BIOLOGY E/M TEST

FOR BOTH BIOLOGY-E AND BIOLOGY-M, ANSWER QUESTIONS 1-30

Directions: Each set of lettered choices below refers to the numbered questions or statements immediately following it. Select the one lettered choice that best answers each question or best fits each statement, and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1-3 refer to the following molecules.

(A) Deoxyribose
(B) Ribose
(C) Uracil
(D) Cytosine
(E) Thymine

1. Nitrogenous base that occurs in RNA but not in DNA

2. Sugar that occurs in DNA but not in RNA

3. A nitrogenous base that occurs in DNA in equal quantities with guanine

Questions 4-6 refer to the following processes.

(A) Succession
(B) Dispersion
(C) Fertilization
(D) Speciation
(E) Mutation

4. The inability of two populations to interbreed after being separated by a barrier for a long period of time

5. The change in plant types inhabiting an area over time, resulting in a climax community

6. Plants growing in and around a pond eventually filling in the pond and changing it to a terrestrial habitat

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Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

7. The pH of human blood is slightly basic. Which of the following is most likely to be the pH of human blood?

   (A) 10.6
   (B) 7.4
   (C) 7.0
   (D) 6.4
   (E) 4.6

8. A student examined two different groups of cells and made the following observations.

Trait	Cell I	Cell II
Cell wall	Present	Present
Ribosomes	Present	Present
Nucleus	Absent	Present
Ability to photosynthesize	Present	Absent
Cell respiration	Present	Present

   These observations support which of the following conclusions?

   (A) Cell I is more complex in its organization than cell II.
   (B) Cell I is a prokaryote.
   (C) The ancestors of Cell II appeared earlier in the fossil record than the ancestors of cell I.
   (D) Cell II does not have a cell membrane.
   (E) Both groups of cells are from plants.

9. Ritualized contests between individuals in a population with little risk of serious injury or death to participants within the species lead to

   (A) a stable dominance hierarchy
   (B) biological altruism
   (C) divergent evolution
   (D) instinctive behavior
   (E) a broader habitat

10. Which of the following correctly explains how a favorable genetic trait can increase in frequency in a population?

    (A) Lamarck's principle
    (B) Natural selection
    (C) Adaptive radiation
    (D) Genetic recombination
    (E) Segregation of alleles

11. Blood flows from the heart to the lungs in the pulmonary artery and returns from the lungs to the heart in the pulmonary vein. The blood in the pulmonary artery is

    (A) higher in O_2 and lower in CO_2 content than the blood in the pulmonary vein
    (B) higher in both O_2 and CO_2 content than the blood in the pulmonary vein
    (C) lower in O_2 and higher in CO_2 content than the blood in the pulmonary vein
    (D) lower in both O_2 and CO_2 content than the blood in the pulmonary vein
    (E) higher in O_2 content, but about the same in CO_2 content as the blood in the pulmonary vein

12. A microscopic unicellular organism is observed to have the following characteristics: a food gullet, a flagellum, chloroplasts, mitochondria, and a nucleus. This organism belongs to which kingdom?

    (A) Protista
    (B) Plantae
    (C) Fungi
    (D) Animalia
    (E) Monera

13. It is observed that a stream is free of pollutants within a few miles downstream from a point at which a small amount of sewage is being dumped into it. This is most likely the result of

    (A) succession
    (B) eutrophication
    (C) evaporation
    (D) photosynthesis
    (E) decomposition

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14. As rain mixes with chemicals such as sulfur dioxide in the air, acid rain is produced. This may result in

    (A) lowering the pH in ponds, thus limiting the survival of many organisms
    (B) lowering the pH in ponds, thus affecting water temperature
    (C) raising the pH in ponds, thus encouraging the growth of organisms
    (D) raising the pH in ponds, thus limiting animal development
    (E) depleting atmospheric carbon dioxide available for photosynthesis

15. If the air temperature is lowered significantly, which of the following changes is most likely to occur in the breathing rates of frogs and mice?

