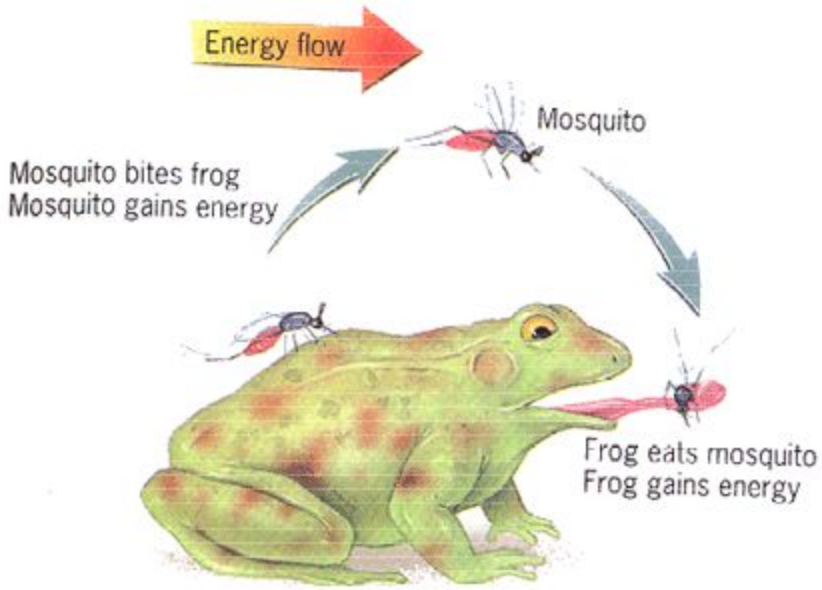
1.	These organisms live at or near deep ocean vents and derive energy from inorganic sulfur compounds:
a)	autotrophs
b)	chemautotrophs
c)	biotrophs
d)	heterotrophs
e)	homotrophs
	Ans: b Difficulty: Easy Link to: 9.2

2.	These organisms make sugar from sunlight, carbon dioxide and water:
a)	autotrophs
b)	chemautotrophs
c)	biotrophs
d)	heterotrophs
e)	homotrophs
	Ans: a Difficulty: Easy Link to: 9.2

3.	These organisms cannot make their own organic compounds from inorganic ones and must feed on other living things:
a)	autotrophs
b)	chemautotrophs
c)	biotrophs
d)	heterotrophs
e)	homotrophs
	Ans: d Difficulty: Easy Link to: 9.2

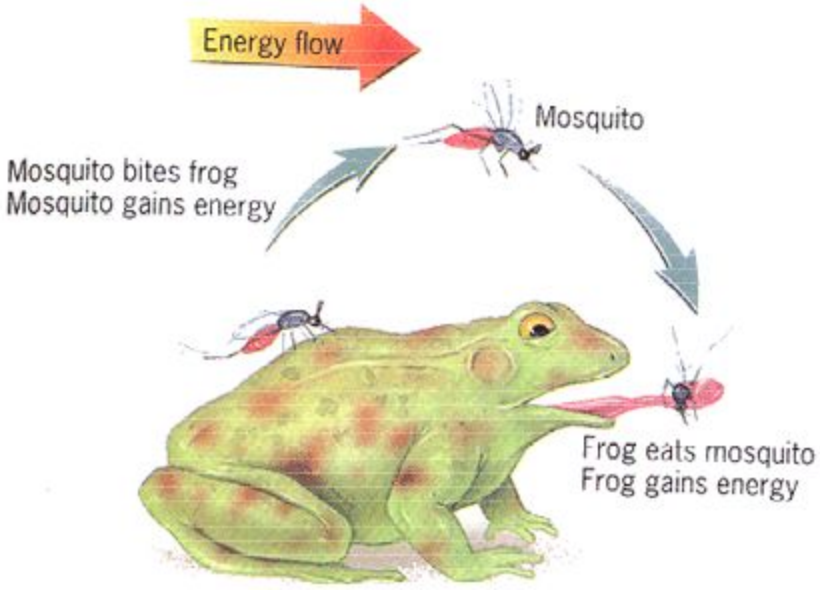
4.	The diagram below illustrates a closed ecosystem which contains only mosquitoes and frogs. The mosquitoes feed on the blood of the frogs, and the frogs eat the mosquitoes. This ecosystem is impossible because:



a)	it is a perpetual motion machine and will never stop
b)	according to the 2nd law of thermodynamics, some energy is always lost in any transfer
c)	frogs are herbivores
d)	there is no change in biomass through time
e)	it violates the 1st law of thermodynamics – that energy is neither created nor destroyed, but only changes forms

