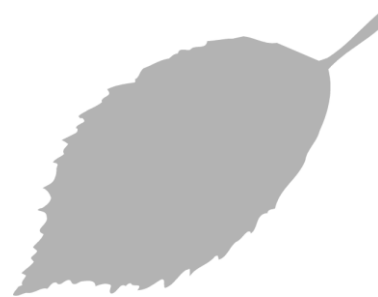


**Massachusetts
Tests for Educator Licensure® (MTEL®)**



**Earth
Science (14)**

PRACTICE TEST



www.mtel.nesinc.com

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INTRODUCTION

This document is a printable version of the Massachusetts Tests for Educator Licensure® (MTEL®) Earth Science (14) Online Practice Test. This practice test is a sample test consisting of 100 multiple-choice questions and 2 open-response item assignments.

To assist you in recording and evaluating your responses on the practice test, a [Multiple-Choice Answer Sheet](#), an [Answer Key Worksheet](#), and an [Evaluation Chart](#) by test objective are included for the multiple-choice questions. A blank [Response Sheet](#), [Evaluation Information](#), and [Sample Responses and Analyses](#), as well as a [Scoring Rubric](#), are included for the open-response items. Lastly, there is a [Practice Test Score Calculation](#) worksheet.

PURPOSE OF THE PRACTICE TEST

The practice test is designed to provide an additional resource to help you effectively prepare for the MTEL Earth Science (14) test. The primary purpose of the practice test is to help you become familiar with the structure and content of the test. It is also intended to help you identify areas in which to focus your studies. Education faculty and administrators of teacher preparation programs may also find this practice test useful as they help students prepare for the official test.

TAKING THE PRACTICE TEST

In order to maximize the benefits of the practice test, it is recommended that you take this test under conditions similar to the conditions under which the official MTEL tests are administered. Try to take the practice test in a quiet atmosphere with few interruptions and limit yourself to the four-hour time period allotted for the official test administration. You will find your results to be more useful if you refer to the answer key only after you have completed the practice test.

INCORPORATING THE PRACTICE TEST IN YOUR STUDY PLAN

Although the primary means of preparing for the MTEL is your college education, adequate preparation prior to taking or retaking the MTEL test is strongly recommended. How much preparation and study you need depends on how comfortable and knowledgeable you are with the content of the test.

The first step in preparing to take the MTEL is to identify what information the test will address by reviewing the objectives for your field. A complete, up-to-date list of the [Test Objectives](#) is included in the [Test Information Booklet](#) for each test field. The test objectives are the core of the testing program and a helpful study tool. Before taking or retaking the official test, focus your study time on those objectives for which you wish to strengthen your knowledge.

This practice test may be used as one indicator of potential strengths and weaknesses in your knowledge of the content on the official test. However, because of potential differences in format and difficulty between the practice test and an official MTEL Earth Science (14) test, it is not possible to predict precisely how you might score on an official MTEL Earth Science (14) test. Keep in mind that the subareas for which the test weighting is greatest will receive emphasis on this test. Refer to the [Test Information Booklet](#) for additional information about how to prepare for the test.

**EARTH SCIENCE
PRACTICE TEST**

GENERAL TEST DIRECTIONS

This practice test consists of two sections: (1) a multiple-choice question section and (2) an open-response item assignment section. Each multiple-choice question on the practice test has four answer choices. Read each question carefully and choose the ONE best answer. Record each answer on the answer sheet provided.

- Sample Question:
1. What is the capital of Massachusetts?
 - A. Worcester
 - B. New Bedford
 - C. Boston
 - D. Springfield

The correct answer to this question is C. You would indicate that on the answer sheet.

The open-response section of this practice test requires written responses. Directions for the open-response item assignments appear immediately before those assignments.

You may work on the multiple-choice questions and open-response item assignments in any order that you choose. You may wish to monitor how long it takes you to complete the practice test. When taking the actual MTEL Earth Science (14) test, you will have one four-hour test session in which to complete the test.

MULTIPLE-CHOICE ANSWER SHEET

Question Number	Your Response
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Question Number	Your Response
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MULTIPLE-CHOICE QUESTIONS

1. A hypothesis provides which of the following in a scientific investigation?
 - A. a question that can be answered by researching existing literature
 - B. a format for outlining the approach to be used in the investigation
 - C. a summary of previous research on the topic being investigated
 - D. a proposed explanation for the phenomena being investigated

2. In order to isolate the relationship between two variables in an experiment, scientists must:
 - A. carry out the experiment in a laboratory setting.
 - B. predict the full range of possible outcomes of the experiment.
 - C. control the conditions under which the experiment is carried out.
 - D. limit the scope of the experiment to the investigation of known facts.

3. A climatologist is investigating the causes of an extended drought in a particular region. Which of the following questions would provide the best foundation for the climatologist's investigation into the causes of the drought?
 - A. How could the drought conditions in the region best be managed?
 - B. What variables affect the region's precipitation during droughts?
 - C. How long did other droughts in the region last?
 - D. Why do droughts strike only in certain regions and not others?

4. A scientist is investigating the source of a petroleum contaminant in a high-yield drinking-water well. The well is deep and draws from a confined aquifer. Test wells drilled immediately to the north and to the east of the well are found to be contaminated. Test wells drilled to the south and west are not. The scientist concludes that the contaminant must be coming from the north and east. Which of the following factors would most reduce the validity of the scientist's conclusion?
- A. The contaminated test wells are on the up-gradient side of the drinking-water well where groundwater in the confined aquifer flows toward the well.
 - B. The uncontaminated samples were collected when the pump for the drinking-water well was on, while the other samples were collected when it was off.
 - C. The contaminated samples were collected on the same day by different people.
 - D. The uncontaminated test wells were drilled to a depth that is above the confined aquifer supplying water to the drinking-water well.
5. A researcher is analyzing data collected for a study of climate change. Which of the following actions by the researcher would most strongly bias the analysis?
- A. noting flaws in the research design that may have generated faulty data
 - B. removing data that significantly differ from expected results
 - C. altering the graphical presentation of the data set to make it more readable
 - D. summarizing data collected on a daily basis into a weekly average
6. A hydrologist is collecting water samples to determine the dissolved oxygen content of a pond that has become choked with weeds. To most closely reflect the actual dissolved oxygen content of the pond water, which of the following methods should the hydrologist use to collect the water samples?
- A. The water should be collected from below the pond's surface in various locations, filling and then sealing the containers rapidly and recording the locations.
 - B. The samples should be collected from the pond's surface near the outlet where the water is moving rapidly and few weeds are growing.
 - C. The water should be collected from near the bottom, making sure to leave some air space in the container and including some of the organic matter found in the pond.
 - D. The samples should be collected near the pond's inlet and should avoid including any organisms or debris that may be in the water.

7. A researcher investigating the geologic history of a region collects data on the orientation of a limestone layer exposed along a highway. The convention for reporting the orientation of the limestone layer typically would include which of the following information?
- A. the meters below the land surface of different sections of the top of the exposed part of the limestone
 - B. the angle between an imaginary vertical line and the uppermost surface of the limestone
 - C. the degree measurements that show the strike and dip of the bedding plane of the limestone
 - D. the thickness of the limestone and how it has changed from its original horizontal position
8. Hydrologists are helping establish the variability of discharge on a particular river. They determine the average discharge of the river over the past 100 years using historical data. Which of the following is the best measure of the variability of this data set?
- A. the median
 - B. the standard deviation
 - C. the mode
 - D. the arithmetic mean
9. A scientist collects 50 years of temperature data from the Midwest that show a steady increase in daytime summer temperatures. Which of the following is the best way for the scientist to use these data to make predictions about how the average temperatures may increase in the coming years?
- A. Plot the data set and extend the line of best fit into the coming years.
 - B. Take the median of the data set and add that to the average temperature for each coming year.
 - C. Determine the range of the data set and assume any future increases will be within that range.
 - D. Calculate the total change over time in the data set and assume it reflects the minimum increase in the future.

10. Which of the following is the best example of using a physical model to understand a complex natural system?
- A. Paleontologists reconstruct the habitat of an extinct fossilized animal by examining the type of rock in which the animal was found and the associated plant fossils.
 - B. Meteorologists use historical data correlating sunspot cycles with short-term temperature changes to predict winter weather several years in advance.
 - C. Geologists measure changes in the speed and direction of seismic waves produced by explosions or earthquakes to locate deposits of oil and natural gas.
 - D. Oceanographers study damage produced when 25 cm waves are generated in a scaled-down replica of San Francisco Bay to assess how a tsunami might affect the region.

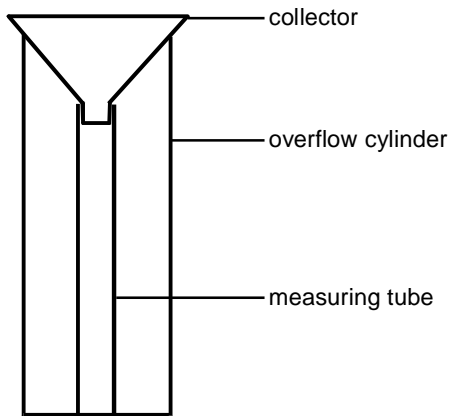
11. Use the graphic below to answer the question that follows.



The map symbol shown above typically appears at the bottom of a topographic map and is known as the declination. A scientist reading the map in the field uses the declination for which of the following purposes?

- A. estimating the relief between two distant points on the map
 - B. adjusting the latitude and longitude values on a flat map to account for Earth's spherical shape
 - C. assessing the approximate distance to locations represented on the map
 - D. determining the difference between true north as it is represented on the map and magnetic north
12. Which of the following would be an appropriate use of global positioning system (GPS) technology?
- A. monitoring the motion and development of a storm system
 - B. locating the latitude and longitude of a geologic outcrop in the field
 - C. estimating the percent of land area covered in forest vegetation
 - D. calculating the moisture content of soil over a large geographic area

13. Use the graphic below to answer the question that follows.



The standard rain gauge shown above has a long, narrow measuring tube and a funnel-shaped collector at the top. The area of the top of the collector is 10 times greater than that of the measuring tube. This difference between the cross-sectional area of the measuring tube and the collector is designed to:

- A. ensure that the rainfall measured represents a realistic average.
- B. reduce the effect of wind on rainfall accumulation.
- C. minimize the amount of splashed rainwater that can enter the device.
- D. provide a more precise measurement of total rainfall.
14. Before using a pH meter to determine the pH of a water sample, it is important to do which of the following to ensure the resulting reading will be accurate?
- A. The sample should be refrigerated in a sealed container.
- B. The meter should be calibrated with a buffer solution.
- C. The sample should be filtered to remove any organic matter.
- D. The meter should be allowed to warm up.
15. Following an outdoor field trip, a student reports to the teacher that he has a tick imbedded in his skin. The appropriate procedure for the teacher to follow upon discovering the imbedded tick is to:
- A. have the student call his parents to inform them that he has possibly contracted Lyme disease.
- B. leave the tick alone and inform the student that he needs to visit his doctor as soon as possible.
- C. have the school nurse remove the tick from the student immediately and save it for identification.
- D. encourage the student to remove the tick himself and report the matter to his parents.

