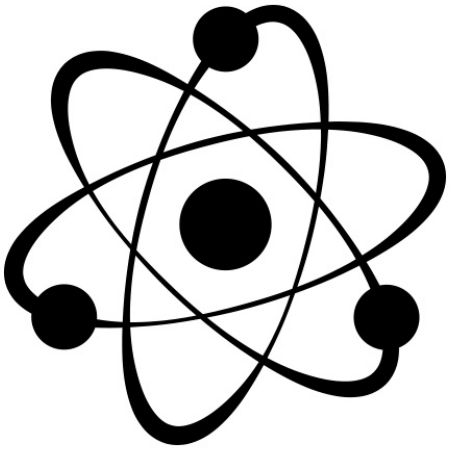


SCIENCE

PRACTICE TEST

FORM 17B

SCIENCE TEST

35 Minutes—40 Questions

DIRECTIONS: There are 6 passages in this test, each accompanied by several questions. Use the data in the passage, charts, and figures to choose the best answer to each question presented. Then, mark the corresponding oval on your answer sheet. You may look back at the passages while answering questions.

You may NOT use a calculator on this portion of the test.

Passage I

A study was conducted to examine whether *Solanum lycopersicum* (a species of tomato plant) grow best when given distilled water, apple juice, lemon-lime soda, or whole milk. First, the *S. lycopersicum* seeds were separately planted in different pots. Over the next 15 days, the tomato plants were given a total of 300 mL of liquid. Figure 1 shows how the height, in cm, of each tomato plant changed over time as they were given the different types of liquid. Table 1 shows the percent by volume of water, sugar, sodium, and protein, respectively, present in each of the 4 liquids tested in the study.

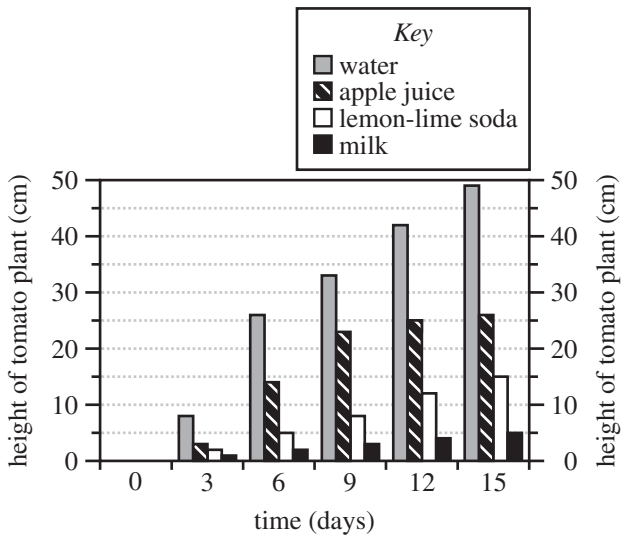


Figure 1

Table 1

Liquid	Percent by volume			
	water	sugar	sodium	protein
Water	100.0	0.0	0.0	0.0
Apple juice	94.8	4.8	0.1	0.0
Lemon-lime soda	89.2	10.7	0.1	0.0
Milk	85.3	5.3	0.1	3.2

Table adapted from U.S. Department of Agriculture, *USDA National Nutrient Database for Standard Reference, Release 28.* 2016.

1. According to Figure 1, the height of the tomato plant that was given apple juice at 9 days was closest to which of the following values?

A. 3 cm
B. 8 cm
C. 23 cm
D. 25 cm

2. Suppose a company wants to start growing large amounts of *S. lycopersicum*. Based on Figure 1, which of the 4 liquids should the company use to grow the plants in order to maximize plant growth for harvest?

F. Water
G. Apple juice
H. Milk
J. Lemon-lime soda

3. Consider the 4 liquids in order of the percent by volume of water, from highest to lowest. From liquid to liquid, as the percent by volume of water decreased, the height of the plant at 15 days:

A. increased only.
B. decreased only.
C. increased and then decreased.
D. decreased and then increased.

4. Consider the statement "The *S. lycopersicum* grew due to the liquid between 0 and 3 days, between 3 and 6 days, between 6 and 9 days, between 9 and 12 days, and between 12 and 15 days." This statement is consistent with the data in Figure 1 for how many of the 4 liquids?

F. 1
G. 2
H. 3
J. 4

5. A student predicted that the *S. lycopersicum* would grow more from the milk than from the apple juice by the end of the experiment. Do the data in Figure 1 support this prediction?

