SCIENCE REASONING TEST TWO

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

Seasonal variations in climate tend to affect regional sea levels. One study, using selected sites on the West Coast of the United States, recorded monthly average surface temperatures and monthly average sea levels (measured in meters) for a one year period. Data are graphed in Figure 1. The variations presented in Figure 1 are representative of climactic changes in the Northern Hemisphere. At sites closer to the equator, however, sea level is more constant throughout the year.

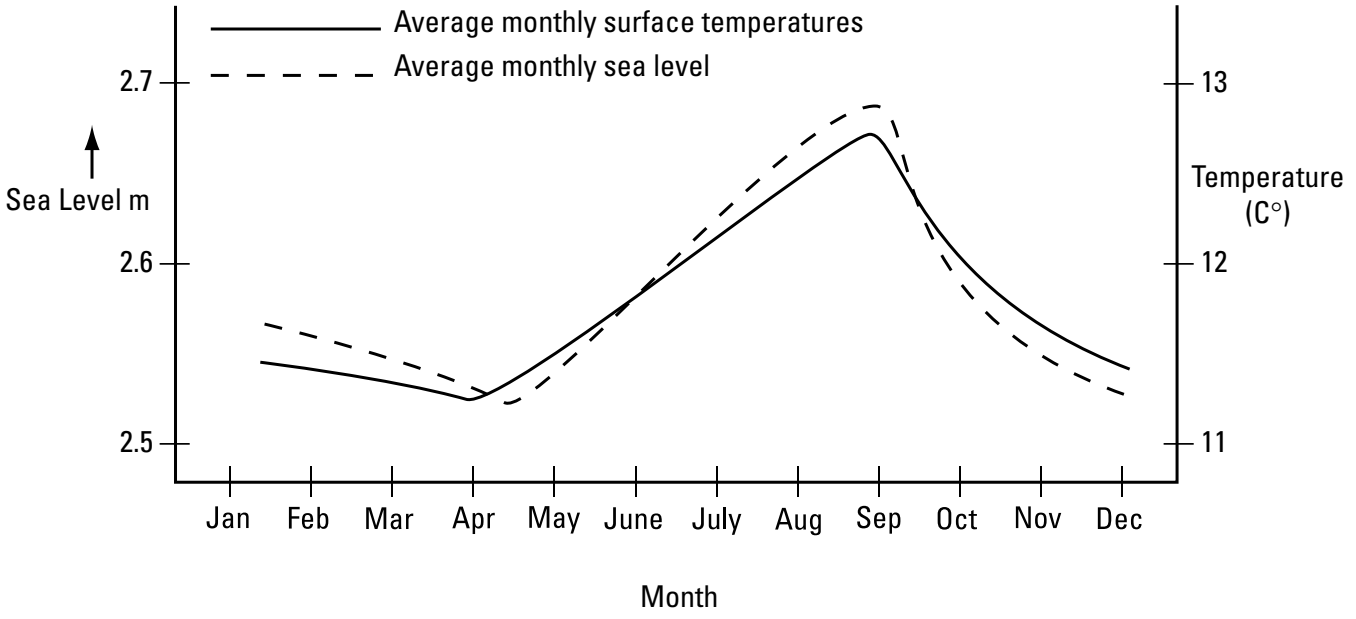

FIGURE 1

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1. According to the information in the figure, average monthly surface temperatures tend to be the highest in which of the following months?

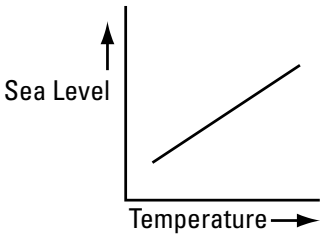
   A. March
   B. July
   C. September
   D. November

2. In October, the average monthly surface temperature and average monthly sea level, respectively, were:

   F. 2.60 m and 12.0°C
   G. 2.60 m and 12.5°C
   H. 2.55m and 12.0°C
   J. 2.55m and 12.5°C

3. Which of the following graphs describes the relationship between average monthly surface temperatures and average monthly sea level, for the time periods in the figure?

