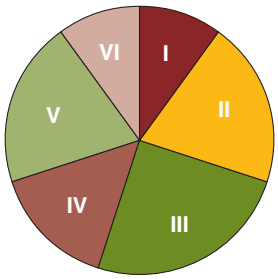
Earth and Space Sciences: Content Knowledge (0571)

Test at a Glance

Test Name	**Earth and Space Sciences: Content Knowledge**
Test Code	**0571**
Time	**2 hours**
Number of Questions	**100**
Format	**Multiple-choice questions**



Content Categories		Approximate Number of Questions	Approximate Percentage of Questions
I.	Basic Scientific Principles of Earth and Space Sciences	8–12	8–12%
II.	Tectonics and Internal Earth Processes	18–22	18–22%
III.	Earth Materials and Surface Processes	23–27	23–27%
IV.	History of the Earth and its Life-Forms	13–17	13–17%
V.	Earth's Atmosphere and Hydrosphere	18–22	18–22%
VI.	Astronomy	8–12	8–12%

About This Test

The Earth and Space Sciences: Content Knowledge test is designed to assess whether an examinee has the knowledge and competencies necessary for a beginning teacher of Earth and Space Sciences in a secondary school.

The 100 multiple-choice questions address the examinee's knowledge of fundamental scientific concepts, methods, principles, phenomena, and interrelationships.

Questions are derived from topics typically covered in introductory college-level courses in the Earth and Space Sciences, including geology, meteorology, oceanography, astronomy, and environmental science.

The questions require a variety of abilities, including an emphasis on the comprehension of critical concepts, analysis to address and solve problems, and an understanding of important terms. Some questions may require the examinee to integrate concepts from more than one content area.

The test covers the six broad content areas of basic scientific principles of Earth and Space Sciences, tectonics and internal Earth processes, Earth materials and surface processes, history of the Earth and its life-forms, Earth's atmosphere and hydrosphere, and astronomy.

In addition, a substantial number of the questions require knowledge and/or abilities listed under the content area of History and Nature of Science.

This test may contain some questions that will not count toward your score.

Topics Covered

Representative descriptions of knowledge/abilities covered in each category are provided below.

I. Basic Scientific Principles of Earth and Space Sciences

- The role of energy in Earth systems
- The transfer and measurement of heat and the laws of thermodynamics as they relate to Earth systems
- The structure of atoms and compounds, and their interrelationships in the solid, liquid, and gaseous components of Earth systems
- Nuclear reactions and their products as they relate to the Earth and Space Sciences
- Fundamental biological, chemical, and physical processes as they apply to the study of Earth and Space Sciences
- The patterns, interrelationships, and intrarelationships of matter and energy

II. Tectonics and Internal Earth Processes

- Plate tectonics, including the history of its development as a unifying theory
- The processes by which Earth's crust is deformed
- Earthquakes and how they provide information about Earth
- The origin and effects of Earth's magnetic field

III. Earth Materials and Surface Processes

- The characteristics of minerals and rocks and the methods used to identify them
- The cycling of Earth materials
- The processes of rock weathering and soil formation
- Sedimentary processes and how rocks are formed from these processes
- Igneous processes and how rocks are formed from these processes
- Metamorphic processes and how rocks are formed from these processes
- The interrelationships between civilization and Earth materials as resources
- The processes by which a landscape evolves
- Recognition and interpretation of geologic features as represented by photographs and topographic and geologic maps
- The interrelationships between civilization and natural hazards

IV. History of the Earth and its Life-Forms

- The principle of uniformitarianism
- The basic assumptions behind stratigraphic correlation
- How rocks provide a record of Earth's history
- Earth's origin, including the formation of the atmosphere and hydrosphere
- How time is measured
- Paleontology, including the origin of life, development of life, and use of the fossil record

