

SCIENCE REASONING TEST ONE

35 Minutes—40 Questions

DIRECTIONS: There are seven passages in this test. Each passage is followed by several questions. After reading a passage, circle the best answer to each question. You may refer to the passages as often as necessary. You are NOT permitted to use a calculator on this test.

Passage 1

Factors affecting the survival rates of various species were investigated for evidence of periods of widespread extinction in the Earth's history. The percentage of various foraminiferans species groups intact at certain points in the geologic record was estimated using various techniques. These species groups were examined at three different sites: Site I (an equatorial climate); Site II (a Northern climate); and Site III (a Far Northern climate). The mean annual temperature was also estimated. Results are presented in Figure 1.

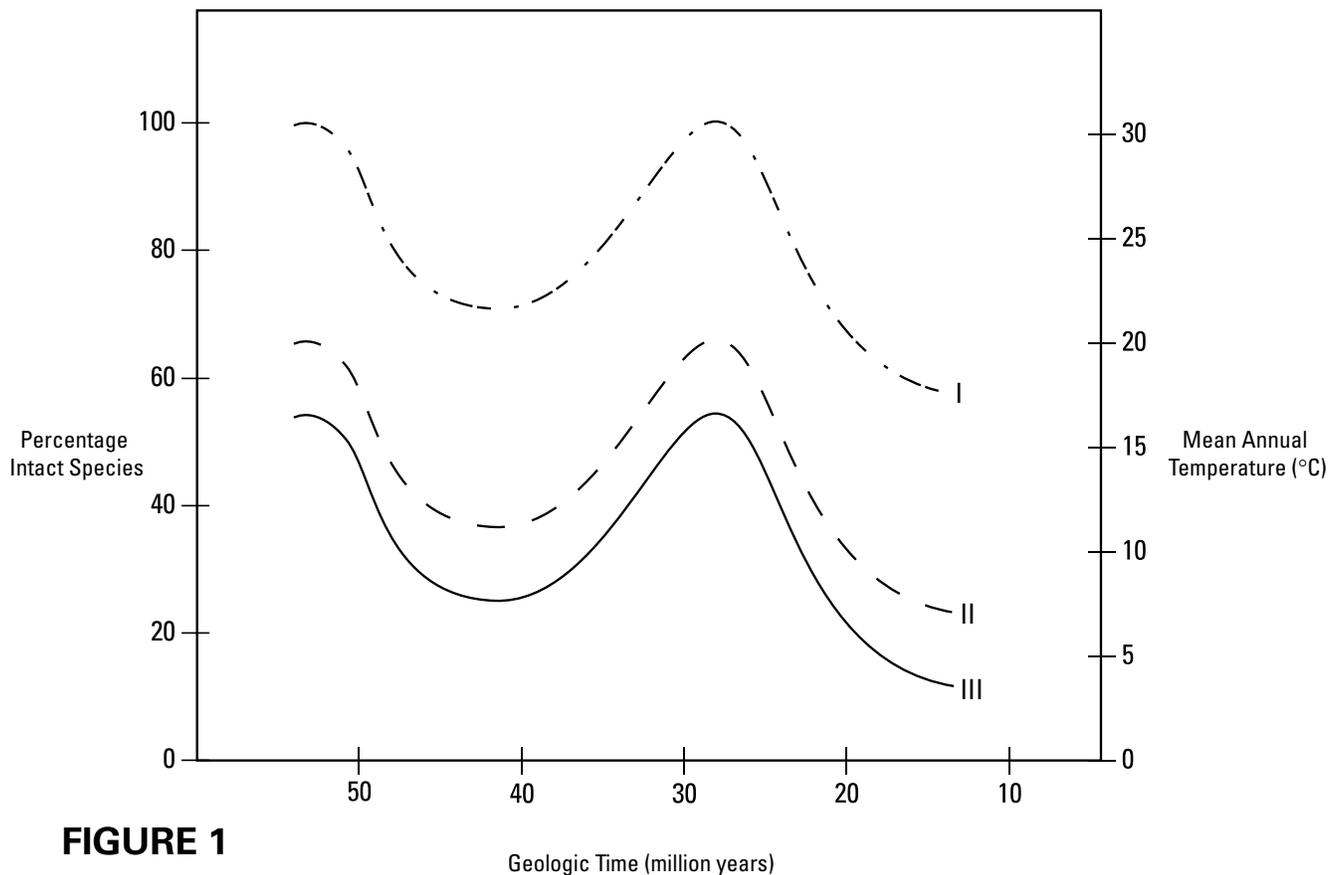


FIGURE 1

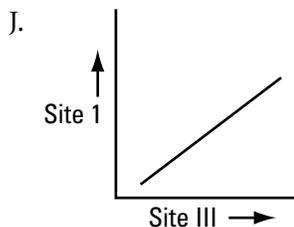
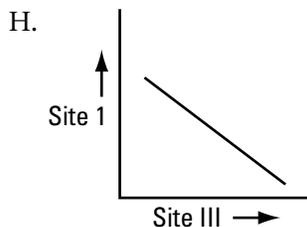
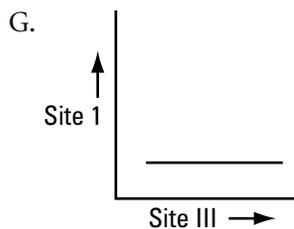
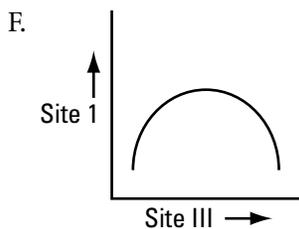
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1. Approximately 30 million years ago, what was the mean annual temperature at Site II?
 - A. 25°C
 - B. 19°C
 - C. 13°C
 - D. 10°C

2. What was the percentage of intact species at Site I, 40 million years ago?
