

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

BIOLOGY

Tuesday, January 26, 1999 — 9:15 a.m. to 12:15 p.m., only

The answer paper is stapled in the center of this examination booklet. Open the examination booklet, carefully remove the answer paper, and close the examination booklet. Then fill in the heading on your answer paper.

All of your answers are to be recorded on the separate answer paper. For each question in Part I and Part II and the multiple-choice questions in Part III, decide which of the choices given is the best answer. Then on the answer paper, in the row of numbers for that question, circle with pencil the number of the choice that you have selected. The sample below is an example of the first step in recording your answers.

SAMPLE: ① 2 3 4

If you wish to change an answer, erase your first penciled circle and then circle with pencil the number of the answer you want. After you have completed all three parts of the examination and you have decided that all of the circled answers represent your best judgment, signal a proctor and turn in all examination material except your answer paper. Then and only then, place an X in ink in each penciled circle. Be sure to mark only one answer with an X in ink for each question. No credit will be given for any question with two or more X's marked. The sample below indicates how your final choice should be marked with an X in ink.

SAMPLE: ⊗ 2 3 4

For questions in Part III that are not multiple-choice questions, record your answers in accordance with the directions given in the examination booklet.

When you have completed the examination, you must sign the statement printed at the end of the answer paper, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer paper cannot be accepted if you fail to sign this declaration.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part I

Answer all 59 questions in this part. [65]

Directions (1–59): For each statement or question, select the word or expression that, of those given, best completes the statement or answers the question. Record your answer on the separate answer paper in accordance with the directions on the front page of this booklet.

1 In which process are simple materials chemically combined to form more complex materials?

- 1 synthesis 3 hydrolysis
2 pinocytosis 4 cyclosis

2 Which reactions in the list below are associated with metabolism?

- (A) cellular reactions that release energy
(B) photosynthetic reactions that store energy
(C) muscle reactions that use energy

- (1) A and B, only (3) C and A, only
(2) B and C, only (4) A, B, and C

3 Which scientist is correctly paired with his contribution to biological science?

- 1 Miller — first to observe mitotic cell division
2 Linnaeus — devised a binomial system for naming organisms
3 Darwin — invented the electron microscope
4 Watson — first to observe cells

4 The chart below indicates the elements contained in four different molecules and the number of atoms of each element in those molecules.

Element	Number of Atoms			
	Molecule A	Molecule B	Molecule C	Molecule D
Hydrogen	12	0	3	0
Carbon	6	1	0	1
Nitrogen	0	0	1	0
Oxygen	6	2	0	3
Calcium	0	0	0	1

Which molecule can be classified as organic?

- (1) A (3) C
(2) B (4) D

5 According to the five-kingdom classification system, which two groups of organisms are classified as protists?

- 1 bryophytes and tracheophytes
2 coelenterates and annelids
3 protozoa and algae
4 bacteria and chordates

6 The shape, size, and internal structure of the mitochondrion have been revealed by

- 1 studies of the chemical activity of enzymes
2 the development of wet-mount techniques
3 electron-microscope studies
4 detailed studies of chromosomes

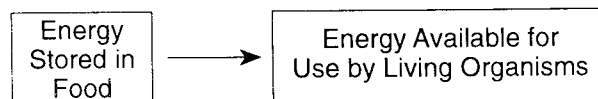
7 Lipase, maltase, and protease are members of a group of catalysts known as

- 1 enzymes 3 carbohydrates
2 hormones 4 fats

8 In the equations below, A represents a food substance, and B represents its completely digested end product. Which equation represents the change that takes place as a result of chemical digestion?

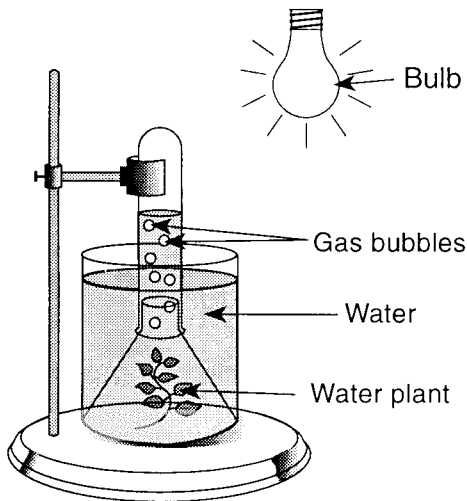
- (1) $A + \text{water} \rightarrow A + A + A$
(2) $A + \text{water} \rightarrow B + B + B$
(3) $B + B + B \rightarrow A + \text{water}$
(4) $A + A + A \rightarrow A + \text{water}$

9 Which process is represented by the arrow in the diagram below?

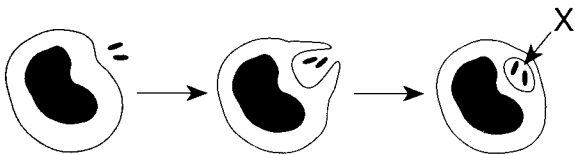


- 1 growth 3 regulation
2 respiration 4 excretion

- 10 In the setup shown below, which color light will cause the plant to produce the *smallest* number of gas bubbles?



- 1 red
2 orange
3 blue
4 green
- 11 Which organisms are *not* able to make organic molecules from inorganic raw materials?
- 1 mushrooms
2 algae
3 bryophytes
4 tracheophytes
- 12 The diagram below represents a white blood cell engulfing some bacteria.



- The structure labeled X is most likely a
- 1 nucleus
2 centriole
3 ribosome
4 vacuole
- 13 Freshwater protozoans excrete ammonia and mineral salts by means of
- 1 diffusion through the cell membrane
2 small vacuoles released through the cell membrane
3 small tubes leading from the cytoplasm to openings in the cell membrane
4 contraction of food vacuoles

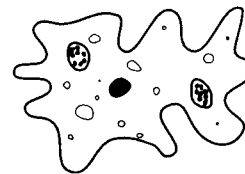
- 14 Which organism lacks a specialized transport system?

1 earthworm
2 grasshopper
3 human
4 hydra

- 15 Which sequence best represents the pathway of a gas as it passes from the atmosphere into a leaf?

1 guard cell → xylem → palisade cell
2 stomate → air space → spongy cell
3 air space → phloem → palisade cell
4 cuticle → epidermis → spongy cell

- 16 The diagram below represents a unicellular organism.



This organism is able to survive without a specialized respiratory system because

- 1 it possesses a nucleus that controls the synthesis of respiratory enzymes
2 its vacuoles release oxygen from stored nutrients
3 its respiratory surface is in direct contact with a watery environment
4 it possesses chloroplasts that produce oxygen when exposed to sunlight

- 17 The lenticels of certain plants have the same function as

1 anthers
2 phloem
3 xylem
4 stomates

- 18 When a chemical is added to a slide containing a paramecium, the paramecium moves away from the chemical. This movement is an example of

1 passive transport of chemicals
2 a response to a stimulus
3 a tropic response
4 active transport of water

19 Which gas is excreted as a waste product of autotrophic nutrition in maple trees?

- 1 nitrogen
- 2 oxygen
- 3 carbon dioxide
- 4 methane

20 To aid in the transmission of an impulse, neurotransmitters are secreted

- 1 along an axon
- 2 by a dendrite
- 3 by a cyton
- 4 into a synapse

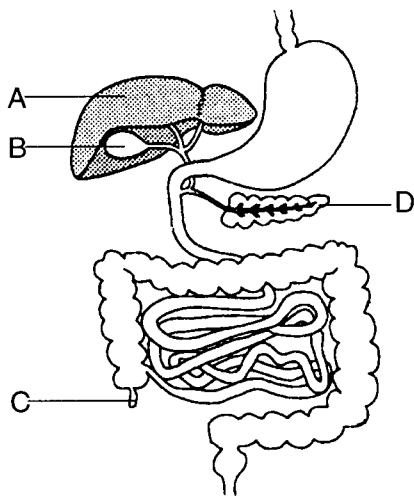
21 Plants bend toward light because cells on the dark side of the stem elongate. This elongation is influenced by hormones known as

- 1 auxins
- 2 antigens
- 3 adenines
- 4 amylases

22 Locomotion in chordates may be described as the interaction between

- 1 an endoskeleton and muscles
- 2 tentacles and contractile fibers
- 3 cilia and an exoskeleton
- 4 chitinous appendages and muscles