A. Yes; at 15 days, the height of the tomato plant given milk was about 20 cm greater than the height of the tomato plant given apple juice.
B. Yes; at 15 days, the height of the tomato plant given milk was about 45 cm greater than the height of the tomato plant given apple juice.
C. No; at 15 days, the height of the tomato plant given milk was about 20 cm less than the height of the tomato plant given apple juice.
D. No; at 15 days, the height of the tomato plant given milk was about 45 cm less than the height of the tomato plant given apple juice.

6. Based on Table 1, when 300 mL of each of the 4 liquids was given to the plants over the 15-day period, sugar accounted for more than 30 mL of the volume of which liquid(s)?

F. Lemon-lime soda only
G. Lemon-lime soda and milk only
H. Water and apple juice only
J. Water, apple juice, and milk only

Passage II

A science teacher distributed the table below to students in a class. The table lists 5 properties for each of Samples A–H. The teacher instructed students to assume that each sample was a solid sphere composed of a single hypothetical pure substance.

Sample	Boiling point (°C)	Melting point (°C)	Density (g/cm^3)	Volume (cm^3)	Mass (g)
A	907	420	3.0	3.0	9.0
B	759	63	3.0	3.0	9.0
C	759	63	3.0	2.0	6.0
D	883	192	3.0	2.0	6.0
E	907	420	6.0	2.0	12.0
F	907	420	6.0	2.0	12.0
G	759	63	6.0	1.0	6.0
H	883	192	6.0	1.0	6.0

Note: Assume that mass, volume, and density were determined at 20°C and that all 5 properties were determined at 1 atmosphere (atm) of pressure.

The teacher asked each of 4 students to predict which samples are composed of the same substance using the data from the table.

Student 1

2 samples must be composed of the same substance if they have the same density, volume, and mass. 2 samples must be composed of different substances if they have different values for any of these 3 properties. The composition of the samples cannot be determined solely by the boiling point or the melting point.

Student 2

2 samples must be composed of the same substance if they have the same boiling point, melting point, and density. 2 samples must be composed of different substances if they have different values for any of these 3 properties. The composition of the samples cannot be determined solely by the volume or the mass.

Student 3

2 samples must be composed of the same substance if they have the same values for at least 3 of the 5 properties. 2 samples must be composed of different substances if they have different values for at least 3 of the 5 properties.

Student 4

2 samples must be composed of the same substance if they have the same values for all 5 properties. 2 samples must be composed of different substances if they have different values for any of the 5 properties.

7. Based on Student 4's explanation, the same substance composes both of the samples in which of the following pairs?

A. Samples B and C
B. Samples C and D
C. Samples E and F
D. Samples F and G

8. Based on Student 1's explanation, the same substance composes both of the samples in which of the following pairs?

F. Samples A and C
G. Samples B and C
H. Samples D and G
J. Samples G and H

9. Suppose that the temperature of Sample D is increased to 350°C at 1 atm of pressure. At 350°C, would Sample D be a solid or a liquid?

A. Solid, because the melting point of Sample D is 192°C.
B. Solid, because the melting point of Sample D is 883°C.
C. Liquid, because the melting point of Sample D is 192°C.
D. Liquid, because the melting point of Sample D is 883°C.

10. Consider the following statement "Two samples having the same volume will always be composed of the same substance, regardless of the values of the other 4 properties." Which of the students, if any, would be likely to agree with this statement?

F. Student 1 only
G. Students 1 and 2 only
H. All of the students
J. None of the students

11. Which of Students 1, 2, and 3 would be likely to agree that Sample C and Sample D are composed of the same substance?

A. Students 1 and 2 only
B. Students 1 and 3 only
C. Students 2 and 3 only
D. Students 1, 2, and 3

12. Consider the claim that 2 samples that have the same density, volume, mass, and melting point are composed of the same substance, even if two samples have different boiling points. Which of Students 2 and 3, if either, would be likely to agree with this statement?

F. Student 2 only
G. Student 3 only
H. Both Student 2 and Student 3
J. Neither Student 2 nor Student 3

13. Suppose that the temperature of Sample F is increased to 950°C at 1 atm of pressure. Compared to the sample's density at 20°C and 1 atm, will the new density be lower or higher?