A.



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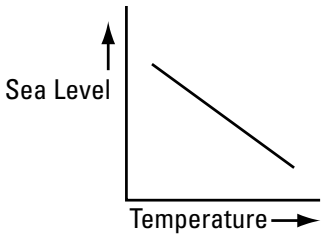

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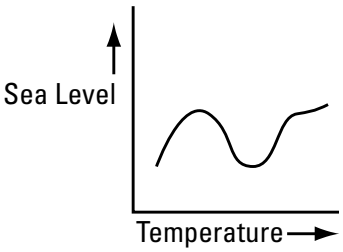

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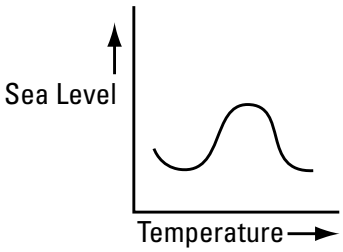

4. Sea levels are more constant at the Equator and vary only slightly from 2.5 meters. Based on the information in the figure, it can be inferred that, at the Equator, average monthly surface temperatures:

   F. increase in the months from June to October.
   G. decrease in the months from June to October.
   H. remain fairly constant in the months from June to October.
   J. increase in the months from January to July.

5. In December, temperatures in the Northern Hemisphere are generally cold; however, in the Southern Hemisphere, the seasons are six months behind the Northern Hemisphere and temperatures are generally warm. From the information in the figure, it can be inferred that, in August, the temperature and sea level in the Southern Hemisphere would be:

   A. 2.75m and 13.5°C
   B. 2.60m and 13.0°C
   C. 2.60m and 12.0°C
   D. 2.55m and 11.5°C

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Passage 2

Different types of radiation produce differing amounts of damage when absorbed by biological organisms. The amount of damage depends on two factors: (1) The type of radiation; and (2) The amount of radiation absorbed, measured in rads. The amount of damage is measured in rems. By definition, 1 rem of any two radiations will produce the same amount of biological damage. Certain substances are more effective at shielding or guarding organisms from radiation damage. Table 1 presents values in rems for three types of shields: (1) An unshielded condition; (2) Shield X; and (3) Shield Y. The effectiveness of a shield is determined by the amount of reductions in rems from the unshielded condition.

TABLE 1

RADIATION	DOSE IN RADS				
	1	2	3	4	5
X rays					
Unshielded	1	2	3	4	5
Shield X	0.10	0.20	0.30	0.40	0.50
Shield Y	0.12	0.22	0.30	0.41	0.52
Alpha Particles					
Unshielded	10	20	30	40	50
Shield X	1	2	3	4	5
Shield Y	5	10	15	20	25
Slow Neutrons					
Unshielded	4	8	12	16	20
Shield X	0.40	0.80	1.2	1.6	2.0
Shield Y	0.44	0.89	1.8	2.4	3.2
Fast Neutrons and Protons					
Unshielded	10	20	30	40	50
Shield X	1	2	3	4	5
Shield Y	5	10	15	20	25
Heavy Ions					
Unshielded	20	40	60	80	100
Shield X	20	40	60	80	100
Shield Y	20	40	60	80	100

6. At a dose of 1 rad, Shield X reduces the rems produced by alpha particles by which of the following amounts?

F. 1 rem
G. 3 rems
H. 5 rems
J. 9 rems

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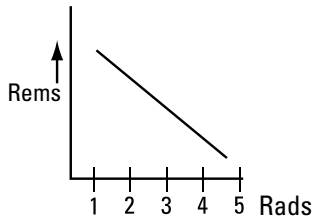
7. Which of the following graphs best depicts the relationship between the number of rems of slow neutrons transmitted through Shield Y and the dose of slow neutrons in rads?

A.



