Earth Science

EXAM CODE 360
CATALOG NUMBER GEOx101

CREDIT HOURS 3
LEVEL LOWER

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The most current content guides are available at: www.excelsior.edu/contentguides
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Before You Choose This UExcel Exam

Uses for the Examination

- Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination. The examination may be used to help fulfill a science requirement or as a free elective for all Excelsior College Degree programs that allow for free electives.

- Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.

- Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable grade.

Exam-takers who have applied to Excelsior College should ask their academic advisor where this exam fits within their degree program.

Exam-takers not enrolled in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll at Excelsior College should ask an admissions counselor where this exam fits within their intended degree program.

Examination Length and Scoring

The examination consists of approximately 120 four-option multiple-choice questions, most of which are multiple choice; for samples of all the item types on this exam, see the sample items in the back of this guide. Some items are unscored, pretest items. The pretest items are embedded throughout the exam and are indistinguishable from the scored items. You will have two (2) hours to complete the examination. Your score will be reported as a letter grade.

UExcel Exam Resources

Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at: www.excelsior.edu/bookstore

UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. Once you register for your UExcel exam, you are eligible to purchase the corresponding practice exam, which can be taken using any computer with a supported Web browser. Each practice exam includes two forms that you may take within a 180-day period.
Excelsior College Library

Enrolled Excelsior College students can access millions of authoritative resources online through the Excelsior College Library. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. Special library pages relate to the nursing degree exams and other selected exams. To access it, visit www.excelsior.edu/library (login is required).

Our library provides:

• 24/7 availability
• The world’s most current authoritative resources
• Help and support from staff librarians

Online Tutoring

Excelsior College offers online tutoring through SMARTTHINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMARTTHINKING, go to www.excelsior.edu/smartthinking. Once there, you may download a copy of the SMARTTHINKING Student Handbook as a PDF.

MyExcelsior Community

MyExcelsior Community enables Excelsior College students and alumni to interact with their peers online. As members, students can participate in real-time chat groups, join online study groups, buy and sell used textbooks, and share Internet resources. Enrolled students have automatic access from their MyExcelsior page. Visit www.excelsior.edu/myexcelsiorcommunity.

Preparing for UExcel Exams

How Long Will It Take Me to Study?

A UExcel exam enables you to show that you’ve learned material comparable to one or more 15-week college-level courses. As an independent learner, you should study and review as much as you would for a college course. For a 3-credit course in a subject they don’t know, most students would be expected to study nine hours per week for 15 weeks, for a total of 135 hours.

Study Tips

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

• preview or survey each chapter
• highlight or underline text you believe is important
• write questions or comments in the margins
• practice re-stating content in your own words
• relate what you are reading to the chapter title, section headings, and other organizing elements of the textbook
• find ways to engage your eyes, your ears, and your muscles, as well as your brain, in your studies
• study with a partner or a small group (if you are an enrolled student, search for partners on MyExcelsior Community)
• prepare your review notes as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.

Using UExcel Practice Exams

We recommend taking the first form of the practice exam when you begin studying, to see how much you already know. After taking the first practice exam, check your performance on each question and find out why your answer was right or wrong. This feedback will help you improve your knowledge of the subject and identify areas of weakness that you should address before taking the exam. Take the second form of the practice exam after you have finished studying. Analyze your results to identify the areas that you still need to review.
Although there is no guarantee, our research suggests that students who do well on the practice exams are more likely to pass the actual exam than those who do not do well (or do not take advantage of this opportunity).

**About Test Preparation Services**

Preparation for UExcel® exams and Excelsior College® Examinations, though based on independent study, is supported by Excelsior College with a comprehensive set of exam learning resources and services designed to help you succeed. These learning resources are prepared by Excelsior College so you can be assured that they are current and cover the content you are expected to master for the exams. These resources, and your desire to learn, are usually all that you will need to succeed.

There are test-preparation companies that will offer to help you study for our examinations. Some may imply a relationship with Excelsior College and/or make claims that their products and services are all that you need to prepare for our examinations.

Excelsior College is not affiliated with any test preparation firm and does not endorse the products or services of these companies. No test preparation vendor is authorized to provide admissions counseling or academic advising services, or to collect any payments, on behalf of Excelsior College. Excelsior College does not send authorized representatives to a student’s home nor does it review the materials provided by test preparation companies for content or compatibility with Excelsior College examinations.

To help you become a well-informed consumer, we suggest that before you make any purchase decision regarding study materials provided by organizations other than Excelsior College, you consider the points outlined on our website at [www.excelsior.edu/testprep](http://www.excelsior.edu/testprep).