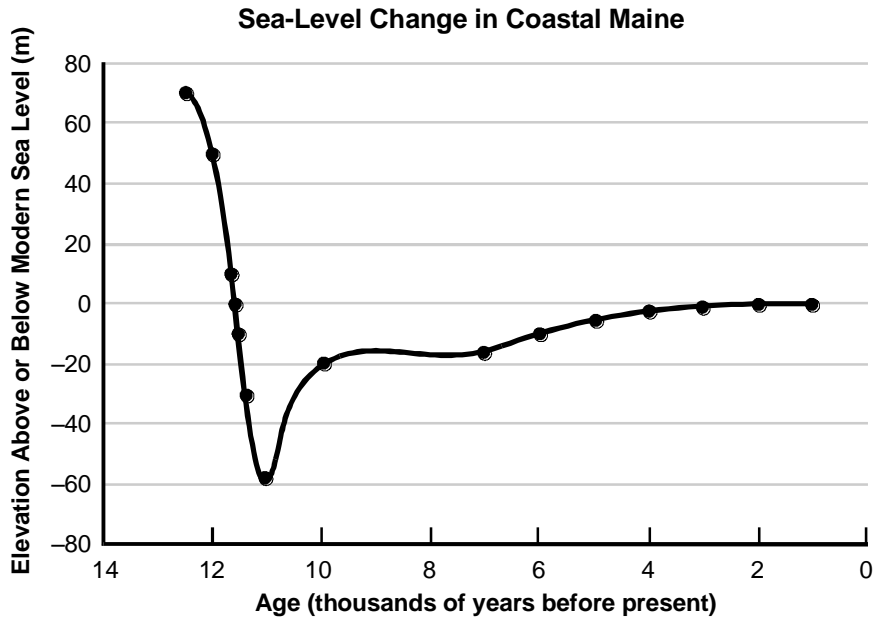
16. In 1965, two researchers detected cosmic background radiation coming from all directions in space. This discovery provided the first direct evidence of the:
- A. earliest formation and expansion of the universe.
 - B. presence of black holes at the center of the Milky Way galaxy.
 - C. massive size and homogeneity of the universe.
 - D. bending of light by large gravitational fields.
17. When Alfred Wegener proposed that the continents had changed position over time, many scientists rejected his proposal even though some of the evidence he presented was compelling. Which of the following describes the primary scientific reason many geologists originally rejected Wegener's continental drift proposal?
- A. He was trained in a different scientific discipline and was considered an amateur.
 - B. His hypothesis lacked a convincing mechanism to explain what forces moved the continents.
 - C. He did not defend and argue the merits of his ideas since the evidence was strong.
 - D. His field work was poorly executed and lacked the rigor associated with most sciences of the day.
18. The significant increase of which of the following interactions between Earth systems has the greatest potential to indirectly cause a rise in sea level?
- A. deforestation of tropical regions, reducing carbon sequestration by the biosphere
 - B. pollution of coastal waters with agricultural runoff, triggering algal blooms
 - C. eruption of low-latitude volcanoes, producing a change in atmospheric chemistry
 - D. desertification of semi-arid lands, generating wind-blown dust in the troposphere

19. The development and marketing of new technologies have often been done without understanding the long-term consequences that adopting such technologies may have on society. The most serious example of a technology that ultimately had a major effect on human health and the environment was the introduction and use of:
- A. radioactive isotopes for tracing the location of diseased tissue.
 - B. chlorofluorocarbons for air-conditioning.
 - C. lithium-ion batteries for powering digital devices.
 - D. electromagnetic waves for sending data across great distances.
20. Media accounts of major hurricanes often mention a growing concern that global warming will increase the frequency of major hurricanes affecting the United States. Most climatologists are uncomfortable with this kind of statement from the media primarily because it is:
- A. a generalization that does not accurately reflect the complexity of research on the topic.
 - B. an unsubstantiated rumor without any support in the broader scientific community.
 - C. a government issue that only official agencies should address to avoid unnecessarily scaring the public.
 - D. an unethical strategy for selling news that may cause disruption to the larger economy.
21. Bowen's reaction series helps geologists explain the occurrence of various minerals in a particular igneous rock primarily because it defines the:
- A. temperature at which different minerals in a magma will solidify.
 - B. rate at which crystals grow within a cooling magma.
 - C. chemical changes that occur after a rock has solidified.
 - D. crystal systems that will develop as a rock forms under pressure.
22. Which of the following is a characteristic of muscovite mica and biotite mica that makes them easy to identify?
- A. specific gravity
 - B. chemical reactivity to acid solutions
 - C. conchoidal fracture
 - D. perfect cleavage in one direction

23. Economically valuable minerals, such as gold and silver, are often found in the country rock surrounding large plutons. The formation of these types of minerals under these conditions is commonly the result of:
- A. isostatic readjustment.
 - B. magmatic differentiation.
 - C. hydrothermal alteration.
 - D. chemical weathering.
24. Carbon is cycled through the atmosphere, the hydrosphere, the biosphere, and the lithosphere. Which of the following describes one step in the movement of carbon from the atmosphere to the lithosphere?
- A. the production of carbonic acid from limestone during weathering
 - B. the extraction of bicarbonate ions from seawater during coral reef formation
 - C. the formation of carbon dioxide during the decay of biomass
 - D. the absorption of atomic carbon in seawater by deep-ocean sediments
25. Small-scale geothermal heating and cooling systems for individual homes have become popular throughout the United States. These home geothermal systems primarily rely on the:
- A. high temperature of groundwater found deep within Earth.
 - B. compression of steam pumped underground.
 - C. infrared energy given off by soils at night.
 - D. year-round stability of the temperature underground.

26. Seismologists first established the physical character of Earth's outer core based on the fact that:
- A. S waves do not pass through liquid substances.
 - B. P and S waves are reflected from solids at different angles.
 - C. P waves do not pass through high-temperature materials.
 - D. P and S waves are refracted differently from irregular surfaces.
27. Studies during the 1950s and 1960s showed that the ferromagnetic minerals in ocean-floor basalts aligned with Earth's magnetic field when the basalts were still molten. This information provided evidence supporting:
- A. the theorized stability of Earth's rotational velocity.
 - B. a four-billion-year-old estimate of Earth's age.
 - C. the hypothesized liquid state of the upper mantle.
 - D. a mechanism to help explain how lithospheric plates moved apart.
28. The broad shape and gentle slope of Hawaiian volcanoes are, to a great extent, a result of the erupted magma's:
- A. high gas content.
 - B. mafic composition.
 - C. low iron content.
 - D. felsic composition.
29. Which of the following are landscape features typically associated with an active strike-slip fault?
- A. hanging valleys and tarns
 - B. kame terraces and eskers
 - C. horsts and grabens
 - D. scarps and sag ponds

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

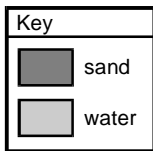
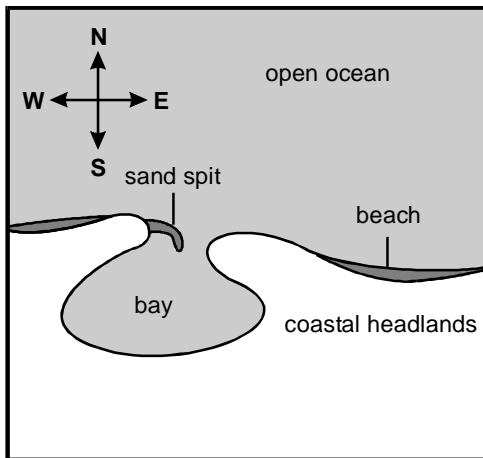


The graph above shows the approximate change in sea level along the coast of central Maine over the past 13,000 years. Which of the following is primarily responsible for the sudden drop in sea level that occurred along Maine's coast between 12,500 years ago and 11,500 years ago?

- A. isostatic rebound of the bedrock crust resulting from the melting of continental glaciers
- B. rapid erosion of unconsolidated glacial deposits due to climate changes
- C. tectonic uplift of the region resulting from the subduction of the North American plate
- D. sudden resurgence of continental glaciers due to major shifts in ocean circulation

31. Lichens, plant roots, and fungi are able to chemically weather rock. These organisms typically accomplish this by:
- A. drawing molecular water from the crystals that make up the rock.
 - B. producing acids that cause the decomposition of the rock.
 - C. extracting minerals directly from the rock through osmosis.
 - D. manufacturing salts that alter the rock's crystal structure.
32. Which of the following properties of water is primarily responsible for its role in mechanical weathering?
- A. Water increases in density as it goes from 0°C to 4°C and then decreases above 4°C.
 - B. The capacity of liquid water to store heat energy is very high.
 - C. The hydrogen bonding between water molecules gives it a high surface tension.
 - D. Water increases in volume as it goes from a liquid to a solid state.
33. In some desert regions, a thin layer of closely packed pebbles and cobbles covers the ground surface. This phenomenon, known as desert pavement, is primarily caused by the:
- A. differential erosion of sediments by wind.
 - B. slow dispersal of material from the base of alluvial fans by gravity.
 - C. breakup of bedrock under hot and dry conditions.
 - D. deposition of coarse-grained sediments during flash flooding.
34. In New England, it is common to find striations in the surface of exposed rock outcrops. These linear grooves are primarily produced by:
- A. ice that is well below its freezing point at the base of surging glaciers.
 - B. extreme temperature changes that produce fractures in the bedrock underlying glaciers.
 - C. large rocks that are embedded in the base of glaciers.
 - D. silt-rich water under tremendous pressure at the base of continental glaciers.

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



Which of the following best explains the formation of the sand spit across the entrance to the bay shown in the above diagram?

- A. Coastal winds blowing from the east move sand from the beach to the entrance of the bay where tides alter the shape of the deposit.
- B. Longshore currents flowing from the west slow down and deposit sand where they cross the entrance to the bay.
- C. Tidal currents flowing north and south slow down and deposit sand where they flow in and out of the entrance of the bay.
- D. Ocean waves move the beach sand toward the west where it is carried into the entrance of the bay and modified by tidal currents.