    (A) Both will increase their breathing rates.
    (B) Both will decrease their breathing rates.
    (C) Both will continue to breathe at the same rates as before the experiment began.
    (D) The frogs will breathe faster and the mice will breathe more slowly.
    (E) The frogs will breathe more slowly and the mice's breathing rate will stay the same.

16. Most amphibians are characterized by all of the following EXCEPT

    (A) simple lungs
    (B) multichambered heart
    (C) eggs protected by shells
    (D) larvae that developed in water
    (E) external fertilization

17. All of the following structures form at some time during the embryological development of vertebrates EXCEPT

    (A) a notochord
    (B) paired appendages
    (C) a ventral nerve cord
    (D) a ventral heart
    (E) paired gill slits

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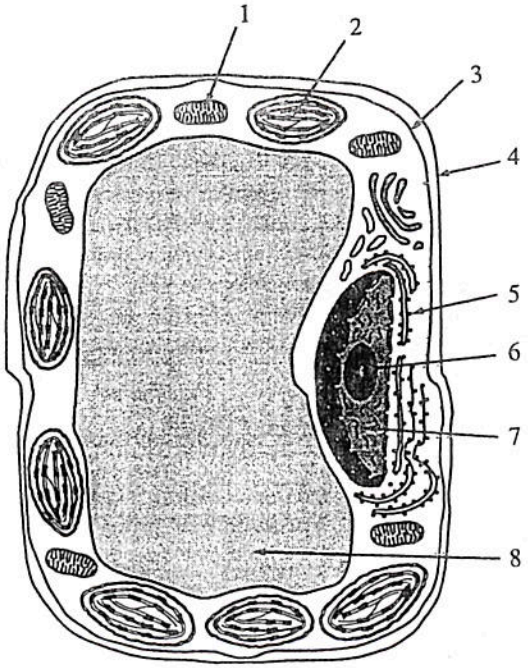
Questions 18-21 refer to the diagram below, which represents a single cell of an organism.



18. The movement of ions into and out of the cell is controlled by structure

    (A) 1
    (B) 2
    (C) 3
    (D) 5
    (E) 6

19. Which of the following structures would be absent if this were an animal cell?

    (A) 2
    (B) 3
    (C) 5
    (D) 6
    (E) 7

20. RNA associated with structure 5 supports the idea that

    (A) genetic information is coded in a double helix
    (B) photosynthesis occurs in the cell
    (C) the cell moves about freely
    (D) the cell can synthesize certain proteins
    (E) respiration occurs in the cell

21. Structure 1 is found in both plant and animal cells because both

    (A) pump out excess water
    (B) require energy
    (C) divide by using centrioles
    (D) move by using cilia
    (E) convert light energy to chemical energy

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Questions 22-25 refer to the following breeding experiment the purpose of which is to investigate inheritance in pea plants.

P	Plants with round yellow peas	x	Plants with wrinkled green peas
		↓	
F_1		All plants with round yellow peas	
		↓	
F_2		272 plants with round yellow peas 87 plants with wrinkled yellow peas 94 plants with round green peas 30 plants with wrinkled green peas	

22. According to the data, how many genes control the production of the four observed traits (i.e., round , wrinkled, yellow, and green)?

(A) One
(B) Two
(C) Three
(D) Four
(E) Eight

23. The ratio of different types of F_2 progeny is approximately

(A) 1:1:1:1
(B) 1:2:2:1
(C) 2:2:2:1
(D) 4:3:2:1
(E) 9:3:3:1

24. The two phenotypes for pea color result from

(A) sex-linked genes
(B) codominant alleles
(C) different genes on the same chromosome
(D) different genes on different chromosomes
(E) different alleles of the same gene

25. The results obtained in the experiment indicate which of the following to be true for the original parents (the P-generation) ?

(A) Both are homozygous for color and for shape.
(B) Both are heterozygous for color and for shape.
(C) Both are heterozygous for color and homozygous for shape.
(D) Both are homozygous for color and heterozygous for shape.
(E) One is homozygous for color and shape, whereas the other is heterozygous for both traits.

