CERT – GRADE 6 – SCIENCE – TEST 1

35 Minutes—28 Questions

DIRECTIONS: There are six passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

PASSAGE I

The following figures contain information related to how solar panels installed on rooftops can collect solar energy, which is measured in Watts (W). Figure 1 shows the percent of sunlight that a given solar panel can collect on a typical day in various cities, and Figure 2 shows the number of Watts of energy collected by the solar panel on one such typical day in the same cities.

Figure 1

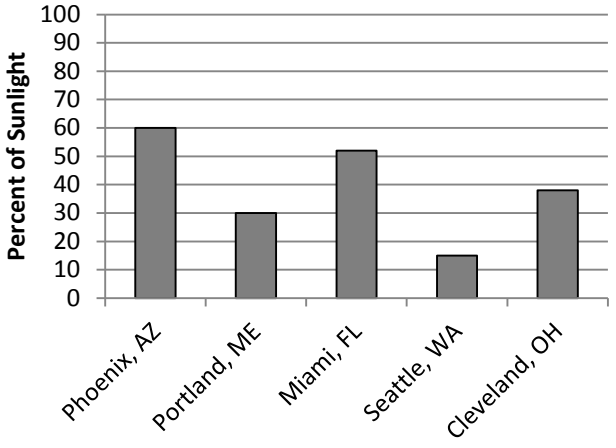
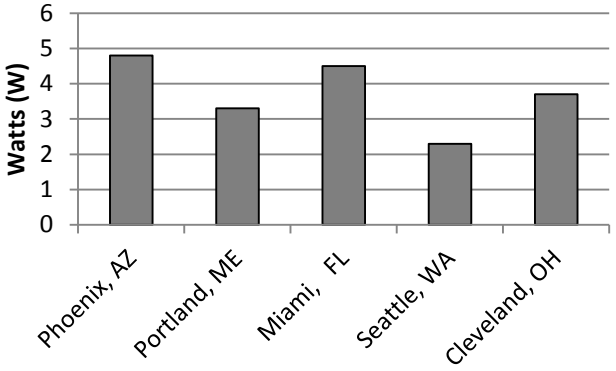


Figure 2



1. Based on Figure 1, the percent of sunlight that a given solar panel can collect on a typical day is lowest in which of the following cities?

- **A.** Phoenix, AZ
- **B.** Portland, ME
- **C.** Seattle, WA
- **D.** Cleveland, OH

2. Based on Figure 2, it is reasonable to conclude that the number of Watts was measured and recorded to the nearest:

- **F.** hundreds.
- **G.** tens.
- **H.** units.
- **J.** tenths.

3. Assuming that all of the following statements are true, which best explains why the percent of sunlight that a given solar panel can absorb on a typical day in Seattle, WA, is lower than the percent in Miami, FL?

- **A.** A typical day in Seattle is much cloudier than a typical day in Miami.
- **B.** The soil in Miami is much sandier than the soil in Seattle.
- **C.** A typical day in Seattle is much colder than a typical day in Miami.
- **D.** Seattle is on the west coast of the United States, while Miami is on the east coast.

4. Based on Figures 1 and 2, as the percent of sunlight collected increases, the energy collected:

- **F.** increases.
- **G.** decreases.
- **H.** increases, then decreases.
- **J.** remains constant.

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PASSAGE II

All chemical reactions occur at a certain *rate*. The rate of a given chemical reaction refers to the speed at which the chemicals react. There are several factors that can affect the rate at which a chemical reaction occurs. For example, rate can be affected by the *concentrations* (relative amounts per unit volume) of the chemicals being reacted. The temperature at which the reaction takes place can also affect rate. Finally, the addition of a catalyst (a substance that increases the rate of a chemical reaction without being affected itself) can also increase the rate of a chemical reaction.

Solution A is a colorless liquid. Chemical B is a white, chalky powder. When Chemical B is dissolved in Solution A, a chemical reaction occurs and the resulting solution is red in color.

Experiment 1

At a room temperature of 23 degrees Celsius (ºC), students in a chemistry lab dissolved 20 grams (g) of Chemical B in 100 milliliters (ml) of Solution A by gently stirring Solution A as Chemical B was added. The students recorded the time it took for the solution to turn red. This procedure was repeated 4 times. The average time for the 4 trials was calculated to be 30 seconds (sec).