 - F. 40%
 - G. 45%
 - H. 55%
 - J. 70%

3. From the information given in the figure, as the mean annual temperature increased, the percentage of intact species
 - A. increased.
 - B. decreased.
 - C. remained constant.
 - D. was not affected by temperature changes.

4. The relationship between the percentage of intact species at Site I and the percentage of intact species at Site III, over the time periods presented in the figure, is shown in which of the following graphs?
 - F.
 - G.
 - H.
 - J.



5. For which of the following sites was the percentage of intact species never higher than 60%?
 - I. Site I
 - II. Site II
 - III. Site III
 - A. II only
 - B. III only
 - C. II and III only
 - D. I, II, and III

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Passage 2

Factors related to density, pressure, and acceleration due to gravity (g) were measured as a function of depth below the earth's surface. Table 1 presents the data, separated by the four regions of earth's interior: crust, mantle, outer core, and inner core. The surface of the earth is represented by a depth of zero kilometers.

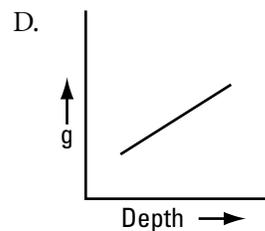
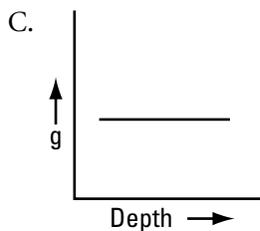
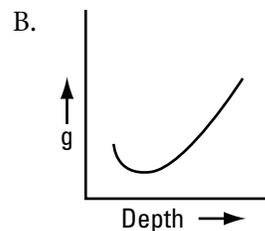
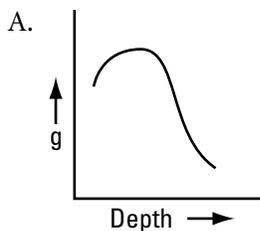
TABLE 1

