ACT Science Reasoning Diagnostic Test 4 Science Test 4 - Key

Passage I

A scientist wished to investigate the effect on the rate of production of material C with varying concentrations of component materials A and B. All reactions were performed at the same temperature. The results are given in the table below:

Experiment	Conc. A (mole/L)	Conc. B (mole/L)	Rate C (mole/sec)
1	0.01	0.01	1×10^{-5}
2	0.02	0.01	2×10^{-5}
3	0.03	0.01	3×10^{-5}
4	0.01	0.02	4×10^{-5}
5	0.01	0.03	9×10^{-5}
6	0.02	0.02	8×10^{-5}

1. Which concentration has the greater effect on the rate?

By comparing columns A, B, and C, we can see that multiplying

(column A) $\times$ (column B) $\times$ (column B) $\times$ (10) = column C.

Since the quantity in column B is included twice in the calculation, it has a greater affect on the rate.

The correct answer is B, concentration B.

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2. If the concentration of B were tripled in Experiment 2, what effect would this have on the rate?

Since the quantity in column B is tripled, the new calculation for the rate would be

(column A) $\times$ 3(column B) $\times$ 3(column B) $\times$ (10) = 9(column C).

We can see that the rate C would increase by 9 after multiplying 3×3.

The correct answer is J, Rate increases x 9.

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3. If the concentration of A were doubled in Experiment 3, what effect would this be expected to have on the rate?

Adjusting our original formula, we get

2(column A) $\times$ (column B) $\times$ (column B) $\times$ (10) = 2(column C).

The correct answer is B, Rate doubles.

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4. According to the data, what happens if the amount of B were doubled and the temperature dropped 10 degrees C ?

Since we are given no data regarding temperature, we do not have enough information to determine this.

The correct answer is J, There is not enough data.

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5. Based on the data provided, which of the following is the most probable rate of production of C if the concentration of A in Experiment 2 were decreased to 0.005 moles/L ?

In the original Experiment 2, the concentration of A is 0.02 mole/L. If it is changed to 0.005 mole/L, this is one-fourth of the original concentration. The resulting concentration C would also be one-fourth of its original concentration.

The correct answer is A, $0.5 \text{ x} \times 10^{-5}$.

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6. What would the rate be if a scientist used twice as much water in Experiment 6?

If twice as much water is used, the concentrations of A and B would each be reduced by half. In Experiment 6, the concentrations of A and B would both change from 0.02 to 0.01.

Using our original formula and new concentrations of A and B, we calculate the new concentration of C.

(column A) $\times$ (column B) $\times$ (column B) $\times$ (10) = column C

(0.01) $\times$ (0.01) $\times$ (0.01) $\times$ (10) = column C

The correct answer is J, 1×10^{-5}.

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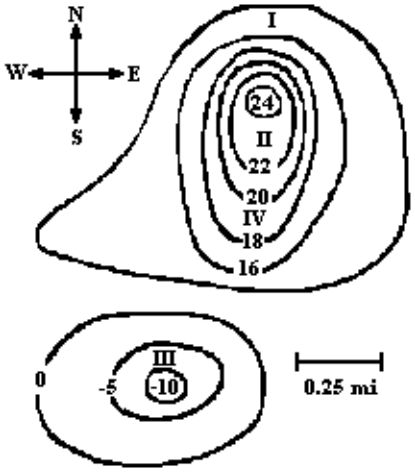
7. Which of the following best represents the rate? (k is a constant)

This is the formula we determined in #1 by looking closely at the table.

The correct answer is C, Rate = k $\times$ (conc A) $\times$ (conc B) $\times$ (conc B).

Passage II

A contour map of a surface is presented below. Elevation is in meters and is relative to sea level.



8. What point is at the highest elevation?

The highest elevation is indicated by the highest number value. The Roman numeral II marks this area.

The correct answer is G, II.

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9. What point is near the steepest incline?

The steepest incline occurs when the contour lines are closest together.

The correct answer is A, I.

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10. What point is at the lowest elevation?

The lowest elevation is indicated by the lowest number value. The Roman numeral III marks this area.

The correct answer is H, III.

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11. Which side of the hill has the gentler slope?