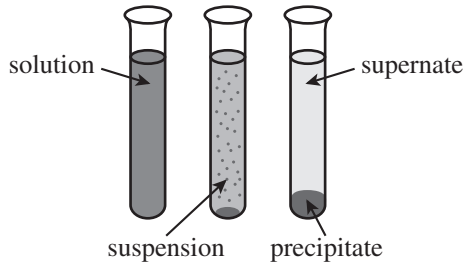
A. Lower; Sample F will be a liquid, and liquids typically have lower densities than solids.
B. Lower; Sample F will be a gas, and gases typically have lower densities than solids.
C. Higher; Sample F will be a liquid, and liquids typically have higher densities than solids.
D. Higher; Sample F will be a gas, and gases typically have higher densities than solids.

Passage III

When aqueous silver nitrate ($AgNO_3$) is placed into solutions of K_2CrO_4, NaOH, or C_2H_2, *precipitation reactions* occur, resulting in the formation of solid *precipitates* such as silver chromate (Ag_2CrO_4), silver oxide (Ag_2O), and silver acetylide (Ag_2C_2) and a liquid *supernate*. The balanced precipitation reaction equations are of the following form:

$$2AgN0_3 + \text{solution} \rightarrow Ag_2X(\text{precipitate}) + \text{supernate}$$

Two experiments were conducted to study the production of the solids in these reactions. The diagram below shows the stages during which the reactions form a liquid supernate and a solid precipitate.



diagram

In each trial of the experiments, Steps 1–3 were performed:

1. A 50 mL solution of either K_2CrO_4, NaOH, or C_2H_2 was prepared in a graduated cylinder.
2. A selected volume of aqueous $AgNO_3$ was poured into the graduated cylinder.
3. When the reaction stopped, the supernate was carefully discarded and the mass of the precipitate was measured in grams.

The graduated cylinders were kept at selected temperatures throughout each step of the experiments. The atmospheric pressure was 14.7 psi during all trials of each experiment.

Experiment 1

In each trial, a selected volume of $AgNO_3$ was tested at 30°C (see Figure 1).

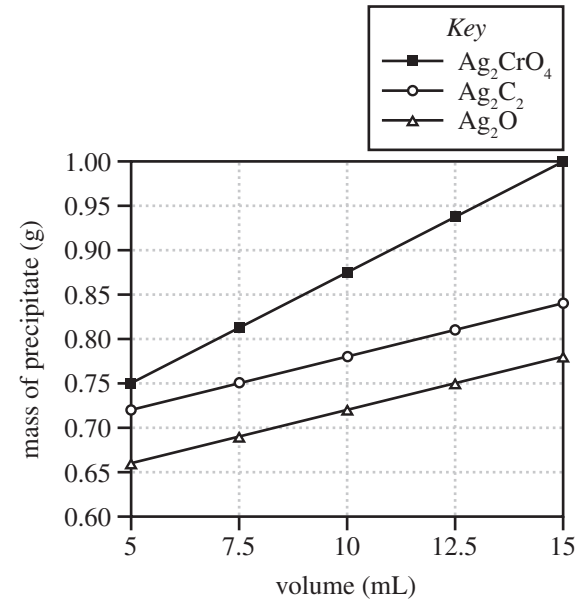


Figure 1

Experiment 2

In each trial, 10 mL of aqueous $AgNO_3$ was tested at selected temperatures (see Figure 2).

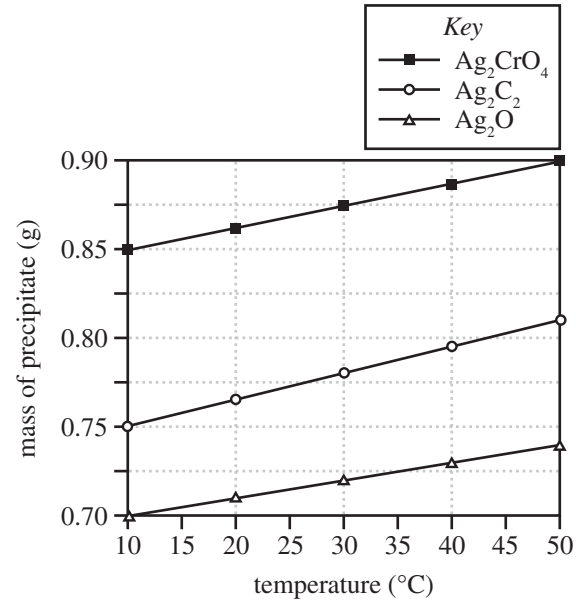


Figure 2

14. Consider the mass of Ag_2O precipitate produced in Experiment 2 for aqueous $AgNO_3$ at 30°C. The same approximate mass of Ag_2O precipitate was produced in the trial in Experiment 1 for what volume of aqueous $AgNO_3$?