	Depth (km)	Density (g/cm^3)	Pressure (kbar)	g (cm/s^2)
Crust	0	1.02	0	981
	21	2.80	5	983
Mantle	81	3.48	26	984
	221	3.54	73	989
	571	3.95	199	999
	1471	4.81	607	1001
	2671	5.45	1227	1042
Outer Core	2971	10.09	1442	1050
	3671	11.00	2154	874
	4471	11.69	2844	641
	5156	12.12	3281	427
Inner Core	5371	12.48	3385	355
	5771	12.52	3529	218
	6071	12.53	3592	122

6. Which of the following conclusions is supported by the data?

- F. As depth increases, density constantly decreases.
- G. As depth increases, acceleration due to gravity constantly increases.
- H. As depth increases, pressure constantly increases.
- J. As depth increases, density increases and then decreases.

7. Which of the following graphs depicts the relationship between depth and acceleration due to gravity?



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8. The inner core starts at a depth of approximately 5300 kilometers and extends to over 6500 kilometers. One would expect that the acceleration due to gravity over this depth range would
- F. gradually decrease and then increase.
 - G. go no lower than 100 cm/s^2 .
 - H. gradually start to increase.
 - J. decrease until it reaches 0 cm/s^2 .
9. For which of the following factors are measurements in the mantle at least twice the maximum level of measurements in the crust?
- I. Density
 - II. Pressure
 - III. g
- A. II only
 - B. I and II only
 - C. I and III only
 - D. I, II, and III
10. A density of 11.75 g/cm^3 and an acceleration due to gravity of about 550 cm/s^2 would probably occur at which of the following places?
- F. Outer Core, depth of 4200 km
 - G. Outer Core, depth of 4800 km
 - H. Inner Core, depth of 4200 km
 - J. Inner Core, depth of 4800 km

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Passage 3

The carrying capacity of an ecosystem is defined as the maximum number of organisms that a system can support on a sustained basis. This carrying capacity is determined by the availability of two types of resources: (1) natural resources, such as nutrients, water, and light; and (2) space. Three experiments were conducted to determine factors that influence the carrying capacity of various ecosystems.

Experiment 1

Bacteria were allowed to grow under ideal conditions in a cultured dish. Both natural resources and space were plentiful. Figure 1 presents the number of bacteria in this dish as a function of time.

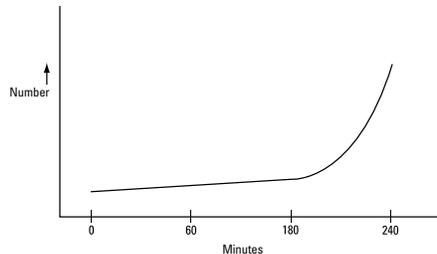


FIGURE 1

Experiment 2

In certain natural systems, the amount of nutrients is limited by various factors. A system of blue-green algae was observed at various times of year to determine the limiting effect of nutrients. Figure 2 presents the number of blue-green algae in this system as a function of time of year.

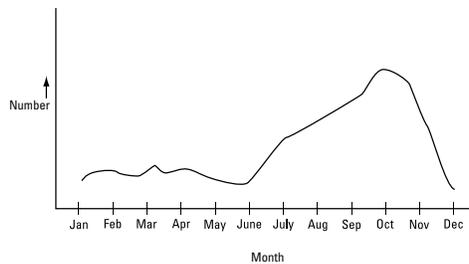


FIGURE 2

Experiment 3

In natural ecosystems, the number and type of predators can also influence the carrying capacity for a specific organism. A study was conducted to observe the number of snowshoe hares and their lynx predators over a forty-year period. The results are presented in Figure 3.

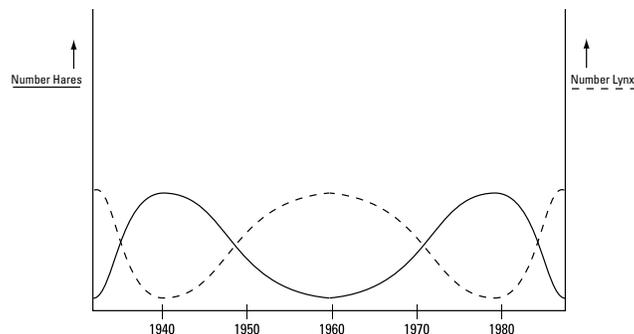


FIGURE 3

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11. From the information given, which of the following is not a factor in determining an ecosystem's carrying capacity?