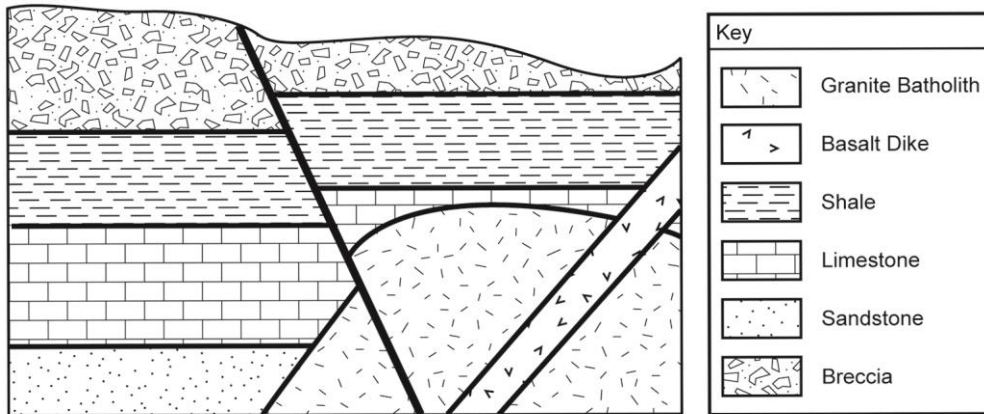
36. During which of the following epochs was Long Island, Cape Cod, and Martha's Vineyard formed?

- A. Eocene
- B. Miocene
- C. Pliocene
- D. Pleistocene

37. The extensive coal beds that formed during the Pennsylvanian period are primarily made from:

- A. the compressed remains of microscopic marine organisms.
- B. solidified oil deposits that were slowly heated over millions of years.
- C. the fossilized remains of swamp vegetation.
- D. lithified mud deposited when shallow seas covered parts of North America.

38. Use the graphic below to answer the question that follows.



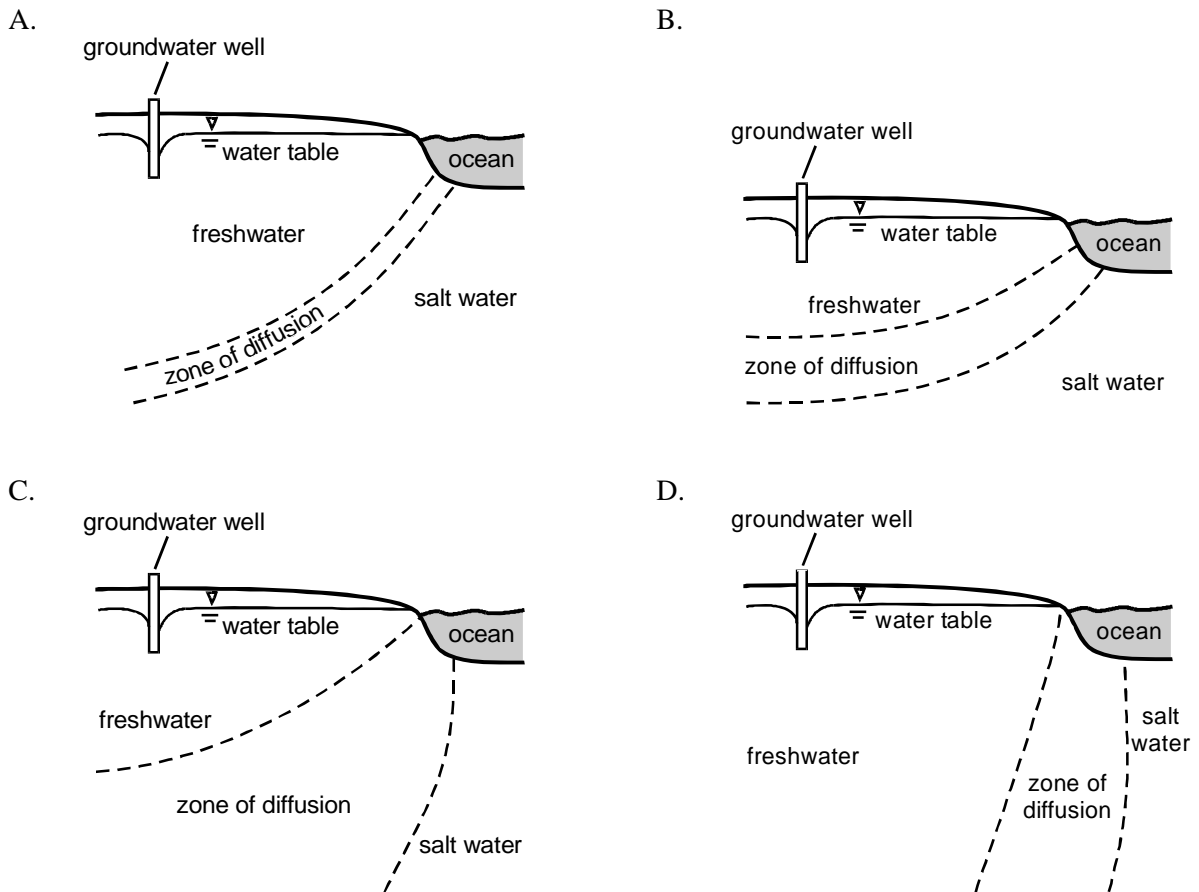
No overturned strata. Not to scale.

In the geologic cross section shown above, a fault has offset the geologic features exposed in the cross section. Which of the following statements about the sequence of geologic events is confirmed by the relationships in the cross section?

- A. The basalt dike was intruded after the faulting occurred.
- B. The granite batholith was intruded after the breccia was deposited.
- C. The fault occurred while the shale was being deposited.
- D. The basalt dike was intruded after the sandstone was deposited.

39. Measuring the age of a lava flow by radiometric dating requires:
- A. comparing the proportion of radioactive parent isotope to stable daughter product in the rock.
 - B. assessing the level of radioactivity emitted by the isotopes in a sample of the rock with a Geiger counter.
 - C. evaluating the changes in the rock's mineral structure to determine the sample's exposure to ionizing radiation.
 - D. analyzing changes in the atomic number of the radioactive isotopes in the rock by measuring beta and alpha emissions from a sample.
40. Graded bedding in a sedimentary rock is an indication of which of the following depositional environments?
- A. desert
 - B. high-energy beach
 - C. marginal marine
 - D. alluvial fan
41. Water in its solid form is less dense than water in its liquid form. This characteristic is primarily a result of the:
- A. rigid three-dimensional structure of ice that keeps water molecules from getting too close to each other.
 - B. high viscosity of liquid water that makes its molecules more closely packed than other liquids.
 - C. internal kinetic energy of ice that keeps the molecules in ice relatively far apart due to their rapid vibration.
 - D. high heat capacity of liquid water that allows it to store energy with only a small change in volume.
42. The High Plains Aquifer extends from South Dakota to central Texas. Since the early 1900s, the surface of the aquifer has dropped significantly in parts of Texas, Oklahoma, and Kansas. This change in the aquifer is primarily due to which of the following?
- A. a reduction in forest cover from logging that has increased evaporation rates from exposed soils overlying the aquifer
 - B. a shift in climate conditions during the past 100 years that has reduced the water available for aquifer recharge
 - C. the compaction of soils from mechanized farming that has reduced the permeability of soils overlying the aquifer
 - D. the withdrawal of water for agricultural use that has been greater than the aquifer's recharge rate from precipitation

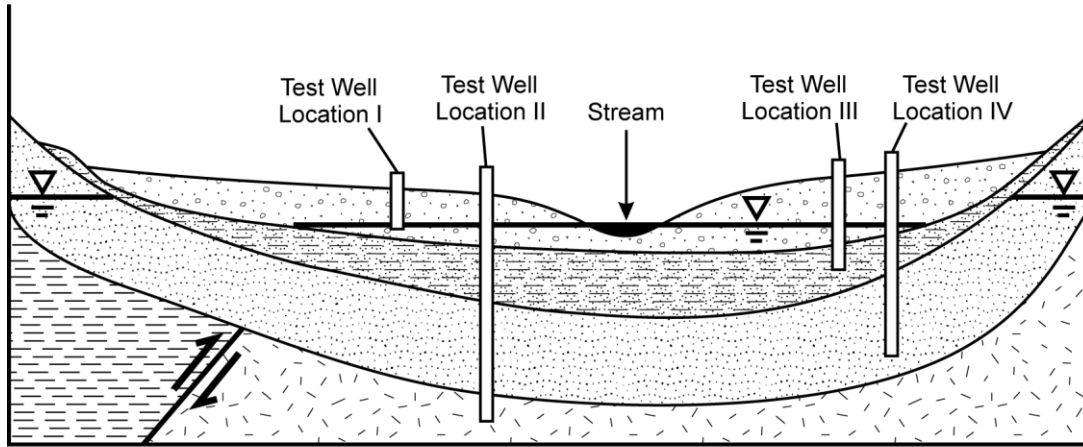
43. In a coastal freshwater aquifer where withdrawals are in equilibrium with the recharge rate, which of the following diagrams best represents the interface between salt water and freshwater?



44. The hydraulic conductivity of a sediment is a measure of the rate at which the sediment can transmit water. Which of the following sediments is likely to have the greatest hydraulic conductivity?

- A. a poorly sorted mixture of fine- and medium-sized sand grains
- B. a well-sorted silt deposit
- C. a poorly sorted mixture of clay and small gravel
- D. a well-sorted coarse-sand deposit

Use the information below to answer the three questions that follow.



No overturned strata. Not to scale.

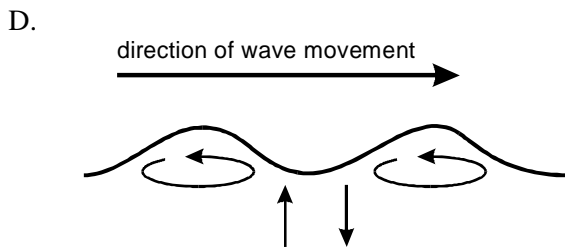
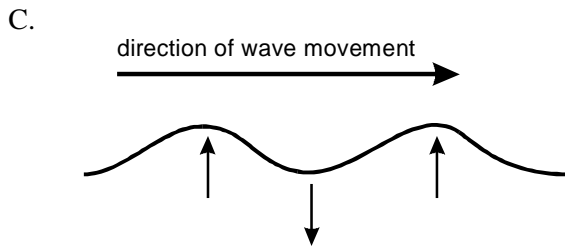
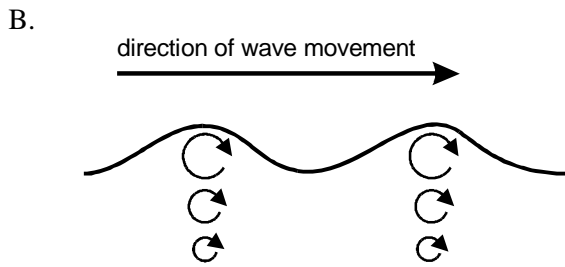
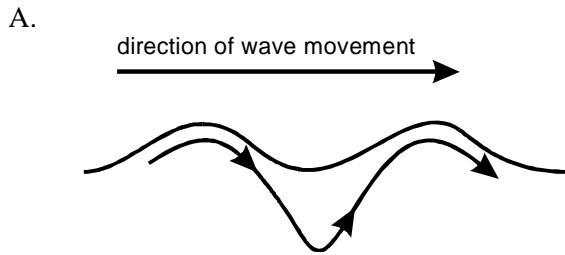
Key	
	Granite
	Shale
	Medium Sand
	Sand and Gravel
	Clay Aquitard
	Water Table Surface
	Fault Zone

The above geologic cross section of a New England river valley shows two distinct aquifers, the underlying bedrock geology, and the sedimentary deposits overlying the bedrock. Four test wells have been drilled in the valley to different depths in an attempt to locate a high-yield groundwater supply for a town in the area.

