

SCIENCE TEST

DIRECTIONS: The passages below are each followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding circle on your answer sheet. You may refer to the passages as often as necessary.

Passage I

The table below lists several minerals and the chemical elements of which they are made. The common crystal colors for each mineral and the common uses for

each mineral are listed in the table. Also listed are two physical properties of the minerals: the density in grams/cubic centimeter (g/cm^3) and the hardness (10 is the hardest). Hardness is determined by using the minerals to scratch materials of known hardness.

Mineral	Elements	Color	Uses	Density (g/cm^3)	Hardness
Diamond	carbon	clear, blue, yellow	gemstones, abrasives	3.5	10
Corundum	aluminum, oxygen	red, blue	gemstones, abrasives	3.9–4.1	9
Beryl	beryllium, aluminum, silicon, oxygen	green, blue-green	gemstones, source of beryllium for airplane alloys	2.7–2.9	7.5
Tourmaline	aluminum, boron, silicon, oxygen, hydrogen	red, blue	gemstones, high-pressure gauges	3.0–3.3	7
Spinel	magnesium, aluminum, oxygen	red, yellow, greenish-brown	gemstones	3.5–4.1	8
Garnet	magnesium, iron, aluminum, silicon, oxygen	red	gemstones, abrasives	3.6–4.3	7.5
Topaz	aluminum, silicon, oxygen, fluorine, hydrogen	clear, yellow, blue-green	gemstones	3.5	8
Quartz	silicon, oxygen	clear, purple, yellow	gemstones, pressure gauges, glass, heat-ray lamps, abrasives	2.7	7

1. According to the data, one could generalize that minerals used in abrasives:
 - A. contain carbon.
 - B. have a hardness of 7 or above.
 - C. are always red in color.
 - D. have a density above 4.0 g/cm^3 .
2. According to the data in the table, which of the following minerals is the softest?
 - F. Corundum
 - G. Beryl
 - H. Tourmaline
 - J. Spinel

3. According to the data in the table, if you had a blue gemstone, which of the following could it be?

- I. Corundum
- II. Tourmaline
- III. Quartz

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

4. Many types of sand are made entirely of silicon and oxygen. Which mineral in the table is most likely found in those types of sand?

- F. Corundum
- G. Spinel
- H. Topaz
- J. Quartz

Passage II

Most newly hatched ducks are covered with a dull *plumage* (feathers). When the ducks reach maturity, the females in some species retain the dull plumage but the males develop brightly colored plumage. Adult males remain brightly colored during the fall and winter of each year. During spring their plumage becomes dull again.

Several theories exist concerning the purpose of the unique appearance of the male ducks. Two scientists discuss their theories.

Scientist 1

The distinct color and pattern of the males enable females to identify males of their own species. Males of each species have a characteristic plumage that differs from that of males of other species. Females mate only with males of their own species. They reject males of all other species.

Females tend to prefer to mate with those males within their species that have the brightest plumage. These selected males tend to have an intimidating effect on other males, who are inclined to stay away and not mate with the females.

In addition, the brightly colored males tend to be healthier than the less brightly colored males. This gives them an advantage in attracting females and producing offspring. Their offspring also tend to be healthy.

Scientist 2

The distinct color of the male plumage helps them defend their territories against others of their own species and own sex. They warn other males to stay out of their territories by singing and displaying their plumage.

If this theory is correct, the males fight primarily for territory and not over mates. After mating, the males stand guard over the females. If an intruder enters the territory, the males display their bright feathers to distract the intruder and lure it away. Occasionally the males may resort to physical combat to defend their territories.

The brightly colored males typically own territories with abundant food supplies. They are able to provide sufficient food for their offspring, whose chances of survival are excellent.

5. According to Scientist 1, brightly colored males differ from dull-colored males in that brightly colored males are:
 - A. unhealthy.
 - B. better able to attract mates.
 - C. better able to lure away males of the same species.
 - D. unable to defend large territories.
6. According to Scientist 2, when an intruder approaches a male duck's territory, the male duck may:
 - F. hide from the intruder.
 - G. sneak away with the offspring.
 - H. fly to the nest to attack his mate.
 - J. sing loudly and flap his wings at the intruder.
7. All of the following behaviors of male ducks are consistent with Scientist 2's viewpoint EXCEPT that the males:
 - A. stand guard over the nests.
 - B. fight the intruders that enter their territories.
 - C. sit on the eggs while the females guard the territory.
 - D. distract intruders away from the location of the young.

