California Subject Examinations for Teachers®

TEST GUIDE

MULTIPLE SUBJECTS SUBTEST II

Sample Questions and Responses and Scoring Information

CS-TG-QR102X-01

Sample Test Questions for CSET: Multiple Subjects Subtest II

Below is a set of multiple-choice questions and constructed-response questions that are similar to the questions you will see on Subtest II of CSET: Multiple Subjects. You are encouraged to respond to the questions without looking at the responses provided in the next section. Record your responses on a sheet of paper and compare them with the provided responses.

Calculators will be provided for this assessment. Basic four-function calculators (model Texas Instruments TI-108) will be provided for examinees taking Multiple Subjects Subtest II: Science; Mathematics. Directions will not be provided at the test administration and the model distributed is subject to change. You may not bring your own calculator for CSET: Multiple Subjects Subtest II.

1. Which of the following steps in making a cup of coffee involves a chemical change in matter?

   A. Whole-bean coffee is ground in a coffee grinder.

   B. A burner on a propane stove is lighted to heat water.

   C. Water in a kettle begins to boil.

   D. Boiling water is poured through a filter containing ground coffee.

2. Which of the following is the best example of the refraction of light waves?

   A. Markings on flowers that are invisible in normal light can be seen in ultraviolet light.

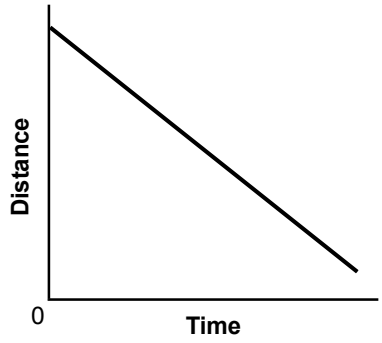
   B. Deep lakes appear to be blue or green in color.

   C. Sunlight striking a black box will make the box warmer than the same light striking a white box.

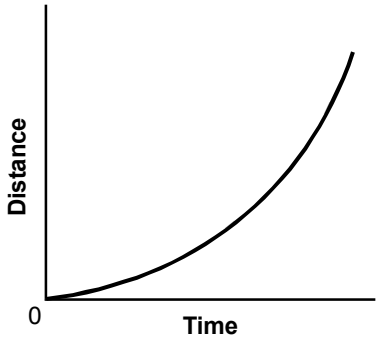
   D. Light passing through raindrops produces a rainbow.

3. A large round boulder is pushed from the top of a smooth steep hill and rolls to the bottom. Which of the following graphs shows the distance the boulder travels with respect to time as it rolls down the hill?

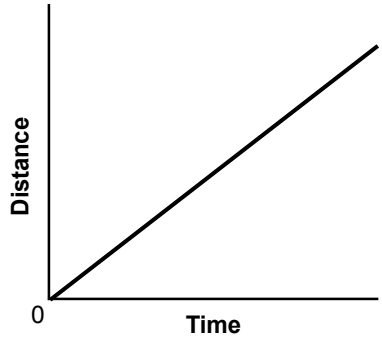
A.



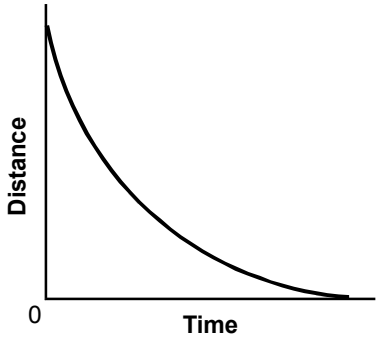
B.



C.



D.



4. The stems of a bunch of just-cut white flowers are immersed in a container of water to which blue dye has been added. After 24 hours, 2 tablespoons of salt are added to the water. Twenty-four hours later the flowers will most likely appear:

   A. wilted and light blue.

   B. fresh and white.

   C. wilted and white.

   D. fresh and light blue.

5. Certain species of acacia trees have long hollow thorns that house stinging ants. The ants feed on nectar produced by the tree and attack anything that touches the tree. The relationship between the ants and the acacias is an example of:

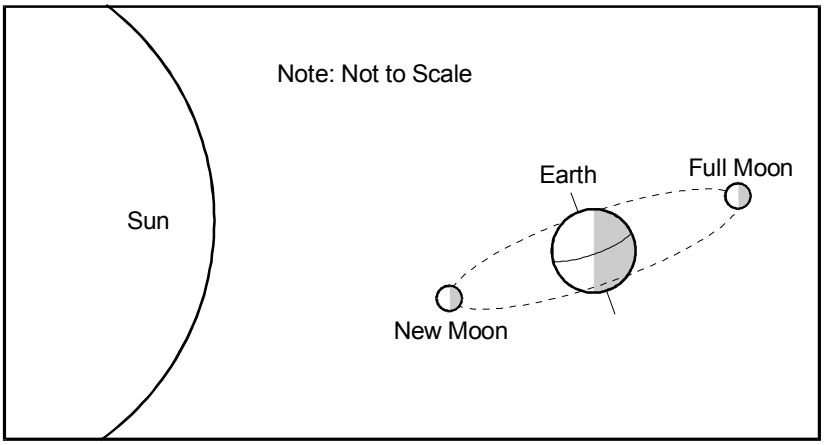
   A. mutualism.