45. Which of the following explains the primary reason why the water table surfaces of the two different aquifers are at different elevations?
- A. The water in the medium sand is confined by the clay layer and does not interact with the unconfined surface aquifer.
 - B. The water from the stream is seeping into the surrounding sand and gravel, keeping it at the same level as the stream surface.
 - C. The recharge of groundwater on the hillsides of the valley is greater than it is in the center of the valley due to the greater slope.
 - D. The recharge volume of both aquifers is affected by differences in the sediments through which surface waters percolate into the ground.
46. In which of the following test well locations will the depth and location of the well shown in the cross section be most likely to yield a regular and abundant source of groundwater throughout the year?
- A. test well location I
 - B. test well location II
 - C. test well location III
 - D. test well location IV
47. Other than precipitation, which of the following is the most likely direct source of water for the aquifer composed of the medium sand deposit?
- A. shale
 - B. stream
 - C. fault
 - D. granite

48. Which of the following ocean surface water masses is likely to have the greatest density?
- A. cold and relatively high salinity waters of the North Atlantic Ocean
 - B. warm and high salinity waters of the Caribbean Sea
 - C. cold and moderately saline waters of the equatorial eastern Pacific Ocean
 - D. warm and low salinity waters of the South China Sea
49. In recent years, scientists have documented a drop in the salinity of the North Atlantic Ocean. The primary concern of scientists studying this phenomenon is that a large drop in the salinity of North Atlantic water would affect the:
- A. acidity of the surface water in one of the world's most important fisheries.
 - B. amount of precipitation in the temperate latitudes of the Northern Hemisphere.
 - C. rate at which heat is transferred northward by the Gulf Stream.
 - D. formation of sea ice in a region already under stress from climate change.
50. The movement of deep-ocean currents is driven primarily by which of the following?
- A. the transfer of surface wave energy through friction
 - B. gravitational effects of the Moon
 - C. the orbit and rotational motion of Earth
 - D. temperature and salinity gradients

51. Which of the following cross-sectional diagrams best depicts the motion of water particles in a nonbreaking ocean wave?



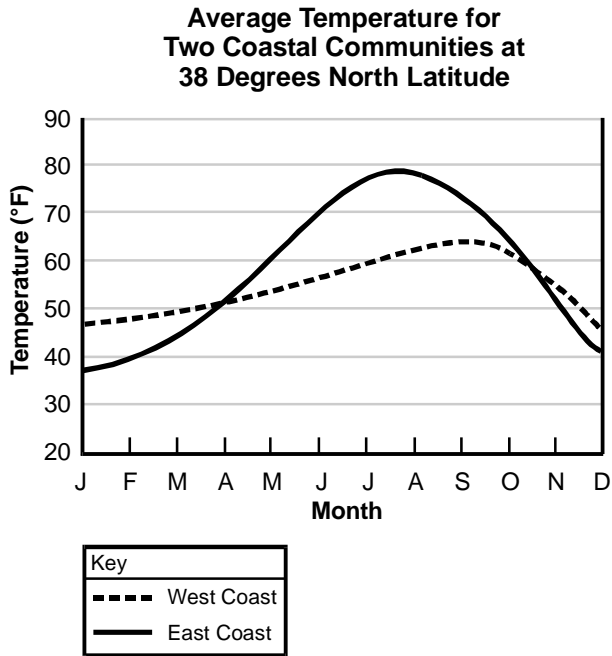
52. Over the past 50 years, the Mississippi Delta has diminished in size as the Gulf of Mexico has flooded many areas that were previously above sea level. This has been primarily the result of which of the following processes?
- A. overuse of groundwater resources and the consequent sinking of the land surface of the delta
 - B. downwarping of the North American plate and the resulting drop in the overlying delta deposits
 - C. increased frequency of major tropical storms and the related increase in erosion of the delta
 - D. reduced replenishment of sediment and ongoing compaction of delta deposits
53. The narrow longshore currents that transport sand grains along the immediate coastline are primarily produced by:
- A. tidal forces that fluctuate throughout the day.
 - B. local winds that blow parallel to the beach.
 - C. waves that strike the beach at an angle.
 - D. beach runoff that carries water back into the surf.
54. Which of the following sedimentary rocks would most likely have formed from sediments accumulating in a deep-ocean trench?
- A. shale
 - B. sandstone
 - C. breccia
 - D. limestone
55. Submerged flat-topped seamounts called guyots are found in a variety of locations in the world's oceans. These guyots are typically formed through which of the following processes?
- A. the growth of coral reefs
 - B. the accumulation of marine diatoms
 - C. the erosion of volcanic islands
 - D. the uplift of tectonic plate fragments

56. Scientists believe that submarine canyons that formed well below sea level and cut to the bottom of the continental rise most likely were produced when:
- A. fine-grained marine sediments of the continental shelf were fractured by the weight of the overlying water.
 - B. geologic faults lying perpendicular to the continental shelf ruptured, offsetting overlying sediments.
 - C. turbidity currents scoured channels in the unconsolidated sediments of the continental shelf.
 - D. dense freshwater from coastal rivers flowed down over the continental shelf, eroding soft marine muds.
57. The Atlantic Ocean began to form as a result of which of the following geologic events?
- A. the erosion of a plate margin from repeated continental glaciations
 - B. the subduction of one continental plate beneath another
 - C. the development of a large syncline east of the Appalachian Mountains
 - D. the growth of a rift valley along a major fracture zone in the crust
58. Which of the following geologic structures is characteristic of a passive continental margin?
- A. a thick sedimentary platform
 - B. an inundated forearc basin
 - C. a complex accretionary wedge
 - D. an active fault zone
59. Which of the following organisms is most responsible for fixing atmospheric carbon dioxide to create organic molecules?
- A. coral polyps
 - B. bacteria
 - C. phytoplankton
 - D. protozoa

60. Which of the following is a critical part of the increase in primary productivity that occurs during the summer months in the Arctic Ocean?
- A. Increased sunlight supports sustained growth of phytoplankton.
 - B. Seasonal influx of nutrients from snowmelt stimulates the rapid growth of algae.
 - C. Mixing of deep water with surface water brings essential nutrients up to the photic zone.
 - D. Spring winds cause increased oxygenation of the surface waters, promoting zooplankton blooms.
61. The colorful displays in the atmosphere known as the aurora borealis result from which of the following?
- A. the nuclear disintegration of radioactive isotopes in the thermosphere during solar storms
 - B. the combustion of dust particles in the stratosphere during the peak of the sunspot cycle
 - C. the chemical reaction of molecules in the troposphere from ionizing solar radiation
 - D. the excitation of gases caused by the interaction of the solar wind and the magnetosphere
62. Which of the following explains why the sky appears blue?
- A. Air molecules selectively scatter the shorter wavelengths of visible light.
 - B. Air molecules reflect the longer wavelengths of visible light.
 - C. Water vapor refracts visible light into its component frequencies.
 - D. Water vapor selectively absorbs visible light at certain wavelengths.

63. Overcast nights tend to be warmer than clear nights even when temperatures on the preceding day have been the same. This is primarily because on overcast nights:
- A. evaporation rates are substantially reduced.
 - B. clouds radiate infrared energy downward.
 - C. convection currents are unable to develop.
 - D. water vapor condenses, releasing energy.
64. As a result of the Coriolis effect, wind currents tend to:
- A. cool off as they converge and rise.
 - B. flow in a straight path as they cross lines of longitude.
 - C. heat up as they diverge and sink.
 - D. curve as they flow over Earth's surface.
65. An occluded front typically forms under which of the following conditions?
- A. A wedge of cool air between two warm fronts is forced upward as one of the fronts overtakes the other.
 - B. A cold front catches up with a warm front, forcing warm air between the fronts upward and producing rain.
 - C. A wedge of cold air between two warm fronts is forced upward as one of the fronts overtakes the other.
 - D. A cold front overrides another cold front, trapping warm air at the surface and producing rain.
66. Which of the following climate characteristics is the primary factor controlling the type of vegetation in the prairie of the upper Midwest?
- A. strong seasonal winds
 - B. limited annual precipitation
 - C. regular grass fires
 - D. temperature extremes

67. Use the chart below to answer the question that follows.



The chart above shows the average temperature over the course of a year in a West Coast community and an East Coast community at 38 degrees north latitude. Which of the following is the most significant factor responsible for the difference between the patterns of temperature change of the two coastal locations over the course of the year?

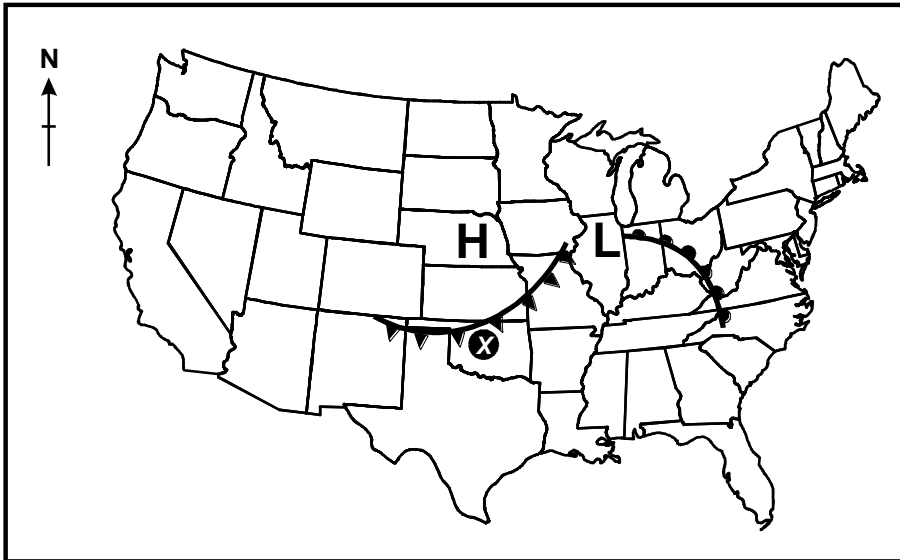
- A. the inland topography adjacent to the two locations
- B. the amount of precipitation at different times of the year
- C. the direction of large-scale winds throughout the year
- D. the moderating effect of near-shore waters in each location

68. The polar jet stream typically has a major effect on the weather of the northern half of the United States. Which of the following is a major factor responsible for increasing the wind speed in the region of the polar jet stream?
- A. the geographical shift in temperature patterns associated with the different phases of the Arctic Oscillation
 - B. the gradual drop in pressure that occurs between the troposphere and stratosphere
 - C. the steep pressure gradient that exists between very cold northern air and warmer southern air
 - D. the seasonal change in atmospheric instability over temperate and tropical oceans
69. Fossil evidence indicates that tropical conditions once existed across the United States during the late Paleozoic era. This difference in the climate of North America today and the climate during the Paleozoic era was caused primarily by changes in the:
- A. concentration of oxygen in the atmosphere.
 - B. intensity of solar radiation.
 - C. directions in which ocean currents flow.
 - D. positions of the continents.
70. Approximately 14,000 years ago, warmer conditions began to melt the Pleistocene ice sheets. This warming was suddenly interrupted around 12,700 years ago by 1,000 years of below-average temperatures in northeastern North America and northern Europe. The onset of this sudden and prolonged cold snap, known as the Younger Dryas event, was caused primarily by which of the following?
- A. a reduction in tropical air masses moving north due to a shift in the position of the subtropical jet stream
 - B. a change in the ocean currents in the North Atlantic caused by an increased input of freshwater
 - C. a decrease in the intensity of solar energy output due to changes in the Sun's magnetic field
 - D. a change in the timing of the seasons caused by variations in Earth's orbital parameters

71. In which of the following situations is energy absorbed by water?
- A. Dew forms on a lawn just before dawn in the summer.
 - B. Ice crystals grow on a window pane on a cold winter night.
 - C. Fog dissipates as the Sun rises on a fall morning.
 - D. Clouds develop over a mountain range on a warm spring day.