F. 7.5 mL
G. 10 mL
H. 12.5 mL
J. 15 mL

15. How many volumes were tested in Experiment 1, and how many volumes were tested in Experiment 2 ?

	Experiment 1	Experiment 2
A.	1	1
B.	1	5
C.	5	1
D.	5	5

16. Which of the following statements describes a difference between Experiments 1 and 2 ? In Experiment 1:

F. only Ag_2CrO_4 was tested, but in Experiment 2, Ag_2CrO_4, Ag_2O, and Ag_2C_2 were tested.
G. Ag_2CrO_4, Ag_2O, and Ag_2C_2 were tested, but in Experiment 2, only Ag_2CrO_4 was tested.
H. the same volume of $AgNO_3$ was tested, but in Experiment 2, multiple volumes of $AgNO_3$ were tested.
J. multiple volumes of $AgNO_3$ were tested, but in Experiment 2, the same volume of $AgNO_3$ was tested.

17. Which of the following variables remained constant throughout both experiments?

A. Volume of $AgNO_3$
B. Temperature
C. Atmospheric pressure
D. Mass of precipitate collected

18. If a temperature of 55°C had been tested in Experiment 2, would the mass of Ag_2CrO_4 precipitate produced more likely have been greater than 0.90 g or less than 0.90 g ?

F. Less than 0.90 g, because for aqueous $AgNO_3$ in a given solution, the mass of precipitate produced decreased as the temperature decreased.
G. Less than 0.90 g, because for aqueous $AgNO_3$ in a given solution, the mass of precipitate produced decreased as the temperature increased.
H. Greater than 0.90 g, because for aqueous $AgNO_3$ in a given solution, the mass of precipitate produced increased as the temperature decreased.
J. Greater than 0.90 g, because for aqueous $AgNO_3$ in a given solution, the mass of precipitate produced increased as the temperature increased.

19. Consider the balanced precipitation reaction equation in the passage. Based on the equation, if 8 moles of $AgNO_3$ are consumed, how many moles of precipitate are produced?

A. 4
B. 8
C. 12
D. 16

20. Suppose that the Ag_2CrO_4 precipitate produced in Experiment 1 during the 7.5 mL aqueous $AgNO_3$ trial is to be collected and separated into complete 0.3 g samples for further testing. Based on Figure 1, how many complete 0.3 g samples can be collected for testing in this way?

F. 1
G. 2
H. 3
J. 4

Passage IV

Figure 1 is a diagram of an *LCR series circuit*. The circuit has a power source and the following components: an inductor (L), a capacitor (C), and a resistor (R).

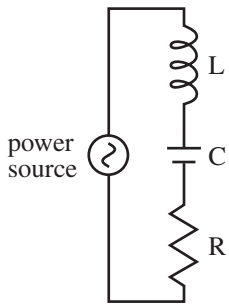


Figure 1

Electric current can move through a circuit with a positive current (flowing in a clockwise direction) or with a negative current (flowing in a counterclockwise direction). Figure 2 shows how the power source voltage, V_S (in volts, V), and the electric current in the circuit, I (in amperes, A), changed over a time interval of 60 milliseconds (msec) while at resonance.

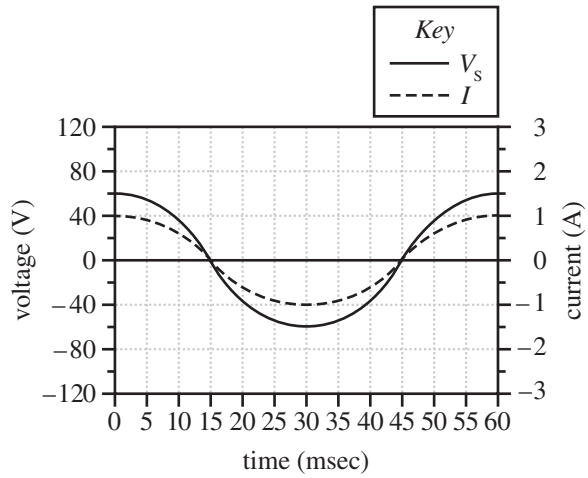


Figure 2

The changes in voltage across each of the three components—V_L, V_C, and V_R, respectively—during the same 60 msec time interval are shown in Figure 3 below.

