California Subject Examinations for Teachers®

TEST GUIDE

SCIENCE SUBTEST 1: GENERAL SCIENCE

Sample Questions and Responses and Scoring Information

CS-TG-QR118X-04

Sample Test Questions for CSET: Science Subtest I

Below is a set of multiple-choice questions and constructed-response questions that are similar to the questions you will see on Subtest I 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 **IA**																	18 **VIIIA**
1 **H** 1.01	2 **IIA**											13 **IIIA**	14 **IVA**	15 **VA**	16 **VIA**	17 **VIIA**	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.0	12 **Mg** 24.3	3 **IIIB**	4 **IVB**	5 **VB**	6 **VIB**	7 **VIIB**	8	9 **VIIIB**	10	11 **IB**	12 **IIB**	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	111	112	113	114	115	116	117	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. Which of the following best describes the most widely accepted theory of the solar system's evolution?

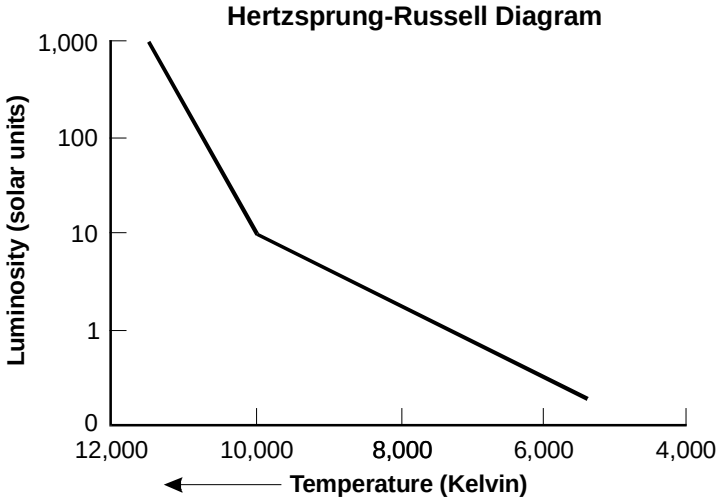
   A. A small star grew as it consumed comets, eventually becoming large enough to ignite fusion reactions and attract planetary bodies.

   B. A star existing within the Milky Way Galaxy pulled in comets and interstellar dust traveling through its gravitational field.

   C. The remnant elements of the explosion of a massive star coalesced, forming planets that circled the hydrogen core of the exploded star.

   D. A spinning cloud of interstellar dust and gas shrank under the force of gravity, producing a central star and revolving planetesimals.

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



The graph shows the relationship between the temperature and luminosity of main-sequence stars as depicted on a Hertzsprung-Russell diagram. Which of the following best describes the change in luminosity that occurs as the temperature increases above 10,000 Kelvin?

A. The change in luminosity decreases exponentially.

B. The change in luminosity per unit temperature increases.

C. The change in luminosity decreases logarithmically.

D. The change in luminosity per unit temperature decreases.

3. Regional metamorphism, in which large areas covering hundreds of miles are affected, is believed to be primarily the result of:

   A. vertical stresses associated with intraplate rifting and faulting.

   B. high temperatures associated with intrusions of magma into rock.

   C. horizontal stresses associated with convergent plate boundaries.

   D. high temperatures associated with the deep burial of geologic strata.

4. Which of the following best describes the underlying principle that allows radiometric dating to be used as an absolute dating technique?

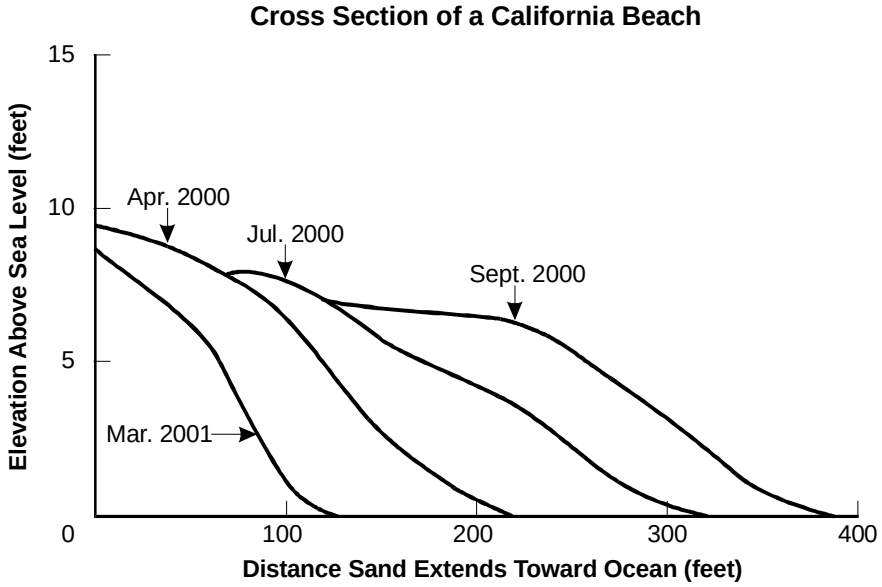
   A. The decay rate of naturally occurring radioactive elements into other elements is predictable.