72. Under which of the following conditions is advection fog most likely to form?
- A. Cold air becomes trapped beneath a layer of warmer air.
 - B. Hot dry air in contact with the surface cools after sunset.
 - C. Cool moist air warms as it flows down a mountain side.
 - D. Warm moist air flows over cold ocean water.

73. Use the map below to answer the question that follows.

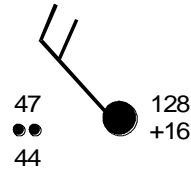


The weather map shown above depicts a cold front moving across the center of the United States during the late spring. The temperature north of the front is in the low 60s and the air mass is dry, while south of the front the temperature is in the mid-80s and it is very humid. As the cold front approaches and passes through the location marked with an X, which of the following weather conditions is most likely to develop?

- A. clear skies and light wind
- B. thunderstorms and high wind
- C. thick fog and moderate drizzle
- D. low clouds and steady light rain

74. The psychrometer is based on which of the following principles?
- A. Relative humidity can be calculated by comparing the evaporative cooling that occurs in a particular location to the air temperature.
 - B. The apparent temperature can be determined by comparing the actual temperature in a location with the relative humidity.
 - C. The density of an air mass can be calculated by comparing the molecular weight of dry air to the molecular weight of the actual air.
 - D. The adiabatic cooling of an air mass can be determined by comparing the actual pressure in a location to the theoretical sea-level pressure.

75. Use the graphic below to answer the question that follows.



The station model plot shown above indicates which of the following weather conditions?

- A. clear skies, light northwesterly winds, and rising atmospheric pressure
- B. overcast skies, light rain, moderate northwesterly winds, and rising atmospheric pressure
- C. partly cloudy skies, poor visibility, strong northwesterly winds, and rising temperature
- D. scattered clouds, light southwesterly winds, and falling atmospheric pressure

76. Climatologists have used computer models to investigate possible consequences of increased average global temperatures on various Earth systems. According to the models, which of the following changes in an Earth system is likely to occur in association with an increase in average global temperatures?
- A. Regions prone to drought will become drier, due to longer periods without adequate rainfall.
 - B. Jet stream winds will shift position more frequently, causing rapid changes in weather conditions.
 - C. Hurricanes will become less common in tropical areas, due to a strengthening of the Coriolis effect.
 - D. El Niño events will occur at longer intervals, causing anomalous weather conditions to last longer.
77. The distinguishing characteristic of the atmospheric pollutant known as particulate matter is that it comprises:
- A. acidic liquids and gases generated by fixed sources.
 - B. fragments of natural substances visible to the unaided eye.
 - C. droplets and solids small enough to be suspended in the air.
 - D. heat-trapping chemicals that absorb infrared energy.
78. Which of the following is an effective way to reduce the acid precipitation resulting from power plant emissions?
- A. reacting sulfur dioxide with calcium hydroxide by forcing exhaust through a spray of lime and water
 - B. filtering the dust particles generated by the breakdown of coal through fine mesh filtration systems
 - C. converting carbon monoxide to carbon dioxide with smokestack catalytic converters
 - D. removing volatile hydrocarbon compounds found in coal before the fuel is burned
79. Which of the following is a major challenge for climate researchers trying to establish the effect that human activities have had on global climate?
- A. determining the effect that water vapor generated from natural sources has had on climate change
 - B. compiling the evidence of climate change from different countries with a variety of concerns and priorities
 - C. measuring the subtle changes in the environment that have occurred as the global climate has warmed
 - D. distinguishing what shifts in the climate system might be exclusively due to natural long-term changes

80. Which of the following resources can be considered renewable or nonrenewable depending on how it is managed?
- A. metallic ore deposits
 - B. solar energy
 - C. freshwater aquifers
 - D. wind power
81. According to prevailing theory, which of the following led to the formation of the Moon?
- A. A minor planet orbiting between Mars and Earth was captured by Earth's gravitational field.
 - B. Debris was ejected from Earth following a collision with an interplanetary body.
 - C. A massive meteor with an elliptical orbit that passed near Earth was pulled in by Earth's gravity.
 - D. Clouds of gas and dust circling the Sun coalesced into the planets and their satellites at the same time.
82. The rotational period of the Moon exactly equals its orbital period in a phenomenon known as synchronous rotation. This characteristic of the Moon's motion is responsible for which of the following?
- A. the timing of the Moon rise being about 50 minutes later each day
 - B. the path of the Moon across the sky being from east to west
 - C. the full Moon always rising at the approximate time of sunset
 - D. the same side of the Moon always facing Earth
83. Two high tides occur almost simultaneously on opposite sides of Earth. Which of the following best describes the underlying reason that a high tide occurs on the side of Earth that faces away from the Moon?
- A. the difference in the gravitational pull on either side of Earth
 - B. the drag caused by frictional forces between water and the ocean floor
 - C. the strength of the Sun's gravitational pull on ocean water
 - D. the tilt of Earth's axis relative to the Moon's orbit

84. Which of the following explains why lunar eclipses typically occur only two or three times a year instead of each month?
- A. Earth's axis is tilted relative to the plane of its orbital path around the Sun.
 - B. The time it takes Earth to orbit the Sun is much longer than the orbital period of the Moon.
 - C. The Moon's orbital path is tilted relative to the plane of Earth's solar orbit.
 - D. The time it takes for the Moon to orbit Earth is much longer than Earth's rotational period.
85. The energy output of the Sun is maintained by which of the following processes?
- A. the conversion of hydrogen into helium in the core
 - B. the combustion of gases drawn into the chromosphere
 - C. the explosion of volatile compounds in the corona
 - D. the breakdown of high-energy particles in the photosphere
86. Scientists believe that the asteroids of the asteroid belt formed when:
- A. debris from outside the solar system was captured by the Sun's gravity.
 - B. fragments of planetesimals failed to coalesce into one or more planets.
 - C. several moons orbiting Jupiter were destroyed by meteor impacts.
 - D. dust and ice in the early solar system clumped together.
87. The Oort cloud is a region in space that scientists have determined is:
- A. the source of most comets.
 - B. an area where new stars form.
 - C. the location of the asteroid belt.
 - D. an area where a supernova occurred.

88. Which of the following is a characteristic of Venus that distinguishes it from the other seven planets?
- A. The temperature extremes on Venus are the greatest in the solar system.
 - B. Venus's orbital path is well outside of the plane of the ecliptic.
 - C. Venus's axial rotation is opposite in direction to its orbital path.
 - D. The crust of Venus is primarily composed of iron and nickel.
89. Which of the following groups of substances makes up most of a comet's nucleus?
- A. soot particles, sodium, and complex hydrocarbons
 - B. nickel, iron, and hydrogen compounds
 - C. methane, carbon, and elemental oxygen
 - D. ice, carbonaceous dust, and frozen gases
90. Which of the following best summarizes Newton's first law of motion as it relates to the Moon's orbit around Earth?
- A. The Moon's inertia keeps it moving tangent to its orbit, while Earth's gravitational field deflects it from a straight path.
 - B. The Moon's rotation keeps it on the same path, while its velocity is maintained by Earth's gravity.
 - C. The Moon's acceleration is driven by its mass, while its circular motion is maintained by its gravitational attraction to Earth.
 - D. The Moon's weight causes it to fall toward Earth, while centripetal force accelerates it away from Earth.

91. An astronomer observes rapidly fluctuating radio signals from distant galaxies that occur as precisely spaced bursts of radiation. It is likely that the astronomer has located:
- A. an expanding planetary nebula.
 - B. an oscillating black hole.
 - C. a rotating neutron star.
 - D. an eclipsing binary star system.
92. A main sequence star becomes a red giant when which of the following events occurs?
- A. the hydrogen in the star's core is used up
 - B. expansion of the core causes it to cool down
 - C. the helium in the outer layers of the star begins to fuse
 - D. combustion of gases on the star's surface causes it to expand
93. When a star such as the Sun reaches a late stage of its life, it typically becomes a:
- A. neutron star comprising the nuclei of fused iron and carbon atoms.
 - B. white dwarf comprising mainly carbon and oxygen.
 - C. black hole produced by compression of the extremely dense core.
 - D. Cepheid variable star produced by instability in the star's dying core.
94. Astronomers use which of the following properties of stars to plot them on the Hertzsprung-Russell diagram?
- A. proximity to Earth and age
 - B. lifecycle stage and spectral class
 - C. temperature and luminosity
 - D. size and composition

95. Use the table below to answer the question that follows.

Star	Apparent Magnitude	Absolute Magnitude
Sirius	-1.4	1.5
Deneb	1.3	-6.9
Betelgeuse	0.8	-5.5
Arcturus	-0.1	-0.3

The table above lists the apparent and absolute magnitudes of four stars. From this information, which of the following stars can be assumed to be the farthest from Earth?

- A. Sirius
 - B. Deneb
 - C. Betelgeuse
 - D. Arcturus
96. Redshift for some galaxies is larger than for other galaxies in different parts of the universe. This difference shows that galaxies are:
- A. concentrated in the region of space closest to Earth.
 - B. developing at different rates depending on how their mass is distributed.
 - C. clustered in different regions of space by their age.
 - D. receding from each other at different rates depending on how far away they are.