- A. The number of predators
- B. The amount of algae present
- C. Availability of natural resources
- D. Availability of space

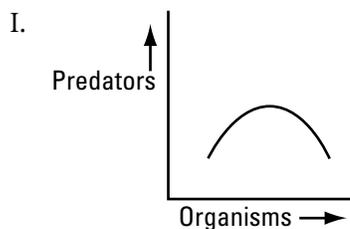
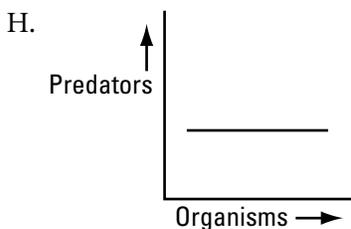
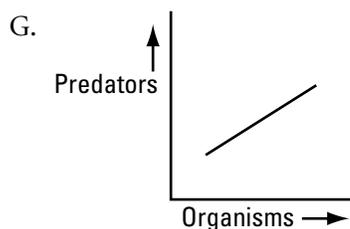
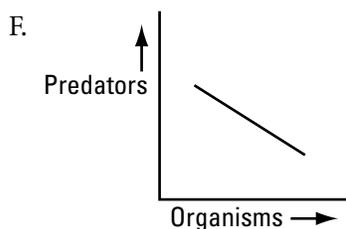
12. In Experiment 2, the amount of nutrients is largest for this population of blue-green algae in what month?

- F. January
- G. April
- H. August
- J. October

13. From Experiment 1, if ideal conditions continue, it would be predicted that the number of bacteria will:

- A. continue to increase.
- B. start to decrease.
- C. increase and then become constant.
- D. decrease to a level of zero.

14. Which of the following graphs best describes the relationship between the number of organisms and the number of organisms' predators using the information in Experiment 3?



15. In which of the following two months was the amount of nutrients the lowest for blue-green algae in Experiment 2?

- A. January and September
- B. January and June
- C. September and October
- D. October and November

16. If the conditions continue in Experiment 3, it can be predicted that the number of hares in 2000 will be:

- F. smaller than the number of lynx in 2000.
- G. larger than the number of lynx in 2000.
- H. the same as the number of lynx in 2000.
- J. extinct.

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Passage 4

Total radiation is the sum of direct and scattered radiation that strikes the earth's surface. Radiation units are measured in kcal/cm². Table 1 presents information on the amount of total radiation recorded in a cloudless sky as a function of the time of year and the latitude. A latitude of 0° is located at the equator. The table presents latitudes for both the Northern Hemisphere (N) and the Southern Hemisphere (S) by month of the year (J= January; D = December).

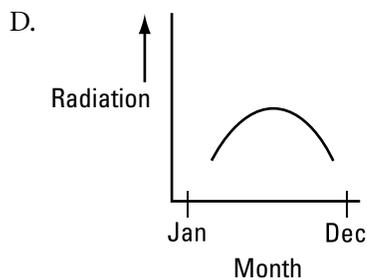
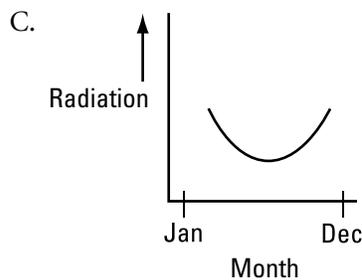
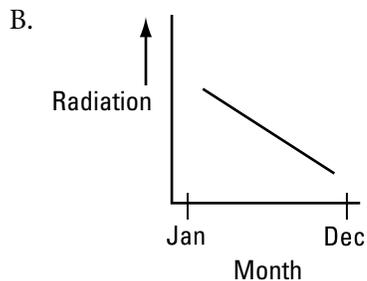
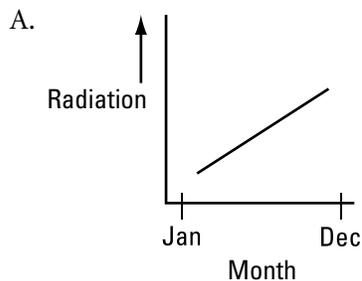
TABLE 1
Month