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## Preparing for This Exam

### Prior Knowledge

No prior knowledge of earth science is required before you study for this exam.

### Using the Content Outline

Each content area in the outline includes (1) the recommended minimum hours of study to devote to that content area and (2) the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. Chapter numbers and titles may differ in other editions.

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

### Using the Sample Questions and Rationales

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.
Recommended Resources for the UExcel Exam in Earth Science

The study materials listed below are recommended by Excelsior College as the most appropriate resources to help you study for the examination. For information on ordering from the Excelsior College Bookstore, see page 1 of this guide. You may also find resource materials in college libraries. Public libraries may have some of the textbooks or may be able to obtain them through an interlibrary loan program.

You should allow sufficient time to obtain resources and to study before taking the exam.

Textbooks

This textbook was used by the examination development committee to verify all questions on the exam. It may be purchased from the Excelsior College Books Store. www.excelsior.edu/bookstore


These textbooks were identified by the examination development committee as a resource to help you gain a deeper understanding of the subject.


These study materials may be purchased from the Excelsior College Bookstore.

Open Educational Resources

Massachusetts Institute of Technology offers free, high quality course materials through Open Courseware.

MIT: Environmental Earth Science

Reducing Textbook Costs

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.

Hippocampus.org Earth Science resources
www.hippocampus.org/HippoCampus/Earth%20Science?sessionid=B14450F34292C5F2E8C2950C6942F995

Open Course Library
opencourselibrary.org/geol-101-introduction-to-physical-geology/
Content Outline

General Description of the Examination

The UExcel Earth Science examination is based on material typically taught in a one-semester, three-credit, lower-level course in geology, meteorology, and oceanography. The content of the examination corresponds to introductory course offerings such as Earth Science, Physical Geology, Geoscience, Environmental Geoscience, and Earth-System Science.

The examination measures knowledge of facts and terminology of earth science, understanding of plate tectonics, the rock cycle, the hydrologic cycle, earth history, geologic hazards, and energy resources, and the ability to apply this knowledge and understanding in an analysis of earth’s processes.

No prior knowledge of earth science is required before beginning study for this exam.

Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Understand the concepts and theories involved in the study of our planet.
2. Describe the basic concepts of earth science and their historical development.
3. Explain the evolution of the earth.
4. Demonstrate familiarity with the different types of Earth’s physical, climatic, and tectonic environments.
5. Explain the fundamentals of volcanology, plate tectonics, paleontology, hydrology, petrology, and meteorology.
6. Recognize and evaluate the risks and consequences of natural disasters.
7. Understand how and why natural disasters occur.
Content Outline

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the Earth Science examination, the percent of the examination devoted, and the hours to devote to each content area are listed below.

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Percent of the Examination</th>
<th>Hours of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Introduction</td>
<td>5%</td>
<td>7</td>
</tr>
<tr>
<td>II. Plate Tectonics</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>III. The Rock Cycle</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>IV. The Hydrologic Cycle</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>V. Geologic Hazards</td>
<td>20%</td>
<td>27</td>
</tr>
<tr>
<td>VI. Earth History</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>VII. Earth and Energy Resources</td>
<td>5%</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Note: Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

I. Introduction

5 PERCENT OF EXAM | 7 HOURS OF STUDY

Tarbuck (2015)

Ch. 1, Introduction to Earth Science

Ch. 11, Geologic Time

A. What is earth science?
   1. Geology
      a. Physical geology
         b. Historical geology
   2. Meteorology
   3. Oceanography

B. Uniformitarianism and catastrophism

C. Scientific method
   1. Hypothesis
   2. Theory

D. Earth systems
   1. Geosphere
   2. Hydrosphere
   3. Biosphere
   4. Atmosphere

E. Internal structure of the earth
   1. Layers by composition
      a. Crust
         1) Continental
II. Plate Tectonics

A. Wegener's continental drift hypothesis
   1. Pangaea
   2. Evidence for continental drift
      a. Continental fit
      b. Fossil match
      c. Rock types and structures
      d. Ancient (paleo) climates

B. Major lithospheric plates
C. Plate boundaries
   1. Divergent
      a. Mid-ocean ridges
      b. Sea floor spreading
      c. Continental rifts
   2. Convergent
      a. Deep ocean trenches and subduction zones
      b. Oceanic-continental convergence
      c. Oceanic-oceanic convergence
      d. Continental-continental convergence