23 Which lettered structure in the diagram below produces enzymes for the digestion of nutrients in the small intestine?



- (1) A
- (2) B
- (3) C
- (4) D

24 Which two activities in the chart below best describe the process of transport?

A	Walking from one place to another
B	Inhaling air into the trachea
C	Absorbing glucose into the villi
D	Distributing nutrients by means of blood vessels

- (1) A and C
- (2) B and C
- (3) C and D
- (4) A and D

25 Which part of the blood is correctly paired with its function?

- 1 red blood cells — fight infection
- 2 plasma — transports wastes and hormones
- 3 platelets — produce antibodies
- 4 white blood cells — carry oxygen

26 Choking on food is most likely caused by an interference with the proper functioning of the

- 1 diaphragm
- 2 nasal cavity
- 3 bronchial tubes
- 4 epiglottis

27 As urine is excreted, muscle contractions of the urinary bladder will cause the urine to pass into the

- 1 ureter
- 2 glomerulus
- 3 urethra
- 4 Bowman's capsule

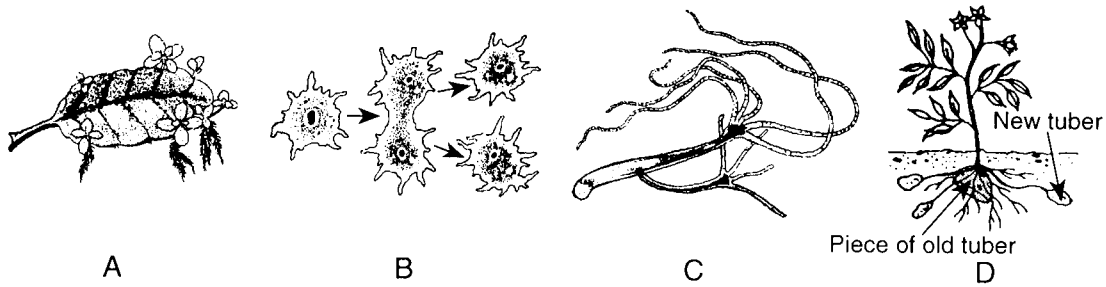
28 Which statement best describes the chemical substances secreted by endocrine glands?

- 1 They are secreted in one place and most often act at another.
- 2 They are distributed by the nervous system.
- 3 They are found only in vertebrates.
- 4 They are secreted into specialized ducts for transport.

29 In the knee, the ends of the leg bones are held together primarily by

- 1 ligaments
- 2 smooth muscle
- 3 tendons
- 4 cardiac muscle

30 Which two diagrams show organisms reproducing by vegetative propagation?



- (1) A and B
(2) B and C

- (3) C and D
(4) A and D

31 Which mitotic event in the chart below occurs after the other three events have taken place?

A	Appearance of spindle fibers
B	Separation of chromatids by the action of spindle fibers
C	Disintegration of the nuclear membrane
D	Replication of chromosomes

- (1) A (3) C
(2) B (4) D

32 The production of motile monoploid gametes takes place in

- 1 ureters 3 male gonads
2 ovaries 4 gastric glands

33 The series of cellular divisions by which the zygote becomes a multicellular embryo is known as

- 1 gastrulation 3 meiosis
2 cleavage 4 disjunction

34 Which term best describes most organisms whose eggs are fertilized externally?

- 1 terrestrial autotrophs
2 terrestrial heterotrophs
3 aquatic autotrophs
4 aquatic heterotrophs

35 Which organisms do *not* receive direct nourishment from the parent during their internal development stage?

- 1 marsupials 3 humans
2 mice 4 cows

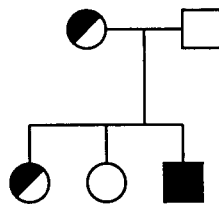
36 Scientists have been able to produce mutations in plants by irradiating their seeds with gamma rays. The result of one of the mutations was a plant that could not produce flowers. Because of this lack of flowers, the plant would *not* be able to

- 1 carry out photosynthesis
2 transport water
3 reproduce sexually
4 grow more than a few inches tall

37 A student placed some seeds on a moist paper towel in a petri dish. Another petri dish was filled with water and seeds. The petri dishes were covered and exposed to identical experimental conditions. After several days, the student noticed that the seeds submerged in water did not germinate, but those on the paper towel did. The best explanation for these results is that the seeds

- 1 on the towel were warmer than those under water
2 on the towel were able to receive more light
3 submerged in water built up carbon dioxide
4 submerged in water did not receive enough oxygen

38 The pedigree chart below shows the pattern of inheritance for a sex-linked trait.



Key

- normal female
- ◐ carrier female
- normal male
- male exhibiting trait

If this couple has another son, what is the probability that he will exhibit this sex-linked trait?

- (1) 0%
- (2) 25%
- (3) 50%
- (4) 100%

39 Bacteria that produce colonies containing a red pigment were distributed on nutrient agar and exposed to ultraviolet light for several days. The colonies that developed were red, with the exception of one colony that was white. The appearance of this white bacterial colony most likely resulted from

- 1 a mutation
- 2 codominance
- 3 synapsis
- 4 multiple alleles

40 A garden hose that had been lying on a green lawn for several days was removed. Which statement best explains the presence of yellow grass in the area where the hose had been?

- 1 The lack of sunlight under the hose altered the genotype of the grass.
- 2 Gene expression is not affected by the environment.
- 3 The hose altered genes in the grass, causing the grass to switch from autotrophic to heterotrophic nutrition.
- 4 The lack of sunlight under the hose affected chlorophyll production.

41 Artificial selection is illustrated by

- 1 random mating taking place in a population
- 2 the appearance of a new species on an isolated island
- 3 a gardener producing a new hybrid by cross-pollinating plants
- 4 wind assisting the pollination of grass in a field

42 The gene-chromosome theory states that

- 1 chromosomes from both parents always have identical genes
- 2 genes exist at definite loci in a linear sequence on chromosomes
- 3 homologous chromosomes do not have alleles
- 4 Mendel's principles no longer apply to genetics

43 All of the offspring produced in a cross involving a brown mink and a silver-blue mink are brown. When these brown mink offspring were crossed with each other, the ratio of brown to silver blue was 3:1. The results of these crosses are best explained by

- 1 independent assortment and crossing-over
- 2 dominance, segregation, and recombination
- 3 codominance, segregation, and recombination
- 4 recombination and intermediate inheritance

44 In many breeds of cattle, the polled condition (absence of horns) is dominant over the presence of horns, and homozygous red coat color crossed with homozygous white coat color produces roan. Which cross will produce only horned roan offspring?

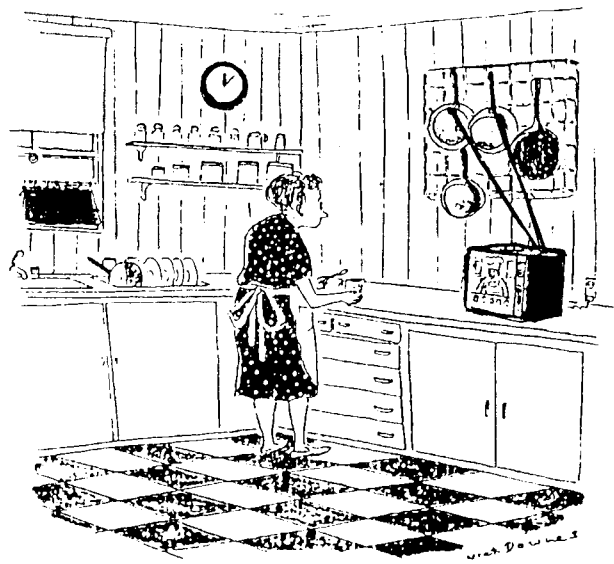
- 1 polled red × horned white
- 2 horned roan × horned roan
- 3 horned red × horned white
- 4 polled roan × horned roan