   B. parasitism.

   C. commensalism.

   D. predation.

6. **Use the diagram below to answer the question that follows.**



According to the diagram above, which of the following statements about the full moon is true?

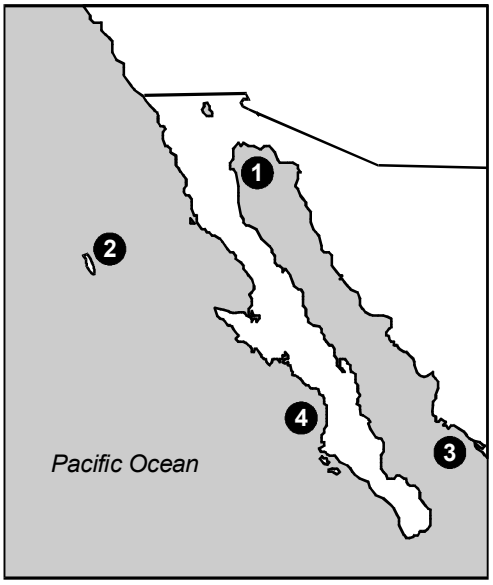
A. A lunar eclipse is visible somewhere on Earth whenever there is a full moon.

B. The full moon is never in the sky at the same time as the sun.

C. The moon always appears full somewhere on Earth.

D. A full moon occurs whenever the moon is closest to Earth.

7. **Use the map below to answer the question that follows.**



Which point on the map above would be likely to experience the greatest daily difference between high and low tides?

A. Point 1

B. Point 2

C. Point 3

D. Point 4

8. If the number 360 is written as a product of its prime factors in the form a^3b^2c, what is the numerical value of $a + b + c$?

   A. 10

   B. 16

   C. 17

   D. 22

9. The problem below shows steps in finding the product of two two-digit numbers using this standard multiplication algorithm. The missing digits in the problem are represented by the symbol □.

$$\begin{array}{r} \square 9 \\ \times \quad 3\,6 \\ \hline 2\,9\square \\ +\ \square\,4\,\square\square \\ \hline \square\square\square\square \end{array}$$

   What is the hundreds digit in the product of the two numbers?

   A. 1

   B. 4

   C. 6

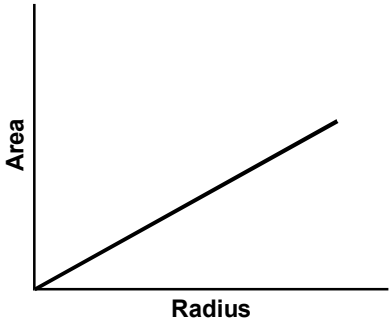
   D. 7

10. **Use the table below to answer the question that follows.**

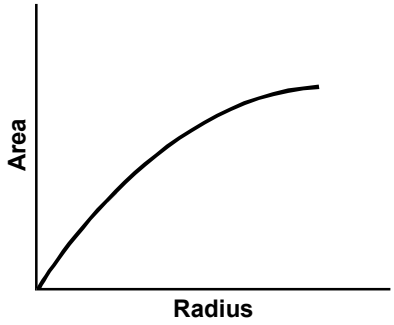
Radius	Area
0.0	0
1.0	3.14
2.0	12.57
3.0	28.31
4.0	50.29

The table gives the area of several circles of different radii. Which of the following graphs best represents the data in the table?

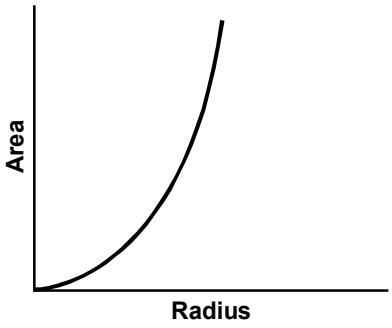
A.



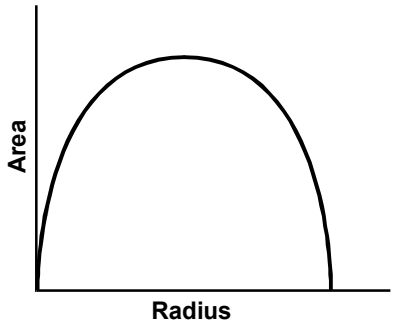
B.