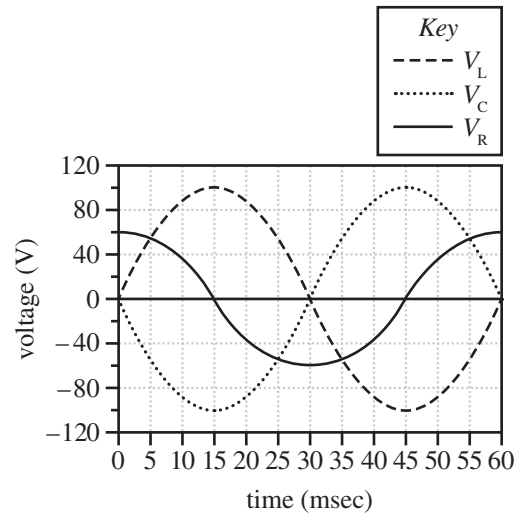


Figure 3

21. According to Figure 2, the minimum negative value of V_S was approximately:

A. –10 V.
B. –40 V.
C. –60 V.
D. –70 V.

22. The *amplitude* of a wave is the vertical distance between a peak or valley on the wave and 0. Based on Figure 3, the amplitude for V_C is:

F. 50 V.
G. 60 V.
H. 100 V.
J. 200 V.

23. Based on Figures 2 and 3, which of the following measurements varied the *most* during the 60 msec time interval?

A. I
B. V_S
C. V_R
D. V_C

24. *Polarity* can be determined by whether a voltage has a positive or negative value (a voltage of 0 V is considered to have no polarity). Based on Figures 2 and 3, which 2 voltages always show *opposite* polarity?

F. V_L and V_C
G. V_L and V_R
H. V_C and V_S
J. V_C and V_R

25. According to Figure 2, at which of the following times was the current in the circuit flowing in a clockwise direction?

A. 15 msec
B. 30 msec
C. 45 msec
D. 55 msec

26. The table below lists the electrical charge (in micro-coulombs, μC) stored in the capacitor at 3 different times during the 60 msec time interval.

Time (msec)	Charge (μC)
34	0.47
45	1.04
56	0.47

Based on Figures 2 and 3, during the time interval of 34 msec to 56 msec, is it more likely that the charge on the capacitor changed in sync with V_C or I ?

F. V_C; both the charge and V_C increased then decreased over that time interval.
G. V_C; both the charge and V_C decreased then increased over that time interval.
H. I; both the charge and I increased then decreased over that time interval.
J. I; both the charge and I decreased then increased over that time interval.

Passage V

The presence of nitrogen in substrates can affect the synthesis of the amino acid *glutamine* in bacteria, preventing population growth. If the presence of nitrogen in the environment is limited properly, bacteria can achieve regular synthesis of glutamine and sustain growth. Alternately, augmentations to the nitrogen regulatory gene *glnR* can result in the development of *N-regulatory mutations* which allow the bacteria to synthesize glutamine normally despite the presence of nitrogen.

The number of bacteria found in a nitrogen-rich substrate can indicate the success of mutations to the glnR gene in regulating nitrogen control. Scientists tested 4 mutations, each suspected of being effective in nitrogen control, on a nitrogen-sensitive bacteria *Salmonella typhimurium*.

Study

A nutrient substrate with significant nitrogen content was prepared and separated into sterile petri dishes (Dishes 1–5). Then 1×10^8 cells of *S. typhimurium* were added to each dish. In Dishes 1–4, a different mutation was made to the glnR gene. There were no mutations made to the glnR genes of the cells in Dish 5. Table 1 lists, for each of Dishes 1–4, the mutation made to the bacteria before they were added to the dish.

Table 1

Dish	Mutation
1	W
2	X
3	Y
4	Z

The 5 dishes were incubated at 37°C for 2 days. At the end of the incubation period, the number of colonies growing in the nutrient substrate in each dish was observed. The results are shown in Table 2.

Table 2

Dish	Number of colonies
1	62
2	4
3	22
4	89
5	3

27. Based on the results of the study, which of the mutations resulted in the greatest improvement in synthesis of glutamine?

A. Mutation W
B. Mutation X
C. Mutation Y
D. Mutation Z

28. Which dish in the study was intended to serve the purpose of testing whether *S. typhimurium* cells could experience some growth in a nitrogen-rich environment without being mutated?