Latitude	J	F	M	A	M	Ju	Jy	A	S	O	N	D
90 N	0	0	0.1	10.0	21.9	26.0	23.8	12.9	2.4	0	0	0
70 N	0	1.6	6.0	13.1	20.5	23.6	21.2	14.6	7.5	2.7	0.5	0
40 N	8.8	12.2	16.4	20.3	23.0	24.0	23.4	20.9	17.0	13.2	9.7	7.7
10 N	18.1	19.8	21.1	21.2	21.2	21.0	21.1	20.6	21.2	20.1	18.5	17.5
0	20.2	20.9	21.5	20.4	19.3	18.8	19.1	19.3	21.2	21.2	20.4	19.2
10 S	22.0	21.8	21.1	19.2	17.7	16.3	16.3	17.3	20.4	21.4	21.8	22.0
40 S	24.9	20.6	16.4	12.2	8.7	7.3	8.1	9.0	14.3	18.7	22.8	25.2
70 S	22.6	14.2	7.3	2.2	0.1	0	0	0	5.0	11.4	21.0	24.9
90 S	24.9	12.3	1.7	0	0	0	0	0	0	9.0	22.6	27.0

17. At a latitude of 40°S, what is the amount of total radiation in September, based on the information in the table?
- A. 20.9 kcal/cm²
 - B. 14.3 kcal/cm²
 - C. 9.0 kcal/cm²
 - D. 0.0 kcal/cm²
18. At a latitude of 70°S, a measurement of 21.0 kcal/cm² of total radiation was recorded. According to the data in the table, this measurement took place during what month?
- F. April
 - G. July
 - H. November
 - J. December

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19. Which of the following graphs best depicts the relationship between total radiation and the month of the year at a latitude of 40°N?



20. In March, the total radiation recorded in a cloudless sky at a certain location was 21.3 kcal/cm^2 . It can be inferred from the table that this measurement was taken at what latitude(s)?

- F. Between the Equator and 10°N
- G. Between 10°S and the Equator
- H. Between 10°N and 10°S
- J. Between 10°S and 40°S

21. For the month of July, as distance away from the Equator increases, the total amount of radiation:

- A. decreases.
- B. increases.
- C. remains constant.
- D. increases in the Northern Hemisphere but decreases in the Southern Hemisphere.

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Passage 5

Recent advances in biotechnology have allowed researchers to genetically engineer certain plants to produce their own pesticides. Two scientists discuss the advantages and disadvantages of this type of engineering related to a certain species of corn.

Scientist 1

Genetic engineering will allow farmers to grow large supplies of corn more economically than before. Genetic engineering endows plants with certain abilities, including the capacity to withstand exposure to herbicides and to create their own pesticides. Researchers have inserted into corn a gene from the bacterium *Bacillus thuringiensis*, usually referred as Bt. The gene makes a protein lethal to certain caterpillars that destroy corn plants. For instance, one variety of Bt corn releases its own insecticide to fight off the European corn borer, a type of moth. Another engineered Bt variety produces a new protein, Cry3Bb, an insecticidal protein used to control corn rootworms. Corn rootworms, a type of beetle, feed on corn roots and interfere with the plant's ability to absorb water and nutrients and to remain upright.

There are two advantages to a genetically engineered form of insect control: it reduces the need for chemical pesticides, and the Bt protein, which is present in very low concentrations, has no effect on humans. The new genes do make new proteins; however, these proteins are nontoxic to humans, rapidly digestible, and do not have the characteristics of proteins known to cause allergies. The results of new research studies should demonstrate that farmers will be able to significantly increase the world's supply of corn through genetic engineering.

