1.	In which country was the bird *Parus major* studied as an example of adjustment to global warming?
a)	United States
b)	England
c)	China
d)	France
e)	Canada
	Ans: b Difficulty: Easy Link to: Case Study

2.	Which of the following terms refers to study of the global-scale connections between atmosphere, oceans, biosphere, climate, and the Earth:
a)	earth system science
b)	greenhouse effect
c)	global circulation model
d)	deforestation
e)	microclimate
	Ans: a Difficulty: Medium Link to: 23.1

3.	Which of the following terms refers to computer simulations designed to predict changes in the atmosphere and in the Earth's climate:
a)	earth system science
b)	greenhouse effect
c)	global circulation model
d)	deforestation
e)	microclimate
	Ans: c Difficulty: Medium Link to: 23.4

4.	The persistent trend of increasing temperatures over three decades is an indication that global warming is really happening. What was the warmest decade since temperatures have been recorded?
a)	the 1990s
b)	the 1980s

c)	the 1970s
d)	the 1960s
e)	the 1950s
	Ans: a Difficulty: Easy Link to: 23.1

5.	Which of the following is an example of carbon-dioxide sequestration?
a)	smoke-stack emissions
b)	the injection of carbon dioxide into subsurface geologic reservoirs
c)	the reversal of global warming
d)	scrubbing carbon dioxide out of power-plant emissions
e)	emissions trading
	Ans: b Difficulty: Difficult Link to: 23.8

6.	The carbon-dioxide content in the Earth's atmosphere before 1500 A.D. was between 200 and 300 ppm. The carbon dioxide content today is about 450 ppm. Which single historical development can be blamed for this increase?
a)	the invention of agriculture
b)	the Industrial Revolution
c)	the American Revolution
d)	splitting of the atom
e)	the election of George Bush
	Ans: b Difficulty: Easy Link to: Critical Thinking Issue

7.	Which of the following is a major effect of El Niño:
a)	heavy rains along the western coast of South America
b)	droughts in California
c)	increased tooth decay
d)	global warming of the Earth
e)	widening of the ozone hole

Ans: a
Difficulty: Medium
Link to: 23.4

8. The "atmospheric window":

I.	allows part of Earth's back-radiation to escape into space
II.	is a seasonal hole where stratospheric ozone is reduced to near zero
III.	Is a gap in the atmospheric absorption spectrum, between the absorption dominated by water vapor and carbon dioxide

a) I only
b) II only
c) I and III
d) II and III
e) I, II, and III

Ans: c
Difficulty: Difficult
Link to: 23. A Closer Look, 23.3

9. The effect of continental glaciation is to:

a) cause El Niño weather patterns
b) cool global climate
c) destroy ozone
d) warm global climate
e) decrease precipitation

Ans: b
Difficulty: Easy
Link to: 23.3

10. Constant energy input to a physical object will heat it up. Eventually it will reach a temperature that will cause it to:

a) radiate heat energy all the time
b) radiate heat energy at the same rate it receives energy
c) absorb heat energy all the time
d) stop absorbing energy from the source
e) radiate heat energy at a rate greater than its energy input

	Ans: b Difficulty: Medium Link to: 23.2

11.	During the last two million years or so, the climate of the Earth has:
a)	been very nearly constant
b)	swung sharply both up and down in temperature
c)	slowly decreased in humidity
d)	slowly increased in temperature
e)	seen a steady decrease in precipitation worldwide
	Ans: b Difficulty: Easy Link to: 23.3

12.	Global-scale wind currents are produced by:
a)	the tilt of the Earth
b)	gravity
c)	differential heating of the Earth by the Sun
d)	the Coriolis effect produces high and low pressure systems
e)	ocean currents
	Ans: c Difficulty: Easy Link to: 23.2

13.	Which of the following is a plausible argument that burning fossil fuels may not lead to severe global warming:
a)	conversion from oil to alternative energy may quickly reduce CO_2 in the atmosphere
b)	average global temperature during the last 100 years actually has declined by 0.5°C
c)	melting glaciers may increase the Earth's albedo
d)	rising global sea level will reduce gasoline consumption
e)	various negative feedbacks may reduce the effects
	Ans: e Difficulty: Medium Link to: 23.4

14.	Which of the following appears to contribute to global cooling and not to warming?

a)	aerosols
b)	methane
c)	chlorofluorocarbons (CFCs)
d)	carbon dioxide
e)	nitrous oxide

Ans: a
Difficulty: Easy
Link to: 23.4

15.	Which of the following is not a potential adverse effect of global warming?
a)	retreat of glaciers
b)	more extreme weather patterns
c)	sea level rise
d)	an increase of UVB radiation
e)	All of these are adverse effect of global warming