Ans: b
Difficulty: Difficult
Link to: A Closer Look 9.1

5.	The example of a closed system containing only frogs an mosquitoes in it – the frogs live by eating mosquitoes, and the mosquitoes live by biting frogs – is impossible because:



a)	the transfer of energy is never 100% efficient
b)	of the laws of relativity
c)	energy changes form, not amount
d)	of the finite amount of biomass in the system
e)	both frogs and mosquitoes are autotrophs

Ans: a
Difficulty: Medium
Link to: A Closer Look 9.1

6.	A large portion of the total primary production in the oceans, about 25%, occurs in:
a)	hydrothermal vent areas
b)	coral reefs and lagoons
c)	coastal areas and upwelling areas
d)	the open ocean
e)	estuaries

Ans: c
Difficulty: Easy
Link to: 9.5

7.	The U.S. has sent several space missions to the planet Mars. A major goal of these missions has been the search for life. Which of the following characteristics of Mars argue against the presence of life?

a)	Mars has a polar cap of frozen carbon dioxide.
b)	The atmosphere is mostly carbon dioxide and there is little oxygen.
c)	The canyons on Mars show evidence of water erosion.
d)	The distance between Mars and the Sun is in the range to provide energy for life.
e)	All of these argue for the presence of life on Mars

Ans: b
Difficulty: Medium
Link to: 9.2

8.	An ecosystem must lie between a source of usable energy and a sink for degraded (heat) energy. What would happen if an ecosystem were suddenly closed to all energy, neither receiving nor giving energy to the outside?
a)	the system would slowly grow colder and colder
b)	the system would slowly grow hotter and hotter
c)	entropy death – all energy would become evenly distributed through the ecosystem
d)	the system would reach a steady state, and all production within it could continue infinitely
e)	the system would undergo a local increase in order

Ans: c
Difficulty: Difficult
Link to: A Closer Look 9.1

9.	Biomass refers to the amount of organic matter. The Earth's biomass may be measured in units of _____. The change in biomass is called _____.
a)	grams per m^2; net production
b)	kg * m / sec^2; deforestation
c)	m^3; productivity
d)	hectares; organic flux
e)	kg; productivity

Ans: a
Difficulty: Easy
Link to: 9.2

10.	What is meant by energy "fixation"?
a)	storage of light energy in the green parts of a plant
b)	the capture of light energy by plants

c)	the production of biomass
d)	the transfer of light energy to energy in chemical bonds of an organic compound
e)	the energy flow in ecosystems

Ans: d
Difficulty: Medium
Link to: 9.2

11.	Self-nourishing organisms are called:
a)	exotrophs
b)	endotrophs
c)	autotrophs
d)	heterotrophs
e)	chemoautotrophs

Ans: c
Difficulty: Easy
Link to: 9.2

12.	Firewood is the primary source of fuel for cooking and heating in many cultures. Approximately what percentage of the world's total energy use involves firewood?
a)	25%
b)	20%
c)	15%
d)	10%
e)	5%

Ans: e
Difficulty: Medium
Link to: Case Study

13.	The flow of energy through biological systems is analogous to energy flow in physical systems. The law of the conservation of energy in ecosystems has its equivalent in physical systems as:
a)	the laws of relativity
b)	entropy
c)	environmental ethics
d)	quantum physics
e)	one of the laws of thermodynamics

	Ans: e Difficulty: Medium Link to: 9.3

14.	How does chemosynthesis differ from photosynthesis:
a)	the energy in hydrogen sulfide is used by certain bacteria to make organic compounds
b)	chemosynthesis is more energy efficient than photosynthesis
c)	chemosynthesis takes place only in the absence of sunlight
d)	a and b are correct
e)	all of these
	Ans: a Difficulty: Medium Link to: 9.2

15.	Matter and energy are both always conserved, both in physical systems and biological systems. This principle is stated in the:
a)	first law of enthalpy
b)	first law of entropy
c)	first law of thermodynamics
d)	the first law of energy efficiency
e)	the second law of thermodynamics
	Ans: c Difficulty: Easy Link to: 9.4

16.	The following is the chemical expression for photosynthesis: $6CO_2 + 6H_2O \rightarrow C_aH_bO_6 + 6O_c$. The correct values for a, b, and c are:
a)	a=12, b=12, c=12
b)	a=6, b=12, c=2
c)	a=12, b=24, c=12
d)	a=6, b=4, c=2
e)	a=1, b=2, c=1
	Ans: b Difficulty: Medium Link to: 9.2, Working It Out