Scientist 2

The consequences of growing and consuming genetically engineered corn have not been fully tested. Studies need to be done to determine all the potential environmental impacts before the crops are grown on a commercial scale. For instance, studies need to be conducted to determine the effects on nontarget organisms. Laboratory studies have indicated that Bt corn has harmful effects on green lacewings, which are predators of the corn borer. The effects in soil ecosystems from residue from Bt corn roots are also unknown. More tests on cross pollination and weedy relatives of crops to define the impact of transgene flow are needed; i.e., what happens when another plant is fertilized by the genetically engineered plant? Also, the new crop could contain increased toxins or new allergens. Claims that the new corn is not harmful to humans are unsubstantiated. How do we know if the new food that is produced by genetic engineering is identical to the old food? Finally, a large scale commercialization of the new corn guarantees a rapid evolution of resistance in corn rootworms and the loss of effectiveness of the engineered Bt corn. Currently, there are no plans to combat how rootworms will develop resistance. New studies are needed on the effects of Bt corn along with studies to compare the effectiveness of the new Bt corn with the full range of alternative rootworm-control methods, including crop rotation.

22. Which of the following statements, if true, would weaken the argument of Scientist 2?

- F. New allergens are discovered nearly every year.
- G. In large doses, *Bacillus thuringiensis* causes kidney damage in humans.
- H. *Bacillus thuringiensis* negatively affects nontarget organisms in the area in which altered plants are grown.
- J. The cross pollination of genetically altered plants with other plants has no negative consequences.

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23. Each of the following statements, if true, would support the argument of Scientist 1 except:
- A. genetically engineered crops reduce the need for chemical pesticides.
 - B. genetically engineered plants are able to withstand exposure to herbicides.
 - C. *Bacillus thuringiensis* has no negative effect on humans.
 - D. The new proteins produced by Bt contain minor allergens.
24. New research indicated that Bt corn reduced the population of corn rootworms and green lacewings in fields growing genetically corn. This result would support:
- F. Scientist 1, because the Bt corn was killing its predators.
 - G. Scientist 1, because corn rootworms are harmful to corn.
 - H. Scientist 2, because corn rootworms are beneficial to corn.
 - J. Scientist 2, because the Bt corn was harming nontarget organisms.
25. Which of the following statements best describes how the genetic alteration works in corn plants, based on the information in the passages?
- A. Following natural cross-pollination, corn plants begin to produce a scent that wards off certain predator insects.
 - B. A special gene is inserted into corn plants; the gene produces a protein lethal to predator insects.
 - C. A special gene is mixed with the soil in which corn plants are grown; the gene deters predators from damaging the corn plants.
 - D. A special gene produces proteins, lethal to corn plant predators; this protein is sprayed on the roots of corn plants to keep damaging insects away from the crops.
26. The statement “Farmers will be able to grow large supplies of corn more economically than before” supports which of the following Scientists?
- F. Scientist 2, because the cost of corn crop maintenance has decreased.
 - G. Scientist 2, because genetically engineered plants will not be used.
 - H. Scientist 1, because Bt corn produces crops that have special growth abilities.
 - J. Scientist 1, because Bt corn produces larger corn stalks.
27. On which of the following statements would the two Scientists most likely disagree?
- A. Genetically engineered corn can produce its own pesticides.
 - B. New research studies will support the beneficial aspects of genetically engineered corn.
 - C. Bt corn will affect various organisms that prey on corn.
 - D. Genetic engineering could be used with other crops.
28. On which of the following statements would both Scientists most likely agree?
- F. New research studies will strengthen their arguments.
 - G. Bt corn does not affect nontarget organisms.
 - H. Bt corn is not harmful to humans.
 - J. Large scale commercialization of genetically engineered corn should begin immediately.

