



California Subject Examinations for Teachers®

TEST GUIDE

SCIENCE SUBTEST II: GENERAL SCIENCE

Sample Questions and Responses and Scoring Information

Copyright © 2015 Pearson Education, Inc. or its affiliate(s). All rights reserved.
Evaluation Systems, Pearson, P.O. Box 226, Amherst, MA 01004

California Subject Examinations for Teachers, CSET, and the CSET logo are trademarks of the
Commission on Teacher Credentialing and Pearson Education, Inc. or its affiliate(s).

Pearson and its logo are trademarks, in the U.S. and/or other countries, of Pearson Education, Inc. or its affiliate(s).

CS-TG-QR119X-04

Sample Test Questions for CSET: Science 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: Science. 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.

Scientific calculators **will be provided** for the examinees taking General Science Subtests I and II, as well as the specialty subtests of Biology/Life Science, Chemistry, Earth and Planetary Science, and Physics. Refer to the California Educator Credentialing Examinations website for a list of the calculator models that may be provided. Directions for the use of the calculator will not be provided at the test administration. You will not be allowed to use your own calculator for CSET: Science subtests.

PERIODIC TABLE OF THE ELEMENTS

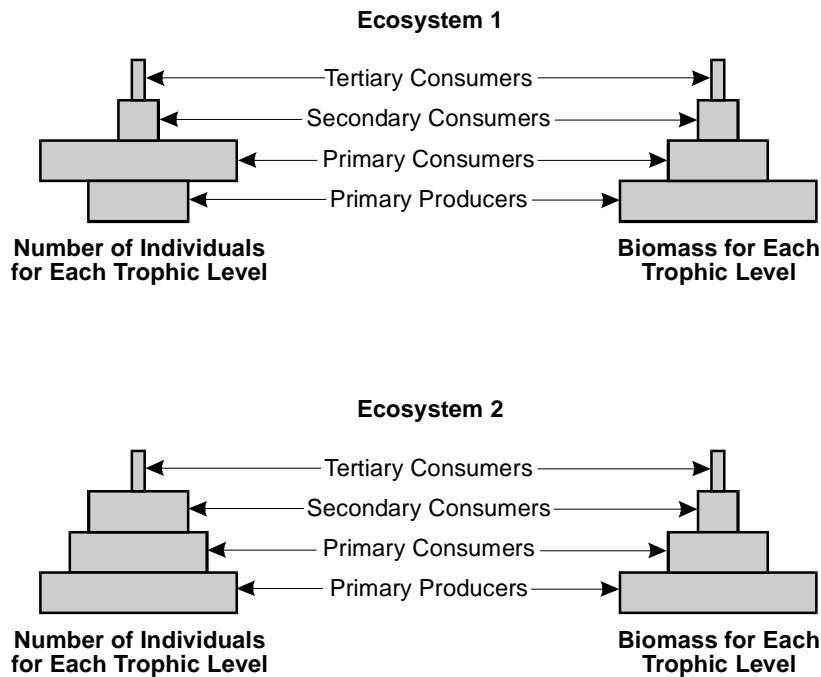
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																																																																		
IA	IIA	IIIB		IVB	VB	VIB	VIIIB		IB		IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA																																																																		
1 H 1.01	2 He 4.00	3 Li 6.94	4 Be 9.01	11 Na 23.0	12 Mg 24.3	13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9	19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8	37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	55 Cs 132.9	56 Ba 137.3	57-71	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)	87 Fr (223)	88 Ra (226)	89-103	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 110	111 111	112 112	113 113	114 114	115 115	116 116	117 117	118 118

Lanthanide Series	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinide Series	89 Ac (227)	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Some of the elements 110 and above have been reported but not fully authenticated and named.

1. Use the information below to answer the question that follows.

Trophic Pyramids for Two Ecosystems



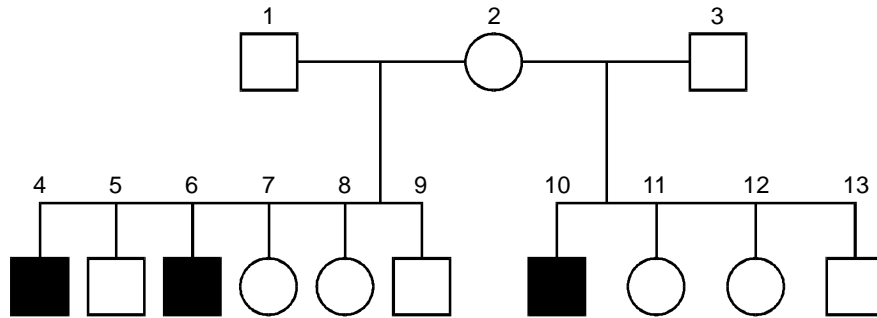
The diagrams above show two types of trophic pyramids for two different ecosystems. One type of pyramid shows the number of individual organisms that make up each trophic level, while the other shows the total biomass of all organisms at each trophic level.