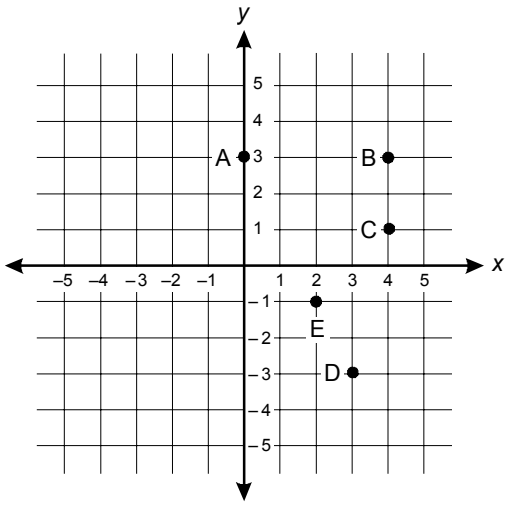
C.



D.



11. **Use the graph below to answer the question that follows.**



Point *E* is on a line with a slope of 2 in the *x*-*y* plane. Which of the following points is also on the line?

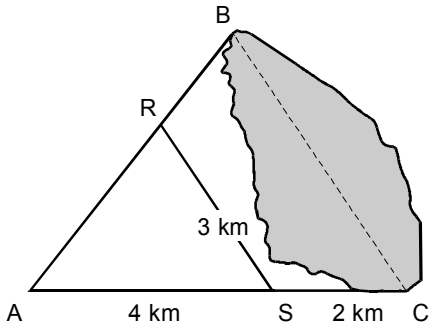
A. *A*

B. *B*

C. *C*

D. *D*

12. **Use the diagram below to answer the question that follows.**



Note: not drawn to scale

To find the length of a lake, surveyors measure the distances shown such that $\triangle ABC$ and $\triangle ARS$ are similar. If $RS = 3$ km, $AS = 4$ km, and $SC = 2$ km, what is BC, the length of the lake?

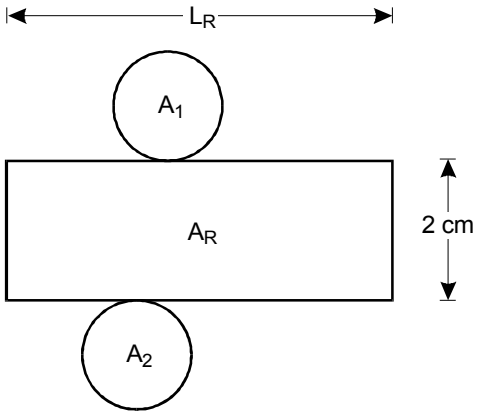
A. 4.5 km

B. 5 km

C. 6 km

D. 8 km

13. **Use the diagram below to answer the question that follows.**



The figure above is rolled up and folded to make a cylinder of volume 10 cm^3. Which of the following statements about the figure must be true?

A. The area of the rectangular section, A_R, is 10 cm^2.

B. The length of the rectangle, L_R, is 5 cm^2.

C. The area of each circular section, A_1 and A_2, is 5 cm^2.

D. The sum of the areas of the circular sections, $A_1 + A_2$, equals 5 cm^2.

14. The range of hourly wages for 15 employees of a small company starts at $7.50 and ends at $21.40. If only one worker receives the median wage of $8.90, how many workers receive a higher hourly wage?

    A. 5

    B. 6

    C. 7

    D. 8

15. Each of the numbers from 4 to 24 inclusive is written on a separate piece of paper and placed in a bag. If one of these pieces of paper is randomly selected from the bag, what is the probability that the number on it will be a prime number?

    A. $\frac{2}{7}$

    B. $\frac{3}{10}$

    C. $\frac{1}{3}$

    D. $\frac{7}{20}$

16. **Complete the exercise that follows.**

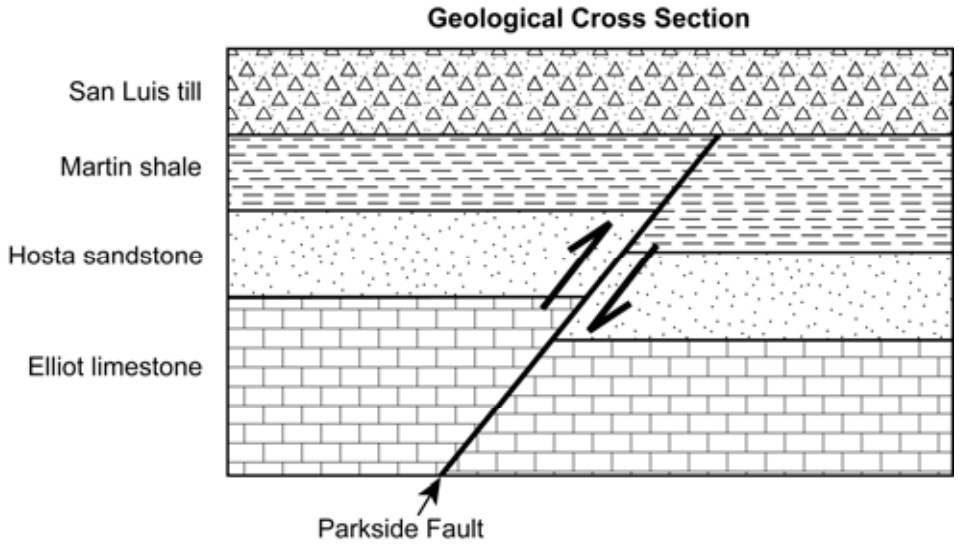
A butterfly collector is studying a species of butterfly that has expanded its range into a new area over the last thirty years. The butterflies in the new area feed on a species of flower that has a deeper throat than the flowers exploited by the butterfly species in its original range. The average length of the proboscis that is used to suck nectar from flowers is also greater in butterflies that inhabit the new area. The collector hypothesizes that individual butterflies that moved into the area and exploited the new flower grew longer proboscises during their lifetimes in order to reach the nectar. The gene for the longer proboscis was then inherited by the offspring of these individuals until the entire population consisted of butterflies with longer proboscises than butterflies in the original population.