F. Dish 1
G. Dish 2
H. Dish 4
J. Dish 5

29. Based on the results of the study, what is the order of the suspected mutations, from the mutation with the *least* potential to regulate nitrogen control to the mutation with the *most* potential to regulate nitrogen control?

A. X, Y, W, Z
B. X, Z, W, Y
C. Z, W, Y, X
D. Z, X, W, Y

30. In the study, the scientists tested the effect of Mutation W in the nutrient substrate with 10 mM of a nitrogen source. After the study, the scientists repeated their test of the effect of Mutation W, but with three other measurements of the nitrogen source. The three measurements and their corresponding results are shown in the table below.

Measurement of nitrogen source	Number of colonies
20 mM	21
30 mM	7
40 mM	2

What is the relationship, if any, between the measurements of the nutrient source and its effect on the success of Mutation W ?

F. As the measurement of the nitrogen source increases, the success of Mutation W decreases only.
G. As the measurement of the nitrogen source increases, the success of Mutation W increases only.
H. As the measurement of the nitrogen source increases, the success of Mutation W first increases then decreases.
J. There is no relationship between the measurement of the nitrogen source and the success of Mutation W.

31. When the bacteria were added to it, the dish that was intended to serve as the control dish in the study lacked which of the following?

I. Nitrogen
II. Nutrient substrate
III. Mutation

A. I only
B. III only
C. I and II only
D. II and III only

32. Which of the following statements about the success of mutations in bacteria resulting in nitrogen control is consistent with the results of the study for Dishes 3 and 4 ? The number of bacteria that exhibited nitrogen control due to:

F. Mutation Y was about 2 times the number of bacteria that exhibited nitrogen control due to Mutation Z.
G. Mutation Z was about 2 times the number of bacteria that exhibited nitrogen control due to Mutation Y.
H. Mutation Y was about 4 times the number of bacteria that exhibited nitrogen control due to Mutation Z.
J. Mutation Z was about 4 times the number of bacteria that exhibited nitrogen control due to Mutation Y.

33. Augmentations to another gene, glnA, are also able to affect nitrogen control in *S. typhimurium*. Which of the following statements gives the most likely reason glnA was not tested while glnR was tested? The scientists:

A. did not want to determine the success of N-regulatory mutations to a specific gene.
B. did not want to determine the effect of nitrogen synthesis of glutamine in the bacteria.
C. wanted to determine the success of N-regulatory mutations to a specific gene.
D. wanted to determine the effect of nitrogen synthesis of glutamine in the bacteria.

Passage VI

A green roof is a roof of a building that is partially or completely covered with vegetation to reduce storm water runoff. A series of studies were conducted to examine how the volume of runoff from green roofs is affected by vegetation height and the presence of a cloth filter beneath the soil.

Runoff was collected across a segment of green roof in a lab kept at 24°C. The segment was tilted 20° and had layers of different materials. After water was released over the roofing segment, any runoff fell into a metal collection tray (see diagram) and was irrigated into a measuring device.

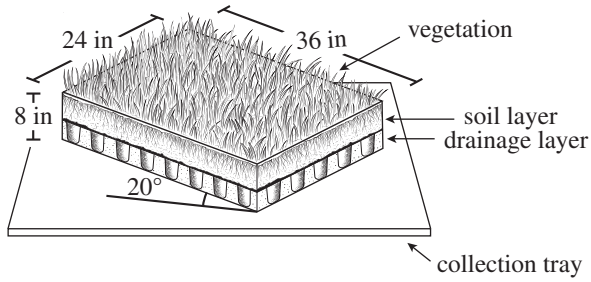


diagram of roofing segment

Study 1

The following steps were followed in each of the first 3 of 4 trials.

1. A 2 in thick cloth filter was placed on top of the drainage layer.
2. A 5 in deep layer of a certain light-weight, loamy soil was used as the growing medium.
3. A combination of plants including grasses, alpines, and other hardy succulents were used as the top vegetation layer.
4. Water was released at a constant rate (100 mL/hr) over the top layer of plants.
5. For the next 700 min, the volume of drainage collected over each 25 min period was measured.

In the first, second, and third trials, the vegetation height was 2.5 in, 4.0 in, and 6.5 in respectively.

In the fourth trial, all steps were carried out except Step 3. (No plants were used as a top layer.)

Figure 1 shows the results of the 4 trials.