V. Earth's Atmosphere and Hydrosphere

- The structure of the water molecule as it relates to its special properties (e.g., high specific heat, density changes)
- The paths that water follows as it moves through the water cycle and the energy transfers that accompany this movement
- The origin, distribution, and variation of climate
- The systematic development and movement of weather patterns and phenomena
- The interrelationships between civilization and the atmosphere and hydrosphere
- The processes by which water moves on and beneath Earth's surface
- Glaciers and ice ages
- The physical and chemical characteristics and processes of the oceans
- The interrelationships between the waters of the oceans and the solid Earth

VI. Astronomy

- The characteristics and consequences of Earth's motion
- The relationships between Earth, the Moon, and the Sun
- Characteristics of and relationships between the components of the solar system in terms of composition, size, and motions
- The internal and surface processes of planetary bodies and their natural satellites
- The characteristics of stars and the processes that occur within them
- The structure of the Milky Way and other galaxies
- Hypotheses that relate to the origin and development of the universe

VII. History and Nature of Science

- Scientific methods of problem solving
- The importance of the application of Earth and Space Sciences to everyday life
- The historical development of science and the contributions made by major historical figures as well as members of cultural/ethnic groups (e.g., ancient Chinese and Greek astronomers, Galileo, Darwin, Curie, Hutton)
- The use of various measurement systems
- Compilation, evaluation, and interpretation of data, including analysis of errors
- The proper methods involved in using laboratory and field materials and equipment in a safe and appropriate manner, and in conducting safe field experiences
- The appropriate use of equipment/instruments for measurement and observation in Earth and Space Sciences
- Computer and related technologies as they apply to investigative activities
- Issues associated with the use and production of various energy sources (e.g., fossil fuels, nuclear, hydroelectric, geothermal)

Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

Directions: Each of the questions or statements below is followed by four suggested answers or completions. Select the one that is best in each case.

1. Which of the following would be expected to result from a collision between a continental lithospheric plate and an oceanic lithospheric plate?

   (A) A volcanic island arc

   (B) A chain of coastal volcanic mountains

   (C) A mid-oceanic ridge

   (D) A transform fault

2. Normally, S-P arrival intervals from a minimum of how many seismic stations are required to uniquely locate the epicenter of an earthquake?

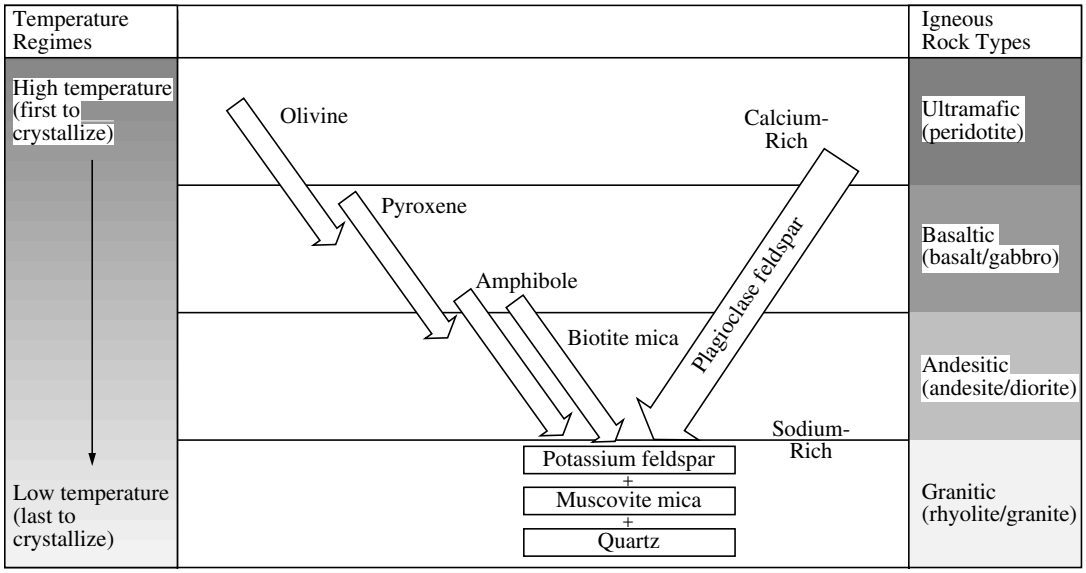
   (A) 1

   (B) 2

   (C) 3

   (D) 4

3.