Using your knowledge of evolutionary theory:

- discuss the validity of the researcher's explanation for the increase in average proboscis length in butterflies inhabiting the new area; and

- provide an alternative explanation that is consistent with accepted evolutionary theory for the change in proboscis length in butterflies inhabiting the new area.

17. **Use the diagram below to complete the exercise that follows.**



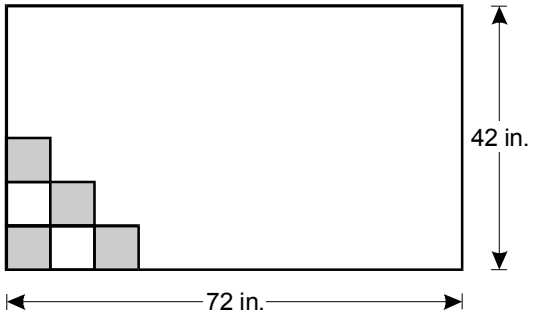
The diagram above represents a geological section through a sequence of layers of sedimentary rock. In this sequence, the following events, which are listed in random order, have occurred.

deposition of the Elliot limestone
Parkside fault
deposition of the Martin shale
deposition of the San Luis till
erosion between the Martin shale and the San Luis till
deposition of the Hosta sandstone

Using your knowledge of geology:

- list the correct order in which the events occurred, from longest ago to most recent; and
- identify one piece of evidence that supports the conclusion that erosion has occurred between the Martin shale and the San Luis till.

18. **Use the diagram and the information below to complete the exercise that follows.**



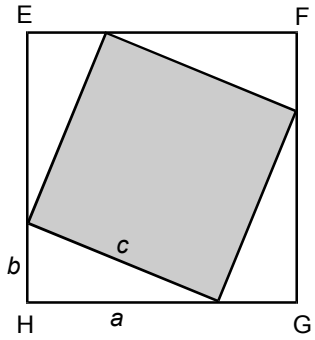
An artist is planning to construct a rectangular wall design from square tiles. The wall design is to be 72 inches long and 42 inches wide. All the square tiles must be the same size, and the length of the sides of the tiles must be a whole number.

Using your knowledge of number theory and geometry:

- find three different sizes of square tiles that could be used to completely fill the rectangular space, with no tiles overhanging the border; and

- determine the smallest number of square tiles that could be used to fill the rectangular space.

