperature.

Answer:

The process of a phase change, such as the evaporation of perspiration from the skin, requires the exchange of energy known as latent heat. As molecules of water escape, or evaporate, from the skin, energy is taken from the environment. During evaporation, the more energetic, faster-moving molecules escape most easily and the average motion of all the molecules left behind decreases as each additional molecule evaporates. Since temperature is a measure of average molecular motion, the slower motion suggests a lower water temperature. Therefore, evaporation is a

cooling process because the energy needed to change the water's phase from liquid to a gas is taken from the environment.

62 Does the expansion of air cause its temperature to increase or decrease? Why?

Answer:

Expansion decreases the temperature of air. As air rises in the atmosphere the surrounding air pressure decreases allowing for the air to expand. Because there is no other energy source, the air molecules use their own energy to spread out. This energy loss causes a reduction in molecular speed and, therefore, air temperature as well.

63 In the discussion of the earth's annual energy balance, we saw that the earth absorbed approximately 51 units of solar energy but emitted 117 units of infrared energy. What prevents the earth from getting colder and colder?

Answer:

Only a fraction of the emitted energy passes through into space. The majority of the energy is absorbed in the atmosphere mainly by greenhouse gases (primarily water vapor and carbon dioxide) and clouds. Much of this absorbed energy is then radiated back to earth, producing the atmospheric greenhouse effect and, therefore, preventing the cooling of the earth.

64 If the amount of snow and ice in the polar regions of the earth were to decline due to global warming, how would you expect this to affect the radiation budget of the earth?

Answer:

The percent of radiation reflected from a given surface is the albedo. Snow has one of the highest albedo percentages, in that up to 95% of sunlight may be reflected from the snow surface. If total snow cover on earth is reduced, the energy that would have been reflected becomes absorbed instead. Increased polar snow and ice melt will result in higher sea levels, which coupled with rising ocean temperatures will cause an increase in evaporation rates that will add more water vapor (a greenhouse gas) to the atmosphere and, subsequently, increase the amount of radiation returned to earth.

65 Explain why sunrises and sunsets typically have colors of red, orange, and yellow.

Answer:

Solar radiation entering the earth's atmosphere is scattered as it strikes air molecules and dust particles. Because air molecules are much smaller than the wavelengths of visible light, they more effectively scatter the shorter (blue) wavelengths than the longer (red) wavelengths. At sunrise and sunset, the sun is (typically) located on the horizon and sunlight must travel a longer distance through a thicker portion of the atmosphere. As sunlight travels along this path, the shorter wavelengths of visible light are more effectively scattered by the atmospheric air particles and the longer wavelengths of red, orange, and yellow are allowed to pass through, thereby creating the image of a red/orange sun.