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Questions 26-30

A class was studying the effects of chemicals on the development of roots on bean (*Phaseolus vulgaris*) stems. The stems were cut from 10-day-old seedlings before any branching had taken place. The stems were suspended for 7 days in beakers containing a 3% solution of compound *Q* in water. The length and number of roots formed were recorded in the table below.

Table I

	Day 3	Day 5	Day 7
Number of roots in 3% solution *Q*	6	12	17
Average length (millimeters)	2	3	4

In a second experiment, a new batch of 10-day-old bean stems were exposed to different concentrations of compound *Q* for 7 days. The length and number of roots formed were recorded in the table below.

Table II

	Water	1% Solution *Q*	2% Solution *Q*	3% Solution *Q*	4% Solution *Q*
Number of roots after 7 days	1	5	12	18	3
Average length (millimeters)	12	4	3	3	1

In a third experiment, a new batch of stems were exposed to a 3% solution of compound *X* in water for 7 days. The length and number of roots formed were recorded in the table below.

Table III

	Day 3	Day 5	Day 7
Number of roots in 3% solution *X*	0	1	2
Average length (millimeters)	-	11	10

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26. In Table III, no data were recorded for the length of roots on plants after 3 days in compound *X* most likely because

    (A) the data were lost
    (B) there were no roots to measure
    (C) the roots were damaged
    (D) day 3 was used as a control
    (E) the values on days 5 and 7 were more meaningful

27. The plants in 3% solution *X* respond most like those in

    (A) water
    (B) 1% solution *Q*
    (C) 2% solution *Q*
    (D) 3% solution *Q*
    (E) 4% solution *Q*

28. In the experiment summarized in Table II, the total length of root tissue produced is greatest in plants grown in

    (A) water
    (B) 1% solution *Q*
    (C) 2% solution *Q*
    (D) 3% solution *Q*
    (E) 4% solution *Q*

29. The experiment reported in Table I could have best been improved by

    (A) testing more compounds
    (B) counting and measuring the roots on day 4
    (C) testing root development in water without solution *Q*
    (D) measuring the roots in centimeters
    (E) testing more species of plants

30. Which of the following hypotheses is best supported by the data?

    (A) The development of roots of bean stems is affected by solution *Q*.
    (B) Solution *Q* stimulates root elongation.
    (C) Solution *X* stimulates root formation.
    (D) The greater the concentration of solution *Q*, the more roots are produced.
    (E) Bean stems grow faster in solution *Q* than in solution *X*.

If you are taking the Biology-E test, continue with questions 31-40.
If you are taking the Biology-M test, go to question 41 now.

BIOLOGY-E SECTION

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

31. Characteristics of birds but not of mammals include which of the following?

    I. Feathers
    II. Giving birth to live young
    III. Four-chambered hearts

    (A) I only
    (B) III only
    (C) I and II only
    (D) I and III only
    (E) I, II, and III

32. It is thought that the Galapagos Islands were originally colonized by one species of finch. Today these islands contain many species of finches that occupy diverse niches. This most likely resulted from which of the following?

    I. Biological magnification
    II. Convergent evolution
    III. Adaptive radiation

    (A) I only
    (B) II only
    (C) III only
    (D) II and III only
    (E) I, II, and III

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Questions 33-35

The energy flow between trophic levels in a lake in a northern deciduous forest is shown in the table below. The solar energy available to producers is 1,490,000 kcal/m^2/year. The difference between gross productivity and net productivity is the respiratory energy of the organism.

ENERGY FLOW IN A LAKE IN A NORTHERN DECIDUOUS FOREST (kcal/m^2/yr)

Trophic Level	Energy Consumed	Waste Energy	Gross Productivity	Net Productivity
Producer	–	1,480,000	10,000	8,000
Primary Consumer	2,000	1,600	200	180
Secondary Consumer	100	80	40	10
Decomposer	40	30	10	trace

33. In the lake community described in the table, which of the following represents the respiratory energy used by autotrophic organisms?