19. **Complete the exercise that follows.**



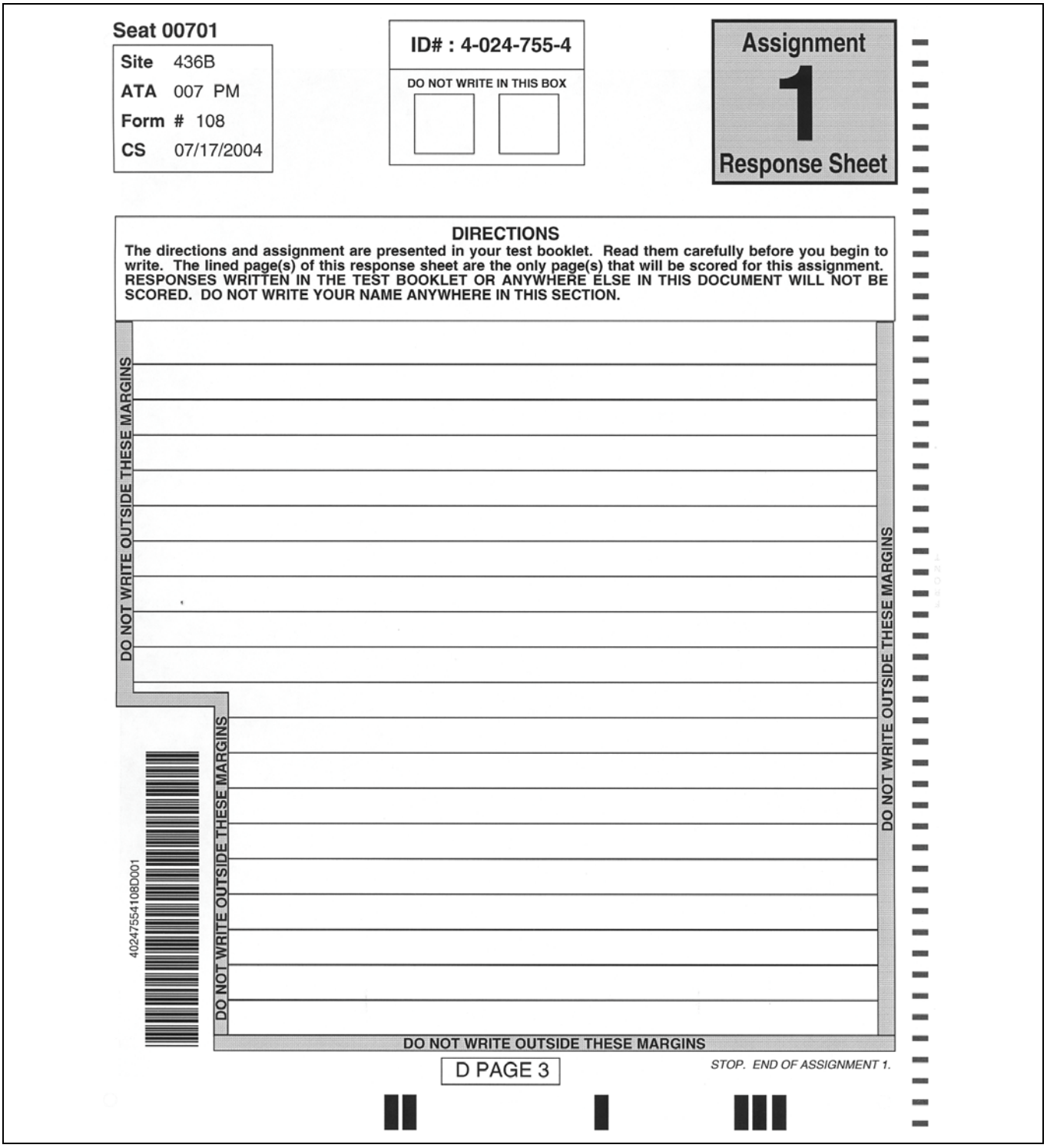
Four congruent triangles, each having legs of length *a* and *b* and hypotenuse of length *c*, are arranged as in the diagram above to produce square *EFGH*.

Using your knowledge of algebra and geometry:

- write an expression for the area of square *EFGH* in terms of the length of its sides;
- write an expression for the area of square *EFGH* in terms of the area of its component parts (i.e., four triangles and a square); and
- set these two expressions equal and show that this leads to a proof of the Pythagorean theorem.

Sample Written Response Sheets for CSET: Multiple Subjects Subtest II

For questions 16–19, examinees would record their written response to each question on a one-page response sheet located in their answer document. The length of their response to each question is limited to the lined space available on the response sheet. A sample of the response sheet is provided below.



Annotated Responses to Sample Multiple-Choice Questions for CSET: Multiple Subjects Subtest II

Science

1. **Correct Response: B.** (SMR Code: 1.1) A chemical change is a process in which a substance is changed into one or more different substances. Of the response choices given, only response choice B involves this type of change. When a propane stove is lighted, the propane gas combines chemically with oxygen from the atmosphere in a reaction that produces carbon dioxide and water.

2. **Correct Response: D.** (SMR Code: 1.2) The refraction, or bending, of light waves occurs when light passes from one transparent medium into another. When light traveling in air enters a raindrop, it is bent because light travels more slowly in water than in air. The light is dispersed into a spectrum, or rainbow, because the light waves associated with each color of light—from violet to red—bend at slightly different angles.

3. **Correct Response: B.** (SMR Code: 1.2) The force of gravity causes a round object to accelerate as it rolls down an inclined surface. Therefore, in the scenario described, the boulder will travel increasingly faster as it rolls down the hill. The upward curving line on the graph reflects the fact that the distance the boulder travels per unit of time (e.g., per second) increases as it accelerates.

4. **Correct Response: A.** (SMR Code: 2.1) Plant stems contain tubelike structures called xylem, which normally carry water from the roots to the rest of the plant. If the stems are cut and quickly immersed, the xylem can still transport water upward. During the first 24 hours, the flowers will take up the dyed water, and the white flowers will turn light blue as the dye enters the cells. After the salt is added, the concentration of salt in the water in the container will be greater than in the plant cells. Water will then be drawn out of the plant cells during the next 24 hours, causing the flowers to wilt. At the end of 48 hours, the flowers will appear wilted and light blue.

5. **Correct Response: A.** (SMR Code: 2.2) Mutualism is a relationship between two different species in which each species is benefited by its association with the other. In this example, the ants protect the acacia tree by attacking animals that might harm the acacia, while the tree supplies the ants with food and shelter.

6. **Correct Response: B.** (SMR Code: 3.1) The moon appears full only when it is located in the part of its orbit that is directly opposite the sun relative to Earth's position. Since the sun and moon are in opposite sectors of the sky with respect to Earth, both cannot be viewed at the same time from a position on Earth. The full moon will rise on the eastern horizon after the sun sets on the western horizon.