Comparing the north, south, east, and west sides of the hill, we see that the south side has the most space between contour lines, indicating a more gradual slope.

The correct answer is B, South.

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12. What is the approximate horizontal distance between the highest and lowest points?

Estimating the distance between the highest point (24 meters) and the lowest point (–10 meters) by using the measuring segment of 0.25 miles, we see that about 1 mile separates the two areas.

The correct answer is G, 1 mile.

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13. Down which side of the hill will water flow the fastest?

Water would flow fastest down the steepest side, which is the north side.

The correct answer is A, North.

Passage III

A scientist wished to observe the reactions of sugar placed in water containing yeast. To study this, the investigator used sugar with a radioactive marker and observed where the radioactivity went. A summary of his results appears below.

Experiment 1:

A sample of radioactively marked sugar was dissolved in water and the flask was sealed. After 24 hours in the dark, radioactivity was found in the sugar only.

Experiment 2:

A sample of radioactively marked sugar was dissolved in water and the flask was sealed. After 24 hours in a well-lit room, a tiny amount of radioactivity was found in the water, but the rest of the radioactivity was still in the sugar.

Experiment 3:

A sample of radioactively marked sugar was dissolved in water containing yeast and the flask was sealed. After 24 hours in the dark, radioactivity was found in the yeast cells, in the carbon dioxide in the air in the flask, and in alcohol produced by the yeast. No sugar remained in the flask.

Experiment 4:

A sample of radioactively marked sugar was dissolved in water containing yeast and the flask was sealed. After 24 hours in a well-lit room, radioactivity was found in the yeast cells, in the carbon dioxide in the air in the flask, and a small amount in the water. None was found in the alcohol, and no sugar was in the flask.

14. Which experiments served as control(s) for the yeast experiment?

Experiment 1 included no light and no yeast. This would serve as the control experiment for Experiment 3, which included yeast. Experiment 2 used a well-lit room but no yeast. This experiment serves as control for Experiment 4, which also uses a well-lit room, but includes yeast.

The correct answer is J, 1 and 2.

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15. Which experiment(s) served as control(s) for Experiment 4 to insure that yeast was responsible for the change in the sugar?

As was determined in question #14, Experiment 2 serves as control for Experiment 4.

The correct answer is B, 2.

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16. Which of the following can be concluded from the evidence of Experiments 1 & 3?

Experiment 1 did not contain yeast and Experiment 3 did. This is the only difference between the two experiments. By looking at the results of Experiment 3, we see that the sugar disappears and carbon dioxide and alcohol are now present. The yeast must be reacting with the sugar to convert it to both carbon dioxide and alcohol. Radioactivity is present in the yeast, carbon dioxide, and alcohol.

The correct answer is H, Sugar converts to alcohol & CO_2 by yeast.

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17. What valid conclusion can be drawn from Experiments 3 and 4?

Experiment 3 occurs in the dark and Experiment 4 occurs in a well-lit room. This is the only difference between the two experiments. By looking at the results of Experiment 3, we see that the sugar disappears and radioactivity becomes present in the yeast and the carbon dioxide and alcohol byproducts. The water does not contain radioactivity. By looking at the results of Experiment 4, we see that the sugar disappears and the carbon dioxide, alcohol, and water now contain radioactivity. The light must have some role causing the water to contain radioactivity, but the exact interaction is unknown.

The correct answer is A, Either yeast uses sugar differently in light, or alcohol, yeast, and water may interact.

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18. What evidence in Experiment 3 shows that the yeast actually uses the sugar?

The radioactivity transfers from the sugar to the yeast, so the yeast must be using the sugar.

The correct answer is H, Presence of radioactivity in the yeast cells.

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19. From the evidence presented, does the presence or absence of light make a difference in the results of the experiment?

Light does change the outcome of Experiments 2 and 4 as compared to their controls. The exact role of the light cannot be determined however.

The correct answer is B, Yes, but its full impact is not revealed by the experiments.

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20. If the investigator wished to examine whether the alcohol in Experiment 4 was ever radioactive he should

The alcohol may be radioactive, then become non-radioactive. If the experimenter checks often, he can track the radioactivity of the alcohol.

The correct answer is H, check contents of flask every few hours.