(A) 10 kcal/m^2/year
(B) 200 kcal/m^2/year
(C) 1,600 kcal/m^2/year
(D) 2,000 kcal/m^2/year
(E) 10,000 kcal/m^2/year

34. According to the table, the energy consumed by decomposers is larger than the net productivity of secondary consumers because decomposers

(A) are heterotrophs
(B) have a very efficient metabolism
(C) represent a large fraction of the total biomass of the system
(D) also absorb light energy
(E) also obtain energy from producers and primary consumers

35. Which of the following is the maximum amount of energy available to animals that eat herbivores?

(A) 2,000 kcal/m^2/year
(B) 180 kcal/m^2/year
(C) 100 kcal/m^2/year
(D) 40 kcal/m^2/year
(E) 10 kcal/m^2/year

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Questions 36-40 refer to the following experiments and results obtained.

Students removed fruit flies, *Drosophila melanogaster*, from a large culture and exposed groups of these flies to different concentrations of a pesticide, as shown in Figure I. After the exposures, the surviving flies were counted. The results are shown in Figure II. The flies from each flask were then removed to a new culture flask and permitted to breed. After the eggs were laid, the adult flies were removed. When the offspring became adults, they were exposed to the same concentrations of the pesticide as were their parents. The results of the second exposure are shown in Figure III.

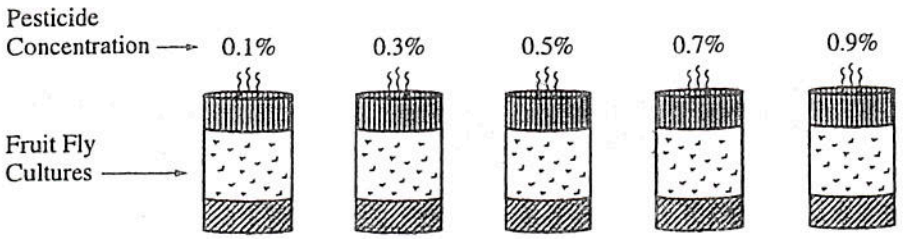

Figure I

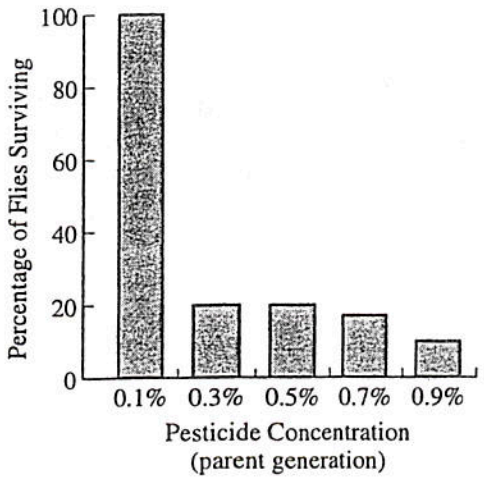

Figure II

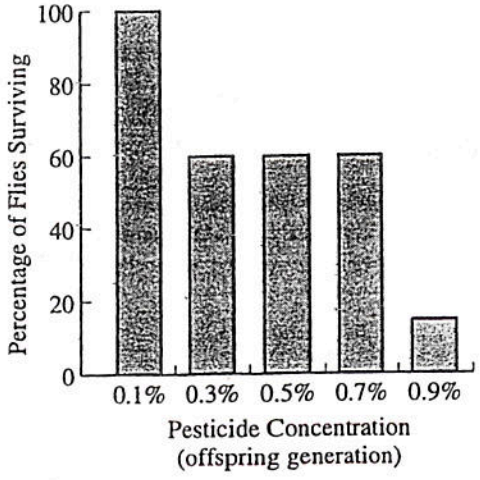

Figure III

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36. The data suggest that the effect of the pesticide on the flies is