Ans: d
Difficulty: Easy
Link to: 23.2

16.	Incoming solar radiation is partly reflected back into space by the Earth's:

I.	atmosphere
II.	land surface
III.	ocean surface

a)	I only
b)	II only
c)	III only
d)	II and III
e)	I, II, and III

Ans: e
Difficulty: Easy
Link to: 23.3

17.	Which of the following is not a major greenhouse gas?
a)	carbon-dioxide
b)	methane
c)	CFCs
d)	water vapor

e)	ozone
	Ans: e Difficulty: Easy Link to: A Closer Look, 23.3

18.	"Weather" as we know it is a phenomenon of the:
a)	ionosphere
b)	ozone layer
c)	troposphere
d)	stratosphere
e)	hydrosphere
	Ans: c Difficulty: Easy Link to: 23.2

19.	Which of the following is responsible for catching most of Earth's back-radiation to space?
a)	water vapor
b)	sulfur dioxide
c)	particulate matter
d)	carbon dioxide
e)	CFCs
	Ans: a Difficulty: Medium Link to: 23.4

20.	How does air temperature change with altitude in the upper stratosphere and why?
a)	it decreases due to the presence of water vapor
b)	it decreases or increases, depending on the time of day
c)	it increases, due to the destruction of ozone by ultraviolet light
d)	it increases due to the greenhouse effect
e)	it is isothermal, due to loss of earthshine to space
	Ans: c Difficulty: Easy Link to: 23.2

21.	Which feedback mechanism in the Earth-atmosphere system is incorrect?

a)	increased atmospheric CO2 leads to an increased greenhouse effect
b)	increased glacial melting leads to decreased albedo
c)	decrease in cloud albedo leads to increased atmospheric temperature
d)	decreased atmospheric H_2O leads to an increased greenhouse effect
e)	increased surface temperature leads to increased evaporation

Ans: d
Difficulty: Medium
Link to: 23.4

22.	The part of the atmosphere where weather occurs is the:
a)	tropopause
b)	stratopause
c)	troposphere
d)	stratosphere
e)	homeosphere

Ans: c
Difficulty: Easy
Link to: 23.2

23.	Venus and Mars are our closest neighbors. Which of the following statements about these planets is not correct?
a)	Venus is closer to the Sun than Mars is
b)	The atmosphere of Venus is richer in carbon dioxide than the atmosphere of the Earth
c)	Venus is too hot to live on, and any water there is in vapor form
d)	Mars has a very thin atmosphere
e)	Mars is too hot to live on and never contained any water

Ans: e
Difficulty: Medium
Link to: 23.4

24.	Why does only approximately half of the solar energy emitted towards the Earth ever arrive at the surface?
a)	the rest is lost in transit through the vacuum of space
b)	the rest is lost because the speed of the light is slower in the atmosphere than in the vacuum
c)	the rest is absorbed by the atmosphere or reflected into space

d)	the rest is refracted through the atmosphere
e)	the rest is converted into heat energy

Ans: c
Difficulty: Medium
Link to: 23.4

25.	What portion of the solar radiation hitting the Earth is reflected back into space without ever getting to the surface of the planed?
a)	5%
b)	15%
c)	25%
d)	30%
e)	40%

Ans: c
Difficulty: Easy
Link to: 23.3

26.	With an increase in altitude, the average change in temperature in the Earth's troposphere is:
a)	6.5°F warmer per km
b)	6.5°F cooler per km
c)	6.5°C cooler per km
d)	called the adiabatic ellipse rate
e)	impossible to measure

Ans: c
Difficulty: Medium
Link to: 23.2

27.	Which gas absorbs earthshine in the wavelengths that typically pass through the atmospheric window?
a)	CFCs
b)	CO_2
c)	ozone
d)	water vapor
e)	argon

Ans: a
Difficulty: Easy
Link to: 23.4

28.	In addition to their role in ozone depletion, CFCs play a role in global warming by:
a)	absorbing solar radiation
b)	absorbing earthshine in the 10 micron region
c)	blocking ultraviolet-B radiation
d)	destroying ozone, which cools the Earth
e)	reducing the albedo of the Earth
	Ans: b Difficulty: Medium Link to: 23.4

29.	The "atmospheric window" is important to the understanding of the greenhouse effect because it _____. The window is threatened by anthropogenic emissions of _____.
a)	is transparent to radiation with a wavelength of about 10 microns; methane and CFCs
b)	allows convective cooling of the troposphere; carbon dioxide
c)	blocks UV-B radiation; ozone
d)	is transparent to sunshine; nitrogen
e)	blocks acid precipitation; sulfur dioxide
	Ans: a Difficulty: Medium Link to: 23.4

30.	Large volcanic eruptions appear to make the Earth's climate _____, at least temporarily.
a)	drier
b)	more stormy
c)	wetter
d)	cooler
e)	less stormy
	Ans: d Difficulty: Easy Link to: 23.5

31.	The "atmospheric window":
a)	falls between wavelengths of 12 and 16 microns
b)	represents the wavelengths of radiation leaving the Earth that are least absorbed by substances in the atmosphere.
c)	would be blocked by a build-up of CO_2 in the atmosphere

d)	represents sunlight that is most likely to be absorbed in the atmosphere
e)	all of these