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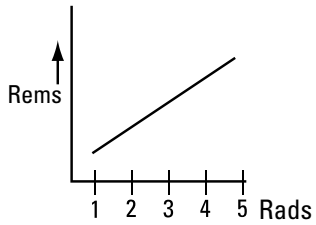

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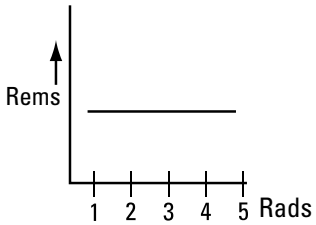

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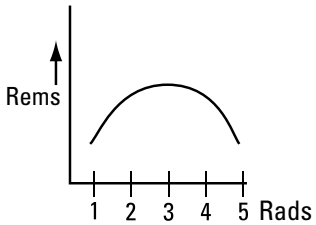

8. Is the statement "Shield X reduces the amount of rems better than Shield Y for all types of radiation" supported by the data in the table?

F. Yes, because the rems for Shield X are lower than for Shield Y for all types of radiation.
G. Yes, because the rems for Shield X are lower than for the Unshielded condition for all types of radiation.
H. No, because the rems for Shield X and Shield Y are equal for heavy ions.
J. No, because the rems for Shield Y are lower than for the Unshielded condition for all types of radiation.

9. At all dose levels, which shield is able to reduce the amount of fast neutron and proton damage by over 50% from the Unshielded condition?

A. Shield X
B. Shield Y
C. Both Shields X and Y
D. Neither Shield X nor Shield Y

10. The amount of damage produced by 2 rads of unshielded alpha particles is the same amount of damage produced by:

F. 1 rad of unshielded X rays.
G. 4 rads of fast neutrons and protons under Shield Y.
H. 5 rads of slow neutrons under Shield X.
J. 5 rads of slow neutrons under Shield Y.

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Passage 3

Various substances contribute to air pollution in the Earth's environment. Table 1 presents information on various substances known to pollute the environment. Effects of these substances on both the environment and humans are listed. A greenhouse gas is a gas that is potentially trapped in the Earth's atmosphere. Concentration (C) is normal concentration in the atmosphere, measured in parts per million (ppm) or parts per billion (ppb). Residence Time (R) is the time the substance can be trapped in the atmosphere.

TABLE 1

Pollutant	Effects	C	R
Carbon Monoxide (CO)	Greenhouse gas; toxic	0.1ppm	1-2 months
Carbon Dioxide (CO_2)	Greenhouse gas	350ppm	500 years
Nitrous Oxide (N_2O)	Greenhouse gas	310ppb	140 years
Sulfur Dioxide (SO_2)	Irritant	0.2 ppb	Hours/Days
Methane (CH_4)	Greenhouse gas	1.6ppm	7-10 Years

Two experiments were conducted to determine how various factors affect the concentration of these substances in the atmosphere.

Experiment 1

It was hypothesized that levels of industrial production would affect the concentration of these substances. The levels of these substances were measured at two sites: Site One, an area with heavy industrialization, and Site Two, an area with light industrialization. The results are presented in Table 2.

TABLE 2

Site	CO	CO_2	N_2O	SO_2	CH_4
One	0.20	375	315	0.31	2.1
Two	0.09	365	315	0.20	1.5

Experiment Two

It was also hypothesized that the levels of these substances have been gradually increasing over time. The concentration levels in Table 1 were measured in 1998. The concentration levels of these five substances in 1988 were also recorded and the results are presented in Table 3.

TABLE 3

Time	CO	CO_2	N_2O	SO_2	CH_4
1988	0.09	350	290	0.15	1.4
1998	0.10	350	310	0.20	1.6

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11. From 1988 to 1998, which of the following conclusions is supported by the data in Experiment 2?

    A. Concentration levels of CO, CO_2, N_2O, SO_2, and CH_4 only have been decreasing.
    B. Concentration levels of CO, CO_2, N_2O, SO_2, and CH_4 only have been increasing.
    C. Concentration levels of CO, N_2O, SO_2, and CH_4 only have been increasing.
    D. Concentration levels of CO_2 only have been decreasing.