97. Astronomers have speculated about what creates different types of galaxies. The leading hypothesis is that the:
- A. collision of disk-like, relatively small galaxies produces larger spiral and elliptical galaxies.
 - B. presence or absence of a black hole determines whether a galaxy will develop into an elliptical or spiral type of galaxy.
 - C. gravitational attraction of the matter in galaxies causes them to change type as they age.
 - D. abundance or scarcity of heavy elements determines whether elliptical or spiral galaxies will form from preexisting gas clouds.
98. Which of the following provides evidence of the existence of dark matter in the universe?
- A. the redshift of distant galaxies
 - B. the high energy emitted by quasars
 - C. the rotational velocity of galaxies
 - D. the size of superclusters
99. Which of the following supported the scientific conclusion that the universe began with an inflationary expansion?
- A. the proportion of the different elements found in asteroids
 - B. the motion of galaxies receding from Earth in all directions
 - C. the variation in the density of different regions of space
 - D. the release of energy observed in nuclear fusion reactions
100. Which of the following provides evidence that the universe is expanding?
- A. the changing distance between stars in the Milky Way
 - B. the calculated distance to the cosmic horizon
 - C. the shifting of the spectral lines of galaxies
 - D. the emptiness of most regions of space

DIRECTIONS FOR THE OPEN-RESPONSE ITEM ASSIGNMENTS

This section of the test consists of two open-response item assignments that appear on the following pages. You will be asked to prepare a written response of approximately 150–300 words (1–2 pages) for each assignment. You should use your time to plan, write, review, and edit your response for each assignment.

For each assignment, read the topic and directions carefully before you begin to work. Think about how you will organize your response. You may use any blank space in this test booklet to make notes, write an outline, or otherwise prepare your response.

As a whole, your response to each assignment must demonstrate an understanding of the knowledge of the field. In your response to each assignment, you are expected to demonstrate the depth of your understanding of the subject area by applying your knowledge rather than by merely reciting factual information.

Your response to each assignment will be evaluated based on the following criteria.

- **PURPOSE:** the extent to which the response achieves the purpose of the assignment
- **SUBJECT KNOWLEDGE:** appropriateness and accuracy in the application of subject knowledge
- **SUPPORT:** quality and relevance of supporting evidence
- **RATIONALE:** soundness of argument and degree of understanding of the subject area

The open-response item assignments are intended to assess subject knowledge. Your responses must be communicated clearly enough to permit valid judgment of the evaluation criteria by scorers. Your responses should be written for an audience of educators in this field. The final version of each response should conform to the conventions of edited American English. Your responses should be your original work, written in your own words, and not copied or paraphrased from some other work.

Be sure to write about the assigned topics. Please write legibly. You may not use any reference materials during the test. Remember to review your work and make any changes you think will improve your responses.

Write or print your response in the space provided following the assignment.

OPEN-RESPONSE ITEM ASSIGNMENT #1

Use the information below to complete the exercise that follows.

You are an oceanographer designing a research project to determine how the character of a coastline might affect the severity of a tsunami striking the region. Prepare a response in which you:

- describe a plausible hypothesis that addresses the research topic;
- describe an investigation, experiment, or field study that would test the hypothesis; and
- describe the methods used in collecting and analyzing the data.

OPEN-RESPONSE ITEM ASSIGNMENT #2

Use the information below to complete the exercise that follows.

Over the past 50 years, geoscientists have collected evidence proving that the lithospheric plates have moved great distances over long periods of time. Prepare a response in which you:

- describe two types of evidence that support the extensive movement of plates over time; and
- explain the underlying mechanism most scientists believe is driving this rearrangement of the plates.

PRACTICE TEST RESULTS

PRACTICE TEST RESULTS OVERVIEW

The practice test provides valuable information regarding your preparedness for the MTEL Earth Science (14) test. In this section, you will find information and tools to help you determine your preparedness on the various sections of the test.

Multiple-Choice Questions

A Multiple-Choice Question Answer Key Worksheet is provided to assist you in evaluating your multiple-choice responses. The worksheet contains five columns. The first column indicates the multiple-choice question number, the second column indicates the objective to which the test question was written, and the third column indicates the correct response. The remaining columns are for your use in calculating the number of multiple-choice questions you answered correctly or incorrectly.

An Evaluation Chart for the multiple-choice questions is also provided to help you assess which content covered by the test objectives may require additional study.

Open-Response Items

Evaluation Information, Sample Responses and Analyses, as well as a Scoring Rubric are provided for these items. You may wish to refer to this information when evaluating your practice test responses.

Total Test

Practice Test Score Calculation information is provided to help you estimate your score on the practice test. Although you cannot use this practice test to precisely predict how you might score on an official MTEL Earth Science (14) test, you may be able to determine your degree of readiness to take an MTEL test at an operational administration. No passing score has been determined for the practice test.

**MULTIPLE-CHOICE QUESTION
ANSWER KEY WORKSHEET**

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
1	0001	D		
2	0001	C		
3	0001	B		
4	0001	D		
5	0001	B		
6	0002	A		
7	0002	C		
8	0002	B		
9	0002	A		
10	0002	D		
11	0003	D		
12	0003	B		
13	0003	D		
14	0003	B		
15	0003	C		
16	0004	A		
17	0004	B		
18	0004	A		
19	0004	B		
20	0004	A		
21	0005	A		
22	0005	D		
23	0005	C		
24	0005	B		
25	0005	D		
26	0006	A		
27	0006	D		
28	0006	B		
29	0006	D		
30	0006	A		
31	0007	B		
32	0007	D		
33	0007	A		
34	0007	C		

**MULTIPLE-CHOICE QUESTION
ANSWER KEY WORKSHEET (continued)**

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
35	0007	B		
36	0008	D		
37	0008	C		
38	0008	D		
39	0008	A		
40	0008	C		
41	0009	A		
42	0009	D		
43	0009	A		
44	0009	D		
45	0009	A		
46	0009	D		
47	0009	C		
48	0010	A		
49	0010	C		
50	0010	D		
51	0010	B		
52	0010	D		
53	0010	C		
54	0011	A		
55	0011	C		
56	0011	C		
57	0011	D		
58	0011	A		
59	0011	C		
60	0011	A		
61	0012	D		
62	0012	A		
63	0012	B		
64	0012	D		
65	0012	B		
66	0013	B		
67	0013	C		
68	0013	C		

**MULTIPLE-CHOICE QUESTION
ANSWER KEY WORKSHEET (continued)**

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
69	0013	D		
70	0013	B		
71	0014	C		
72	0014	D		
73	0014	B		
74	0014	A		
75	0014	B		
76	0015	A		
77	0015	C		
78	0015	A		
79	0015	D		
80	0015	C		
81	0016	B		
82	0016	D		
83	0016	A		
84	0016	C		
85	0016	A		
86	0017	B		
87	0017	A		
88	0017	C		
89	0017	D		
90	0017	A		
91	0018	C		
92	0018	A		
93	0018	B		
94	0018	C		
95	0018	B		
96	0019	D		
97	0019	A		
98	0019	C		
99	0019	C		
100	0019	C		

Count the number of multiple-choice questions you answered correctly:

_____ of 100 multiple-choice questions

MULTIPLE-CHOICE QUESTION PRACTICE TEST EVALUATION CHART

In the evaluation chart that follows, the multiple-choice questions are arranged in numerical order and by test objective. Check your responses against the correct responses provided to determine how many questions within each objective you answered correctly.

Subarea I: Nature of Science

Objective 0001: Understand the nature of scientific inquiry and scientific processes.

1D ___ 2C ___ 3B ___ 4D ___ 5B ___ _____/5

Objective 0002: Understand the processes of gathering, organizing, analyzing, and reporting scientific data.

6A ___ 7C ___ 8B ___ 9A ___ 10D ___ _____/5

Objective 0003: Understand scientific tools, instruments, materials, and safety practices.

11D ___ 12B ___ 13D ___ 14B ___ 15C ___ _____/5

Objective 0004: Understand the historical and contemporary relationships among science, technology, and society.

16A ___ 17B ___ 18A ___ 19B ___ 20A ___ _____/5

Subarea I (Objectives 0001–0004) Total _____/20

**MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)**

Subarea II: Geology

Objective 0005: Understand the characteristics, classification, and formation of rocks, minerals, and geologic energy resources.

21A ____ 22D ____ 23C ____ 24B ____ 25D ____ ____/5

Objective 0006: Understand the earth's structure and its internal dynamics and the constructional forces that have shaped its surface.

26A ____ 27D ____ 28B ____ 29D ____ 30A ____ ____/5

Objective 0007: Understand processes of weathering, erosion, and deposition and the landforms they produce.

31B ____ 32D ____ 33A ____ 34C ____ 35B ____ ____/5

Objective 0008: Understand geologic time divisions, methods of relative and absolute dating, and major events in the earth's geologic history.

36D ____ 37C ____ 38D ____ 39A ____ 40C ____ ____/5

Subarea II (Objectives 0005–0008) Total ____/20

**MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)**

Subarea III: Oceanography and Freshwater Systems

Objective 0009: Understand the hydrologic cycle and types, characteristics, and uses of freshwater systems.							
41A	42D	43A	44D	45A	46D	47C	____/7

Objective 0010: Understand the characteristics of ocean water, ocean currents, tides, and waves.							
48A	49C	50D	51B	52D	53C		____/6

Objective 0011: Understand the origin, structure, and topography of ocean basins and continental shelves.							
54A	55C	56C	57D	58A	59C	60A	____/7

Subarea III (Objectives 0009–0011) Total ____/20

**MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)**

Subarea IV: Meteorology

Objective 0012: Understand the composition, structure, and properties of the earth's atmosphere.

61D ____ 62A ____ 63B ____ 64D ____ 65B ____ _____/5

Objective 0013: Understand the characteristics of the earth's major climatic regions and analyze factors that affect global and regional climate conditions.

66B ____ 67C ____ 68C ____ 69D ____ 70B ____ _____/5

Objective 0014: Understand the conditions in the atmosphere that produce different types of weather.

71C ____ 72D ____ 73B ____ 74A ____ 75B ____ _____/5

Objective 0015: Understand the effects that weather and climate have on society and the causes of atmospheric pollution and climate change.

76A ____ 77C ____ 78A ____ 79D ____ 80C ____ _____/5

Subarea IV (Objectives 0012–0015) Total _____/20

**MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)**

Subarea V: Astronomy

Objective 0016: Understand the characteristics, movements, and interactions of the earth, moon, and sun.					
81B	82D	83A	84C	85A	____/5

Objective 0017: Understand the organization and components of the solar system.					
86B	87A	88C	89D	90A	____/5

Objective 0018: Understand stars and their evolution.					
91C	92A	93B	94C	95B	____/5

Objective 0019: Understand the origin, structure, and evolution of the universe.					
96D	97A	98C	99C	100C	____/5

Subarea V (Objectives 0016–0019) Total ____/20

OPEN-RESPONSE ITEM EVALUATION INFORMATION

How Open-Response Items Are Scored

Open-response items are scored through a process called focused holistic scoring. Scorers judge the overall effectiveness of the response rather than individual aspects considered in isolation. Scorer judgments are based on the quality of the response, not on length or neatness. Responses must be long enough to cover the topic adequately and scorers must be able to read what is written.