- 45 Which components of DNA are held together by weak hydrogen bonds?
- 1 phosphate and adenine
 - 2 phosphate and deoxyribose
 - 3 thymine and deoxyribose
 - 4 cytosine and guanine
- 46 Biologically similar organisms have similar DNA and proteins. This statement supports the concept of
- 1 diversity in species
 - 2 acquired characteristics
 - 3 use and disuse
 - 4 organic evolution
- 47 The embryos of fish, chickens, and pigs have gill slits and a tail. The presence of these features suggests that
- 1 all these animals can swim
 - 2 pigs developed from chickens
 - 3 these animals may have had a common ancestor
 - 4 gill slits and tails are required for embryonic development
- 48 Characteristics of a species that make its members better able to live and reproduce in their environment are known as
- 1 favorable adaptations
 - 2 homologous structures
 - 3 abiotic factors
 - 4 biotic factors
- 49 A large population of houseflies was sprayed with a newly developed, fast-acting insecticide. The appearance of some houseflies that are resistant to this insecticide supports the concept that
- 1 species traits tend to remain constant
 - 2 biocides cause mutations
 - 3 variation exists within a species
 - 4 the environment does not change
- 50 Darwin's studies of finches on the Galapagos Islands suggest that the finches' differences in beak structure were most directly due to
- 1 acquired characteristics in the parent finches
 - 2 the size of the island where the finches live
 - 3 mating behaviors of the different finch species
 - 4 adaptations of the finches to different environments

- 51 The fresh remains of an unknown vertebrate were discovered in the Amazon Basin. To help determine the vertebrate's possible relationship to other animals, scientists compared the external structure of its digestive organs to that of other vertebrates. This procedure is typical of work done in the field of comparative

- | | |
|------------|----------------|
| 1 cytology | 3 embryology |
| 2 anatomy | 4 biochemistry |

- 52 Which concept is most closely related to the cartoon shown below?



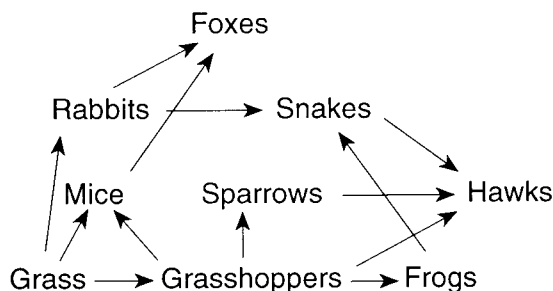
"Today's recipe for what I call 'the origin of life' requires a bit of hydrogen, nitrogen, compounds of sulfur, carbon, a smattering of metals: iron, magnesium. . ."

- 1 the heterotroph hypothesis
 - 2 regeneration
 - 3 speciation
 - 4 survival of the fittest
- 53 A student set up a terrarium containing moist soil, several plants, and snails. The terrarium was placed in a sunny area. Which factor is *not* essential for the maintenance of the terrarium?
- 1 a constant source of energy
 - 2 a living system capable of incorporating energy into organic compounds
 - 3 a cycling of materials between organisms and their environment
 - 4 the introduction of another heterotroph into the terrarium

54 A moss-covered log is overturned by a hungry bear looking for insects to eat. The bear disturbs an ant colony, and some chipmunks leave the hollow log to search for another home in the forest. Which relationship do these organisms have with each other?

- 1 They are all of the same species.
- 2 They all require the same type of food.
- 3 They are part of a community.
- 4 They are abiotic factors in a forest.

55 The diagram below represents a food web.



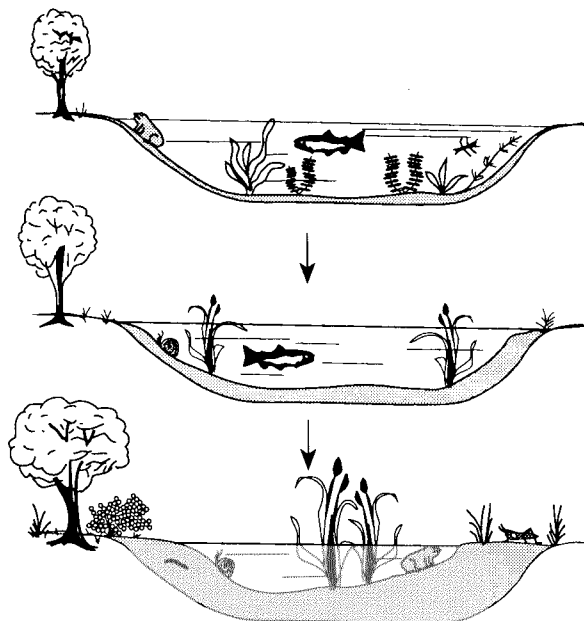
Which statement is supported by the information shown?

- 1 Foxes, snakes, and sparrows are secondary consumers.
 - 2 Snakes eat grass, grasshoppers, and frogs.
 - 3 Rabbits, mice, and grasshoppers contain the greatest amount of stored energy.
 - 4 Sparrows and hawks are omnivores.
- 56 Humans often have not given much thought to the long-term impacts of technological change. As the 20th century comes to a close, most scientists would agree that humans should
- 1 use knowledge of ecology to consider the needs of future generations of humans and other species
 - 2 use new technology to expand human influence on all natural communities
 - 3 learn how to control every aspect of the environment so that damage due to technology will be spread evenly
 - 4 develop the uninhabited parts of Earth for the human population increase

57 Respiration and photosynthesis have the *least* effect on the cycling of

- | | |
|------------|------------|
| 1 carbon | 3 oxygen |
| 2 nitrogen | 4 hydrogen |

58 The diagram below represents an ecological process.



Which statement is most closely related to the process shown in the diagram?

- 1 Climax communities do not develop in aquatic habitats.
 - 2 Ecosystems tend to change with time until a stable system is formed.
 - 3 Humans have modified the environment through the use of technology and pollution.
 - 4 Succession involves changes in plant species only.
- 59 An activity that would help to ensure a suitable environment for future generations is the increased use of
- | | |
|----------------|-----------------------|
| 1 fossil fuels | 3 biological controls |
| 2 pesticides | 4 chemical dumps |

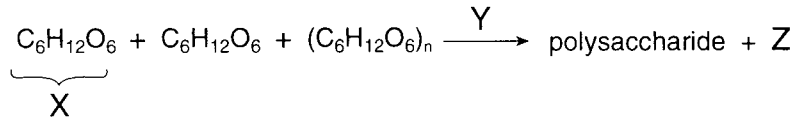
Part II

This part consists of five groups, each containing ten questions. Choose two of these five groups. Be sure that you answer all ten questions in each group chosen. Record the answers to these questions in accordance with the directions on the front page of this booklet. [20]

Group 1 — Biochemistry

If you choose this group, be sure to answer questions 60–69.

Base your answers to questions 60 through 62 on the chemical reaction represented below and on your knowledge of biology.



60 Letter Y most likely represents

- | | |
|----------------------|-------------|
| 1 a neurotransmitter | 3 a lipid |
| 2 a hormone | 4 an enzyme |

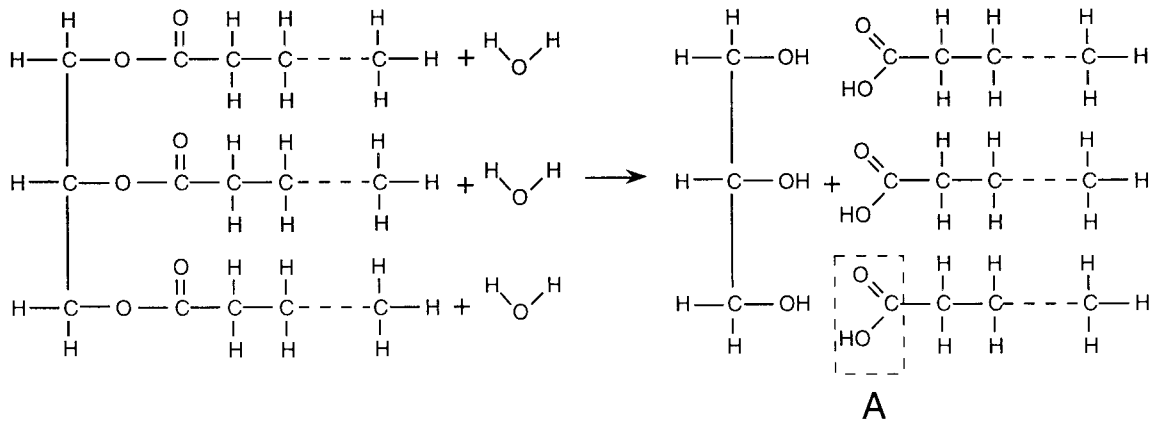
61 Letter Z most likely represents molecules of

- | | |
|------------------|-----------------|
| 1 water | 3 glycogen |
| 2 plant hormones | 4 nucleic acids |

62 If this reaction takes place in an organism that requires sunlight to produce substance X, the organism must be

- | | |
|-----------------|----------------|
| 1 a heterotroph | 3 an autotroph |
| 2 an annelid | 4 a fungus |

Base your answers to questions 63 and 64 on the equation below and on your knowledge of biology.