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Passage 6

Two experiments were conducted to determine the effects that aspirin has on the human circulatory system.

Experiment 1

When coronary arteries are blocked by fatty plaques, the blood supply to the heart muscle is drastically reduced and chest pain or heart attacks can result. It has been hypothesized that aspirin will work to let blood flow around these blockages, thus reducing or preventing heart attacks. A large study was conducted to test this hypothesis. Twenty two thousand healthy male American doctors over age forty were divided into two groups: half took an aspirin tablet every other day, while the rest took a look-alike placebo. The study lasted five years. The percentage of heart attacks and strokes during this period was recorded and the results are presented in Table 1.

TABLE 1

	Heart Attacks %	Strokes %
Aspirin Group	.05	.08
Placebo Group	.10	.04

Experiment 2

Prostaglandins are substances that the human body produces when swelling and fever occur. One prostaglandin, called thromboxane, is produced in tiny blood cells called platelets and causes them to adhere to one another, thus plugging up any sites of bleeding. Thromboxane, however, can also contribute to heart attacks when it blocks arteries close to the heart. It was hypothesized that aspirin would reduce the body's production of thromboxane. Aspirin was compared with three other drugs. Subjects took a single dose of each drug. The percentage of thromboxane left in platelets after a five hour period and after a five day period was recorded and the results are presented in Table 2.

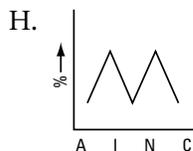
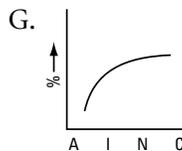
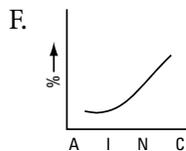
TABLE 2

Drug	% Thromboxane Remaining	
	Five Hours	Five Days
Aspirin (A)	5	35
Ibuprofen (I)	15	95
Naprosyn (N)	22	97
Celebrex (C)	100	100

29. Is the hypothesis "The percentage of heart attacks can be reduced by taking aspirin regularly" supported by the data in Experiment 1?
- A. Yes, because doctors participated in the study.
 - B. Yes, because the rate of heart attacks was lower in the Aspirin group than in the Placebo group.
 - C. No, because the rate of strokes was higher in the Aspirin group than in the Placebo group.
 - D. No, because other drugs were not tested.

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30. Which of the following is the best graphical representation of the percentage of thromboxane remaining after five hours, separated by drug, from the data in Experiment 2?

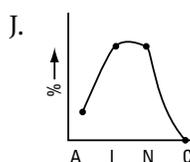
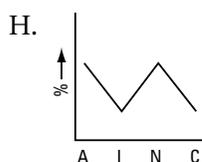
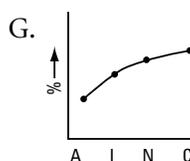
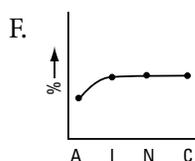


31. It can be inferred from the data in Experiment 2 that the percentage of thromboxane remaining after seven days would be approximately 100% for subjects taking which of the following drugs?

- I. Aspirin
- II. Naprosyn
- III. Celebrex

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

32. Researchers subtracted the percent of thromboxane remaining after 5 hours from the percent of thromboxane remaining after 5 days for each drug. Which of the following is the best graphical representation of this difference?



33. Is the statement “Regularly taking aspirin reduces the risk of contracting major illnesses” supported by the data in the Experiments?

- A. Yes, because aspirin reduced the percentage of thromboxane more than any other drug.
- B. Yes, because aspirin reduced the percentage of heart attacks.
- C. No, because other drugs were not included in Experiment 2.
- D. No, because aspirin did not reduce the percentage of strokes, a major illness, in Experiment 1.

34. It can be inferred from the Experiments that the percentage of thromboxane in the bodies of the subjects in the Aspirin Group in Experiment I was approximately in what daily range?