12. Is the hypothesis "Heavy levels of industrial production increase the concentration of all pollutants" supported by the data in Experiment 1?

    F. Yes, because the concentration levels of all pollutants are higher at Site One versus Site Two.
    G. Yes, because the level of CO and CO_2 are higher at Site One versus Site Two.
    H. No, because the level of N_2O is the same at both Sites.
    J. No, because the concentration levels of all pollutants are higher at Site Two versus Site One.

13. For 1998, the levels of which of the following substances in Experiment 2 are closer to the levels of light industrialization than the levels of heavy industrialization in Experiment 1?

    I. CO
    II. SO_2
    III. CH_4

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

14. According to the data in Experiment 2, from 1988 to 1998, as the concentration of CH_4 increased, the concentration of N_2O:

    F. increased.
    G. decreased.
    H. remained constant.
    J. increased and then decreased.

15. What is the relationship between substance Concentration and Residence Time?

    A. As C increases, R increases.
    B. As C increases, R decreases.
    C. As C increases, R remains constant.
    D. There is no linear relationship between C and R.

16. At Site Two in Experiment 1, how many of the substances measured have concentration levels below normal concentration levels?

    F. 2
    G. 3
    H. 4
    J. 5

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Passage 4

The relative ease with which some common laboratory solvents can be ignited is determined by three properties: (1) Flash Point—the lowest temperature at which a liquid emits vapor in sufficient concentration to form an ignitable mixture with air; (2) Ignition Temperature—the minimum temperature required to initiate self-sustained combustion; and the (3) Flammable Limits—the minimum concentration of vapor in air in which a flame is propagated when an ignition source is present. Below the lower flammable limit, the mixture is too lean to burn; above the upper flammable limit, the mixture is too rich to burn. Table 1 presents values for these variables for some common laboratory chemicals.

TABLE 1

Chemical	Flash Point (°C)	Boiling Point (°C)	Ignition Temperature (°C)	Flammable Limit	
				Lower	Upper
Acetaldehyde	-37.8	21.1	175.0	4.0	60.0
Acetone	-19.0	56.0	538.0	2.6	12.8
Benzene	-11.1	80.1	560.0	1.4	8.0
Carbon disulfide	-30.0	45.8	90.0	1.0	44.0
Cyclohexane	-18.0	80.7	260.0	1.3	8.0
Methel ethyl ketone	-6.1	79.6	515.6	1.9	11.0
Toluene	4.4	110.6	530.0	1.3	7.0

The resistance of these chemicals to common glove materials is also an important factor in laboratory safety. Table 2 presents information on the resistance of four common glove materials: natural rubber, neoprene, nitrile, and vinyl. The resistance scale is as follows: E= Excellent resistance; G = Good resistance; F= Fair resistance; and P= Poor resistance.

TABLE 2

Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetone	G	G	G	F
Benzene	P	F	G	F
Carbon disulfide	P	P	G	F
Cyclohexane	F	E	F	P
Methel ethyl ketone	F	G	G	P
Toluene	P	F	G	F

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17. Based on the information in the table, a lower flammable limit of 1.9 and an upper flammable limit of 11.0 correspond to which chemical?

    A. Benzene
    B. Carbon disulfide
    C. Methel ethyl ketone
    D. Toluene

18. A teacher wanted to choose gloves for students in a chemistry class that were made from a material that had a rating of Fair or better for all of the chemicals in Table 2. The teacher should choose a glove made from which of the following materials?

    F. Natural Rubber
    G. Neoprene
    H. Nitrile
    J. Vinyl

19. A teacher wanted to use chemicals that had a flash point greater than -30.0°C and an ignition temperature greater than 500°C. How many of the chemicals listed in Table 1 have these properties?