17.	Organisms that make their own food from the energy in sulfur are called:

a)	heterotrophs
b)	chemoautotrophs
c)	detrivores
d)	zooplankton
e)	chemozoans

Ans: b
Difficulty: Easy
Link to: 9.2

18.	Areas of especially high biological productivity in the oceans include:
a)	deep ocean trenches
b)	areas near coasts and in areas of upwelling water
c)	areas near the equator and in the centers of large oceanic circulation cells
d)	areas near volcanic islands
e)	areas where there is little change in water temperature with depth

Ans: b
Difficulty: Easy
Link to: 9.5

19.	Energy content of organic matter varies. Which type of organic matter contains the least amount of energy?
a)	leaves and shoots
b)	fat
c)	woody tissue
d)	roots
e)	muscle

Ans: c
Difficulty: Easy
Link to: 9.2

20.	Energy efficiency is generally defined as:
a)	gross production - net production
b)	energy input - energy output
c)	the temperature at which a system reaches steady-state
d)	the amount of energy per unit biomass
e)	the amount of useful work obtained from some amount of energy

	Ans: e Difficulty: Medium Link to: 9.4

21.	Net production equals:
a)	change in biomass over time
b)	gross production minus photosynthesis
c)	sustainable yield
d)	total production minus gross production
e)	biomass plus respiration
	Ans: a Difficulty: Easy Link to: 9.2, Working It Out

22.	Biological productivity is commonly measured as:
a)	net production - respiration
b)	change in biomass
c)	number of births per generation
d)	energy input - energy output
e)	the ratio of production of one trophic level to the production of the next low trophic level
	Ans: b Difficulty: Medium Link to: 9.2

23.	Change in the amount of biomass is called:
a)	primary production
b)	secondary production
c)	net production
d)	biological production
e)	ecological production
	Ans: c Difficulty: Easy Link to: 9.3

24.	A common measure of energy efficiency is called trophic-level efficiency, which is the ratio of:
a)	the material produced by an organism to the material consumed

b)	production of one trophic level to the production of the next lower trophic level
c)	production of one trophic level to the production of the next higher trophic level
d)	material produced to the material assimilated
e)	the movement of net energy from one trophic level to the next higher trophic level

Ans: b
Difficulty: Medium
Link to: 9.4

25.	The second law of thermodynamics states that when energy is transformed from one form to another, it always goes from a more useful form to a less useful form. We also know that living organisms create order from disorder and create useful forms of energy. Is Life a violation of the second law of thermodynamics?
a)	No, because biological energy is fundamentally different from physical energy.
b)	No, because organisms create greater <u>overall</u> disorder in the process of creating order locally.
c)	Yes, but organisms do not obey the laws of thermodynamics.
d)	No, because organisms transfer energy with near 100% efficiency, while energy transfer in physical systems is almost always much lower.
e)	Yes, and the thermodynamic police are on their way.

Ans: b
Difficulty: Medium
Link to: A Closer Look 9.1

26.	Production by heterotrophs is called:
a)	respiration
b)	primary production
c)	secondary production
d)	gross production
e)	net production

Ans: c
Difficulty: Easy
Link to: 9.2

27.	Why might a stream or river, especially one in a humid area, have a much higher proportion of heterotrophs to autotrophs?

a)	CO_2 dissolved in water is less readily available for photosynthesis in streams
b)	aquatic food chains are longer and therefore support more heterotrophs
c)	high pH in humid-area waterways inhibits photosynthesis
d)	less sunlight penetrates into the water
e)	a lot of dead organic matter from the land is washed into the water and is a potential food source for heterotrophs
	Ans: e Difficulty: Medium Link to: 9.5

28.	The case study in the Environmental Science text illustrates:
a)	how rapid human population growth can effect the productivity of an entire continent
b)	that starvation and malnutrition do come as a surprise in an overpopulated continent
c)	sustainable versus non-sustainable use of resources
d)	maximum versus optimum sustainable yield of resources
e)	that production of food has increased in the past 50 years
	Ans: b Difficulty: Medium Link to: Case Study

29.	On average, how much firewood has a Masai girl gathered and carried home by the time she has reached the age of 16?
a)	1 ton
b)	5 tons
c)	10 tons
d)	15 tons
e)	25 tons
	Ans: d Difficulty: Medium Link to: Case Study