63 Which type of reaction is illustrated by the equation?

- 1 dehydration synthesis
- 2 hydrolysis
- 3 carbon fixation
- 4 photolysis

64 The structure in box A represents

- 1 an amino group
- 2 an oil molecule
- 3 a carboxyl group
- 4 a carbon dioxide molecule

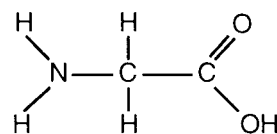
Base your answers to questions 65 and 66 on the information in the chart below and on your knowledge of biology.

Class of Compound	Characteristic
A	Has glycerol as a building block
B	Contains both acid groups and amino groups
C	Formed from subunits containing a nitrogenous base, a phosphate, and ribose
D	Includes sugars and starches

65 What is another characteristic of the compounds in class *D*?

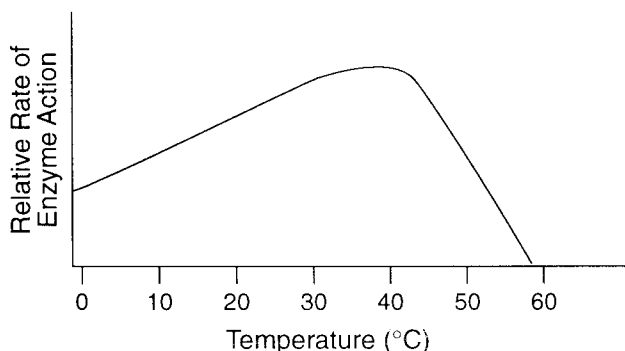
- 1 They are composed of basic subunits known as nucleotides.
- 2 They contain the atoms carbon, hydrogen, and oxygen, with the hydrogen and oxygen in a 2:1 ratio.
- 3 They transfer amino acids to ribosomes during protein synthesis.
- 4 They include chemical compounds such as insulin and hemoglobin.

66 Which class of compounds includes the compound represented in the diagram below?



- | | |
|-------|-------|
| (1) A | (3) C |
| (2) B | (4) D |

67 The effect of temperature on the relative rate of action of an enzyme is represented in the graph below.



The optimum temperature for the action of this enzyme is approximately

- | | |
|----------|----------|
| (1) 15°C | (3) 37°C |
| (2) 22°C | (4) 50°C |

68 Most of the oxygen gas present in the atmosphere is produced as a result of

- 1 photochemical reactions
- 2 cellular respiration
- 3 dehydration synthesis
- 4 alcoholic fermentation

69 Oxygen serves as a hydrogen acceptor during aerobic respiration. This results in the production of

- | | |
|---------------|------------|
| 1 glucose | 3 glycerol |
| 2 lactic acid | 4 water |

Group 2 — Human Physiology

If you choose this group, be sure to answer questions 70–79.

Base your answers to questions 70 and 71 on the blood-typing chart below and on your knowledge of biology.

Individual	Antigens on Red Blood Cells	Antibodies in Plasma
1		anti-B
2	B	

70 Which antibodies, if any, are in the plasma of individual 2?

- 1 anti-A, only
- 2 anti-B, only
- 3 both anti-A and anti-B
- 4 neither anti-A nor anti-B

71 Individual 1 has blood type

- (1) A
 - (3) AB
 - (2) B
 - (4) O
-

72 Arthritis and tendinitis differ in that arthritis is an inflammation of the joints and tendinitis is a

- 1 deposition of uric acid in the joints
- 2 tear in the connective tissue that attaches bone to bone
- 3 disorder involving connective tissue
- 4 type of arthritis found only in infants

73 Which foods should be included in a balanced diet as a good source of roughage?

- 1 red meat and poultry
- 2 fresh fruits and vegetables
- 3 eggs and milk products
- 4 animal fat and plant oil

74 Feces is usually about 40 percent water and 60 percent solid matter. Reducing the water content to 20 percent would most likely result in

- 1 ulcers
- 3 diarrhea
- 2 appendicitis
- 4 constipation

Directions (75–77): For each statement in questions 75 through 77, select the gland, *chosen from the list below*, that is best described by that statement. Then record its *number* on the separate answer paper.

Glands

- (1) Adrenal
- (2) Pancreas
- (3) Parathyroid
- (4) Hypothalamus

75 Cells within this gland secrete a hormone that, in times of emergency, increases the glucose level of the blood and speeds up the actions of the circulatory and respiratory systems.

76 Cells within this gland, which is part of the central nervous system, produce several hormones that affect the functioning of the pituitary gland.

77 Groups of cells within this gland secrete hormones that maintain normal levels of simple and complex carbohydrates in the body.

78 An individual who has had chicken pox rarely gets this disease again. This situation is an example of

- 1 biological control
- 2 negative feedback
- 3 active immunity
- 4 passive immunity

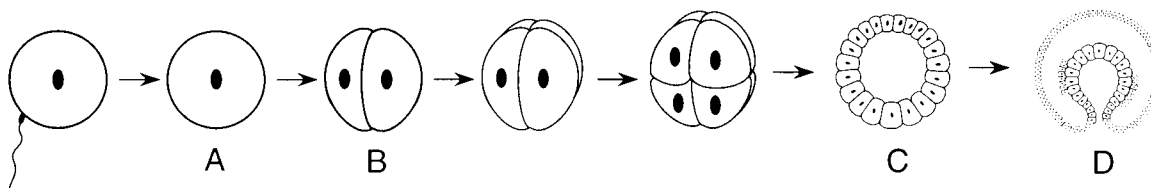
79 Which organic compounds are needed for the synthesis of the plasma membrane, contain a large amount of stored energy, and have been linked to cardiovascular diseases?

- 1 complex carbohydrates
- 2 saturated fats
- 3 simple sugars
- 4 polyunsaturated fats

Group 3 — Reproduction and Development

If you choose this group, be sure to answer questions 80–89.

Base your answers to questions 80 and 81 on the diagram below, which represents some stages in the development of an embryo, and on your knowledge of biology.



80 Which stage represents a zygote?

- (1) A (3) C
(2) B (4) D

81 Which stage represents a blastula?

- (1) A (3) C
(2) B (4) D

82 Which structures control the cyclic nature of menstruation?

- 1 oviduct and uterus
- 2 pituitary and testes
- 3 ovaries and umbilical cord
- 4 pituitary and ovaries

83 Which two processes are included in the pre-natal development of a single human embryo?

- 1 gastrulation and differentiation
- 2 menopause and cleavage
- 3 puberty and gastrulation
- 4 menstruation and fertilization

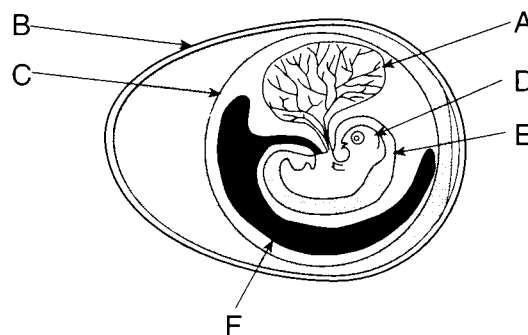
84 Which techniques are sometimes used to help a woman who has blocked fallopian tubes have a child?

- 1 inbreeding and natural selection
- 2 in vitro fertilization and implantation
- 3 hybridization and vegetative propagation
- 4 synapsis and artificial selection

85 Hormones produced by the testes control the expression of traits for

- 1 hair color and eye color
- 2 beard development and number of fingers
- 3 hair color and voice quality
- 4 voice quality and beard development

Base your answers to questions 86 through 88 on the diagram below and on your knowledge of biology.