    A. 3
    B. 4
    C. 5
    D. 6

20. Which chemicals do not have ratings of Poor Resistance to any of the four glove materials listed in Table 2?

    F. acetaldehyde and methel ethyl ketone
    G. acetone and benzene
    H. acetone and cyclohexane
    J. acetaldehyde and acetone

21. Measurement at a particular laboratory indicated that the minimum concentration of vapor in air would be at least 1.5. Which of the following chemicals would be too lean to burn at this limit?

    I. Benzene
    II. Carbon disulfide
    III. Methel ethyl ketone

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

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Passage 5

The human genome, the chemical code which determines human development, has recently been deciphered by two competing scientific groups. Two scientists discuss the possibilities for use of the deciphered human genome.

Scientist 1

The decoding of the human genome should lead quickly to advances that will benefit human life in many respects. First, biologists should be able to develop a variety of techniques that will improve diagnostic procedures and medical treatments for various diseases. The genes for particular diseases can be identified, and the body's mechanisms of self-repair can be manipulated to fight the disease. In newly developing humans, genes for various illnesses can be noted and perhaps removed from the genetic code. The complete blueprint of the human genome should be completed soon; then, scientists will be able to specify fully where all human characteristics are located.

Scientist 2

Not only are uses of the human genome decades away but the genome also has not actually been deciphered, despite claims by competing scientific groups. The human genome contains DNA, a long molecular chain of phosphate and sugar in the shape of a double-helix connected by rungs, called bases. These bases are composed of four compounds: adenine, cytosine, guanine, and thymine. To decipher the human genome requires breaking down the DNA into small segments and then reassembling the data; altogether there are more than three billion letters. To date, both groups have sequenced only about ninety percent of the human genome, and their sequences differ in how the bases are organized.

One group broke the genome into large chunks, called BAC's, about 150,000 DNA letters long. Each BAC was then broken into thousands of snippets, each about 500 DNA letters in length. A computer then reassembled each BAC and the genome is sequenced by piecing BAC's together. The other group broke the whole genome down into fragments that are 2,000 to 50,000 letters long. These fragments are then analyzed and assembled in a large computer run. In the first approach, however, the BAC's are in various stages of completion. In the second approach, the reassembled fragments do not adequately account for various repetitive overlaps of DNA. In either case, years of work remain before the entire human genome is deciphered; medical advances stemming from this decipherment are decades away.

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22. Which scientist(s) would agree with the statement "Practical benefits derived from the human genome are decades away"?

    F. Scientist 1
    G. Scientist 2
    H. Both Scientist 1 and Scientist 2
    J. Neither Scientist 1 nor Scientist 2

23. Information provided by either Scientist would support all of the following statements except:

    A. the human genome is composed of DNA.
    B. in the DNA molecule, bases connect the double helix.
    C. Adenine, cytosine, guanine, and thymine are four bases composing DNA.
    D. DNA is composed only of sugar.

24. Both Scientists would agree with which of the following statements?

    F. The human genome is not completely deciphered.
    G. Medical treatments from use of the human genome will be implemented soon.
    H. The BAC decipherment is the best approach.
    J. Genes for particular diseases can be readily identified from the human genome.

25. From the information in the passages, the overall DNA code consists of approximately how many letters?

    A. 3 billion
    B. 3 million
    C. 50,000
    D. 500

26. According to Scientist 1, advances stemming from the decoding of the human genome should lead to all of the following advances except:

    F. genes associated with specific diseases will be identified.
    G. genes associated with illnesses in newly developing humans may be removed.
    H. diagnostic procedures for certain diseases will be improved.
    J. new bases in the DNA code will be identified.

27. Both Scientists would disagree with which of the following statements?

    A. DNA decipherment will quickly lead to medical advances.
    B. DNA decipherment should not be used to obtain medical advances.
    C. The decipherment of DNA should continue.
    D. The human genome has not been completely deciphered.

28. One group broke the DNA molecule into BAC's, while the other group broke the molecule into smaller fragments. About how many times larger is a BAC than the largest fragment used by the second group?