30.	Which one of the following is a fundamental distinction between life and the non-living environment?
a)	life is made up of organic chemicals, not inorganic chemicals
b)	life creates order out of disorder
c)	living beings are heterotrophs

d)	energy changes form, not amount
e)	natural, inorganic processes are less than 100% efficient

Ans: b
Difficulty: Medium
Link to: 9.2

31.	What are detrivores:
a)	organisms that live in symbiosis with another organism
b)	organisms that feed on dead organic material
c)	organisms that feed on plants only
d)	organisms that hunt for food
e)	organisms that produce their own food

Ans: b
Difficulty: Easy
Link to: 9.2

32.	In the marine system, which of the following are autotrophs:
a)	herbivorous fish
b)	sharks
c)	phytoplankton
d)	zooplankton
e)	filter-feeders

Ans: c
Difficulty: Easy
Link to: 9.5

33.	Most of the carbon in living tissue in the biosphere is stored in?
a)	plankton
b)	the woody tissue of vegetation, especially forests
c)	bacteria and blue green algae
d)	terrestrial and marine mammals
e)	the carbon cycle

Ans: b
Difficulty: Easy
Link to: 9.2

34.	Energy efficiency is the:
a)	ratio of energy output to energy input
b)	sum of energy output and energy input

c)	difference between total photosynthetic energy and total respiration
d)	conservation of energy
e)	total amount of energy produced by autotrophs
	Ans: a Difficulty: Easy Link to: 9.4

35.	In the open ocean, the first trophic level is composed primarily of:
a)	small fish
b)	zooplankton
c)	whales
d)	mussels
e)	phytoplankton
	Ans: e Difficulty: Easy Link to: 9.5

36.	In the figure below, which organisms are autotrophs?
a)	green plants
b)	herbivores
c)	carnivores
d)	decomposers
e)	none of these
	Ans: a Difficulty: Medium Link to: 9.2

37.	In the figure below, which organisms are heterotrophs?
a)	green plants
b)	herbivores
c)	carnivores
d)	decomposers
e)	none of these
	Ans: b Difficulty: Medium Link to: 9.2

38.	In the figure below, which arrow(s) represent(s) respiration?
a)	1
b)	2 and 3
c)	3
d)	4
e)	2 and 5
	Ans: e Difficulty: Medium Link to: 9.2

39.	Bacteria are important residents of the soil because they can carry out chemical reactions that no other life forms are capable of. Which of the following is not a function performed by bacteria?
a)	break down wood (cellulose)
b)	form complex proteins from simple sand and clay particles
c)	convert organic sulfur to inorganic forms
d)	release organic nitrogen into the atmosphere
e)	are symbiotic with mammals and other organisms
	Ans: b Difficulty: Medium Link to: 9.2

40.	The extinction of which of the following would have the most drastic consequences for the continuation of life on earth?
a)	human beings
b)	herbivorous animals
c)	bacteria and blue-green algae
d)	coniferous trees
e)	viruses
	Ans: c Difficulty: Easy Link to: 9.2

41.	The figure below is based on the premise that a person ate only trout (1 per day) for 300 days. If the human ate the frogs directly, he or she would need 10 per day for the same amount of energy. How much grass would be consumed in this new, shorter food chain (skipping the trout)?

a)	about 33 tons
b)	100 tons
c)	300 tons
d)	1,000 tons
e)	10,000 tons

Ans: a
Difficulty: Medium
Link to: 9.1, Working It Out

42.	Autotrophs, at the first trophic level, get their food from:
a)	organic chemicals
b)	inorganic chemicals and sunlight
c)	sunlight, air, and water
d)	chemosynthesis
e)	organic compounds, water, air and sunlight

Ans: b
Difficulty: Easy
Link to: 9.2

43.	Production of biomass is analogous to an individual's personal finances. Gross production is like _____, and net production is like the _____.
a)	total salary before taxes and any deductions; paycheck
b)	total salary before taxes and any deductions; annual tax refund from the I.R.S.
c)	total salary; current bank balance
d)	salary this year; sum of all salary over one's lifetime
e)	paycheck; total salary before taxes and any deductions

Ans: a
Difficulty: Medium
Link to: 9.1, Working It Out

44.	Diagram A below illustrates a hypothetical food chain that supports a person who lives by eating 1 trout per day for 300 days. If the same person ate frogs instead (Diagram B – they're French, maybe), they would need only 10 per day. Fill in the two missing values in Diagram B.
Ans:	900,000 grasshoppers; about 33 tons of grass