D. Support for plate tectonics
   1. Ocean drilling: age of the sea floor
   2. Hot spots
   3. Paleomagnetism
      a. Magnetic reversals
      b. Polar wander
   4. Geographic distribution of earthquakes and volcanoes
   5. Plate motion
      a. Plate velocity
         1) Hot spots
         2) Global Positioning System (GPS)
      b. Driving forces
         1) Mantle convection
         2) Slab pull
         3) Ridge push
         4) Slab suction

III. The Rock Cycle

A. Elements and the periodic table
   1. Atomic structure
      a. Electrons
      b. Protons
      c. Neutrons
      d. Atomic number
      d. Atomic mass number
2. Bonding and compounds
   a. Ionic
   b. Covalent

B. Minerals
   1. Definition
   2. Physical properties
      a. Crystal form
      b. Luster
      c. Color
      d. Streak
      e. Hardness (Mohs scale)
      f. Cleavage
      g. Fracture
      h. Specific gravity
      i. Additional properties
         1) Magnetic
         2) Acid test
   3. Chemical classification
      a. Silicates
         1) Silicon-oxygen tetrahedron
         2) Common rock-forming silicates
            a) Quartz
            b) Feldspar
            c) Mica
            d) Amphibole
            e) Pyroxene
            f) Olivine
      b. Nonsilicates
         1) Carbonates
         2) Halides
         3) Oxides
         4) Sulfides
         5) Sulfates
         6) Native minerals (single elements)
   4. Rocks
      1. Definition

D. Igneous rocks and processes
   1. Magma and lava
      a. Origin of magmas: partial melting
         1) Heat and geothermal gradient
         2) Pressure
         3) Composition of partially melted rock
         4) Volatiles
      b. Composition
         1) Mafic (basaltic)
         2) Intermediates
         3) Felsic (granitic)
      c. Viscosity
      d. Temperature
      e. Gases
   2. Crystallization
      a. Intrusive (plutonic)
      b. Extrusive (volcanic)
      c. Bowen’s reaction series
      d. Magmatic differentiation
         1) Crystal settling
         2) Assimilation
         3) Magma mixing
   3. Classification
      a. Textures
         1) Fine grained (aphanitic)
         2) Coarse grained (phaneritic)
         3) Porphyritic
         4) Glassy
      b. Composition
         1) Ultramafic (ultrabasic)
         2) Mafic (basaltic)
         3) Intermediate (andesitic)
         4) Felsic (granitic)
   4. Plutonic structures
      a. Plutons and batholiths
      b. Dikes
c. Sills

5. Volcanism
   a. Lava flows
      1) Pahoehoe
      2) Aa
   b. Pyroclastic material
   c. Types of volcanoes
      1) Shield
      2) Composite
      3) Cinder cone
   d. Volcanic landforms
      1) Fissure eruptions and lava plateaus
      2) Calderas and craters
      3) Volcanic pipes (conduits) and necks
   e. Volcanic hazards (see also VD)

6. Igneous rocks and plate tectonics

E. Weathering and erosion
   1. Mechanical weathering
   2. Chemical weathering (for example: acid rain)
   3. Rates of and factors affecting weathering
   4. Soil formation
   5. Soil erosion
   6. Mass wasting
      a. Controls and triggers
      b. Types of materials
      c. Rate and type of movement
         1) Fall
         2) Flow
         3) Slide

F. Sedimentary rocks and processes
   1. Sediment
   2. Transport and deposition
   3. Lithification
      a. Compaction
      b. Cementation

4. Igneous rocks and plate tectonics
   a. Detrital?
   b. Chemical

5. Sedimentary features
   a. Fossils
   b. Layering (strata)

G. Metamorphic rocks and processes
   1. Metamorphism
   2. Factors influencing metamorphism
      a. Heat
      b. Pressure
         1) Uniform stress (confining pressure)
         2) Differential stress
      c. Fluids
      d. Time
      e. Parent rock composition
   3. Classification
      a. Texture
         1) Foliated
         2) Nonfoliated
      b. Parent rock
   4. Types of metamorphism
      a. Contact (thermal)
      b. Regional

H. Rock deformation and mountain building
   1. Rock deformation
      a. Elastic
      b. Ductile
      c. Brittle
   2. Folds
      a. Anticlines
      b. Synclines
      c. Domes
      d. Basins
   3. Faults
a. Normal (tensional)
b. Reverse and thrust (compressional)
c. Strike-slip and transform (shear)