    F. 3
    G. 4
    H. 5
    J. 125

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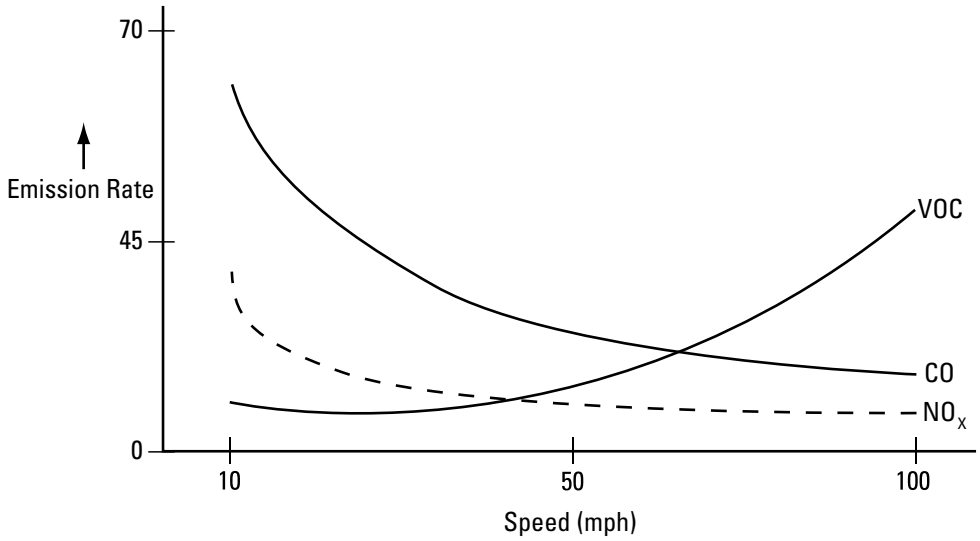
Passage 6

Motor vehicles emit substances that contribute to air pollution: carbon monoxide (CO), nitrogen oxide compounds (NO_x), and volatile organic compounds (VOC). Two studies were conducted to determine factors that affect emission of these substances.

Experiment 1

The emission rates of CO, NO_x, and VOC as a function of speed for noncommercial motor vehicles under 3.5 tons were measured. It was hypothesized that the slower a vehicle is traveling, the more pollutants are emitted. The data are presented in Figure 1.



Experiment 2

The emission rates of CO, NO_x, and VOC for commercial motor vehicles (vehicles 3.5 tons or larger) were measured as a function of place driven. The places driven were categorized as either urban, rural, or interstate. The data are presented in Table 1.

TABLE 1

Type of Vehicle	Place	Emission Rate CO	Emission Rate NO_x	Emission Rate VOC
3.5 to 16 tons	Urban	18.8	8.7	2.75
	Rural	7.3	7.4	0.76
	Interstate	4.2	6.0	0.6
Greater than 16 tons	Urban	18.8	16.2	5.8
	Rural	7.3	14.8	2.6
	Interstate	4.2	13.5	2.3

29. Is the hypothesis "The slower a vehicle is traveling, the more pollutants are emitted" supported by the results of Experiment 1?

A. No, because smaller amounts of NO_x are emitted than CO.
B. No, because amounts of VOC increase as speed increases.
C. Yes, because higher amounts of CO and NO_x are emitted at slower speeds.
D. Yes, because higher amounts of VOC are emitted at slower speeds.

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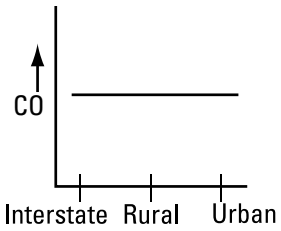
30. At what speed would the emission rates of VOC be higher than the rates for both CO and NO_x?

F. 10 mph
G. 30 mph
H. 50 mph
J. 80 mph

31. Which of the following is the best graphical representation of the emission rates for CO as a function of place for commercial vehicles between 3.5 and 16 tons?

A.