Using the chart above, which of the following explains why a plagioclase crystal in an igneous rock is calcium-rich in the center but becomes progressively higher in sodium content toward the edges?

(A) Calcium-rich plagioclase crystals need more oxygen to form, and sodium-rich plagioclase crystals need less oxygen.

(B) Calcium-rich plagioclase crystals contain more olivine, and sodium-rich plagioclase crystals contain quartz.

(C) Calcium-rich plagioclase crystals are usually found in basalt, and sodium-rich plagioclase crystals are usually found in granite.

(D) Calcium-rich plagioclase crystallizes at higher temperatures, and sodium-rich plagioclase crystallizes at lower temperatures.

4. Which of the following man-made structures is most susceptible to damage by acid precipitation?

   (A) A monument made of granite

   (B) A roof made of slate

   (C) A tombstone made of marble

   (D) A statue made of gabbro

5. Which of the following sequences of events is consistent with the presence of a layer of conglomerate in bedrock just above a layer of shale?

   (A) A volcano erupted, sending lava out over a layer of shale. The lava cooled and hardened into conglomerate.

   (B) The water level of a large lake lowered. A beach then formed where previously there had been lake bottom.

   (C) One-celled organisms developed a colony on the sea floor. Shells made by these organisms accumulated and lithified, forming the conglomerate.

   (D) Mud was deposited and lithified. Subsequent contact metamorphism resulted in localized recrystallization of the shale into a conglomerate.

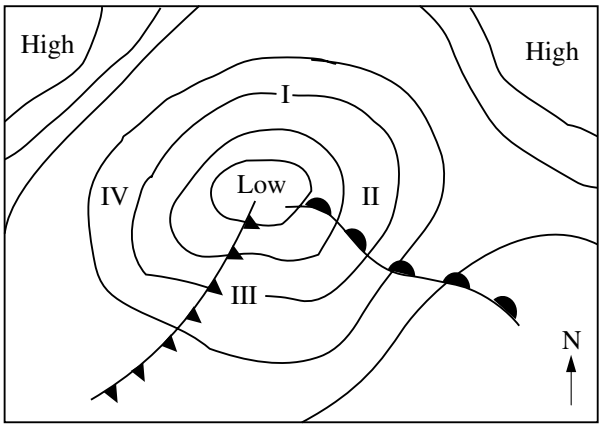
6. During which of the following processes within the hydrologic cycle do water molecules absorb energy?

   (A) Recrystallization of snow in a glacier

   (B) Formation of a cloud from water vapor

   (C) Runoff along the land surface

   (D) Evaporation from the ocean surface



7. The map above shows a mid-Latitude Northern Hemisphere low-pressure cell with accompanying fronts. Which of the following statements about this weather system is true?

   (A) The absolute humidity of the surface air at station I is higher than that at station III.

   (B) The surface wind at station II is coming from the west.

   (C) The wind at station III will shift in a counter-clockwise direction as the system moves eastward.

   (D) The atmospheric pressure at station IV is higher than at stations I, II, or III.

8. The dissolved salts in the Earth's oceans are principally derived from

   (A) marine biological activity

   (B) atmospheric deposition

   (C) the weathering of continental rocks

   (D) the eruptions of undersea volcanoes

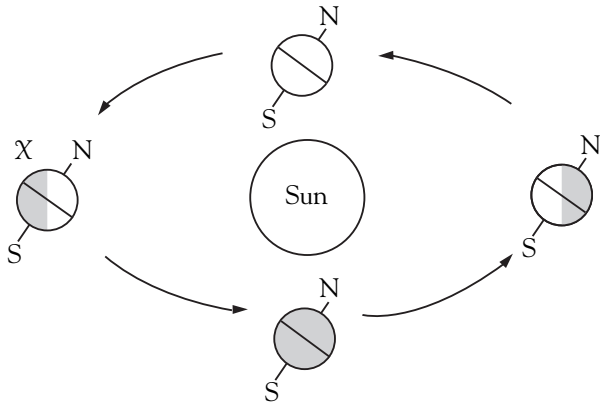
9. Which of the following explains why some localities have normally great tidal ranges (up to 60 feet) and others have one- to two-foot tidal ranges?