Which of the following is the most likely explanation for the difference in the number of individuals at each trophic level between the two ecosystems?

- A. The individual producers in ecosystem 1 are larger than the individual producers in ecosystem 2.
- B. The productivity of ecosystem 1 is greater than the productivity of ecosystem 2.
- C. The individual producers in ecosystem 1 are smaller than the individual producers in ecosystem 2.
- D. The productivity of ecosystem 1 is less than the productivity of ecosystem 2.

2. In some tropical rain forests, a very large biomass of primary producers is supported by soils that exhibit much lower levels of phosphorus and other key nutrients compared to temperate forests. Which of the following statements best explains the high levels of productivity on nutrient-poor soils in some tropical rain forests?
- A. Plants growing under conditions of high temperatures use a different pathway for photosynthesis that requires the use of less nutrients.
 - B. Warm temperatures and high levels of moisture allow decomposers to recycle nutrients rapidly for reuse by primary producers.
 - C. High rainfall in tropical forests creates many streams that contain and distribute high levels of dissolved salts.
 - D. Plants in tropical forests grow very slowly and are extremely efficient at extracting nutrients from the soil.

3. Use the pedigree chart below to answer the question that follows.



Phenotypes

	Unaffected Individual	Affected Individual
Male	□	■
Female	○	●

A rare phenotype appears in the offspring of individuals 1, 2, and 3, all of whom exhibit a normal phenotype. Based on the frequencies in the chart above, which of the following is the most likely mechanism for the inheritance of this trait?

- A. The abnormal phenotype depends on autosomal transmission.
- B. The X chromosome carries the recessive allele.
- C. The abnormal phenotype occurs only by mutation.
- D. The Y chromosome carries the recessive allele.

4. Which of the following best describes the accepted model of DNA replication?

- A. the semiconservative model, in which the two strands of the parental double helix separate, and each provides the template for building a new strand that attaches to the parental strand
- B. the dispersive model, in which a parental DNA molecule replaces segments of its double helix with new genetic material, making the original segments available to assemble new DNA molecules
- C. the conservative model, in which the parental DNA remains intact while providing a template for an identical double helix to be synthesized adjacent to it
- D. the additive model, in which nucleotide chains assemble into double helix configurations, and the segments are linked to correspond to the parental DNA sequence

5. **Use the information below to answer the question that follows.**

Darwin made two distinct claims when proposing his theory of evolution. Darwin's first claim was that all modern species have evolved from ancestral forms. The second claim was that natural selection is the main mechanism for evolutionary change.

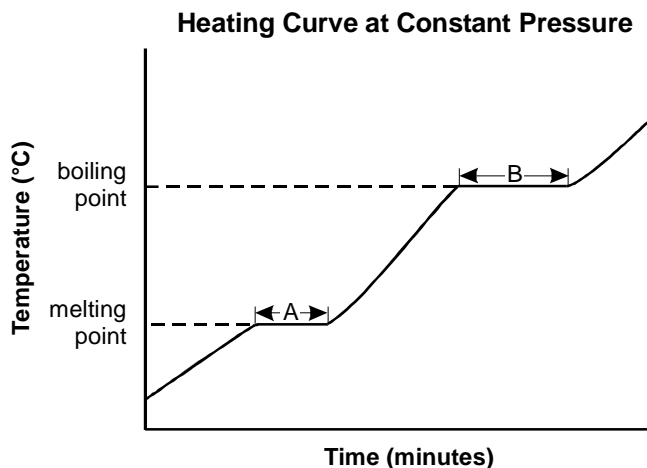
Which of the following observations best supports Darwin's claim that all modern species have evolved from ancestral forms?