   B. The strength of the electrical charge of radioactive elements is a measure of how long they have been radioactive.

   C. The proportions of beta and alpha particles emitted from rock change as a consequence of age and temperature.

   D. The half-life of radioactive elements can be determined by the magnetic field created in the surrounding rocks.

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



Shown above is a cross section of a beach showing typical changes in the contour and form of beach sand along California's coastline between April 2000 and March 2001. Which of the following explanations best describes the likely events responsible for the changes in the contour and form of the beach?

A. Large swells during the summer provided abundant sand, while less sediment was available during the winter months.

B. The small waves during the summer deposited sand on the beach, while the storm waves of winter cut back the beach.

C. Sediment built up during the dry summer months was eroded by heavy winter rains and washed into the ocean.

D. The finer sediment deposited during the summer became compacted and was more stable than the easily eroded coarse winter deposits.

6. When groundwater is pumped from an unconfined sand-and-gravel aquifer, sometimes the amount of groundwater withdrawn exceeds the recharge of the aquifer. Which of the following is the most likely consequence of withdrawing more water from this kind of aquifer than is naturally recharged?

   A. Groundwater supply will remain constant, but quality will be reduced as water is increasingly pulled from the pore spaces of the aquifer sediments.

   B. The water table will drop, but the supply of groundwater will remain undiminished as water is drawn upward into the aquifer from bedrock sources.

   C. Groundwater will be pulled from greater distances, but the water table near the point of withdrawal will remain at the same level.

   D. The water table will be lowered, and water from streams, lakes, and wetlands will move downward into the aquifer in response to the decrease in groundwater elevation.

7. Which of the following best describes the process of fossil fuel formation?

   A. Fossil fuels formed millions of years ago in massive deposits during an unusually warm period and are not currently forming.

   B. Fossil fuels form over hundreds of years from the rapid decay of organic matter in shallow oxygen-rich ponds and swamps.

   C. Fossil fuel formation is ongoing and involves the burial and slow transformation of carbonate rocks under high-pressure conditions.

   D. Fossil fuels form over millions of years from the buried remains of organic matter deposited in low-oxygen aqueous environments.

8. The international emphasis on the recycling of aluminum has been successful primarily because:

   A. strict laws associated with recycling enacted in many states enforce the return of aluminum cans.

   B. there is an ethical incentive for the consumers to recycle aluminum cans.

   C. the extraction of aluminum from ore uses a significantly greater amount of energy than recycling.

   D. mining aluminum ore has become unprofitable under current environmental laws.

9. In the early 1800s, Thomas Young directed a beam of coherent light at a barrier that had two slits cut into it. He then observed the pattern of light produced on the other side of the barrier. This was one of the most important experiments in research related to:

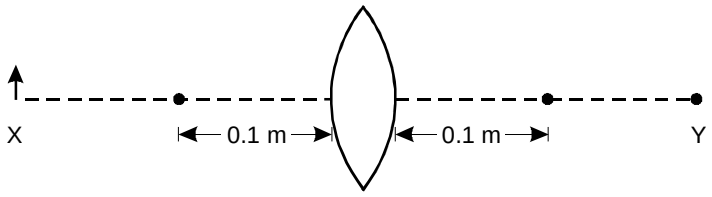
   A. determining the speed of light.