86 Which structure provides nourishment for the developing organism?

- (1) A (3) C
(2) B (4) D

87 Which structure provides a watery environment and protects the embryo from physical shock?

- (1) A (3) E
(2) B (4) F

88 Letter C indicates the

- 1 allantois 3 amnion
2 chorion 4 yolk sac

89 When asked to relate the terms “sperm,” “scrotum,” “testes,” and “zygote,” a student wrote the statements below.

Statements

- (A) They all contain homologous pairs of chromosomes.
- (B) The location of the testes within the scrotum aids in the production of sperm needed for zygote formation.
- (C) Mitotic cell division is involved in the formation of the testes and scrotum, and meiosis is involved in the production of sperm, which is involved in the formation of a zygote.
- (D) Formation of the testes, scrotum, and sperm occurs in human males; zygote formation occurs in females.

Which statements are correct?

- | | |
|------------------------------|---------------------------|
| (1) <i>A, B, and D, only</i> | (3) <i>B and D, only</i> |
| (2) <i>B, C, and D, only</i> | (4) <i>A, B, C, and D</i> |
-

Group 4 — Modern Genetics

If you choose this group, be sure to answer questions 90–99.

Base your answers to questions 90 and 91 on the information below and on your knowledge of biology.

A large population of green aphids lives in a field and feeds on wild rose plants.

- 90 According to the Hardy-Weinberg principle, the stability of the aphid gene pool is maintained partly by the
- 1 type of food the aphids eat
 - 2 type of habitat in which the aphids live
 - 3 color of the aphids
 - 4 large size of the aphid population
- 91 What will most likely result if exposure to insecticides causes mutations in the aphids over several generations?
- 1 Gene frequencies in the aphids will remain constant.
 - 2 Gene frequencies in the aphids will change.
 - 3 The number of gene alterations in the wild roses will increase.
 - 4 The wild roses will become extinct.

Directions (92–93): For each statement in questions 92 and 93, select the genetic change, chosen from the list below, that is best described by that statement. Then record its number on the separate answer paper.

Genetic Changes

- (1) Translocation
 - (2) Addition
 - (3) Deletion
 - (4) Gene mutation
- 92 A random change in the base sequence of DNA results in an alteration of a polypeptide.
- 93 A chromosomal rearrangement is formed after a section breaks off from one chromosome and becomes attached to a nonhomologous chromosome.

- 94 Recombinant DNA is presently used in the biotechnology industry to
- 1 eliminate all infectious disease in livestock
 - 2 synthesize insulin, interferon, and human growth hormone
 - 3 increase the frequency of fertilization
 - 4 create populations that exhibit incomplete dominance
- 95 Oddly shaped red blood cells and severe pain are characteristics of a human genetic disorder known as
- | | |
|---------------------|----------------------|
| 1 hemophilia | 3 phenylketonuria |
| 2 Tay-Sachs disease | 4 sickle-cell anemia |
- 96 Some events that take place during the synthesis of a specific protein are listed below.
- (A) Messenger RNA attaches to a ribosome.
 - (B) DNA serves as a template for RNA production.
 - (C) Transfer RNA bonds to a specific codon.
 - (D) Amino acids are bonded together.
 - (E) RNA moves from the nucleus to the cytoplasm.

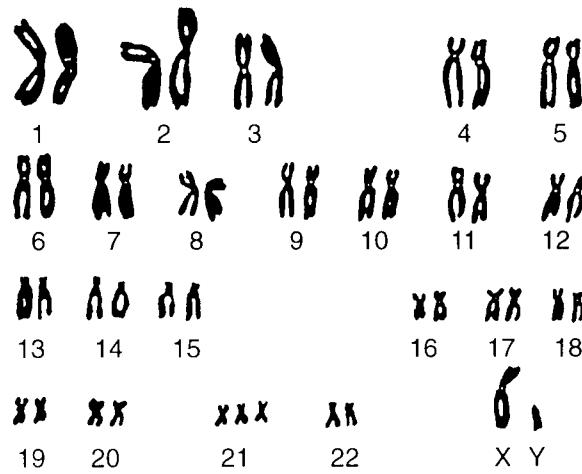
The correct order of these events is

- (1) $B \rightarrow E \rightarrow A \rightarrow C \rightarrow D$
 - (2) $D \rightarrow A \rightarrow E \rightarrow C \rightarrow B$
 - (3) $B \rightarrow C \rightarrow E \rightarrow D \rightarrow A$
 - (4) $C \rightarrow B \rightarrow A \rightarrow E \rightarrow D$
- 97 What is the complementary messenger-RNA sequence for the DNA sequence shown below?

C A A G G T
└─┬─┬─┬─┬─┘

- | | |
|-----------------|-----------------|
| (1) C–A–A–G–G–U | (3) G–U–U–C–C–A |
| (2) G–T–T–C–C–A | (4) C–A–A–G–G–T |

Base your answers to questions 98 and 99 on the diagram of paired homologous chromosomes shown below and on your knowledge of biology.



98 The genetic disorder shown in the diagram most likely resulted from

- | | |
|------------------|---------------|
| 1 crossing-over | 3 polyploidy |
| 2 nondisjunction | 4 segregation |

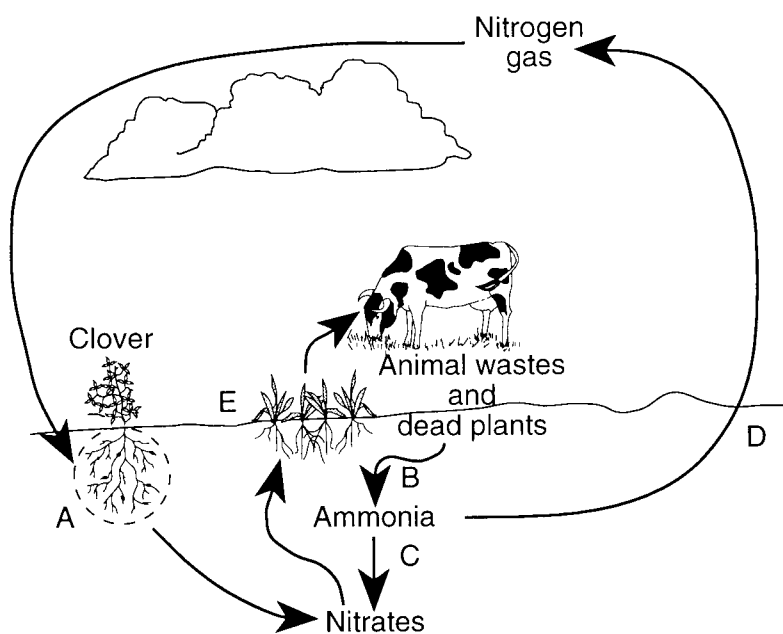
99 Which technique was used to organize the chromosomes as shown in the diagram?

- | | |
|------------------|---------------|
| 1 screening | 3 karyotyping |
| 2 chromatography | 4 grafting |

Group 5 — Ecology

If you choose this group, be sure to answer questions 100–109.

Base your answers to questions 100 and 101 on the diagram of the nitrogen cycle below and on your knowledge of biology. In the diagram, letters A through E represent organisms carrying on a process at that particular point in the cycle.