7. **Correct Response: A.** (SMR Code: 3.4) The tidal range (the difference in height between high tide and low tide) is affected by the shape of the underlying seafloor and the shape of surrounding landforms. Typically, the largest tidal ranges occur in bays, inlets, and narrow gulfs along the edges of ocean basins. These coastal landforms concentrate tidal energy because of their shape and shallowness. A classic example is the Gulf of California, which is shown in the map. The long, narrow shape of the gulf subjects the northernmost end to a large tidal range.

Mathematics

8. **Correct Response: A.** (SMR Code: 1.1) The number 360 is factored as: 2 • 2 • 2 • 3 • 3 • 5, or $2^3 \cdot 3^2 \cdot 5$. Since 2 + 3 + 5 = 10, response choice A is correct.

9. **Correct Response: D.** (SMR Code: 1.2) Using deduction and the rules of multiplication yields the following solution to the mathematics problem:

$$\begin{array}{r} 49 \\ \times\ 36 \\ \hline 294 \\ +\ 1470 \\ \hline 1764 \end{array}$$

   Since 1764 is the product, the hundreds digit is 7, and response choice D is correct.

10. **Correct Response: C.** (SMR Code: 2.1) As the radius increases in constant increments, the area (which is given by the formula Area = *pi* times the radius squared) grows by increasingly larger amounts. The graph in response choice C is the only one that depicts a steeper rate of increase for the area as the radius increases at a constant rate.

11. **Correct Response: B.** (SMR Code: 2.2) The coordinates of point *E* are (2, −1). A line with a slope of 2 passing through point *E* will contain points in which the *y*-coordinate changes by 2 units for each change of 1 unit in the *x*-coordinate. Because the slope is positive, if the change in *x* is in a positive direction (i.e., to the right), the change in *y* will also be in a positive direction (i.e., up). Conversely, if the change in *x* is in a negative direction (i.e., to the left), the change in *y* will also be in a negative direction (i.e., down). The following table illustrates this, using *x*-coordinates of 0, 1, 2, 3, and 4.

x	***y***
0	−5
1	−3
2	−1
3	1
4	3

   Thus, of the points shown on the graph, which have *x*-coordinates of 0, 3, and 4, only point *B*, with coordinates of (4, 3), is on the line, and B is the correct response.

12. **Correct Response: A.** (SMR Code: 3.1) Since $\triangle ABC$ is similar to $\triangle ARS$, the ratios of the lengths of the corresponding sides must be equal. That is, the ratio of the length of side BC to the length of side RS must be equal to the ratio of the length of side AC to the length of side AS. This can be written as the following formula:

$$\frac{BC}{RS} = \frac{AC}{AS}$$

Inserting values into the formula yields:

$$\frac{BC}{3} = \frac{6}{4}$$

Solving for BC (by multiplying both sides of the equation by 3) gives the result that $BC = \frac{18}{4}$, or 4.5 km. Thus, A is the correct response.

13. **Correct Response: C.** (SMR Code: 3.2) The volume of a cylinder is found by multiplying the area of the base by the height: $V = A_{\text{base}} \bullet h$. Since the height of the cylinder is 2 cm, and its volume is 10 cm^3, dividing the volume by the height gives the area of the base, which is therefore 5 cm^2. Since A_1 and A_2 are both bases, response choice C is correct.

14. **Correct Response: C.** (SMR Code: 4.2) If a range of numbers is arranged in increasing order, the median is the middle number. The wage of the only worker out of 15 who receives the median wage must be the eighth number in the range, with 7 of the 15 workers earning less and 7 earning more. Response choice C is therefore correct.

15. **Correct Response: C.** (SMR Code: 4.3) A prime number is a whole number with no divisors except itself and 1. Among the set of 21 numbers from 4 to 24 are seven prime numbers (5, 7, 11, 13, 17, 19, and 23). Since seven of the numbers that can possibly be selected from the bag are prime, the probability that a prime number will be selected is 7 out of 21, or $\frac{1}{3}$. Response choice C is therefore correct.

Examples of Responses to Sample Constructed-Response Questions for CSET: Multiple Subjects Subtest II

Science

Question #16 (Score Point 3 Response)

The researcher's explanation for the increase in average proboscis length is not valid because the ability of the butterflies in the newly colonized area to reach the nectar in the flowers with deeper throats must have already existed as a genetic variant in the original population of butterflies. As the butterfly species moved into the new region those butterflies with longer proboscises were able to take advantage of the resource. The genetic variants in the population with shorter proboscises were not able to take advantage of this resource and therefore were not able to survive and reproduce as effectively as those with the longer proboscises living in the newly colonized region. Eventually, the longer-proboscis variant dominates the population of butterflies living in the newly colonized region. This process is referred to as adaptive radiation.

The researcher's explanation borrows on an evolutionary mechanism proposed by Lamarck, in which physical adaptations of one generation are passed on to the next generation. However, a physical adaptation to new environmental conditions during the lifetime of the individual does not change the makeup of the genome. Only genetic changes to sex cells are passed on to the next generation.