   B. determining the relationship between frequency and color.

   C. understanding the nature of polarized light.

   D. understanding the wave nature of light.

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



A converging lens is used to create an image of the arrow labeled *X*. If the focal length of the lens is 0.1 m, then the image that forms at the point labeled *Y* will be:

A. real and inverted.

B. real and erect.

C. virtual and inverted.

D. virtual and erect.

11. The equation **Error! Bookmark not defined.**$v = a\Delta t$ is sometimes used to find velocity when acceleration and time are known. Another form of this equation is $v = v_0 + a\Delta t$. In this second form of the equation, the function of the term v_0 is to:

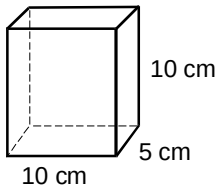
    A. indicate that the equation is valid only for an object that starts at rest.

    B. determine the time at which velocity is equal to zero.

    C. allow the equation to be used even when an object has a nonzero initial velocity.

    D. allow the equation to be used even when acceleration is not due to gravity.

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



The rectangular solid in the diagram is made of a material that has a density 25% that of water. If it is placed in a container of water, how many cubic centimeters of the rectangular solid will be below the surface of the water?

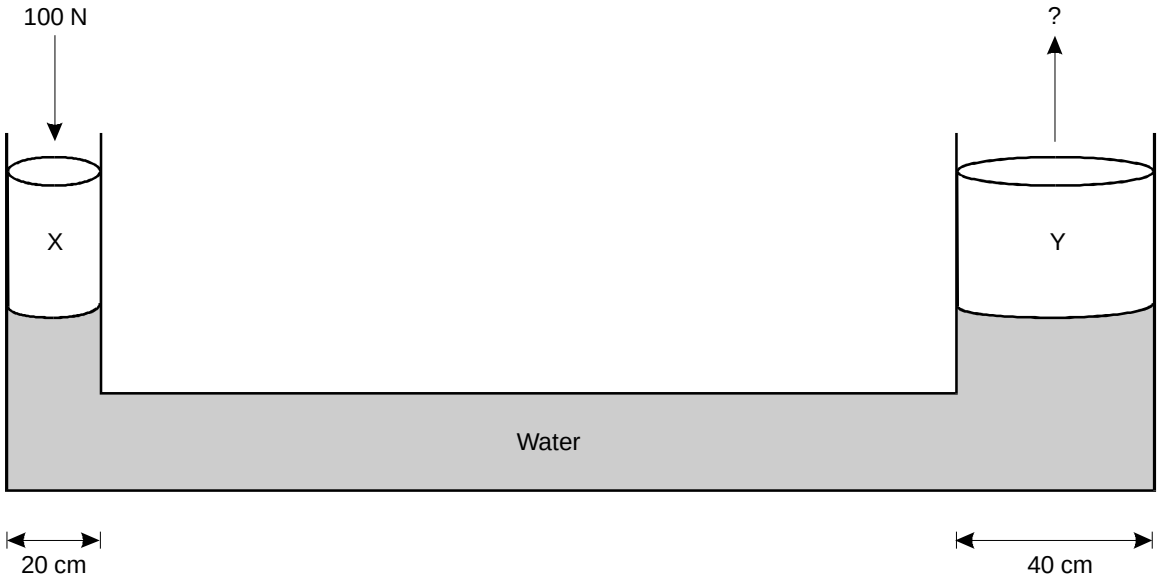
A. 500 cm^3

B. 250 cm^3

C. 125 cm^3

D. 0 cm^3

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



A force of 100 N is applied to piston X. What is the upward force applied by piston Y?

A. 200 N

B. 400 N

C. 800 N

D. 1000 N

14. In the early twentieth century, Robert Millikan created electrically charged oil droplets and then determined their electrical charge by calculating the magnitude of the electrical charge that would suspend them in midair in opposition to gravity. He found that the electrical charge on each oil droplet was always an integer multiple of what we now know as the basic unit charge. Millikan's experiment is credited with discovering:

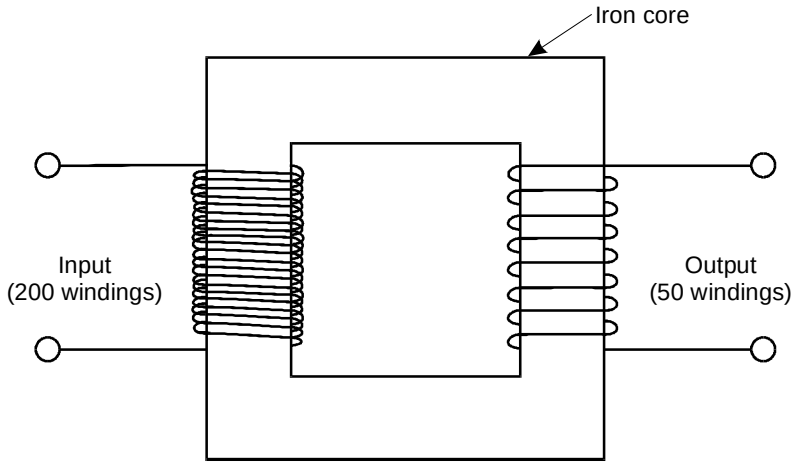
    A. the charge on a single electron.

    B. the relationship described by Ohm's law.

    C. the size of an electron.

    D. the relationship between charge and force.

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



The device in the diagram consists of two windings of wire wrapped around an iron core. The windings are separate from each other, and neither is in direct contact with the other. There are 200 windings of wire on the input side and 50 windings of wire on the output side. The device most likely performs which of the following functions?

A. increasing voltage

B. decreasing voltage

C. converting alternating current to direct current

D. converting direct current to alternating current

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.

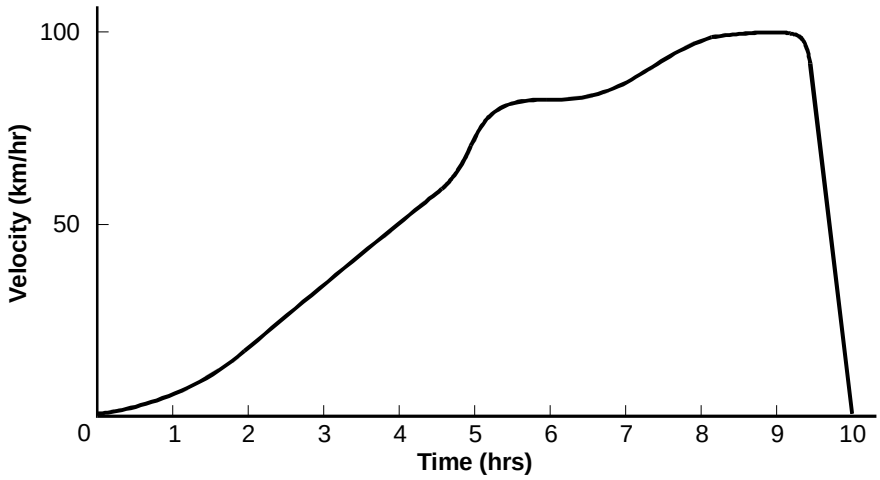
Any time spent responding to an assignment, including scanning the response sheet(s), is part of your testing time. Monitor your time carefully. When your testing time expires, a pop-up message will appear on-screen indicating the conclusion of your test session. Only response sheets that are scanned 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.**

Using your knowledge of the hydrologic cycle:

- draw and label a diagram of the hydrologic cycle that includes all the pathways of the cycle and the physical processes involved; and
- describe the transfer of energy between water and the environment as water evaporates and condenses.

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



The velocity-time graph above represents a trip made by a train.

Using your knowledge of motion and graphs:

- explain the significance of the area between the line drawn to represent the train's velocity and the horizontal axis of the graph;
- explain the significance of the slope of the velocity-time graph; and
- draw an acceleration-time graph for the same trip, with acceleration on the vertical axis and time on the horizontal axis.

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

Astronomy

1. **Correct Response: D.** (SMR Code: 1.1) Astronomers theorize that the solar system formed from a cloud of gas and dust that contracted under its own gravity and began to spin. Most of the cloud gravitated toward the center of this spinning disk, forming the sun. Smaller amounts of matter spun in separate eddies, creating nuclei around which evolving planetesimals formed.

2. **Correct Response: B.** (SMR Code: 1.1) The Hertzsprung-Russell diagram plots the luminosity of stars as a function of their surface temperature. The luminosity increases upward on the vertical axis, while the temperature decreases left to right on the horizontal axis. The increased steepness of the graphed line above 10,000 Kelvin indicates that the change in luminosity per unit temperature increases at that point.