Ans: b
Difficulty: Medium
Link to: 23.4

32.	The figure below illustrates an analogy of the Earth's thermal balance. Water pouring into the bucket is equivalent to in-coming solar radiation, and the water leaking from holes in the bucket is like outgoing thermal radiation (earthshine). The amount of water in the bucket is equivalent to the amount of heat on Earth – a higher water level is like higher temperature on Earth. In this analogy, the greenhouse effect would be like:
a)	putting the bucket on the stove
b)	increasing the stream of water pouring into the bucket
c)	decreasing the stream of water pouring into the bucket
d)	punching some new holes in the bucket
e)	plugging-up some of the holes in the bucket

Ans: e
Difficulty: Medium
Link to: 23.4

33.	About 99% of all air in the Earth's atmosphere is found in:
a)	the troposphere
b)	the tropopause
c)	the stratosphere
d)	the troposphere and the stratosphere
e)	air bubbles in glacial ice

Ans: d
Difficulty: Easy
Link to: 23.2

34.	The figure below illustrates an analogy of the Earth's thermal balance. The amount of water in the bucket is equivalent to the amount of heat on Earth. A higher water level is like higher temperature on Earth. Water pouring into the bucket is equivalent to: _____; and the water leaking from holes in the bucket is like: _____.
Ans:	incoming solar radiation outgoing thermal radiation (Earthshine)
	Difficulty: Medium Link to: 23.4

35.	Refer to the figure below. Take the bucket analogy one step further and say what the greenhouse effect would be in this metaphor.
Ans:	plugging some of the holes in the bucket
	Difficulty: Medium Link to: 23.4

36.	In the figure below, identify the following elements: • the stratosphere • the stratospheric ozone layer • the tropopause • the troposphere
Ans:	(a) stratospheric ozone layer (b) stratosphere (c) tropopause (d) troposphere
	Difficulty: Medium Link to: 23.2

37.	How does the air temperature change with height in the stratosphere and why?
Ans:	temperature rises – heat given off by photo-dissociation of ozone

	Difficulty: Medium Link to: 23.2

38.	List the four main factors by which the temperature at or near the surface of the Earth is determined.
Ans:	the amount of sunlight that the Earth receives the amount of sunlight that the Earth reflects retention of heat by the atmosphere evaporation and condensation of water vapor
	Difficulty: Medium Link to: 23.4

39.	The greenhouse effect is a change in the Earth's climate related to increasing carbon-dioxide content in the atmosphere. What would happen if a significant quantity of carbon-dioxide were removed from the atmosphere?
Ans:	global cooling
	Difficulty: Medium Link to: 23.4

40.	What is polar amplification?
Ans:	the increase in solar radiation absorbed by ice-free ocean versus snow-covered land and ice
	Difficulty: Easy Link to: 23.6

41.	A carbon sequestration project is underway in Norway beneath the North Sea. Explain the purpose of this project.
Ans:	Carbon dioxide produced by a natural gas production facility is injected about 1,000 m into sedimentary rock below a natural gas field. The purpose of this project is to keep carbon dioxide from entering into the atmosphere.
	Difficulty: Medium Link to: 23.8

42.	Name the three gases that have the greatest impact on the greenhouse effect.
Ans:	CO_2 methane H_2O
	Difficulty: Easy Link to: A Closer Look, 23.3

43.	The residence time of carbon dioxide in the atmosphere is about 5 years, much less than that of CFCs (>100 years), even though the abundance of CO_2 is much greater than the abundance of CFCs. Why is this?
Ans:	biosphere recycles CO_2 very fast – rate of input and output from the pool is much faster than for CFCs
	Difficulty: Medium Link to: 23.4

44.	Name two consequences of particulate material in the atmosphere.
Ans:	increased albedo of the Earth reduced surface temperature increased condensation of moisture
	Difficulty: Medium Link to: 23.2

45.	Name three adverse effect of global warning
Ans:	rise in sea level more extreme weather retreat of glaciers break up of sea ice increase of global temperatures migration of animals
	Difficulty: Easy Link to: Chap. 23

46.	What primary feature of the Earth system drives weather and climate?
Ans:	different levels of solar input – temperature differences at the surface.
	Difficulty: Medium Link to: 23.1, 23.4

47.	What was the purpose of the Kyoto Accord?
Ans:	countries that ratified the Kyoto Accord promised to reduce carbon dioxide emissions voluntarily
	Difficulty: Easy Link to: 23.8

48.	Why did the United States not ratify the Kyoto Accord?
Ans:	the U.S. stated that it needed additional scientific study to prove that global warming has resulted from human activities and that serious harm is likely.
	Difficulty: Difficult Link to: 23.8

49.	Our planet has the perfect temperature for life as we know it – not too hot and not too cold. Name two attributes of the Earth that lead to this comfortable balance.
Ans:	distance of the planet to the Sun CO_2 and H_2O in the atmosphere
	Difficulty: Easy Link to: 23.7