At the same temperature of 23 ºC, the students then dissolved 40 g of Chemical B in 100 ml of Solution A by, again, gently stirring Solution A as the predetermined mass of Chemical B was added. The students recorded the time it took for the solution to turn red. This procedure was repeated 4 times. The average time for the 4 trials was calculated to be 14 sec.

Finally, at the same temperature of 23 ºC, the students dissolved 40 g of Chemical B in a solution composed of a mixture of 50 ml of Solution A and 50 ml of distilled water by, again, gently stirring the solution as the predetermined mass of Chemical B was added. The students recorded the time it took for the solution to turn red. This procedure was repeated 4 times. The average time for the 4 trials was calculated to be 15 sec.

Experiment 2

At various room temperatures, the students dissolved 20 g of Chemical B in 100 ml of Solution A by gently stirring Solution A as Chemical B was added. The students recorded the time it took for the solution to turn red. This procedure was repeated 4 times at each temperature. The average time for the 4 trials at each temperature was calculated and recorded in the table below.

Temperature (ºC)	Average time until reaction was completed (sec)
15	40
23	30
30	21
35	18

Experiment 3

The students added 3 drops of manganese dioxide, a catalyst, to 100 ml of Solution A. At a room temperature of 23 ºC, the students then dissolved 20 g of Chemical B in the solution by gently stirring the solution as Chemical B was added. The students recorded the time it took for the solution to turn red. This procedure was repeated 4 times. The average time for the 4 trials was calculated to be 8 sec.

5. How did the students determine that the reaction was completed in each of the experiments?

A. Chemical B was added to the solution
B. The student stopped gently stirring the solution
C. The lab period ended
D. The mixed solution turned red

6. What varied in Experiment 2?

F. The mass of Chemical B used
G. The volume of Solution A used
H. The room temperature of the lab
J. The volume of distilled water used

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7. According to Experiment 1, increasing the amount of Chemical B relative to Solution A:

A. increased the rate of the chemical reaction.
B. decreased the rate of the chemical reaction.
C. did not affect the rate of the chemical reaction.
D. sometimes increased and sometimes decreased the rate of the chemical reaction.

8. Based on the experiments, given 20 g of Chemical B and 100 ml of Solution A, which of the following increased the rate of chemical reaction the most?

F. Adding 3 drops of manganese dioxide to Solution A
G. Increasing the room temperature to 35 ºC
H. Decreasing the room temperature to 15 ºC
J. Stirring the mixture vigorously

9. Based on the results of Experiment 2, it is reasonable to conclude that, if the student had performed trials at a room temperature of 20 ºC, the average time to complete the reaction would have been:

A. between 18 and 21 sec.
B. between 21 and 30 sec.
C. between 30 and 40 sec.
D. more than 40 sec.

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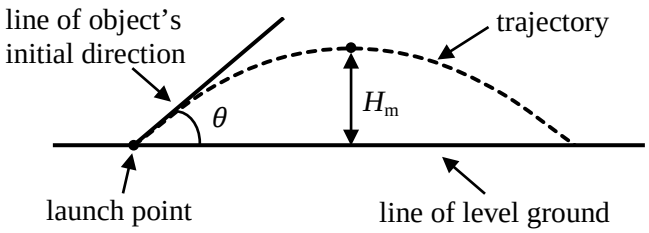
PASSAGE III

When an object, like a rubber ball, is launched into the air, it follows a path called a *trajectory*. As the object travels along its trajectory, its maximum height above the ground, H_m, depends on the object's initial velocity, V_o and the *angle of inclination*, θ. (The angle of inclination is the angle formed by the line of the level ground and the line of the object's initial direction.)



The table below gives H_m, in meters (m), of a rubber ball for various combinations of V_o, in meters per second (m/s), and θ, in degrees.

Trial	V_o (m/s)	θ (degrees)	H_m (m)
1	10	30	1.3
2	20	45	10.2
3	30	60	137.8
4	10	45	2.6
5	20	45	10.2
6	30	45	23.0
7	20	30	5.1
8	20	45	10.2
9	20	60	61.2

10. According to Trials 1-3, as initial velocity and angle of inclination increase, the value of H_m:

F. increases only.
G. decreases only.
H. remains constant.
J. increases, then decreases.

11. Based on the data in the table, H_m will be the greatest for which of the following *initial velocity-angle of inclination* combinations?