(A) noticeable at all concentrations of the pesticide
(B) insignificant at concentrations of 0.1% or lower
(C) directly proportional to the concentration of the pesticide
(D) greater for the offspring than for the parent generation
(E) insignificant if breeding takes place at a higher temperature

37. The results of exposure of the offspring to pesticides suggest that

(A) any increase in pesticide concentration causes a decrease in survival of the offspring
(B) the offspring that were exposed to 0.3% concentrations had the same survival as the offspring exposed to 0.7% concentrations.
(C) the pesticide has no effect on the offspring at concentrations of less than 0.9%
(D) the pesticide would have no effect on the offspring at concentrations greater than 0.9%
(E) the offspring that survived the exposure to the pesticide are sterile

38. If 500 flies were removed from the original culture and exposed to a 0.4% concentration of the same pesticide, how many flies would be expected to survive?

(A) 20
(B) 60
(C) 100
(D) 300
(E) 500

39. The explanation of the results that is most consistent with current biological themes is which of the following?

(A) Both parents and offspring acquired immunity to the pesticide as a result of the direct exposure.
(B) The parents gradually acquired resistance to the pesticide and passed this resistance to their offspring.
(C) Flies that were naturally resistant to each concentration of pesticide produced the next generation of offspring.
(D) The flies exposed to 0.1% pesticide concentration are the ones that mated and produced the next generation.
(E) Flies can acquire resistance only after they are exposed to the pesticide.

40. Which of the following biological processes is illustrated by the results of the experiment?

(A) Habituation
(B) Interspecific competition
(C) Independent assortment
(D) Biological magnification
(E) Selection

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THE ENTIRE BIOLOGY-E TEST ONLY. DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.

BIOLOGY-M SECTION

If you are taking the Biology-M test, continue with the questions 41-50.
Be sure to start this section of the test by filling in oval 41 on your answer sheet.

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

41. In eukaryotes, errors in DNA synthesis have more serious consequences than do errors in RNA synthesis because

    (A) DNA codes for protein, but RNA does not
    (B) ribosomes can correct errors during protein synthesis
    (C) cells produce many more molecules of RNA than of DNA
    (D) DNA errors will be inherited by daughter cells
    (E) all cells have DNA, but many do not have RNA

42. Normal bacteria are able to produce the amino acid proline, which they use for protein synthesis. A mutant that cannot produce proline would most likely

    (A) be unable to grow in media that lack proline
    (B) be unable to grow in media that contain proline
    (C) be unable to grow in any media
    (D) synthesize functional proteins without using proline
    (E) readily mutate to a form that can synthesize proline

43. The oxygen produced during photosynthesis is derived from

    (A) glucose ($C_6H_{12}O_6$)
    (B) CO_2
    (C) H_2O
    (D) ribulose bisphosphate
    (E) ATP

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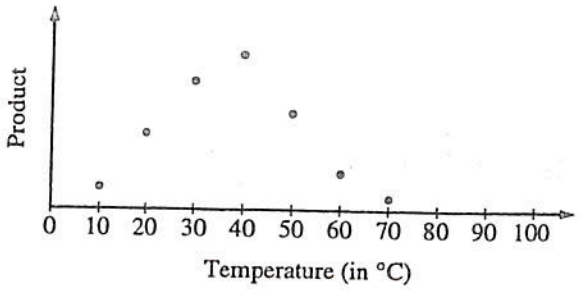
Questions 44-45

The graph below illustrates the data obtained from reactions at various temperatures of an enzyme with its specific substrate at pH 6.



44. Based on the data, what results can be predicted if the experiment is carried out at 5°C ?

(A) The available data are insufficient to make a reliable prediction.
(B) An amount of product equal to that at 20°C would be formed.
(C) An amount of product equal to that at the optimum temperature would be formed.
(D) An amount of product equal to that at 60°C would be formed.
(E) Relatively little product would be formed.