	Difficulty: Medium Link to: 9.2

45.	Of the following processes, **circle** the ones associated with heterotrophs and <u>underline</u> the ones associated with autotrophs. primary production photosynthesis respiration secondary production
Ans:	underlined: primary production, photosynthesis circled: secondary production underlined and circled: respiration
	Difficulty: Medium Link to: 9.2

46.	Why must energy in a usable form continuously be added to an ecological system?
Ans:	Without energy added to the system, it would quickly die because it would run out of usable energy.
	Difficulty: Medium Link to: 9.3

47.	Use the following three statements to answer the questions below. For each one, fill in the letter of the answer that is most correct. A – the sun B – radioactive decay within the Earth C – both A and B a) Energy to drive the tectonic cycle is derived from: b) Energy to drive the rock cycle is derived from: c) Energy to drive the hydrologic cycle is derived from: d) Energy to drive your motorcycle is derived from:
Ans:	(a) B (b) C (c) A (d) A
	Difficulty: Medium Link to: 9.3

48.	Based on your reading, what is the major difference between the ecosystem cycling of sulfur and of calcium?
Ans:	Sulfur has a gaseous phase, calcium does not have a gaseous phase.
	Difficulty: Easy Link to: 9.5

49.	*An ecosystem <u>must</u> lie between a source of usable energy and a sink for degraded (heat) energy.* What would happen to production within the ecosystem if there were no source of energy?
Ans:	production would end
	Difficulty: Medium Link to: 9.3

50.	*An ecosystem <u>must</u> lie between a source of usable energy and a sink for degraded (heat) energy.* What would happen to the system if there was energy input but no sink for degraded energy?
Ans:	heat would accumulate, and the system would grow hotter and hotter
	Difficulty: Medium Link to: 9.3

51.	*An ecosystem <u>must</u> lie between a source of usable energy and a sink for degraded (heat) energy.* What would happen if an ecosystem were suddenly closed to all energy, neither receiving nor giving energy to the outside?
Ans:	entropy death -- all energy would become evenly distributed through the ecosystem
	Difficulty: Medium Link to: 9.3

52.	What is the net production of a tree at the end of a year?

Ans:	It is the increase in total weight, energy content, and stored carbon.
	Difficulty: Medium Link to: 9.2

53.	Energy is fixed by autotrophs. Name the main source of energy that autotrophs on the Earth use to fix energy.
Ans:	sunlight
	Difficulty: Medium Link to: 9.2

54.	The world of Dune (by Frank Herbert) is covered almost entirely by deserts similar to the Sahara (i.e., blowing sand dunes). The inhabitants of this world include a fungus living on and under the sand which feeds on dead organic matter, uncommon small insect-like creatures that eat the fungus, a small house-like creature that eats the insect-like creatures, and giant carnivorous sand worms (miles long) that eat anything on the sand surface. Based on this information, why wouldn't such an ecosystem actually work? Give two reasons.
Ans:	the system described is a closed system which feeds on itself there is no energy source and sink
	Difficulty: Difficult Link to: 9.4

55.	What are the two fundamental characteristics of any system that can sustain life over a long period?
Ans:	energy flow cycling of chemical elements
	Difficulty: Medium Link to: 9.3

56.	Only a small fraction of the energy available in each trophic level is converted to the net production of new tissue. Explain what the rest of the available energy is used for.
Ans:	It is used up by respiration.

	Difficulty: Medium Link to: 9.2

57.	*A moose eats a plant that contains the equivalent of 200 calories of energy. The moose stores the equivalent of 20 calories in its body tissues and through respiration, loses 180 calories as heat.* Does the above example conform to the first law of thermodynamics? Why?
Ans:	Yes, conservation of energy
	Difficulty: Medium Link to: 9.3

58.	*A moose eats a plant that contains the equivalent of 200 calories of energy. The moose stores the equivalent of 20 calories in its body tissues and through respiration, loses 180 calories as heat.* Does the above example conform to the second law of thermodynamics? Why?
Ans:	Yes, storage << total lost as heat
	Difficulty: Medium Link to: 9.3

59.	A mouse and a cricket in a chaparral ecosystem both feed on rye grass. The mouse also eats crickets and coyotes eat mice and crickets. What are the respective trophic levels of all of these organisms? Diagram a food web.
Ans:	
	Difficulty: Easy Link to: 9.2

60.	Define gross production of organic matter.
Ans:	It is the production of organic matter before any use by organisms.
	Difficulty: Medium Link to: 9.1, Working It Out