- A. Similar complex structures, such as the eye, are present in a wide variety of unrelated organisms.
- B. Early embryos of all vertebrate groups, such as mammals, reptiles, and fish, are very similar.
- C. Variation occurs in all species, and this variation may help determine the survival of an individual.
- D. All species appear to be well-adapted to the environment in which they live.

6. Which of the following is one reason why carbon plays a central role in the functioning of all living organisms?
- A. Molecules that contain long carbon chains have an unusually strong and stable structure, which provides rigidity for cell walls.
 - B. Most carbon-based compounds are small enough to diffuse across cell membranes to help maintain cellular homeostasis.
 - C. The arrangement of electrons in the carbon atom allows it to form a large number of different compounds that are involved in life processes.
 - D. Carbon atoms are relatively unreactive with other elements, which allows them to be used as catalysts in metabolic reactions.
7. Which of the following describes the process of transcription during protein synthesis?
- A. A molecule of mRNA is produced from a DNA template.
 - B. Amino acids are produced according to the sequence of bases on a strand of mRNA.
 - C. A tRNA molecule is produced from an mRNA template.
 - D. Proteins are produced according to the sequence of bases on a strand of DNA.
8. Which of the following best describes the function of meiosis in sexually reproducing organisms?
- A. to make cells with exact copies of DNA
 - B. to induce the ovum to become permeable to a sperm cell
 - C. to produce haploid gametes prior to fertilization
 - D. to accomplish the first of several cell divisions in the zygote

9. In most plants, the stomata on the leaves are closed at night and open during the day. Which of the following explains this general pattern?
- A. Evaporative cooling through transpiration would be excessive if continued through the night.
 - B. The stomata are light sensitive and function only in the presence of solar radiation.
 - C. The high concentration of potassium in the nearby guard cells forces the stomata closed.
 - D. The stomata close at night to reduce water loss at a time when a plant does not need CO₂.
10. Which of the following is an example of heat transfer by convection?
- A. Currents are formed in a household water heater as warm water rises to the top and cool water sinks to the bottom.
 - B. A cup of hot coffee placed outside on a cold day becomes cool.
 - C. A rock sitting in the sun decreases in temperature when it is sprayed with water from a hose.
 - D. Sunlight coming through a window warms the window sill.

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



The graph above shows the heating curve of a substance. Which of the following best explains why section B of the graph is longer than section A?

- A. The energy required to change the substance from liquid to gas is greater than to change it from solid to liquid.
- B. The average kinetic energy of the molecules increases as the temperature increases.
- C. The entropy increases more when the substance changes from solid to liquid than when it changes from liquid to gas.
- D. The volume of the substance and the time required to heat it increase as the substance changes phase.

12. Use the data table below to answer the question that follows.

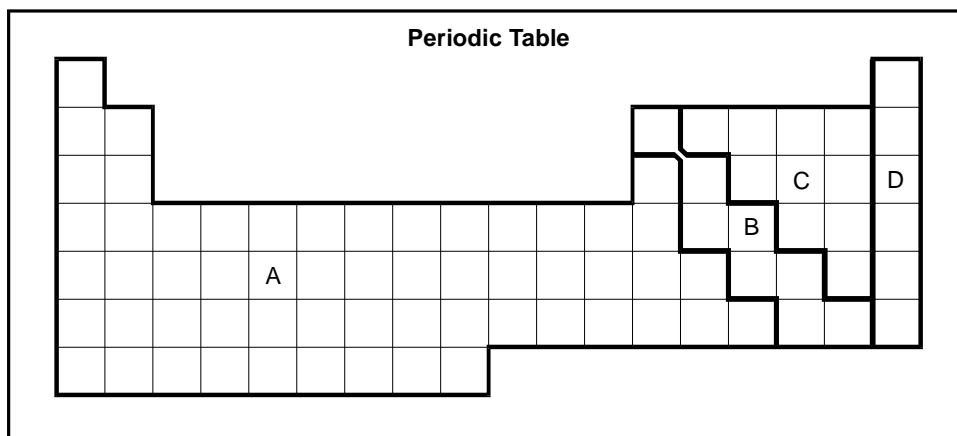
Substance	Phase	Mass	Volume
1	liquid	6 g	8 cm ³
2	liquid	9 g	9 cm ³
3	liquid	20 g	5 cm ³
4	solid	5 g	4 cm ³
5	solid	8 g	9 cm ³

The mass and volume of five substances are measured and recorded. Which of the following is a valid conclusion that can be drawn from the data above?