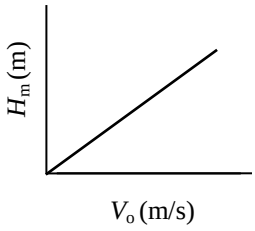
	V_o	θ
A.	30	30
B.	30	60
C.	20	60
D.	10	30

12. In completing Trials 7-9, what was the independent variable and what was the dependent variable?

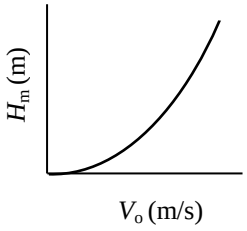
	independent	dependent
F.	H_m	θ
G.	θ	H_m
H.	θ	V_o
J.	H_m	V_o

13. Based on Trials 4-6, the relationship between V_o and H_m is best represented by which of the following graphs?

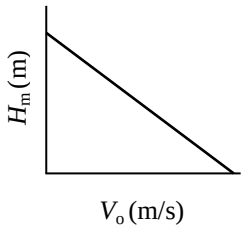
A.



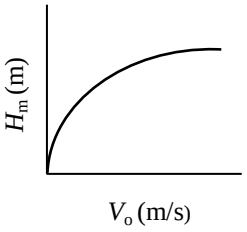
C.



B.



D.



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PASSAGE IV

The fancy-tail guppy is a popular live-bearing, fresh-water, aquarium fish. When fancy-tail guppies are born, both male and female fish look very similar: they are relatively colorless with normal-sized fins and tails. As they reach maturity, however, males develop large, brightly-colored dorsal fins and tails, while females merely increase in size, retaining their relatively colorless state with normal-sized fins and tails.

Scientist 1 and Scientist 2 discuss theories concerning the appearance of adult male fancy-tail guppies.

Scientist 1

There are many varieties, or subspecies, of fancy-tail guppies. The distinct colors and shapes of adult male dorsal fins and tails enable females of the same variety to identify males of their own subspecies. For mating purposes, not necessarily for social purposes, females reject males of all subspecies except their own.

When choosing mates within their subspecies, females tend to prefer males with the brightest dorsal fins and tails. Males with brightly-colored dorsal fins and tails not only attract females, but they also intimidate other males, causing them to avoid the brightly-colored males and all females of the same variety during the mating cycle.

Finally, males with the brightest dorsal fins and tails tend to be healthier and live longer than other males of the same variety. This seems to give such males the opportunity to maximize the number of offspring they produce throughout their lifetimes.

Scientist 2

Both color and size help determine which males are the most dominant among fancy-tail guppies living in the same social group. More specifically, it is the *brightness* of the color of the tail and the *size* of the tail that make the difference in determining which adult males are most dominant.

Males with tails that are bright orange or brilliant yellow, for example, tend to intimidate males with tails that are dark blue or deep purple, especially during mating cycles. During such cycles, less brightly colored males tend to avoid interaction with females and the more brightly colored males of the same social group.

When food supplies are scarce, males with the largest tails splay out their tails in shows of strength and vigor. Such displays tend to intimidate males with smaller tails, which accordingly avoid proximity with the more dominant males. With some of the competition temporarily eliminated, males with the largest tails can eat first. When they are finished nourishing themselves, they allow the less dominant males to eat with the females of their particular social group.

14. According to Scientist 1, brightly-colored fancy-tail guppy males differ from other males in that the brightly-colored males are:

F. smaller in overall size.
G. larger in overall size.
H. preferred by females seeking mates.
J. less likely to be eaten by larger fish.

15. According to Scientist 2, when food is in short supply, fancy-tail guppy males with the brightest and largest tails will likely eat:

A. after females of the same variety.
B. after both females and less brightly colored males.
C. before less brightly colored males, but after females.
D. before both females and less brightly colored males.

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16. Reference to which of the following was included in the discussion of Scientist 2, but not the discussion of Scientist 1?

I. Tail size
II. Mating cycles
III. Color patterns

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

17. According to the discussion of Scientist 1, all of the following are true EXCEPT:

A. A female fancy-tail guppy will not mate with a male of a different variety.
B. A male fancy-tail guppy with a large tail will intimidate males of the same variety with smaller tails.
C. A brightly-colored male fancy-tail guppy will likely live longer than a less brightly-colored male of the same variety.
D. Different varieties of fancy-tail guppies may interact socially.