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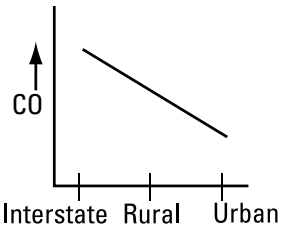

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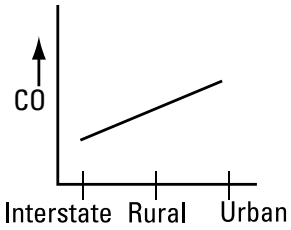

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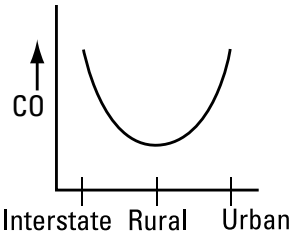

32. From the results of Experiment 2, comparing urban to rural to interstate places, as the emission rates of NO_x decrease, the emission rates of VOC:

F. increase.
G. decrease.
H. remain constant.
J. decrease and then increase.

33. Assume the relationship between emission rate and speed for commercial vehicles is the same as the relationship for noncommercial vehicles. Looking at the results of Experiment 2 for NO_x emissions, which of the following vehicles in which place would be traveling at the slowest speed?

A. 3.5 to 16 tons/Interstate
B. 3.5 to 16 tons/Urban
C. Greater than 16 tons/Interstate
D. Greater than 16 ton/Urban

34. The statement "Holding place constant, emission rates for commercial vehicles greater than 16 tons are higher than the emission rates for commercial vehicles 3.5 to 16 tons" is supported by data in Experiment 2 for which of the following substances?

I. CO
II. NO_x
III. VOC

F. III only
G. I and II only
H. II and III only
J. I, II, and III

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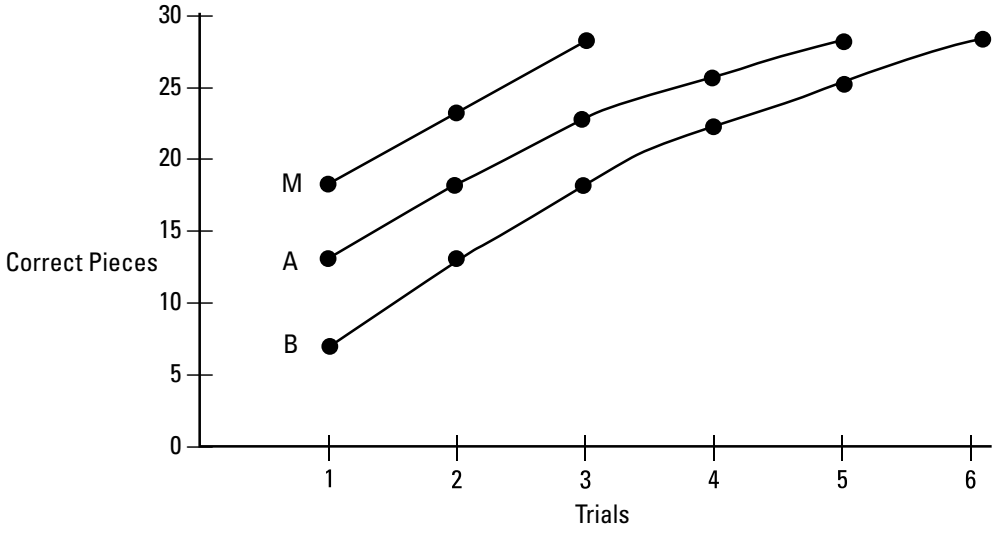
Passage 7

Researchers hypothesized that memory functions would operate differently for experts versus beginners or novices. Three chess players were selected to participate in the following experiments: a master (M), a chess player with a high level of expertise; an average chess player (A), someone with a moderate amount of chess knowledge; and a beginner (B), someone with little experience playing chess. Two experiments were conducted to test memory functions.