   (A) The relative positions of the Moon and Sun are different at different localities.

   (B) The Coriolis effect and rotation of the Earth tend to enhance tidal flow in the higher latitudes.

   (C) Ocean floor topography and the shape of the coastline serve to amplify tidal flow at specific localities.

   (D) Trade winds push the water into large tidal bulges near rocky shorelines.



10. In the illustration above of the Earth's orbit about the Sun, which of the following is true of the Earth at location X?

    (A) The spring equinox occurs.

    (B) The fall equinox occurs.

    (C) It is winter in the northern hemisphere.

    (D) It is summer in the northern hemisphere.

11. Which of the following has provided evidence that the Sun's atmosphere contains sodium atoms?

    (A) Stars with the same spectral class as the Sun are made mostly of sodium.

    (B) The Sun gives off energy produced by the nuclear fusion of sodium in its core.

    (C) Light from the Sun has absorption lines that are consistent with the presence of sodium.

    (D) Solar samples returned to Earth by the Voyager spacecraft contained sodium.

Answers

1. The correct answer is B. The collision of a continental plate with an oceanic plate results in the oceanic plate being subducted beneath the continental plate. The surface features that are formed include a deep offshore trench and a chain of coastal volcanic mountains.

2. The correct answer is C. The arrival interval recorded at one station for a seismic event allows you to determine the distance from the station to the epicenter of the event. To determine the unique location of the epicenter, you must have seismic data from three different points/sites. This process is called triangulation.

3. Choice D is the correct answer. The chart shows that calcium-rich plagioclase will crystallize at higher temperatures and, therefore, before sodium-rich plagioclase, which will crystallize at lower temperatures. Since the crystals grow outward as the magma cools, the center of the feldspar crystal will form first at higher temperatures and the edges will crystallize last at lower temperatures.

4. The correct answer is C. Marble would be particularly susceptible to acid rain because it is made primarily of the mineral calcite, which readily dissolves in acid. The other materials, which contain mostly silicate minerals, would also be affected but over a longer period of time.

5. Choice B is the correct answer. Shale is a fine-grained sedimentary rock made of clay-sized particles. Conglomerate is a sedimentary rock made of various-sized particles, including pebbles. For conglomerate to form on top of shale, a change in the environment must have occurred from one that would allow the deposition of clay (such as a lake bed) to one that would allow the deposition of pebbles (such as a beach).

6. The correct answer is D. Evaporation is an endothermic process in which water molecules absorb energy and undergo a phase change from a liquid to a gas.

7. Choice D is correct. The atmospheric pressure, as contoured on the map with isobars, is highest at station IV. The other statements are not true.

8. Choice C is the correct answer. The salinity of Earth's oceans is attributed primarily to solutes produced by the weathering of continental rocks and transported to the oceans by rivers. The other choices list other plausible sources of salts, but they are all insignificant compared with the continental source.

9. Choice C is the correct answer. The configuration of ocean basins and the shape of the coastline can affect the equilibrium tides, causing phenomena such as standing waves and resonance. The extreme tidal range typical of localities in the Bay of Fundy is a well-known example of the tidal influence of ocean-floor topography and coastline shape.

10. Choice D is the correct answer. When the Earth is at location X, the northern hemisphere receives the most direct rays of the Sun and experiences the greatest number of daylight hours. Under these conditions, it is summer in the northern hemisphere.

11. Choice C is correct. The chemical composition of the Sun's atmosphere has been inferred primarily from absorption lines observed in the solar spectrum.

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