18. An important idea that underlies the theories of both Scientist 1 and Scientist 2 is that:

F. all fancy-tail guppies live in freshwater aquariums with other varieties of fish.
G. female fancy-tail guppies are more colorful than their male counterparts.
H. the external appearance of male fancy-tail guppies of the same subspecies varies from fish to fish.
J. all male fancy-tail guppies live longer than females of the same subspecies.

19. The discovery that female fancy-tail guppies prefer to mate with brightly-colored males of their own variety and other varieties would have which of the following effects on the theories of Scientists 1 and 2?

A. It would disprove part of Scientist 1's theory only.
B. It would disprove part of Scientist 1's theory and part of Scientist 2's theory.
C. It would support part of Scientist 1's theory only.
D. It would support part of Scientist 1's theory and part of Scientist 2's theory.

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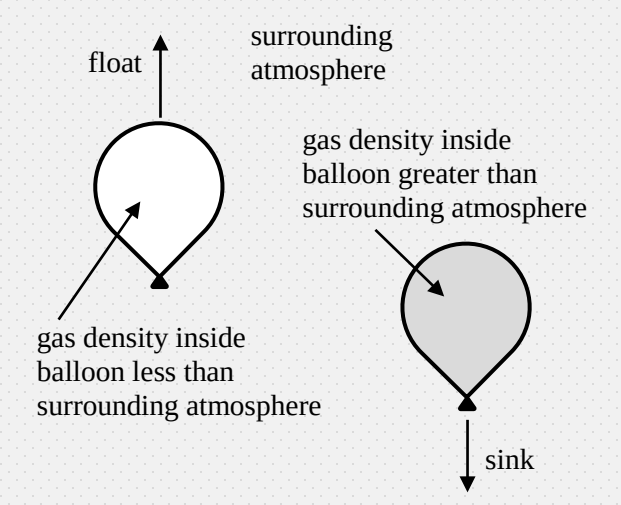
PASSAGE V

Students in a science class performed the following lab experiments to determine the relative densities of 5 gases: Gas 1 – Gas 5. Before the lab began, the students' teacher explained that, if the density of the gas inside a balloon is less than the density of the surrounding atmosphere, the balloon will rise, or float upward. The teacher further explained that, if the density of the gas inside the balloon is greater than the density of the surrounding atmosphere, the balloon will sink, or move downward.



Experiment 1

The students filled three balloons with gas: one with Gas 1 (Balloon 1); one with Gas 2 (Balloon 2); and one with Gas 3 (Balloon 3). The students took the balloons to the gym. The students then held each of the balloons 4 feet above the gym floor before releasing them at the same time. Balloon 1 floated up to the gym ceiling in 13 seconds; Balloon 2 sunk to the gym floor in 3 seconds; and Balloon 3 floated to the gym ceiling in 7 seconds.

Experiment 2

The students reused Balloon 3 from Experiment 1 and filled two new balloons with gas: one with Gas 4 (Balloon 4); and one with Gas 5 (Balloon 5). The students then tied identical 5-gram weights to the bottoms of the balloons. After taking the balloons to the gym, the students released the balloons from a height 4 feet above the gym floor. The students recorded whether the balloon sunk to the gym floor (S) or floated up to the gym ceiling (F). This procedure was repeated two more times, once with identical 8-gram weights attached to the balloons and once with identical 12-gram weights. The results of all three trials are set forth in Table 1.

Table 1

Weight (grams)	Balloon		
	3	4	5
5	S	F	F
8	S	F	F
12	S	F	S

20. Based on Experiment 1, it is reasonable to conclude that the density of Gas 2 is:

F. greater than that of Gas 1 only.
G. greater than that of Gas 1 and Gas 3.
H. less than that of Gas 3 only.
J. less than that of Gas 1 and Gas 3.

21. It is reasonable to assume that the teacher made sure that each of the following remained constant throughout the trials of Experiment 2 EXCEPT:

A. the type and size of the balloons.
B. the density of the surrounding atmosphere.
C. the color of the balloons.
D. the air temperature in the gym.

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22. Based on the results of Experiment 1, it would be reasonable to conclude that which of the following properly lists the gases in order from lowest density to highest density?