- A. Substance 4 will float in Substance 2 when both are in the liquid phase.
- B. Substance 4 will float in Substance 1.
- C. Substance 3, in solid form, will float in the liquid form of Substance 3.
- D. Substance 5 will float in Substance 2.

13. A chemist mixed two solutions in a test tube. The chemist observed that a white precipitate formed and the test tube became warm. Which of the following best explains what occurred in the test tube?
- A. A chemical change caused atoms to be rearranged and new substances to be formed.
 - B. A chemical change occurred, and heat from the reaction caused a phase change in the reactants.
 - C. A physical change caused atoms to be rearranged and new substances to be formed.
 - D. A physical change occurred, and heat from the reaction caused a phase change in the reactants.

14. Use the diagram below to answer the question that follows.



An element is located in the section of the periodic table labeled C above. Based on its position in the periodic table, the electrical conductivity of the element most likely:

- A. is poor at all temperatures.
 - B. increases with increasing temperature.
 - C. is good at all temperatures.
 - D. decreases with increasing temperature.
15. A certain gas at STP exists as a monatomic species and is chemically unreactive. In which part of the periodic table is this element most likely found?
- A. Group 1 (IA)
 - B. Groups 13 (IIIA) through 17 (VIIA)
 - C. Group 18 (VIII A)
 - D. Groups 3 (IIIB) through 7 (VIIB)

CONSTRUCTED-RESPONSE ASSIGNMENT DIRECTIONS

For each constructed-response assignment in this section, you are to prepare a written response.

Read each assignment carefully before you begin your response. Think about how you will organize your response. You may use the erasable notebooklet to make notes, write an outline, or otherwise prepare your response. **However, your final response must be either:**

- 1) typed into the on-screen response box,
- 2) written on a response sheet and scanned using the scanner provided at your workstation, or
- 3) provided using both the on-screen response box (for typed text) and a response sheet (for calculations or drawings) that you will scan using the scanner provided at your workstation.

Instructions for scanning your response sheet(s) are available by clicking the “Scanning Help” button at the top of the screen.

Your responses will be evaluated based on the following criteria.

PURPOSE: the extent to which the response addresses the constructed-response assignment's charge in relation to relevant CSET subject matter requirements

SUBJECT MATTER KNOWLEDGE: the application of accurate subject matter knowledge as described in the relevant CSET subject matter requirements

SUPPORT: the appropriateness and quality of the supporting evidence in relation to relevant CSET subject matter requirements

The assignments are intended to assess subject matter knowledge and skills, not writing ability. Your responses, however, must be communicated clearly enough to permit a valid judgment of your knowledge and skills. Your responses should be written for an audience of educators in the field.

Your responses should be your original work, written in your own words, and not copied or paraphrased from some other work. Please write legibly when using the response sheets. You may not use any reference materials during the testing session. Remember to review your work and make any changes you think will improve your responses.

Any time spent responding to an assignment, including scanning the response sheet(s), is part of your testing time. Monitor your time carefully. When your testing time expires, a pop-up message will appear on-screen indicating the conclusion of your test session. Only response sheets that are scanned before you end your test or before time has expired will be scored. Any response sheet that is not scanned before testing ends will NOT be scored.

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

A series of steps is required to complete the process of protein synthesis.

Using your knowledge of the transmission of genetic information and protein synthesis in eukaryotes:

- describe the processes of transcription and translation in protein synthesis, including the roles of DNA, mRNA, and tRNA; and
- explain how the 20 amino acids found in proteins are formed by only four nucleotide bases.

17. **Complete the exercise that follows.**

The human body consists of several types of systems, including:

- respiratory system
- circulatory system
- digestive system

Select **one** of the systems listed above, and using your knowledge of human body systems:

- identify the system you selected and list the main components of that system;
- describe a primary function of the system in the body; and
- briefly describe how the system you selected interacts with **one** of the other body systems listed.