8. The most important idea that underlies both scientists' theories about ducks is that the:
- F. external appearance of the male and female ducks is similar.
 - G. external appearance of the male and female ducks is different.
 - H. males are colored to blend in with their surroundings.
 - J. females are larger and more striking in color and patterning than males.
9. The discovery that females prefer to mate with dull-colored males would have which of the following effects on the theories of Scientists 1 and 2 ?
- A. It would lend support to Scientist 1's theory only.
 - B. It would disprove Scientist 1's theory.
 - C. It would lend support to Scientist 2's theory only.
 - D. The effect it would have on either scientist's theory could not be determined.
10. Scientist 1 would predict that female ducks select their mates during which of the following seasons?
- F. Spring or summer
 - G. Fall or winter
 - H. Fall or summer
 - J. Spring, summer, or fall

Passage III

Several factors affect the *rate* (how fast the chemicals react) at which a chemical reaction proceeds. Reaction rate is affected by the *concentrations* (relative amounts per unit volume) of the chemicals being reacted and the temperature at which the reaction takes place. The addition of a *catalyst* (substance that affects the rate of a reaction without itself being used up) can also increase the reaction rate.

When Solutions A and B (two colorless liquids) are mixed, a reaction takes place. When the reaction is completed, the mixture turns dark blue.

Experiment 1

Students mixed 20 ml each of Solutions A and B at 22.2° C, and stirred the mixture as the reaction proceeded. The students recorded the time that it took for the mixture to turn dark blue. This was repeated four more times. The average time for the five trials was 29 seconds (sec).

The students then mixed 20 ml of Solution A, 10 ml of Solution B, and 10 ml of distilled water, all at 22.2° C. The average reaction time for five trials was 71 sec.

The students then mixed 10 ml of Solution A, 10 ml of distilled water, and 20 ml of Solution B, all at 22.2° C. The average reaction time for five trials was 72 sec.

Experiment 2

The students mixed 20 ml each of Solutions A and B at three different temperatures. Each time, they stirred until the reaction was complete. The average reaction times for five trials are shown in the table.

Temperature (°C)	Time until reaction was completed (sec)
12.0	58
22.2	29
32.2	15

Experiment 3

The students added 5 drops of copper sulfate, a catalyst, to 20 ml of Solution A. When this was mixed at 22.2° C with 20 ml of Solution B, the average reaction time for 5 trials was 19 sec.

11. Which of the following indicated that the reaction was completed in the experiments?
 - A. Solution A was added to Solution B.
 - B. The two solutions were stirred.
 - C. The mixed solutions turned clear and colorless.
 - D. The mixed solutions turned dark blue.
12. Based on the results of Experiment 2, what is the relationship, if any, between the temperature of the mixture and the reaction time?
 - F. As the temperature increases, the reaction time decreases.
 - G. As the temperature increases, the reaction time stays the same.
 - H. As the temperature decreases, the reaction time increases then decreases.
 - J. There is no relationship between the temperature and the reaction time.
13. How is the experimental design of Experiment 1 different from that of Experiment 2 ?
 - A. Experiment 1 varies the concentration of the solutions and Experiment 2 varies the temperature of the mixture.
 - B. Experiment 1 varies the temperature of the mixture and Experiment 2 varies the concentration of the solutions.
 - C. Experiment 1 varies the concentration of the solutions and Experiment 2 adds a catalyst.
 - D. Experiment 1 adds a catalyst and Experiment 2 varies the temperature of the mixture.

14. Based on the results of Experiment 2, one would predict that if the reaction was repeated at 2° C, the reaction time would be approximately:

- F.** 8 sec.
- G.** 30 sec.
- H.** 60 sec.
- J.** 116 sec.

15. Based on the results of Experiments 2 and 3, which of the following conditions would most likely lead to the longest reaction time?

- A.** A reaction temperature of 50° C and the use of a catalyst
- B.** A reaction temperature of 50° C and no catalyst
- C.** A reaction temperature of 30° C and the use of a catalyst
- D.** A reaction temperature of 10° C and no catalyst

Answer Key

- 1.** B
- 2.** H
- 3.** C
- 4.** J
- 5.** B

- 6.** J
- 7.** C
- 8.** G
- 9.** B
- 10.** G

- 11.** D
- 12.** F
- 13.** A
- 14.** J
- 15.** D