F. Gas1, Gas 2, Gas 3
G. Gas 3, Gas 2, Gas 1
H. Gas 3, Gas 1, Gas 2
J. Gas 1, Gas 3, Gas 2

23. If a fourth trial in Experiment 2 had been conducted with identical 10-gram weights and the results added to Table 1, the new row could be which of the following?

I.	10	S	F	F
II.	10	S	S	F
III.	10	S	F	S

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

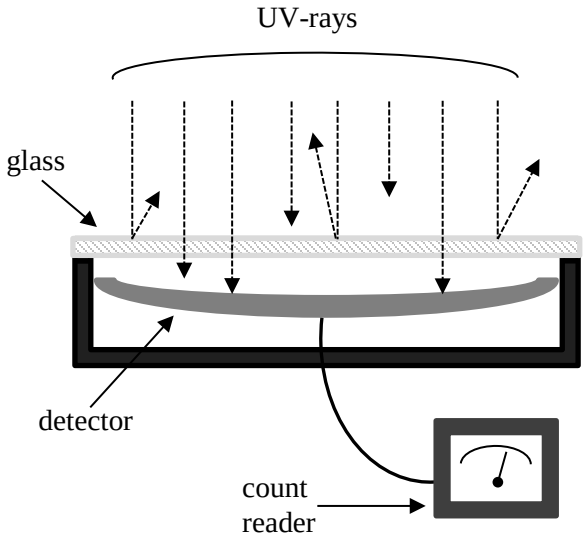
24. Based on the results of Experiment 1 and Experiment 2, which of the 5 gases has the lowest density?

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

PASSAGE VI

A physics student tested various sheets of glass for their ability to reflect ultraviolet rays (UV-rays). Any UV-ray that was not reflected by the sheet of glass passed through the glass and struck a detector which then registered a detection, or *count*. (See Figure 1.)

Figure 1

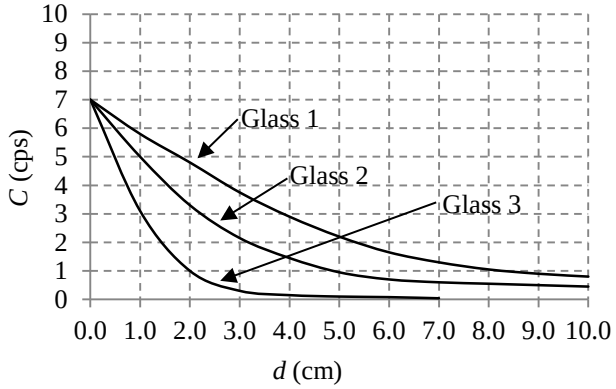


Each sheet was made of Glass 1, Glass 2, or Glass 3. The thickness, *d*, of each sheet of glass was uniform, but sheets of the same type of glass had different thicknesses.

C_o represents the number of counts per second (cps) with no sheet of glass between the UV-ray source and the detector, and *C* represents the cps with a single sheet of glass between the source and the detector.

First, the physics student determined that C_o equals 7 cps. Next, the student measured *C* for various sheets of Glass 1, each having a different thickness. Then, the student graphed *C* versus *d*, in centimeters (cm), for Glass 1. Finally, the student measured *C* for various sheets of Glass 2 and Glass 3, each having a different thickness, and graphed *C* versus *d* for Glass 2 and Glass 3 on the same set of axes. (See Figure 2.)

Figure 2



25. According to Figure 2, when a sheet of Glass 2 that is 4.0 cm thick was tested, *C* was measured to be in which of the following ranges:

A. 0-1 cps.
B. 1-2 cps.
C. 2-3 cps.
D. 3-4 cps.

26. According to Figure 2, a sheet of which glass would need to be the thickest in order to maintain a *C* of 2 cps?

F. Glass 1
G. Glass 2
H. Glass 3
J. It cannot be determined based on the given information.

27. According to the passage, if the student managed to double the number of UV-rays striking the sheet of glass during the experiment, the *C* values for each sheet of glass tested would most likely:

A. increase.
B. decrease.
C. remain constant.
D. increase for Glass 1 and decrease for Glass 2 and Glass 3.

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28. Based on Figure 2, which of the following combinations of glass and thickness had the highest cps?

F. Glass 1 at $d = 3$ cm
G. Glass 2 at $d = 2$ cm
H. Glass 2 at $d = 6$ cm
J. Glass 3 at $d = 1$ cm

END OF TEST