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

Ecology

1. **Correct Response: A.** (SMR Code: 4.1) A biomass pyramid reflects the total weight of living matter at each trophic level, while a numbers pyramid reflects the total number of individual organisms at each trophic level. To have the situation shown for ecosystem 1, where the number of individual producers is smaller than the next higher trophic level yet the biomass is larger, the biomass of individual organisms must be large. This type of pattern might be found in a forest. In ecosystem 2, the large biomass of producers is the result of more, yet smaller, organisms. This would be typical of a grassland ecosystem.
2. **Correct Response: B.** (SMR Code: 4.1) Productivity rates of ecosystems largely depend on the speed of decomposition, which returns nutrients to a form usable by higher organisms. Organic matter in tropical rain forests can be broken down by decomposers in a relatively short time due to the warm moist climate year-round. As a result, nutrients are rapidly recycled for reuse by primary producers such as trees, which quickly pull the nutrients out of the soil and assimilate them into their biomass.

Genetics and Evolution

3. **Correct Response: B.** (SMR Code: 5.1) Since none of the parents display the rare phenotype, yet three of the offspring do, it can be concluded that the rare phenotype is caused by a recessive allele. Also, since the rare phenotype occurs in offspring of both partners of the female parent, she is the likely carrier of the recessive allele. It cannot be definitively ruled out that the trait is transmitted autosomally; however, it is unlikely, since all three parents would have to be carriers of this rare phenotype. Also, since the trait appears only in male offspring, it is most likely sex-linked (i.e., the allele is on the X chromosome). Each male offspring receives either an $X^R Y$ or $X^r Y$ combination from his parents, with r representing the recessive allele. Since males have only one X chromosome, the rare phenotype would appear in all males inheriting the X^r chromosome from the mother.
4. **Correct Response: A.** (SMR Code: 5.1) Watson and Crick predicted that DNA replicated by creating two daughter molecules, each having one new strand and one strand from the original DNA. According to this model, the two strands of the parental double helix separate, each becoming a template for building a new strand, resulting in two identical molecules of DNA. Later experimental evidence supported this method of replication, called the semiconservative model because each new DNA molecule conserves half of the parent molecule.
5. **Correct Response: B.** (SMR Code: 5.1) Research has shown that widely different organisms have strong similarities at the embryonic stage. For example, embryos of fish, reptiles, birds, and mammals all exhibit developing gills and tails at an early stage, and only later take their characteristic forms. This evidence supports the theory that these organisms evolved from common ancestral forms.

Molecular Biology and Biochemistry

6. **Correct Response: C.** (SMR Code: 6.1) A carbon atom has four electrons free to bond with other atoms, allowing carbon molecules to take the form of chains, branching chains, and rings. Each of these structurally different molecules can include large numbers of carbon atoms along with other elements. As a result, carbon can form a wide variety of compounds with different chemical properties and functions.

7. **Correct Response: A.** (SMR Code: 6.1) During protein synthesis, a molecule of messenger RNA is formed from a DNA template in a process similar to DNA replication, except the mRNA molecule that is produced is single-stranded. The mRNA then moves to the cytoplasm and attaches to ribosomes, where the code specified by the mRNA is translated into a protein.

Cell and Organismal Biology

8. **Correct Response: C.** (SMR Code: 7.1) Meiosis, the process by which gametes are produced in sexually reproducing organisms, results in the halving of the number of chromosomes in the daughter cells. This ensures that when two gametes unite, the offspring's somatic cells will have a chromosome number that is normal for the species, with half the chromosomes coming from each parent. Without the halving of the chromosome number, offspring would receive twice the number of chromosomes as its parents.
9. **Correct Response: D.** (SMR Code: 7.1) Stomata permit plants to take up CO_2 and release O_2 during the day as they photosynthesize. Plants, however, also lose water through the stomata. At night, when photosynthesis stops and the plant does not need CO_2 , the stomata close, preventing water loss.

Heat Transfer and Thermodynamics

10. **Correct Response: A.** (SMR Code: 11.1) Convection is the process by which heat is transferred through the movement of a heated fluid. In a household water heater, the water is heated from below by conduction of heat from the heating element to the water. Heating the water causes it to become less dense and, therefore, more buoyant. The heated water rises due to its increased buoyancy, forming currents that rise into the cooler water. As the heated water rises, it transfers some of its heat to the surrounding cooler water. The rising current of water becomes cooler itself, until eventually it becomes cool and dense enough to start sinking.
11. **Correct Response: A.** (SMR Code: 11.1) Section B of the graph is longer than section A because more energy is required to vaporize the substance than to melt it. During a phase change, energy is used to rearrange molecules in a melting solid or to spread molecules apart in a vaporizing liquid. For this reason, the substance stays at a steady temperature until the phase change is complete, at which time the applied energy begins increasing the substance's temperature again.