How to Evaluate Your Practice Responses

On the following pages, you will find two "strong" and two "weak" sample responses. PLEASE DO NOT REVIEW THE SAMPLE RESPONSES UNTIL AFTER YOU HAVE WRITTEN YOUR OWN RESPONSE. When you do review the two "strong" and "weak" sample responses and analyses included here, please note the following points:

- ✓ For the purposes of the practice test, responses are identified as "strong" or "weak" rather than given a score point of 1–4.
- ✓ The responses identified as "strong" may contain flaws; however, these responses do demonstrate the performance characteristics of a "strong response."
- ✓ The two "strong" responses demonstrate the examinees' appropriate understanding and application of the subject matter knowledge. However, these responses do not necessarily reflect the full range of "correct answers" that would demonstrate an understanding of the subject matter.
- ✓ The "Analysis" accompanying each "strong" and "weak" response discusses the main attributes of the responses, but does not identify all flaws or strengths that may be present.

Compare your practice responses to the Sample Responses to determine whether your responses are more similar to the strong or weak responses. Also review the Analyses on those pages and the Scoring Rubric to help you better understand the characteristics of strong and weak responses. This evaluation will help you identify specific problems or weaknesses in your practice responses. Further information on scoring can be found in the Test Information Booklet and Faculty Guide at www.mtel.nesinc.com and at www.doe.mass.edu/mtel; select "FAQ," then "After the Test."

**OPEN-RESPONSE ITEM
SCORING RUBRIC, SAMPLE RESPONSES, AND ANALYSES**

Massachusetts Tests for Educator Licensure®
SCORING RUBRIC FOR SUBJECT TESTS

Performance Characteristics:

Purpose	The extent to which the response achieves the purpose of the assignment.
Subject Matter Knowledge	Accuracy and appropriateness in the application of subject matter knowledge.
Support	Quality and relevance of supporting details.
Rationale	Soundness of argument and degree of understanding of the subject matter.

Scoring Scale:

Score Point	Score Point Description
4	<p>The "4" response reflects a thorough knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is fully achieved. • There is a substantial, accurate, and appropriate application of subject matter knowledge. • The supporting evidence is sound; there are high-quality, relevant examples. • The response reflects an ably reasoned, comprehensive understanding of the topic.
3	<p>The "3" response reflects an adequate knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is largely achieved. • There is a generally accurate and appropriate application of subject matter knowledge. • The supporting evidence is adequate; there are some acceptable, relevant examples. • The response reflects an adequately reasoned understanding of the topic.
2	<p>The "2" response reflects a limited knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is partially achieved. • There is a limited, possibly inaccurate or inappropriate, application of subject matter knowledge. • The supporting evidence is limited; there are few relevant examples. • The response reflects a limited, poorly reasoned understanding of the topic.
1	<p>The "1" response reflects a weak knowledge and understanding of the subject matter.</p> <ul style="list-style-type: none"> • The purpose of the assignment is not achieved. • There is little or no appropriate or accurate application of subject matter knowledge. • The supporting evidence, if present, is weak; there are few or no relevant examples. • The response reflects little or no reasoning about or understanding of the topic.
U	The response is unrelated to the assigned topic, illegible, primarily in a language other than English, not of sufficient length to score, or merely a repetition of the assignment.
B	There is no response to the assignment.

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

I predict that if a tsunami were to hit the coastline large portions will be damaged depending on the area it may hit the hardest. I would first go to the site and investigate any structures near the very edge of the coastline. I would then do samples of exactly what is making up the coastline to research the possibilities. I would see how much it takes to lose portions of the coastline. I would get soil and rock samples and research past tsunamis of the coastline.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is only partially achieved. No adequate hypothesis has been stated. The investigation is weak and irrelevant in parts. Collection of data is vague with no apparent goal to compare, analyze, and form a conclusion.

Subject Matter Knowledge: The necessary steps in the scientific method are not presented well. The candidate fails to show knowledge of how to form an appropriate hypothesis. Knowledge of how to set up a field study is limited. It is unclear why the candidate is investigating the makeup of the coastline, and how that relates to the question. The amount of data to be gathered is limited and the purpose and method not well explained. There is no explanation of what is meant by the phrase "see how much it takes to lose portions of the coastline."

Support: Support is very limited. An on-site investigation could be good, as could be research of past tsunamis, but little is shown as to how a research project would be designed, implemented, and analyzed. Since the hypothesis is weak, the response cannot be developed adequately. Collection of soil and rock samples is irrelevant to the hypothesis as stated.

Rationale: While the candidate understands that some degree of investigation is required, the response is poorly reasoned. "I would then do samples of exactly what is making up the coastline to research the possibilities" is undefined and weak.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

If the coastline is on a fault line, it is more likely for a tsunami to occur, and if the coastline leads directly into the ocean with no embankment, it is more likely for the tsunami to do damage.

Investigate locations where tsunamis have occurred. Go to libraries, look up reports and compare characteristics such as proximity to fault line and if hypothesis can be proven.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is partially achieved. Two hypotheses are stated, but developing a reasonable research project to test either one is lacking. The second and third bullets are barely addressed.

Subject Matter Knowledge: There is a limited understanding of the scientific method, the description of which was insufficiently developed. The candidate has stated two hypotheses, one more easily testable than the other. The methods of investigation, however, do not show knowledge of how to scientifically test either hypothesis. Collecting data is mentioned but not defined as to the specific data needed. Forming a conclusion based on the analysis of data was poorly stated.

Support: Support is very limited and weak. Ideas are presented but not expanded upon. Statements such as "Investigate locations where tsunamis have occurred" are nonspecific. The response lacks relevant examples of the resources for gathering data on past tsunamis and how comparisons would be conducted. The response focuses on fault lines while many other features would be more relevant such as depth of beach, inlet vs. linear coast, elevation, etc.

Rationale: The response indicates a weak understanding of how to conduct a research project, and its lack of development makes it a limited response. The response shows only partial understanding of the subject matter.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

A coastline's location might affect the severity of a tsunami. It is hypothesized that a coastline which is somewhat like a cove is in more danger than a long straight coast. To test this hypothesis, investigations would be done in two ways.

First, looking at data from previous tsunamis would be done to see the difference in severity on the various shaped coastlines. Information would be recorded as to the intensity of earthquakes on the Richter Scale, the shape of the coastline, and the severity of damage done. This data would then be compared and analyzed to see if cove-shaped coastlines actually received more damage.

A second study would be done but with computer models. Different sizes of earthquakes will be triggered to test the hypothesis, and data will be collected to see how high the water got and the velocity at which it came.

All of the data will then be analyzed to see which had the greater severity, a coastline with a cove or one with no cove. The velocity of the waves would also be analyzed, and possible barriers tested to see if the tsunamis can be stopped.

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a strong response because it is characterized by the following:

Purpose: The purpose of the assignment is fully achieved. Each bullet is clearly and thoroughly addressed. A testable hypothesis is offered. Two distinct methods of investigation are provided and explained. The methods of collecting and analyzing the data are well presented.

Subject Matter Knowledge: The response demonstrates an understanding of the scientific method that is complete. The candidate shows understanding of how to form a hypothesis, as the one presented is reasonable and appropriately stated. The methods of investigation are well presented, as two approaches—looking at data from past tsunamis and testing with computer models—are provided. Aspects of data collection and analysis are included logically with the descriptions of the two modes of investigation, as well as detailed in the final paragraph of the response.

Support: The level of detail in the response is strong. The "intensity" of an earthquake as measured on the "Richter Scale," the "velocity" of the water, and "computer models" add high-quality specifics to the response. The candidate goes beyond a general coastline to specify a feature of a coastline. A cove was identified and a research project was developed to study the effects of a tsunami on a cove. Testing "different sizes of earthquakes" would ensure greater validity of results and strengthens the response.

Rationale: The reasoning is sound. The candidate begins by collecting data of previous tsunamis in a detailed manner, and then follows up by developing an investigation using computer models. All data will then be compared and analyzed. Comparing this data with data from coastlines with different shapes will lead to a conclusion about the original hypothesis.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

As an oceanographer studying how the shape of a coastline might affect the severity of a tsunami, I have decided to see if elevation is a factor. My hypothesis is that the higher the elevation of the coastline the less damage there will be to physical features and property.

As a first step in my investigation, I will look at historical evidence from previous tsunamis and make note of the elevation of the land where they hit and the amount of damage done to see if there is any evidence to support my hypothesis. Next I will examine the impact of tsunamis on the coastline by creating a physical model of three different scaled communities--one at sea level, one at 100 ft. above sea level, and one at 200 ft. above sea level. Using a wave simulator, I will create waves at various velocities and observe how they impact the three elevations. I will observe and record my data. I will repeat this process several times.

At the conclusion of my experiment, I will analyze my results and compare it to the data I previously collected on actual tsunamis and form my conclusion. I would expect to find that the higher the elevation of the coastline the less damage will occur.

This experiment could be repeated to test other variables of a coastline such as the slope of the land under water, i.e. gradual and shallow or steep drop and deep. Only one variable should be tested at a time, however.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a strong response because it is characterized by the following:

Purpose: The purpose of the assignment is fully achieved in a clear, sequential manner. The candidate hypothesizes about the elevation of a coastline in relation to tsunamis and proceeds to develop a well-conceived plan of investigation to determine whether higher elevated coastlines experience less damage from tsunamis. The methods of data collection and analysis show solid understanding of how to structure a research project.

Subject Matter Knowledge: The response demonstrates a thorough understanding of the scientific method. After stating a testable hypothesis and collecting data from past tsunamis, the candidate designs an experiment to further test the hypothesis before comparing and analyzing the data. Repeating the test for other conditions such as gradual or steep drops provides evidence that the candidate has thorough knowledge of the topic.

Support: The response is strengthened by understanding that "velocity" of waves is important, and by stating that the experiment will be repeated several times before a conclusion is formed. The tests are repeated at three specific elevations (sea level, 100 ft., 200 ft.) to provide a range of data, further demonstrating the candidate's grasp of the scientific method.

Rationale: The candidate has presented a response that is thorough and well thought-out from hypothesis to data analysis.

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Over the past 50 years geoscientists have collected evidence proving that the lithospheric plates have moved great distances over long periods of time. There are two types of evidence that support the extensive movement.

1. The continents when brought together connect.
2. Fossils that match between continents.

It is believed that the underlying mechanism driving the rearrangement is magma. Magma is hot rock that breaks through the crust wherever a volcano is found. These new volcanoes push the crust apart moving plates apart.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is only partially achieved. The first sentence of this response is merely a verbatim restatement of the prompt. It is followed by two examples that are linked to lithospheric plate movement, but these examples are only mentioned briefly and remain absent of explanation. Similarly, the second bullet dealing with the underlying mechanism is weakly addressed because there is no mention of convection currents. As a result, purpose is only partially achieved since this candidate has not been able to fulfill the charge of each of these bullets.