45. Based on the data, what results could be predicted if the experiment were repeated at pH 4 ?

(A) The available data are insufficient to make a reliable prediction.
(B) An amount of product equal to that at pH 6 would be formed.
(C) An amount of product less than that at pH 6 would be formed.
(D) An amount of product more than that at pH 6 would be formed.
(E) Relatively little product would be formed.

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Questions 46-50

Cytochrome *c* is a respiratory enzyme located in the mitochondria of cells. The amino acid sequence of cytochrome *c* was obtained from different species; the differences in the sequences are illustrated below. The numbers indicate how many amino acids in the cytochrome *c* of a particular species differ from those of various other species.

	Human	Monkey	Sheep	Horse	Dog	Rabbit	Kangaroo	Chicken	Duck	Rattlesnake	Turtle	Tuna fish	Moth	Bread mold	Yeast
Human	0														
Monkey	1	0													
Sheep	10	9	0												
Horse	12	11	3	0											
Dog	11	10	3	6	0										
Rabbit	9	8	4	6	5	0									
Kangaroo	10	11	6	7	7	6	0								
Chicken	13	12	9	11	10	8	12	0							
Duck	11	10	8	10	8	6	10	3	0						
Rattlesnake	14	15	20	22	21	18	21	19	17	0					
Turtle	15	14	9	11	9	9	11	8	7	22	0				
Tuna fish	21	21	17	19	18	17	18	17	17	26	18	0			
Moth	31	30	27	29	25	26	28	28	27	31	28	32	0		
Bread mold	48	47	46	46	46	46	49	47	46	47	49	48	47	0	
Yeast	45	45	45	46	45	45	46	46	46	47	49	47	47	41	0

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46. Based on their differences in cytochrome *c*, which of the following pairs of organisms are most closely related to each other?

(A) Rattlesnake and kangaroo
(B) Monkey and chicken
(C) Turtle and tuna fish
(D) Duck and rabbit
(E) Yeast and bread mold

47. Which of the following organisms appears to be LEAST closely related to humans?

(A) Kangaroo
(B) Tuna fish
(C) Bread mold
(D) Moth
(E) Turtle

48. Based on the diagram, the DNA that codes for cytochrome *c* in monkeys is most similar to that in a

(A) dog
(B) human
(C) horse
(D) chicken
(E) yeast

49. The data reported in this table demonstrate that cytochrome *c* is present in

(A) vertebrates only
(B) mammals and insects only
(C) animals and fungi
(D) bacteria and viruses
(E) eukaryotes and prokaryotes

50. Which of the following best explains why there are relatively few differences in the cytochrome *c* of the diverse organisms in the chart?

(A) Most proteins are the same among members of these groups.
(B) DNA replication is error-free.
(C) All organisms undergo protein synthesis.
(D) The respiratory reactions are recent evolutionary occurrences.
(E) The respiratory reactions are similar in all eukaryotes.

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THE ENTIRE BIOLOGY-M TEST ONLY. DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.

TABLE A

Answers to the SAT II: Biology E/M Subject Mini Test, and Percentage of Students Answering Each Question Correctly in Field Trial

Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*	Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*
1	C			66	26	B			77
2	A			70	27	A			67
3	D			79	28	D			40
4	D			80	29	C			65
5	A			46	30	A			60
6	A			68	31	A			76
7	B			64	32	C			40
8	B			70	33	D			57
9	A			65	34	E			50
10	B			60	35	B			39
11	C			64	36	B			65
12	A			64	37	B			71
13	E			48	38	C			35
14	A			56	39	C			36
15	E			36	40	E			42
16	C			36	41	D			57
17	C			26	42	A			32
18	C			68	43	C			28
19	A			56	44	E			84
20	D			64	45	A			59
21	B			76	46	D			40
22	B			36	47	C			75
23	E			85	48	B			74
24	E			42	49	C			35
25	A			46	50	E			24

*These percentages are based on answer sheets from several field trials. Some of the differences in percentage correct may be due to differences in the ability of the students in each field trial. They may be used as a general indication of the relative difficulty of a particular question.