Dynamic Processes of the Earth

3. **Correct Response: C.** (SMR Code: 2.1) Regional metamorphism occurs during the mountain building and large-scale deformation associated with plate convergences. Large areas of metamorphic rock are formed during these episodes as compared to more limited zones created during contact metamorphism. When two plates collide, the horizontal force creates the pressures and temperatures needed to fold and melt existing rock into metamorphic rock.

4. **Correct Response: A.** (SMR Code: 2.2) Decay rates for many radioactive isotopes have been precisely measured and do not change under normal conditions on or near Earth's surface. A radioactive element in organic or inorganic material has decayed at the same rate since the material's formation. The date of the material can thus be calculated from the proportion of the original isotope to its stable end product currently found in the material.

5. **Correct Response: B.** (SMR Code: 2.3) In general, the stronger the wave action on a beach, the steeper the beach profile. From April through September 2000, the relatively small waves permitted the deposition of sand, which as the summer went on extended the beach further into the ocean. By March 2001, the large waves of winter storms had eroded the sand that had been deposited the previous summer, leaving a steep cross-sectional profile.

6. **Correct Response: D.** (SMR Code: 2.4) Unconfined sand-and-gravel aquifers are very permeable, permitting easy movement of water from the surface into the aquifer. When the amount of groundwater drawn from such an aquifer exceeds its recharge rate, the water table surrounding the well will drop to form a conical depression with the lowest point being at the well's uptake. Since streams, lakes, and wetlands overlying an unconfined aquifer are surface expressions of the elevation of the aquifer, the elevation of the water in these water bodies will also drop as they drain downward in response to the drop in elevation of the water table.

Earth Resources

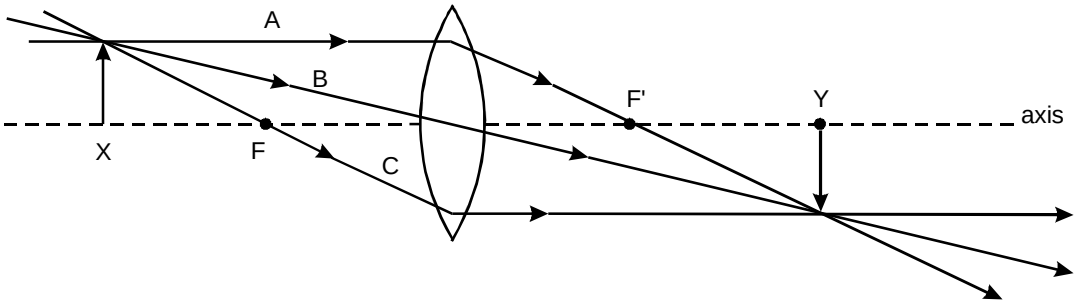
7. **Correct Response: D.** (SMR Code: 3.1) Fossil fuels take millions of years to form from organic material deposited in low-oxygen aquatic environments, such as swamps and certain marine settings. The lack of oxygen inhibits decomposition by microorganisms, and sediments cover the remains and partially preserve them. As the organic material is buried deeper, the increasing pressure causes chemical reactions to take place, transforming the material into carbon-rich coal, natural gas, and oil.

8. **Correct Response: C.** (SMR Code: 3.1) It is extremely energy-intensive to extract and purify raw ore. Although recycling also requires energy and wastes some material, it is nonetheless a more energy- and cost-efficient process. These factors have increased efforts to promote recycling.

Waves

9. **Correct Response: D.** (SMR Code: 8.1) Thomas Young's experiment provided evidence of the wave-like nature of light. When a beam of light of a single color was directed through two slits, Young observed alternating light and dark bands where the light passing through the two slits recombined. Young interpreted these findings as an interference pattern characteristic of waves, in which two colliding wave crests enhance each other, while a crest and trough cancel each other out.

10. **Correct Response: A.** (SMR Code: 8.1) Since the arrow is further from the lens than the focal point (0.1 m), the image formed is both inverted and real, i.e., able to be projected onto a surface. As shown in the diagram below, three reference light rays passing through the arrow's point converge on the opposite side of the lens to determine the image's size and orientation.