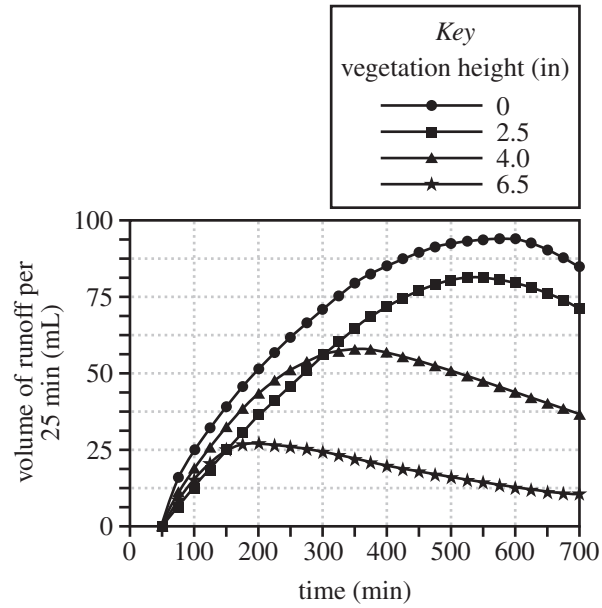


Figure 1

Study 2

The first trial of Study 1 was repeated. Then the first trial of Study 1 was repeated again, but Step 1 was omitted. (No cloth filter was used beneath the soil.) Figure 2 shows the results of the 2 trials.

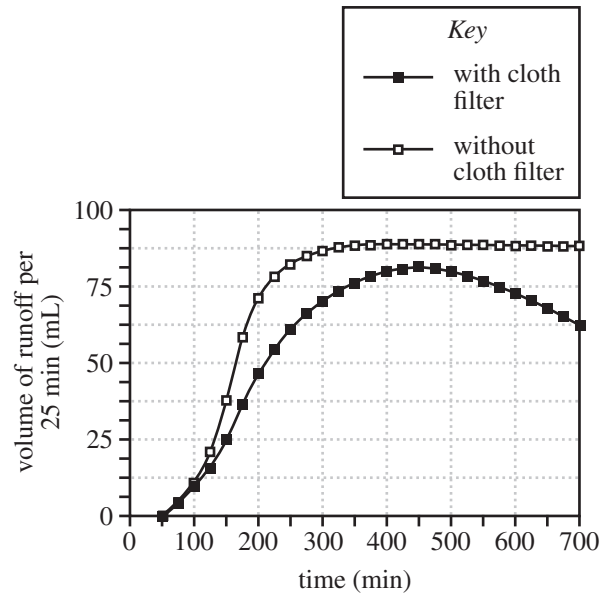


Figure 2

34. The scientists conducting the studies used a collection tray made of a type of metal rather than of fabric to ensure that runoff from the roofing segment would flow from the collection tray to the measuring device. The scientists most likely made that choice because metal, unlike fabric, is:

F. elastic and absorbent, and therefore capable of directing water to the measuring device.
G. inelastic and nonabsorbent, and therefore capable of directing water to the measuring device.
H. elastic and absorbent, and therefore incapable of directing water to the measuring device.
J. inelastic and nonabsorbent, and therefore incapable of directing water to the measuring device.

35. Suppose Study 2 had been repeated, except the temperature of the lab was kept at –1°C. The total volume of water runoff collected during the 700 min in the repeated study would most likely have been:

A. greater than that of the original study, because –1°C is above the freezing point of water.
B. greater than that of the original study, because –1°C is below the freezing point of water.
C. at or near zero, because –1°C is above the freezing point of water.
D. at or near zero, because –1°C is below the freezing point of water.

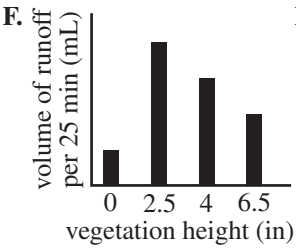
36. According to the results of Study 1, for which of the vegetation heights did the runoff volume per 25 min increase from zero to its maximum value *before* 300 min ?