Natural selection, according to Darwin, states that only the fittest genetic variants will survive to dominate a particular habitat over time through increased survival of their offspring. Therefore, in the newly colonized area the number of butterflies with longer proboscises will increase over time while those with shorter proboscises will decrease.

Question #16 (Score Point 2 Response)

The researcher does not have a valid explanation for the increase in average proboscis length in the butterflies inhabiting the new area. This researcher hypothesizes that individual butterflies grew longer proboscises then passed this trait onto their offspring. Only genetic traits can be inherited by offspring, not traits acquired by an individual.

An alternate explanation would be that, when these butterflies moved into the new range, only the ones with longer proboscises were able to feed and therefore survive. If the proboscis length is a genetic trait, the longer length would be passed on to their offspring.

Question #16 (Score Point 1 Response)

The researcher's explanation for the increase in average proboscises length is valid when Lamarkian inheritance is involved. The butterfly had to adapt to a different food source if it was to survive, which means that it had to find a way to reach the nectar that was necessary to survival. The average length of the proboscises is increased over time in order for the butterfly to reach the nectar in the deeper throat of the flowers.

Genetically, this change was not passed on to offspring as only genetic changes to sex cells can be passed on.

continued on next page

Question #16 (Score Point 1 Response) ***continued***

Natural selection, according to Darwin, says that those who adapt to new situations will survive and will reproduce more successfully than those unable to adapt and change. The evidence of this natural selection will be the increase of the number of butterflies with the longer proboscises and a decrease of those with shorter proboscises. Survival of the fittest prevails here as the new trait prevails.

Question #17 (Score Point 3 Response)

Longest ago - Elliot Limestone deposited - had to be there before layer on top of it

Hosta Sandstone

Martin shale

Fault formation

Erosion of Martin Shale

Most recent - San Luis Till

Martin shale "evened itself out" when the higher Martin shale on the left eroded. Right-hand Martin shale is thicker than left.

Question #17 (Score Point 2 Response)

Oldest deposit was Elliot limestone. Then the Hasta sandstone, Martin shale, Parkside fault, and finally the San Luis till. The Martin shale is thicker on one side.

Question #17 (Score Point 1 Response)

Oldest - Elliot

Hosta

Fault formation

Martin

Erosion

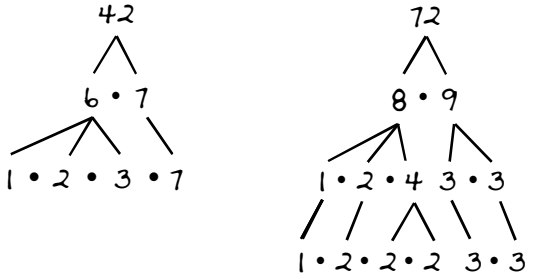
Youngest - San Luis Till

Erosion is required to make till.

Mathematics

Question #18 (Score Point 3 Response)

The length of the sides of a tile must divide both 72 and 42, so it is necessary to find the common factors of 72 and 42. This can be done as follows:



Since 1, 2, 3, and 2 • 3 appear in both lists of factors, the common factors of 42 and 72 are {1, 2, 3, 6}.

Three different size tiles that could be used are 2" x 2", 3" x 3", and 6" x 6" tiles. These sizes will fill the space without overlapping.

To find the fewest number of tiles used, observe that the larger the square tile used, the fewer tiles will be needed. Therefore, the 6" x 6" tiles should be used. Since 6 x 7 = 42 and 6 x 12 = 72, twelve 6" x 6" tiles will be needed along the base of the rectangle and seven 6" x 6" tiles will be needed along the height. Therefore a total of 12 x 7 or 84 tiles will be needed to cover the rectangle.

Question #18 (Score Point 2 Response)

Factoring 72 and 42 we find

$72 = 1 \bullet 2 \bullet 2 \bullet 2 \bullet 3 \bullet 3 \bullet 3$
$42 = 1 \bullet 2 \bullet 3 \bullet 7$

Therefore, three possible tile sizes are

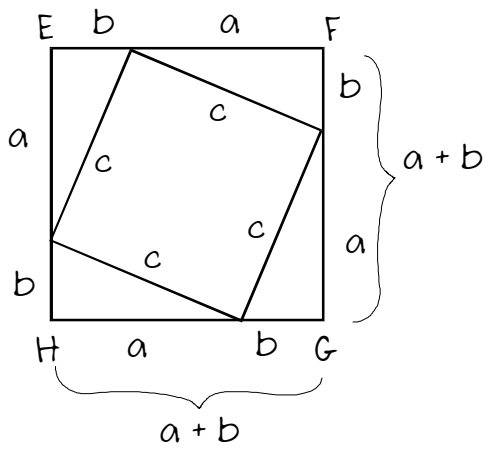
$1 \bullet 1$, $2 \bullet 2$, and $3 \bullet 3$

The fewest tiles would be the largest. This would be $6 \bullet 6$.