Ray A goes parallel to the axis from the arrow point to the lens and then is refracted through focal point F'. Ray B passes in a straight line directly through the center of the lens. Ray C passes from the arrow point through focal point F and then is refracted so it exits the lens parallel to the axis. The place where these rays converge indicates where the point of the projected arrow image will appear.

Forces and Motion

11. **Correct Response: C.** (SMR Code: 9.1) In the equation $v = a\Delta t$, v = velocity, a = acceleration, and Δt = the change in time. This equation assumes that the starting velocity equals 0 and can only be used to determine the velocity of an object initially at rest. If the object is already moving, then its velocity can be taken into account by adding v_0, where v_0 = the starting velocity taken at any point during the motion.

12. **Correct Response: C.** (SMR Code: 9.1) The depth to which an object will be submerged is based on how much water the object's weight can displace. If the object's density is only 25% that of water, then it can only displace 25% of an equal volume of water. When the rectangular solid floats in the water, the upward buoyant force exerted by the water equals the downward force of the solid's weight. This balancing of forces occurs when 25% of the solid's volume, or 125 cm^3, is submerged.

13. **Correct Response: B.** (SMR Code: 9.1) Pascal's law states that pressure applied to an enclosed fluid is transmitted equally throughout the liquid and container walls. Therefore when 100 N of force is applied to piston X, the pressure of the enclosed water increases throughout the container and exerts a force on piston Y equal to the ratio of the areas of the two pistons. Since the area of piston Y is four times that of piston X, the upward force of piston Y is four times 100 N, or 400 N.

Electricity and Magnetism

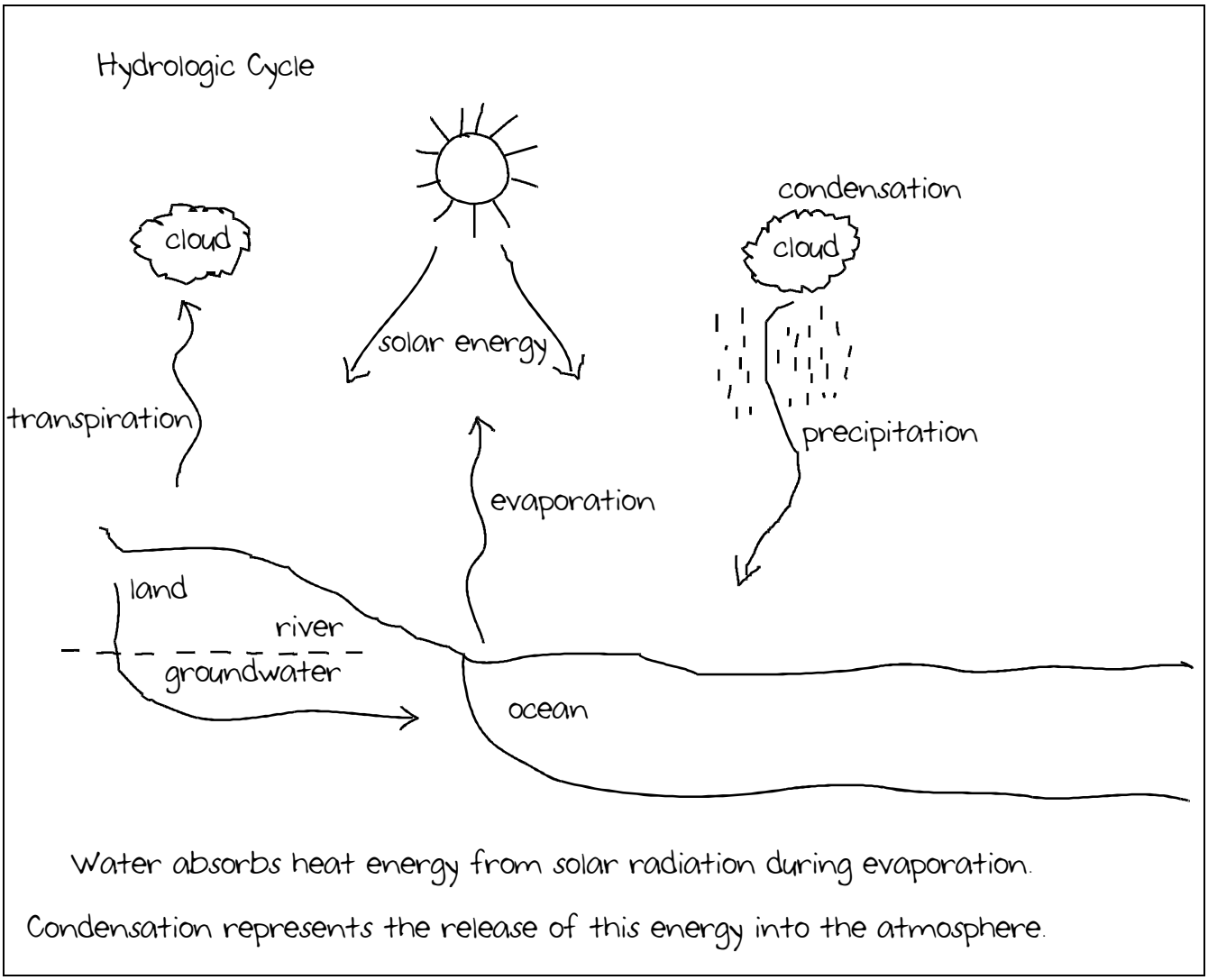
14. **Correct Response: A.** (SMR Code: 10.1) Each electron carries an electrical charge approximately equal to -1.60×10^{-19}. Robert Millikan discovered this experimentally by showing that the oil droplets had an electrical charge equal to some whole-number multiple of this number. After measuring the charge of thousands of oil droplets, he calculated the charge for a single electron by noting the smallest possible difference in charge found between the oil droplets.