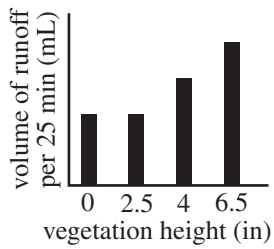
F. at 0 in only
G. at 6.5 in only
H. at 2.5 in and 4.0 in only
J. at 2.5 in and 6.5 in only

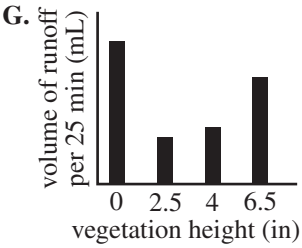
37. Compare the results of the 2 trials in Study 2. In which trial did the volume of drainage water per 25 min reach a greater maximum value and in which trial did the volume of drainage water per 25 min increase from zero to its maximum in the greater amount of time?

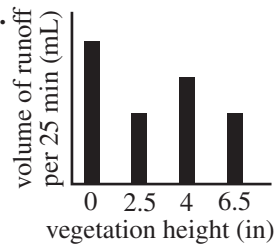
	greater maximum	greater time to maximum
A.	with cloth filter	without cloth filter
B.	without cloth filter	with cloth filter
C.	with cloth filter	with cloth filter
D.	without cloth filter	without cloth filter

38. The volume of runoff measured at 150 min in Study 1 for the 4 vegetation heights is best represented by which of the following graphs?

F.


H.


G.


J.


39. Which factor was kept the same in Study 2 but was varied in Study 1 ?

A. Thickness of the cloth filter
B. Height of vegetation
C. Soil composition
D. Type of fertilizer used

40. Based on the diagram and the description of Study 1, which of the following expressions would most likely be used to calculate the volume of the soil layer in the roofing section (before plants were grown on top)?

F. 5 in × 24 in × 24 in
G. 5 in × 24 in × 36 in
H. 8 in × 24 in × 24 in
J. 8 in × 24 in × 36 in

END OF TEST 4
STOP! DO NOT RETURN TO ANY OTHER TEST.

17B Answer Key

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
English	C	F	D	F	D	H	A	F	B	J	C	J	D	J	C	J	D	G	A	G	B	H	B	F	D	J	D	H	C	J	A	G	D	H	C	G	D	F	A	G
Math	A	J	D	H	B	H	E	H	E	F	C	K	D	J	A	G	D	H	C	J	B	J	C	H	C	K	E	G	E	K	E	J	D	F	C	H	B	J	C	G
Reading	A	G	A	J	C	G	D	H	C	F	D	G	D	J	B	G	A	H	A	H	B	F	D	H	D	H	A	G	A	H	D	J	A	J	B	G	A	H	C	G
Science	C	F	B	J	C	F	C	J	C	J	B	G	B	G	C	J	C	J	A	G	C	H	D	F	D	F	D	J	A	F	B	J	C	G	D	G	B	J	B	G
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75					
English	A	J	B	J	A	J	A	H	C	J	D	F	D	F	C	F	B	J	A	G	D	J	C	J	D	H	C	G	C	J	C	F	C	H	A					
Math	C	H	B	G	E	G	B	G	B	K	D	J	C	K	A	H	D	F	B	F																				

17B Conversion Table

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	74-75	59-60	40	40	**36**
35	72-73	58	38-39	–	**35**
34	71	56-57	37	39	**34**
33	69-70	55	36	38	**33**
32	68	54	34-35	–	**32**
31	67	53	33	37	**31**
30	66	52	32	36	**30**
29	65	50-51	31	–	**29**
28	63-64	47-49	30	35	**28**
27	61-62	44-46	–	34	**27**
26	59-60	42-43	29	32-33	**26**
25	57-58	39-41	28	31	**25**
24	55-56	36-38	26-27	29-30	**24**
23	52-54	33-35	25	26-28	**23**
22	50-51	31-32	23-24	24-25	**22**
21	47-49	30	22	22-23	**21**
20	44-46	28-29	20-21	20-21	**20**
19	42-43	26-27	19	18-19	**19**
18	40-41	24-25	18	17	**18**
17	37-39	20-23	16-17	15-16	**17**
16	34-36	16-19	15	14	**16**
15	31-33	13-15	14	13	**15**
14	28-30	10-12	12-13	11-12	**14**
13	26-27	8-9	11	10	**13**
12	24-25	7	10	9	**12**
11	21-23	5-6	8-9	8	**11**
10	18-20	4	7	7	**10**
9	15-17	–	6	6	**9**
8	13-14	3	5	5	**8**
7	11-12	–	–	4	**7**
6	8-10	2	4	3	**6**
5	7	–	3	–	**5**
4	5-6	1	2	2	**4**
3	3-4	–	–	1	**3**
2	2	–	1	–	**2**
1	0-1	0	0	0	**1**