- F. 10% to 20%
- G. 20% to 40%
- H. 40% to 60%
- J. 60% to 80%

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Passage 7

Two experiments were conducted to test factors that influence the composition of Municipal Solid Waste (MSW). MSW is composed of waste products discarded by residents of cities; MSW is usually recycled or taken to landfills.

Experiment 1

The effects of two different programs to encourage city residents to recycle certain parts of MSW were studied. Program 1 was conducted in one part of a city, while Program 2 was conducted in another part of the city. Table 1 presents the representative composition of MSW by various categories for the entire city. The percent of each category that was recycled is also presented.

TABLE 1

Waste Category	Composition %	Program 1 Recycled %	Program 2 Recycled %
Paper	39.8	77.2	79.3
Yard Waste	9.7	0	5.1
Food Waste	12.0	0	0
Plastic	9.4	35.2	69.3
Other Organics	15.7	0	0
Metal	5.8	0	0
Glass	4.8	52.5	57.3
Batteries	0.1	0	0
Other Inorganics	2.7	0	0

Experiment 2

Components of MSW contain certain toxic substances. The amount of these toxic substances, measured in mg/kg, was sampled at two different landfills, designated as L1 and L2. The data are presented in Table 2.

TABLE 2
Toxic Substance

Waste Category	Arsenic		Lead		Mercury		Zinc	
	L1	L2	L1	L2	L1	L2	L1	L2
Paper	.1	.7	4	19	.3	2	22	30
Yard Waste	.9	6	14	137	.1	1	89	321
Food Waste	.1	1	30	72	.2	.3	20	186
Plastic	.2	.5	59	62	.1	.2	21	97
Other Organics	3	7	108	408	.3	2	174	202
Metal	4	7	342	350	.8	6	145	229
Glass	1	2	84	103	.2	.3	50	71
Batteries	2	7	94	236	.2	.3	40	50
Other Inorganics	1	12	50	110	.2	.9	21	75

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35. The largest difference between Program 1 and Program 2 in the percentage recycled occurred for which of the following waste categories?
- A. Paper
 - B. Yard Waste
 - C. Plastic
 - D. Glass

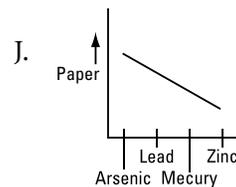
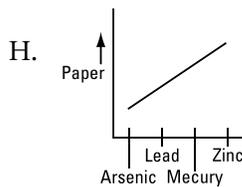
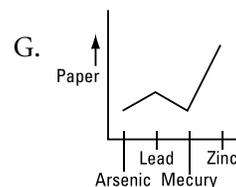
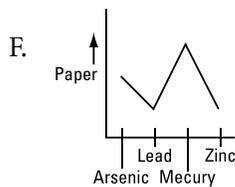
36. Is the statement “At least 30% of MSW is not recycled” supported by the results of Experiment 1?

- F. Yes, because several waste categories were not recycled at all.
- G. Yes, because Program 1 was not as effective as Program 2.
- H. No, because over 75% of Paper was recycled.
- J. No, because batteries and other inorganics were not recycled.

37. Is the statement “The amount of arsenic was higher at L1 than at L2” supported by the results of Experiment 2?

- A. No, because levels of arsenic were lower at L1 than at L2 for each waste category.
- B. No, because levels of arsenic were above minimal environmental standards.
- C. Yes, because levels of arsenic are higher at L1 than at L2 for each waste category.
- D. Yes, because levels of arsenic were within minimal environmental standards.

38. Which of the following is the best graphical representation of the amount of toxic substances in paper at the Landfill 1?



39. The statement “The amount of toxic substances in all waste categories is higher at L2 than at L1” is supported by the data in Experiment 2 for which of the following substances?

- I. Lead
- II. Mercury
- III. Zinc

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

40. The greatest absolute difference between the amount of lead and the amount of zinc at L2 occurred for which of the following waste categories?

- F. Paper
- G. Yard Waste
- H. Other Organics
- J. Metal

END OF SCIENCE REASONING TEST.

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