15. **Correct Response: B.** (SMR Code: 10.1) This device is a step-down transformer used to decrease voltage. Each output-side winding receives the same voltage, induced magnetically from the alternating current in the input windings. The voltages of the output windings simply add together: more windings give a proportionate increase in voltage, fewer windings give a proportionate decrease. Thus, if more input than output windings are present, the voltage will drop.

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

Dynamic Processes of the Earth

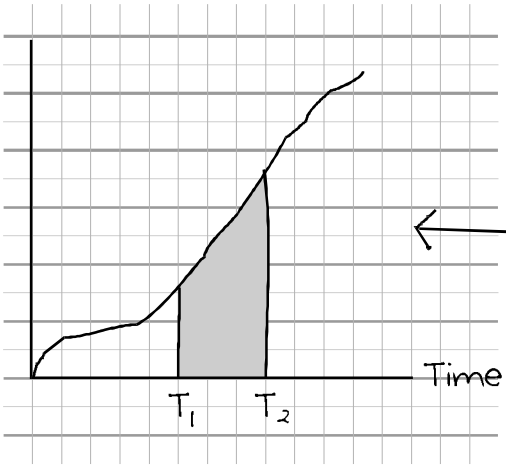
Question #16 (Score Point 3 Response)



Forces and Motion

Question #17 (Score Point 3 Response)

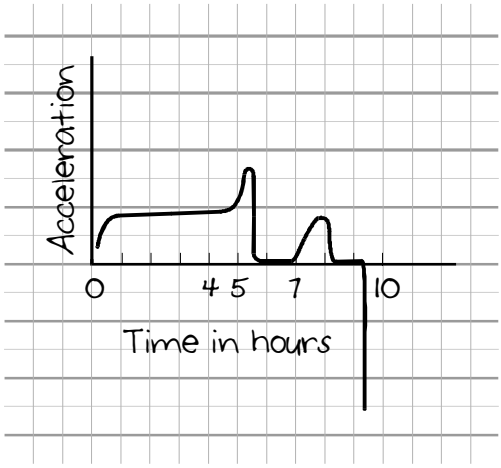
Since velocity = distance over time; velocity x time = distance



distance covered between times T_1 and T_2

So, the area represents the total distance traveled between the two times.

Slope = rise/run = $\triangle v/\triangle t$ the rate of change of speed. This is acceleration, as shown in diagram below.



Scoring Information for CSET: Science Subtest I

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 I 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 23).

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 I

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

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 I

Scores will be assigned to each response to the constructed-response questions on CSET: Science Subtest I 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 subject matter requirements for CSET: Science.** • 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.
2	**The "2" response reflects a general command of the relevant knowledge and skills as defined in the subject matter requirements for CSET: Science.** • 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.
1	**The "1" response reflects a limited or no command of the relevant knowledge and skills as defined in subject matter requirements for CSET: Science.** • 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.
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.**