Structure and Properties of Matter

12. **Correct Response: D.** (SMR Code: 12.1) A substance, whether solid or liquid, will float on another liquid substance if the density of the first substance is less than the density of the second. Only response choice D definitively meets this criterion. Density (d) is defined as the mass (m) per unit volume (V) of a material, shown by the formula $d = m/V$. The density of Substance 5 equals 0.9 g/cm^3 , while the density of Substance 2 equals 1 g/cm^3 . Therefore, Substance 5 will float in Substance 2.
13. **Correct Response: A.** (SMR Code: 12.1) Chemical change involves a rearrangement of atoms through the making and breaking of chemical bonds. Changes in temperature and the formation of a solid precipitate when two solutions are mixed are signs that a chemical change has occurred and the chemical identities of the substances have changed.

14. **Correct Response: A.** (SMR Code: 12.1) The section of the periodic table labeled C encompasses the nonmetals. Nonmetals are characterized by poor electrical conductivity at any temperature, whereas the metals (Section A) have good conductivity that decreases with increasing temperatures.
15. **Correct Response: C.** (SMR Code: 12.1) Since the gas is made up of individual atoms and is chemically unreactive, the atoms of which it is composed must have completely filled valence shells. This property is characteristic of the noble gases in Group 18 (VIII A).

Examples of Strong Responses to Sample Constructed-Response Questions for CSET: Science Subtest II

Molecular Biology and Biochemistry

Question #16 (Score Point 3 Response)

In transcription, double helical DNA unwinds, and one strand acts as a template to assemble mRNA. This occurs in the nucleus of the cell. Then DNA rewinds, and the mRNA travels to the cytoplasm ribosome where the translation takes place. In translation, mRNA acts as a blueprint. The base nucleotides are taken three at a time and translated by tRNA to specific amino acids in the order determined by the mRNA. Then the amino acids are linked by peptic bonds to form a protein.

Triplet nucleotide codons translate to amino acids. Since there are four types of nucleotides that can be arranged in combinations of three, many more than 20 amino acid codons may be formed. Some amino acids are coded by more than one triplet codon, but each codon can link with only one amino acid.

Cell and Organismal Biology

Question #17 (Score Point 3 Response)

The respiratory system is responsible for breathing. It includes the air path to the lungs (that is, the larynx, pharynx, trachea and bronchi), the lungs themselves, and the diaphragm that inflates the lungs. Lung elasticity deflates the lungs. Air is inhaled into the lungs, which have small air tubes (bronchioles) and alveoli (little air bags with capillaries). Oxygen diffuses through the alveoli into the bloodstream. Carbon dioxide diffuses in the opposite direction and is exhaled.

By this method, the respiratory system interacts with circulatory system, which transports blood to the lungs to be oxygenated, and then to the heart, which pumps it to the rest of the body to distribute oxygen and collect CO_2 .

Scoring Information for CSET: Science 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 two constructed-response questions in Subtest II of CSET: Science. 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 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 22).

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

Performance Characteristics for CSET: Science Subtest II

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

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

Scoring Scale for CSET: Science Subtest II

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

SCORE POINT	SCORE POINT DESCRIPTION
<p>3</p>	<p>The "3" response reflects a command of the relevant knowledge and skills as defined in the subject matter requirements for CSET: Science.</p> <ul style="list-style-type: none"> • The purpose of the assignment is fully achieved. • There is an accurate application of relevant subject matter knowledge. • There is appropriate and specific relevant supporting evidence.
<p>2</p>	<p>The "2" response reflects a general command of the relevant knowledge and skills as defined in the subject matter requirements for CSET: Science.</p> <ul style="list-style-type: none"> • The purpose of the assignment is largely achieved. • There is a largely accurate application of relevant subject matter knowledge. • There is acceptable relevant supporting evidence.
<p>1</p>	<p>The "1" response reflects a limited or no command of the relevant knowledge and skills as defined in subject matter requirements for CSET: Science.</p> <ul style="list-style-type: none"> • The purpose of the assignment is only partially or not achieved. • There is limited or no application of relevant subject matter knowledge. • There is little or no relevant supporting evidence.
<p>U</p>	<p>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.</p>
<p>B</p>	<p>The "B" (Blank) is assigned to a response that is blank.</p>