Question #18 (Score Point 1 Response)

Each tile could be 1 inch by 1 inch or since each side is divisible by 2, then each tile could be 2 in. by 2 in. Therefore by using the 2 in. by 2 in. tiles we would only have one-half the number of tiles. Since $2\sqrt{72} = 36$ and $2\sqrt{42} = 21$, a total of $36 + 21 = 57$ tiles would be needed. This would be the fewest number of tiles.

Question #19 (Score Point 3 Response)



Notice that the length of a side of EFGH is equal to a + b, since the length of each side of the square is equal to the sum of the lengths of the legs of a triangle. Therefore the area of EFGH = $(a + b)^2$.

The area of EFGH can also be written as the area of 4 triangles plus the area of the shaded square, which is c^2.

$(a + b)^2 = 4 \times \text{area of triangle} + c^2$

$(a + b)^2 = 4(\frac{1}{2}a \cdot b) + c^2$

$a^2 + 2ab + b^2 = 2ab + c^2$

$- 2ab \quad - 2ab$

$a^2 + b^2 = c^2$, which is the Pythagorean theorem

Question #19 (Score Point 2 Response)

a.) The area of square *EFGH* is $(a + b)^2$.

b.) $c^2 + 4\left(\frac{1}{2}ab\right) = EFGH$ the total area is the shaded square plus the four triangles

c.) $(a + b)^2 = c^2 + 4\left(\frac{1}{2}ab\right)$

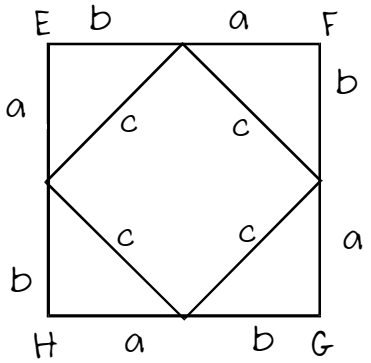
$(a + b)^2 = c^2 + 2ab$

$a^2 + 2(a + b) + b^2 = c^2 + 2ab$

$a^2 + (2a + 2b) + b^2 = c^2 + 2ab$

$a^2 + b^2 = c^2$ which is the Pythagorean theorem

Question #19 (Score Point 1 Response)



The area of the square is $a + b + a + b = 2a + 2b$.

The area of the four triangles and the square is $4ab$ and c^2. So the entire area is $a^2 + b^2 = c^2$.

Scoring Information for CSET: Multiple Subjects Subtest II

Responses to the multiple-choice questions are scored electronically. Scores are based on the number of questions answered correctly. There is no penalty for guessing.

There are four constructed-response questions in Subtest II of CSET: Multiple Subjects. Each of these constructed-response questions is designed so that a response can be completed within a short amount of time—approximately 10–15 minutes. Responses to the constructed-response questions are scored by qualified California educators using focused holistic scoring. Scorers will judge the overall effectiveness of your responses while focusing on the performance characteristics that have been identified as important for this subtest (see below). Each response will be assigned a score based on an approved scoring scale (see page 29).

Your performance on the subtest will be evaluated against a standard determined by the California Commission on Teacher Credentialing based on professional judgments and recommendations of California educators.

Performance Characteristics for CSET: Multiple Subjects Subtest II

The following performance characteristics will guide the scoring of responses to the constructed-response questions on CSET: Multiple Subjects Subtest II.

PURPOSE	The extent to which the response addresses the constructed-response assignment's charge in relation to relevant CSET content specifications.
SUBJECT MATTER KNOWLEDGE	The application of accurate subject matter knowledge as described in the relevant CSET content specifications.
SUPPORT	The appropriateness and quality of the supporting evidence in relation to relevant CSET content specifications.

Scoring Scale for CSET: Multiple Subjects Subtest II

Scores will be assigned to each response to the constructed-response questions on CSET: Multiple Subjects Subtest II according to the following scoring scale.

SCORE POINT	SCORE POINT DESCRIPTION
3	**The "3" response reflects a command of the relevant knowledge and skills as defined in the CSET content specifications.** • The purpose of the assignment is fully achieved. • There is an accurate application of relevant content specifications. • There is appropriate and specific relevant supporting evidence.
2	**The "2" response reflects a general command of the relevant knowledge and skills as defined in the CSET content specifications.** • The purpose of the assignment is largely achieved. • There is a largely accurate application of relevant content specifications. • There is acceptable relevant supporting evidence.
1	**The "1" response reflects a limited or no command of the relevant knowledge and skills as defined in the CSET content specifications.** • The purpose of the assignment is only partially or not achieved. • There is limited or no application of relevant content specifications. • There is little or no relevant supporting evidence.
U	**The "U" (Unscorable) is assigned to a response that is unrelated to the assignment, illegible, primarily in a language other than English, or does not contain a sufficient amount of original work to score.**
B	**The "B" (Blank) is assigned to a response that is blank.**