Subject Matter Knowledge: The response reflects a limited knowledge about the understanding of plate tectonics. While the two types of evidence are accurate, explanation that would show strong subject matter knowledge is not provided. The candidate knows enough to identify magma as an agent of change in lithospheric plate location but is incorrect in the explanation of the role of magma in the movement of lithospheric plates; convection currents, not volcanoes, move the plates. The response is lacking development for both parts; as a result, demonstration of subject matter knowledge suffers.

Support: There is little supporting evidence offered in this response. The response is weakened by its lack of explanations; no specific details are given of what continents might fit together ("when brought together connect") or which fossils were important in identifying those places or of the significance of finding those matching fossils. In part two, the explanation of magma is very basic and fails to address the topic of underlying mechanisms for the motion of plates.

Rationale: There is very little understanding or reasoning evidenced in this response. This candidate is unable to explain why he or she has chosen the evidence in question to support the first bullet, and provides an insufficient answer to the second bullet rather than the explanation of the underlying mechanism for which the prompt calls. The argument is not sound and the degree of understanding of the subject matter is weak.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

One type of evidence to prove that geoscientists are right that the lithospheric plates have moved is that they found the same kind of fossils on two different continents. The plants lived at the same time and grew in the same kind of soil.

Another piece of evidence is that land masses are pulled to the center of the earth due to gravitational forces. If they are being pulled together, that means they had to be at one time pulled apart. The force of gravity causes plates to move.

The underlying mechanism that scientists most believe is that since the earth moves and rotates, physical forces, such as centripetal force, cause the plates to move. Even massive objects like lithospheric plates would be subject to this strong force.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is only partially achieved. While the response begins by demonstrating some sense of purpose, recognizing that finding "the same kind of fossils on two different continents" can show how lithospheric plates have moved over time, the response then loses its focus, which weakens the overall purpose. Though the response begins well, it then moves away from the purpose with the candidate's weak attempt to provide a second type of evidence. Finally, the second section of this response is inaccurate; the rotation of Earth does not affect lithospheric plate motion in the way in which the candidate puts forth.

Subject Matter Knowledge: The first paragraph of the response is accurate and appropriate. The candidate shows some limited subject matter knowledge by recognizing that similar fossils were found on two separate continents. However, the second part of this response relating to forces of gravity is inaccurate as a response to this question. The candidate's response to the second bullet is incorrect: rotation of Earth does not cause movement of the plates. This level of error shows a weaker understanding of lithospheric plate motion.

Support: There is little support in this response. Including the kind of fossil (plant) and details about time and soil is some evidence of understanding. But the examples of gravitational force are both irrelevant and too vague. The inaccuracies indicate that the candidate is unable to address the question and give support using subject matter knowledge.

Rationale: The first part includes some accurate information but it is very limited in its scope. Little understanding of the topic is shown as evidenced by the presence of irrelevant and inaccurate information. The candidate provides one element that is accurate, but does not provide much in the way of explaining what that information does, why it is there, and what it can potentially show about the candidate's knowledge about and understanding of the field of earth science.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

One type of evidence showing that lithospheric plates have moved great distances is fossil evidence in similar rock layers along coastlines of different continents. Where coastlines were once connected, same species of the fern *Glossopteris*, for example, lived and died and became fossils embedded in similar sediment. The rock strata on both continents are identical and can be matched up layer by layer by rock type and by folds and deformations.

Other evidence involves the shapes of the continents. The continents fit together like a jigsaw puzzle indicating that they were once joined. South America and Africa are easily seen to have once been together.

While science always has a lot of theories, it is generally believed that the plates move due to convection currents within the mantle. The plates sit on the mantle, a molten layer of the earth that is heated from deep within the earth. As the heated magma rises and the cooler magma sinks, large convection currents are created under the plates causing them to move slowly over time, perhaps a centimeter per year over millions of years.

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a strong response because it is characterized by the following:

Purpose: The purpose of the assignment is fully achieved. The candidate presents substantial and accurate information. The response provides more than two examples (fossil evidence, rock strata, shapes of the continent) in addressing the first bullet, and then offers an equally full treatment of the second bullet. Explanation of the underlying mechanism is provided; the response does not merely identify the mechanism but shows solid understanding in explaining how the plates are caused to move by the magma.

Subject Matter Knowledge: The examples given are accurate and relevant. Not only did the candidate mention the similarity of fossils but also the fact that the rocks they were found in were similar. The statements about the shape of the continents and how they once fit together provides further evidence that the candidate has thorough knowledge of the subject and is able to demonstrate and apply that knowledge and understanding. The second section indicates a clear understanding of the current belief relative to convection currents in magma and how that process works to move the crustal plates.

Support: The response demonstrates sound support by giving ferns, and more specifically *Glossopteris*, as examples of fossil evidence. The candidate also specifically identifies South America and Africa as "fit[ting] together like a jigsaw puzzle" and that rock strata on two continents not only are "identical" but "can be matched up layer by layer by rock type and by folds and deformations." A clear description of how convection current in the mantle likely drives the motion of the crust is provided by the candidate; all examples are relevant and appropriately detailed.

Rationale: The response is ably reasoned throughout. The candidate provides specific examples in a logical sequence in addressing the first bullet and a sound description and explanation of the mantle in addressing the second. No part of this response appears out of place or sequence; the candidate shows clear understanding of the subject matter.

**SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE
ITEM ASSIGNMENT #2**

Early geologists, when examining the geography of the continental margins, found that some continents seemed to fit together like puzzle pieces. It was even a better fit along the continental shelf margins. This led them to wonder if the continents were once joined.

Further studies showed that specific kinds of rocks and specific rock strata were identical on continents located on opposite sides of the Atlantic Ocean. Some rock layers in Appalachian Mountains extend up to Newfoundland where they end at the edge of the ocean only to reappear at the coast of Ireland. Parts of other mountain ranges are also lined up as though they had been one.

Many geologists are committed to studying the ocean floor. Evidence of tectonic movement along a mid-ocean ridge is being studied. By studying the striations on either side of the ridge and the magnetic orientation they have been able to estimate the rate of divergence and movement of the plates.

The mechanism causing plate movement has to do with the inner layers of the earth. The geothermal heating and cooling of the molten layer is believed to cause the movement of the plates. The magma rises and falls driven by convection currents within the mantle. This causes the plates of the crust to move slowly over time.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a strong response because it is characterized by the following:

Purpose: The candidate fully achieves the purpose of the assignment by giving an extensive response to the first bullet and an accurate but less developed response to the second. The first bullet is handled effectively: description exists of both types of evidence and both examples support what the prompt is asking for: the extensive movement of plates over time. The second bullet explains as well as identifies an underlying mechanism, giving explanation of what is believed to cause the plates to move, as well as identifying a result (convection currents).

Subject Matter Knowledge: The response demonstrates a great deal of knowledge as several types of evidence are appropriately presented. The candidate discusses not only evidence found on land but also evidence discovered under the ocean. Though both bullets do not get equal amounts of attention and the extensive response to the first bullet may seem to overshadow the slighter handling of the second bullet, the candidate's overall response to the prompt is accurate and substantial. In addition, several terms from earth science are used correctly: tectonic movement, divergence, convection currents.

Support: The candidate offers relevant support in describing how scientists have used evidence to explain that continents were once clustered and why they have drifted apart over time. The candidate specifically makes the connection between the rock layers in the Appalachian Mountains and those of the coast of Ireland. Inclusion of the magnetic orientation of striations along mid-ocean ridges strengthens the response. The candidate demonstrates a good grasp of the relevant concepts in the field.

Rationale: Each part of this response is clear, accurate, relevant, and logical. The candidate provides sound reasons why these two types of evidence support plate movement over time as well as a clear, logical explanation of the underlying mechanism.

PRACTICE TEST SCORE CALCULATION

The practice test score calculation is provided so that you may better gauge your performance and degree of readiness to take an MTEL test at an operational administration. Although the results of this practice test may be used as one indicator of potential strengths and weaknesses in your knowledge of the content on the official test, it is not possible to predict precisely how you might score on an official MTEL test.

The Sample Responses and Analyses for the open-response items may help you determine whether your responses are more similar to the strong or weak samples. The Scoring Rubric can also assist in estimating a score for your open responses. You may also wish to ask a mentor or teacher to help evaluate your responses to the open-response questions prior to calculating your total estimated score.

How to Calculate Your Practice Test Score

Review the directions in the sample below and then use the blank practice test score calculation worksheet on the following page to calculate your estimated score.

SAMPLE

Multiple-Choice Section	
Enter the total number of multiple-choice questions you answered correctly:	<u>73</u>
Use Table 1 below to convert that number to the score and write your score in Box A :	A: <input style="width: 50px; border: 1px solid black;" type="text" value="192"/>

Open-Response Section	
Enter the number of points (1 to 4) for your first open-response question:	<u>3</u>
Enter the number of points (1 to 4) for your second open-response question:	<u>3</u>
Add those two numbers (Number of open-response question points):	===== 6
Use Table 2 below to convert that number to the score and write your score in Box B :	B: <input style="width: 50px; border: 1px solid black;" type="text" value="50"/>

Total Practice Test Score (Estimated MTEL Score)	
Add the numbers in Boxes A and B for an estimate of your MTEL score:	A + B = <input style="width: 50px; border: 1px solid black;" type="text" value="242"/>

Practice Test Score Calculation Worksheet: Earth Science

Table 1:

Number of Multiple-Choice Questions Correct	Estimated MTEL Score	Number of Multiple-Choice Questions Correct	Estimated MTEL Score
0 to 25	103	61 to 65	174
26 to 30	112	66 to 70	183
31 to 35	121	71 to 75	192
36 to 40	130	76 to 80	201
41 to 45	139	81 to 85	210
46 to 50	148	86 to 90	219
51 to 55	156	91 to 95	228
56 to 60	165	96 to 100	236

Table 2:

Number of Open-Response Question Points	Estimated MTEL Score
2	31
3	36
4	41
5	46
6	50
7	55
8	60

Print the form below to calculate your estimated practice test score.

Multiple-Choice Section

Enter the total number of multiple-choice questions you answered correctly:

Use Table 1 above to convert that number to the score and write your score in **Box A**: A:

Open-Response Section

Enter the number of points (1 to 4) for your first open-response question:

Enter the number of points (1 to 4) for your second open-response question: =====

Add those two numbers (Number of open-response question points):

Use Table 2 above to convert that number to the score and write your score in **Box B**: B:

Total Practice Test Score (Estimated MTEL Score)

Add the numbers in **Boxes A and B** for an estimate of your MTEL score: A + B =