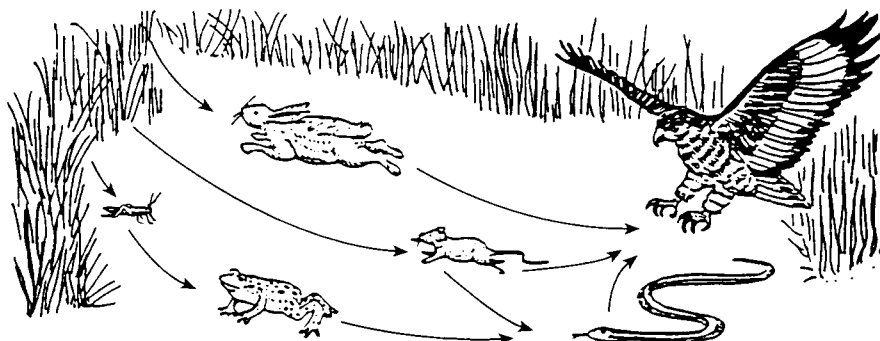
100 Letter *B* represents

- | | |
|---------------|--------------|
| 1 scavengers | 3 autotrophs |
| 2 decomposers | 4 carnivores |

101 Nitrifying bacteria are represented by letter

- | | |
|--------------|--------------|
| (1) <i>A</i> | (3) <i>C</i> |
| (2) <i>E</i> | (4) <i>D</i> |

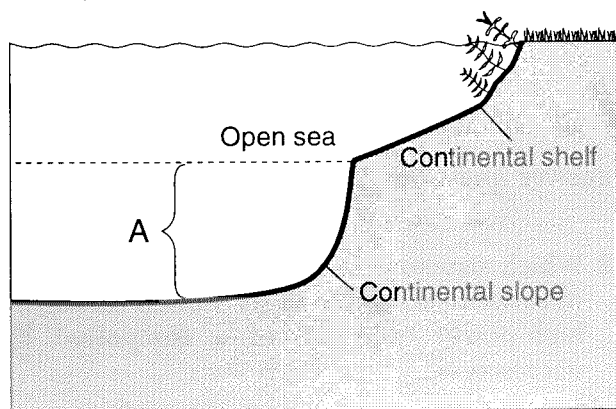
102 The diagram below represents a food web.



If this food web is represented as a pyramid of biomass, the level of the pyramid with the *least* amount of biomass would contain the

- | | |
|---------------|---------|
| 1 grasshopper | 3 mouse |
| 2 grass | 4 hawk |

Base your answers to questions 103 and 104 on the diagram below of a biome and on your knowledge of biology.



103 One characteristic that makes this biome the most stable aquatic environment is its

- 1 absorption and retention of large quantities of solar heat
- 2 lack of organisms that compete for nutrients
- 3 lack of autotrophs
- 4 high CO₂ level

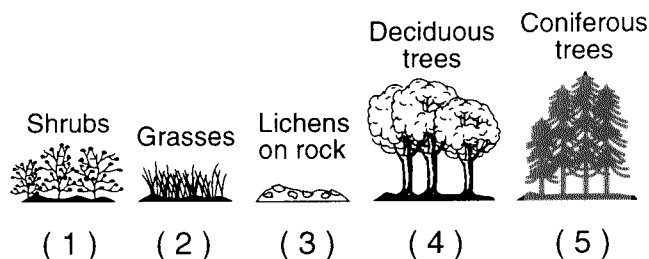
104 Most of the organisms that live in region A are heterotrophs because

- 1 large quantities of salt are dissolved at this depth
- 2 oxygen does not dissolve in the water at this depth
- 3 water temperature varies greatly at this depth
- 4 sunlight cannot penetrate to this depth

105 If two different bird species in the same habitat require the same type of nesting site, both species will most likely

- 1 interbreed and share the nesting sites
- 2 compete for the nesting sites
- 3 change their nesting site requirements
- 4 use the nests of other bird species

Base your answers to questions 106 and 107 on the diagrams below, which represent the stages of an ecological succession in New York State, and on your knowledge of biology. The stages are *not* in order.



106 Which sequence represents a correct order of succession that would involve these stages?

- (1) 2 → 3 → 1 → 4 → 5
- (2) 2 → 1 → 3 → 5 → 4
- (3) 3 → 1 → 2 → 4 → 5
- (4) 3 → 2 → 1 → 5 → 4

107 In which stage would minerals be added during the formation of soil by a community composed primarily of pioneer organisms?

- (1) 1
- (2) 2
- (3) 3
- (4) 5

108 The taiga biome is characterized by

- 1 long, cold winters; frozen subsoil; and no trees
- 2 cold winters, coniferous trees, and much snow
- 3 heavy rainfall, broad-leaved trees, and hot temperatures
- 4 hot days, cool nights, and little precipitation

109 An organism that feeds on the blood of a live rabbit is known as

- 1 a parasite
- 2 a producer
- 3 an herbivore
- 4 a saprophyte

Part III

This part consists of five groups. Choose three of these five groups. For those questions that are followed by four choices, record the answers on the separate answer paper in accordance with the directions on the front page of this booklet. For all other questions in this part, record your answers in accordance with the directions given in the question. [15]

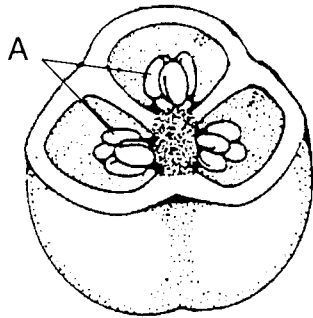
Group I

If you choose this group, be sure to answer questions 110–114.

110 A new concept that is tested in a scientific investigation is known as

- | | |
|------------------|------------------|
| 1 a theory | 3 an inference |
| 2 the hypothesis | 4 an observation |

111 To obtain the view of structure A shown in the diagram below, how was the cut most likely made?



Lower Pistil Section

- 1 longitudinally through the anther, using a teasing needle
- 2 posteriorly through the filament, using a razor blade
- 3 horizontally through the ovary, using a scalpel
- 4 dorsally through the stigma, using a probe

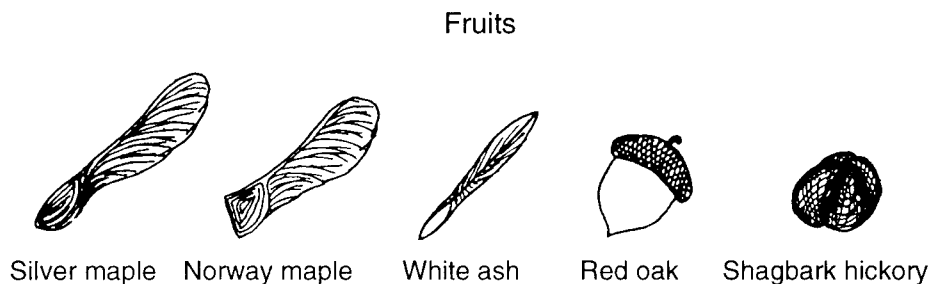
112 Which structure in a stained cheek cell would most likely be visible when viewed through the high-power objective of a compound light microscope?

- | | |
|-------------|---------------|
| 1 cell wall | 3 chloroplast |
| 2 ribosome | 4 nucleolus |

113 Which procedure is the most acceptable method for obtaining the accurate weight of a specimen in a laboratory experiment?

- 1 Make sure the balance weighs accurately before starting the measurement, and then record the weight for three trials and average the results.
- 2 Readjust the balance after weighing the specimen, and then weigh the specimen again.
- 3 Have two classmates use different balances to determine the weight of the specimen, and average the values they obtain.
- 4 Determine the weight of the specimen using one balance, and then measure the weight again using a different balance.

114 The diagrams below show the general appearance of five tree fruits that were used in an experiment to determine the length of time necessary for each type of fruit to fall a set distance. One hundred fruits of each type were used, and the average time of fall for each type of fruit is shown in the data table below.



(Not drawn to scale)

Tree Type	Average Fall Time of 100 Fruits (seconds)
Silver Maple	3.2
Norway Maple	4.9
White Ash	1.5
Red Oak	0.8
Shagbark Hickory	0.8

What could a student correctly infer about the distribution of these fruits if they fell from branches 5 meters above the ground while the wind was blowing at 20 miles per hour?

- 1 A silver maple fruit would land closer to the base of its parent tree than would a shagbark hickory fruit.
 - 2 A white ash fruit would land farther from the base of its parent tree than would a silver maple fruit.
 - 3 A white ash fruit would land closer to the base of its parent tree than would a shagbark hickory fruit.
 - 4 A Norway maple fruit would land farther from the base of its parent tree than would a silver maple fruit.
-

Group 2

If you choose this group, be sure to answer questions 115–119.

Base your answers to questions 115 through 118 on the data table below and on your knowledge of biology.

Human Body Surface Area as It Relates to Body Weight

(The figures are most accurate for people of average build.)