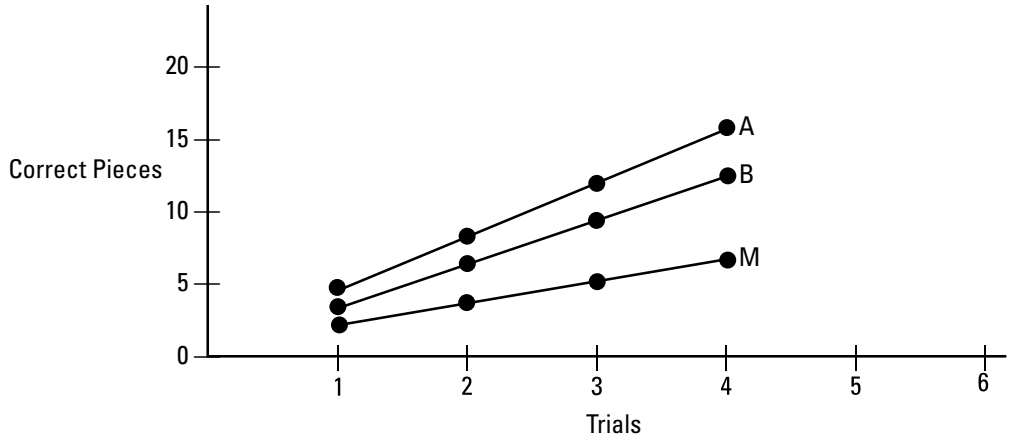
Experiment 1

Two chessboards were placed side by side, separated by a partition. On the left chessboard, a position from an actual chess game was constructed, containing 28 chess pieces. The right side chessboard was empty. Each subject was given a five second look at the chess position and then asked to reconstruct the chess position, from memory, on the right side chessboard. The number of correct pieces placed was recorded. Subjects were given additional trials, each a length of five seconds, until all 28 pieces were placed correctly on the right side chessboard. The data for this experiment are depicted in Figure 1.



Experiment 2

The experimental procedures were identical to those in Experiment 1 with one change: The 28 chess pieces on the left side chessboard were not placed according to an actual chess game but were placed at random. In other words, the left side pieces did not correspond to an actual, or possible, chess game. Subjects once again were given five second intervals to memorize the position and then asked to reconstruct it on the right side chessboard. The data for this experiment are graphed in Figure 2.



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35. From the results in Experiment 1, the master chess player had correctly placed all 28 pieces after how many trials?

    A. 2
    B. 3
    C. 4
    D. 5

36. Is the statement "Master chess players place the pieces correctly in fewer trials than average chess players" supported by the results in both experiments?

    F. Yes, because chess masters used fewer trials in Experiment 1.
    G. Yes, because chess masters used fewer trials in both Experiments.
    H. No, because beginners used more trials in Experiment 1.
    J. No, because average chess players used fewer trials in Experiment 2.

37. Is the statement "Random chess positions are harder to remember than actual chess positions" supported by the data in both experiments?

    A. Yes, because none of the players could reconstruct all of the pieces in Experiment 2.
    B. Yes, because all of the subjects used more trials in Experiment 2 than in Experiment 1.
    C. No, because all of the subjects correctly placed the pieces in both Experiments.
    D. No, because master chess players had better performance in both Experiments.

38. After 3 trials, the greatest difference in performance between Experiment 1 and Experiment 2 was shown by which of the following players?

    F. Master
    G. Average
    H. Beginner
    J. There is not enough information to determine this relationship.

39. If Experiment 2 was continued for several more trials, which of the following results is likely to occur?

    A. An average player would place more pieces correctly than a master player.
    B. A master player would place more pieces correctly than an average player.
    C. Accuracy levels would start to decrease.
    D. All three players would place the 28 pieces correctly.

40. For the data in both Experiments, as trials increase, the number of incorrect pieces placed:

    F. increases.
    G. decreases.
    H. remains constant.
    J. increases for Experiment 1 and decreases for Experiment 2.

END OF SCIENCE REASONING TEST.
STOP!
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