Weight (lb)	Surface Area (m ²)
70	1.1
100	1.4
125	1.6
150	1.8
175	2.0
200	2.2
250	2.7

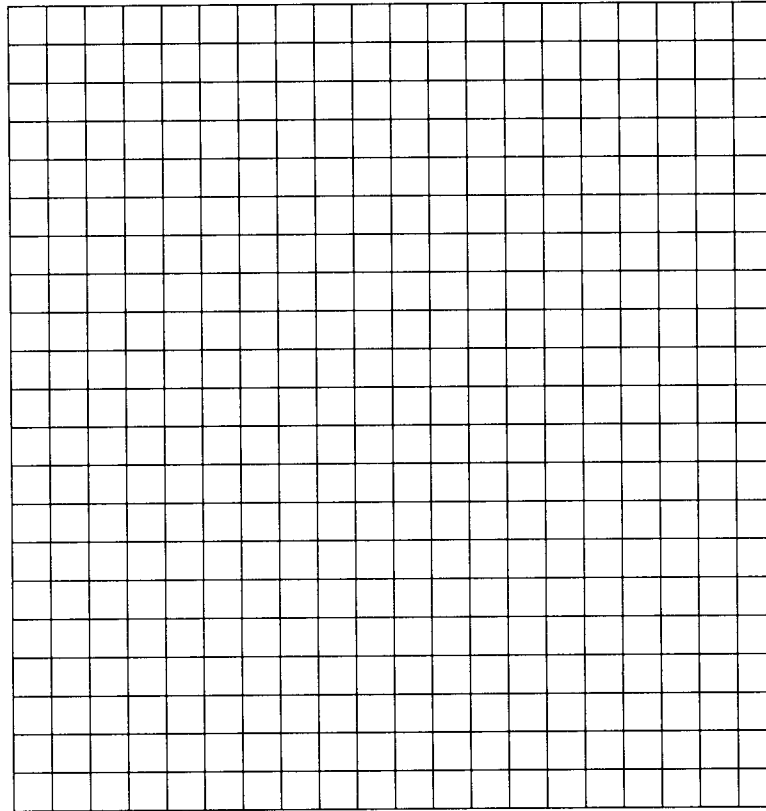
Directions (115–116): Using the information in the data table, construct a line graph on the grid provided on your answer paper, following the directions below. The grid on the next page is provided for practice purposes only. Be sure your final answer appears on your answer paper. You may use pen or pencil for your answer.

115 Mark an appropriate scale on each of the labeled axes.

116 Plot the data from the table. Surround each point with a small circle and connect the points.



Surface Area of the Body (m²)



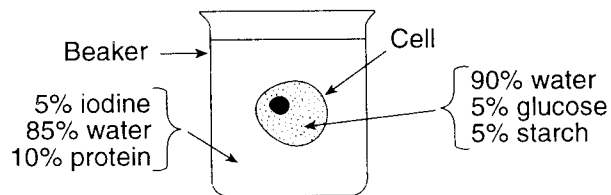
Weight (lb)

117 A normal, healthy individual requires about 1,500 milliliters of water each day for every square meter of body surface area. Approximately how much water will be required each day by a normal, healthy individual who weighs 100 pounds?

- | | |
|--------------|--------------|
| (1) 1,400 mL | (3) 1,800 mL |
| (2) 1,500 mL | (4) 2,100 mL |

118 Using one or more complete sentences, state a relationship between body weight and body surface area. You may use pen or pencil for your answer.

119 Name one substance in the diagram below that would have a net movement out of the cell. You may use pen or pencil for your answer.

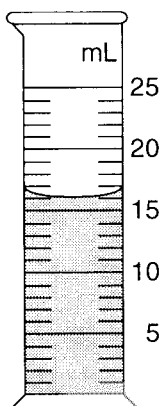


Group 3

If you choose this group, be sure to answer questions 120–124.

120 The volume of liquid shown in the graduated cylinder at the right is

- (1) 15.0 mL
- (2) 16.0 mL
- (3) 16.5 mL
- (4) 17.0 mL



121 A water plant placed in bright light gives off bubbles. A student notes that placing the light at different distances from the plant causes the rate of bubbling to vary. The student decides to design an experiment to investigate the effect of light intensity on the rate of bubble production. An appropriate control for this experiment would be

- 1 a plant at a fixed distance from the light source
- 2 a plant exposed to sunlight
- 3 the addition of oxygen to the water
- 4 the use of blue light on some of the plants

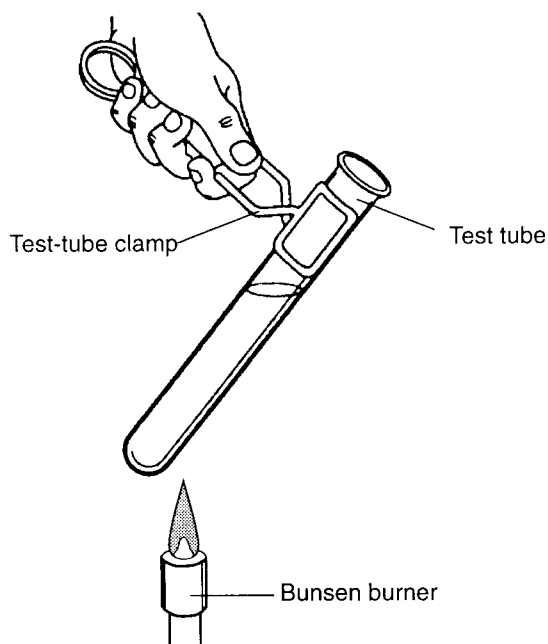
122 After owls eat, they bring back up the indigestible remains of their meals. These regurgitated “pellets” contain the fur and skeletal parts of their prey. A student plans to examine an owl pellet to determine which small vertebrates were consumed by the owl. Which set of equipment should the student use?

- (1) microscope, ultracentrifuge, and stain
- (2) dissecting kit, petri dish, and gloves
- (3) graduated cylinder, balance, and meterstick
- (4) pH paper, liquid indicator, and beaker

123 Which indicator should be used to help identify the building blocks of maltose?

- (1) Lugol's iodine
- (2) pH paper
- (3) Benedict's solution
- (4) bromthymol blue

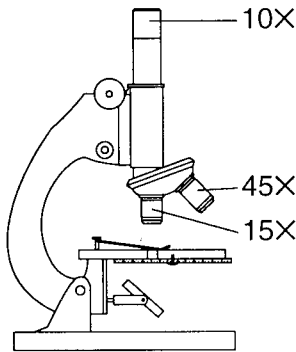
124 Using one or more complete sentences, state one safety precaution that should be used in the laboratory situation illustrated below. You may use pen or pencil for your answer.



Group 4

If you choose this group, be sure to answer questions 125–129.

Base your answers to questions 125 and 126 on the diagram of a compound light microscope below and on your knowledge of biology.



- 125 Which parts of this compound light microscope with clean lenses should be used to improve the quality of the image being observed in the high-power field of view?
- 1 ocular and high-power objective
 - 2 diaphragm and fine-adjustment knob
 - 3 coarse-adjustment knob and low-power objective
 - 4 ocular and diaphragm
- 126 The diameter of the low-power field of this compound light microscope measures 1,200 micrometers. What is the diameter of the high-power field in micrometers?
- (1) 0.4
 - (2) 3.6
 - (3) 40
 - (4) 400
- 127 A student calculated the diameter of the high-power field of a compound light microscope to be 0.5 millimeter. If 10 plant cells fit end to end across the diameter of the high-power field, the average length of each plant cell would be
- (1) 50 μm
 - (2) 5 mm
 - (3) 200 μm
 - (4) 20 mm
- 128 An unstained wet mount of epidermal cells shows few details. Which substance could be added to the slide to make the details more visible?
- 1 methylene blue
 - 2 dilute acid
 - 3 Benedict's solution
 - 4 bromthymol blue
- 129 A student is making a wet-mount preparation of onion epidermis cells for observation with a compound light microscope. The student cuts off a slice of onion, places it on a slide, adds iodine, puts the slide on the stage, and rotates the nosepiece on the microscope to the high-power objective.
- Using one or more complete sentences, state one error in the procedures followed by the student. You may use pen or pencil for your answer.

Group 5

If you choose this group, be sure to answer questions 130–134.

Base your answers to questions 130 through 133 on the reading passage below and on your knowledge of biology.

A Bee or Not a Bee, That Is the Question

Scientists have long been fascinated by the complex society of the bee. They have studied inherited behavior patterns, such as dances and other methods bees use to communicate basic information.

In an investigation conducted by Dr. Harold Esch, a small microphone was placed inside a hive. When a scout bee was communicating information in the form of a dance, Esch heard a loud “thththrr,” followed by a short “beep,” and then some of the worker bees flew out of the hive. Dr. Esch hypothesized that the sounds reported the distance to the nectar supply as well as its quality and quantity.

To test his hypothesis, Esch attached a tiny loudspeaker to an artificial scout bee and placed the bee into the hive to repeat the dance that had been performed by the live scout bee. While conducting the dance, the artificial bee emitted the “thththrr” sound recorded by Esch during his original observations. A ring of worker bees followed the performance with interest, but instead of flying out to seek the nectar, one of the worker bees flew over and stung the artificial scout bee. Smelling the odor of the venom, the other bees withdrew. This happened each time Esch repeated his experiment.

Dr. Esch eventually realized that he had neglected the short chirping beeps that followed the scout’s “thththrr” sound. These beeps were apparently made by one of the worker bees to indicate that the message was understood. When the scout bee hears the beep, she is supposed to stop dancing so the workers can come close to her and smell the odor of the nectar she has found. When the artificial scout bee was once again placed into the hive to perform the dance and stopped the dance after the first beep, the worker bees approached the artificial scout bee and then left the hive in search of the nectar.

- | | |
|---|---|
| <p>130 Scout bees communicate information to other bees by</p> <ol style="list-style-type: none">1 the repeated blinking of their eyes2 a dance performed in the hive3 the number of times they sting4 learned behavior patterns | <p>132 As a result of his investigations, Dr. Esch discovered that</p> <ol style="list-style-type: none">1 artificial bees can be used to find food2 worker bees can fly farther than scout bees3 bees can communicate by means of sound4 each hive has only one scout bee |
| <p>131 Which statement correctly describes the reaction of the worker bees to the artificial bee when it continued to dance after the first beep?</p> <ol style="list-style-type: none">1 One of the worker bees stung the artificial bee.2 The worker bees appeared to ignore the artificial bee.3 The worker bees appeared to accept the artificial bee.4 One of the worker bees brought nectar to the artificial bee. | <p>133 Which statement best accounts for the stinging of the artificial scout bee by the worker bee?</p> <ol style="list-style-type: none">1 Bees are not able to interpret recorded sounds.2 Worker bees learn from other bees.3 Scout bees are aggressive and unable to search for nectar.4 Certain bee behavior is inherited. |
-

134 A laboratory investigation was set up to determine if the hormone thyroxin increases metabolic activity in rats. Twenty rats of the same species, age, and weight were selected and divided into two equal groups. All the factors in the investigation were kept the same, except one group was given distilled water, and the other group was given distilled water containing thyroxin.

State the variable being studied in this investigation. You may use pen or pencil for your answer.

BIOLOGY

Tuesday, January 26, 1999 — 9:15 a.m. to 12:15 p.m., only

Part I Score
(Use table below)	
Part II Score
Part III Score
Total Score

Rater's Initials:

ANSWER PAPER

Student Sex: Male Female

Teacher School

All of your answers should be recorded on this answer paper.

Part I (65 credits)

1	1	2	3	4	21	1	2	3	4	41	1	2	3	4
2	1	2	3	4	22	1	2	3	4	42	1	2	3	4
3	1	2	3	4	23	1	2	3	4	43	1	2	3	4
4	1	2	3	4	24	1	2	3	4	44	1	2	3	4
5	1	2	3	4	25	1	2	3	4	45	1	2	3	4
6	1	2	3	4	26	1	2	3	4	46	1	2	3	4
7	1	2	3	4	27	1	2	3	4	47	1	2	3	4
8	1	2	3	4	28	1	2	3	4	48	1	2	3	4
9	1	2	3	4	29	1	2	3	4	49	1	2	3	4
10	1	2	3	4	30	1	2	3	4	50	1	2	3	4
11	1	2	3	4	31	1	2	3	4	51	1	2	3	4
12	1	2	3	4	32	1	2	3	4	52	1	2	3	4
13	1	2	3	4	33	1	2	3	4	53	1	2	3	4
14	1	2	3	4	34	1	2	3	4	54	1	2	3	4
15	1	2	3	4	35	1	2	3	4	55	1	2	3	4
16	1	2	3	4	36	1	2	3	4	56	1	2	3	4
17	1	2	3	4	37	1	2	3	4	57	1	2	3	4
18	1	2	3	4	38	1	2	3	4	58	1	2	3	4
19	1	2	3	4	39	1	2	3	4	59	1	2	3	4
20	1	2	3	4	40	1	2	3	4					

PART I CREDITS

Directions to Teacher:

In the table below, draw a circle around the number of right answers and the adjacent number of credits. Then write the number of credits (not the number right) in the space provided above.

No. Right	Credits	No. Right	Credits
59	65	29	36
58	64	28	35
57	63	27	34
56	62	26	33
55	61	25	32
54	60	24	31
53	59	23	31
52	58	22	30
51	57	21	29
50	56	20	28
49	55	19	27
48	54	18	26
47	54	17	25
46	53	16	24
45	52	15	23
44	51	14	21
43	50	13	20
42	49	12	18
41	48	11	17
40	47	10	15
39	46	9	14
38	45	8	12
37	44	7	11
36	43	6	9
35	42	5	8
34	41	4	6
33	40	3	5
32	39	2	3
31	38	1	2
30	37	0	0

No. right

Part II (20 credits)

Answer the questions in only two of the five groups in this part. Be sure to mark the answers to the groups of questions you choose in accordance with the instructions on the front page of the test booklet. Leave blank the three groups of questions you do not choose to answer.

**Group 1
Biochemistry**

- 60 1 2 3 4
- 61 1 2 3 4
- 62 1 2 3 4
- 63 1 2 3 4
- 64 1 2 3 4
- 65 1 2 3 4
- 66 1 2 3 4
- 67 1 2 3 4
- 68 1 2 3 4
- 69 1 2 3 4

**Group 3
Reproduction and
Development**

- 80 1 2 3 4
- 81 1 2 3 4
- 82 1 2 3 4
- 83 1 2 3 4
- 84 1 2 3 4
- 85 1 2 3 4
- 86 1 2 3 4
- 87 1 2 3 4
- 88 1 2 3 4
- 89 1 2 3 4

**Group 5
Ecology**

- 100 1 2 3 4
- 101 1 2 3 4
- 102 1 2 3 4
- 103 1 2 3 4
- 104 1 2 3 4
- 105 1 2 3 4
- 106 1 2 3 4
- 107 1 2 3 4
- 108 1 2 3 4
- 109 1 2 3 4

**Group 2
Human Physiology**

- 70 1 2 3 4
- 71 1 2 3 4
- 72 1 2 3 4
- 73 1 2 3 4
- 74 1 2 3 4
- 75 1 2 3 4
- 76 1 2 3 4
- 77 1 2 3 4
- 78 1 2 3 4
- 79 1 2 3 4

**Group 4
Modern Genetics**

- 90 1 2 3 4
- 91 1 2 3 4
- 92 1 2 3 4
- 93 1 2 3 4
- 94 1 2 3 4
- 95 1 2 3 4
- 96 1 2 3 4
- 97 1 2 3 4
- 98 1 2 3 4
- 99 1 2 3 4

Part III (15 credits)

Answer the questions in only three of the five groups in this part. Leave blank the groups of questions you do not choose to answer.

Group 1				
110	1	2	3	4
111	1	2	3	4
112	1	2	3	4
113	1	2	3	4
114	1	2	3	4

Group 2

115 – 116

Surface Area of the Body (m²)

Weight (lb)

117 1 2 3 4

118 _____

119 _____

Group 3

120 1 2 3 4

121 1 2 3 4

122 1 2 3 4

123 1 2 3 4

124 _____

Group 4

125 1 2 3 4

126 1 2 3 4

127 1 2 3 4

128 1 2 3 4

129 _____

Group 5

130 1 2 3 4

131 1 2 3 4

132 1 2 3 4

133 1 2 3 4

134 _____

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

Signature