4. Mountain building
   a. Island arcs
   b. Volcanic arcs
   c. Accreted terranes
   d. Continental collisions
   e. Fault-block mountains
   f. Isostasy

IV. The Hydrologic Cycle

25 PERCENT OF EXAM  |  34 HOURS OF STUDY

Tarbuck

Ch. 5, Running Water and Groundwater
Ch. 6, Glaciers, Deserts, and Wind
Unit 5, The Global Ocean (Ch. 13–15)
Unit 6, Earth's Dynamic Atmosphere (Ch. 16-20)

A. Distribution of water
B. Driving mechanism (solar energy)
C. Components (water balance)
   1. Evaporation
   2. Condensation
   3. Precipitation
   4. Evaporation and transpiration (evapotranspiration)
   5. Runoff
   6. Infiltration
D. Running water
   1. Drainage basins and divides
   2. Flow
      a. Discharge
      b. Gradient
   3. River processes
      a. Erosion
      b. Transportation
   1) Types of load
      a) Dissolved
      b) Suspended
      c) Bed load
   2) Competence
   3) Capacity
   c. Deposition
4. Base level
5. Channel patterns
   a. Meandering streams
      1) Point bars
      2) Cut banks
      3) Oxbow lakes
   b. Braided streams
   c. Floodplains
   d. Natural levees
   e. Deltas
6. Floods (see also VC)

E. Groundwater

1. Groundwater system
   a. Unsaturated zone (zone of aeration)
   b. Saturated zone
   c. Water table
2. Storage and movement
   a. Porosity
   b. Permeability
   c. Aquifer
   d. Aquitard
   e. Darcy's Law
      1) Hydraulic gradient
      2) Hydraulic conductivity
3. Springs
   a. Hot springs
   b. Geysers
4. Wells
   a. Drawdown
b. Cone of depression

5. Groundwater problems
   a. Depletion
   b. Subsidence
   c. Contamination

6. Karst features
   a. Caverns
      1) Stalagmites
      2) Stalactites
   b. Sinkholes

F. Glaciers
1. Definition
2. Types
   a. Valley (alpine)
   b. Ice sheets and ice caps
3. Glacial budget
   a. Zone of accumulation
   b. Zone of wastage (ablation)
   c. Snowline
4. Erosional features
   a. Cirques
   b. Arêtes and horns
   c. U-shaped valley (glacial trough)
   d. Hanging valley
   e. Fjords
5. Depositional features
   a. Glacial drift
   b. Glacial erratics
   c. Moraine
   d. Drumlín
   e. Kettle
6. Glaciation
   a. Ice ages

b. Causes
   1) Greenhouse gases
   2) Plate movements
   3) Earth’s orbital variations (Milankovitch’s model)

G. Oceans
1. Features of the oceans
   a. Continental margins
      1) Passive
         a) Continental shelf
         b) Continental slope
            i. Submarine canyon
            ii. Turbidity currents
         c) Continental rise
      2) Active
         a) Trenches
         b) Accretionary wedge
   b. Ocean basins
      1) Abyssal plain
      2) Seamounts
      3) Oceanic plateau
   c. Mid-Oceanic ridges
      1) Formation of rift valleys
      2) Spreading centers
2. Properties of ocean water
   a. Temperature
   b. Salinity
   c. Density
3. Marine organisms
   a. Plankton
   b. Nekton
   c. Benthos
   d. Food chain
4. Ocean circulation
   a. Surface
      1) Coriolis effect
      2) Upwelling
5. Shorelines
   a. Longshore currents
   b. Wave refraction
   c. Erosional features
      1) Wave-cut cliffs and platforms
      2) Sea arches and stacks
   d. Depositional features
      1) Barrier islands
      2) Spits and bars
   e. Coastal erosion and stabilization
      1) Beach nourishment
      2) Artificial structures (for example: sea walls, groins, breakwaters)
   f. Estuaries

6. Tides
   a. Diurnal pattern
   b. Causes of tides

H. Atmosphere and climate
   1. Differences between weather and climate
   2. Composition of the atmospheres
   3. Structure of the atmosphere
      a. Troposphere
      b. Stratosphere
      c. Mesosphere
      d. Thermosphere
   4. Solar radiation
      a. Reflection
      b. Scattering
      c. Absorption
   5. Global distribution of temperature
   6. Global air circulation
      a. Trade winds
      b. Westerlies
      c. Polar winds
   7. Water in the atmosphere
   a. Humidity
   b. Relative humidity
   c. Cloud formation
   d. Precipitation mechanisms

8. Weather patterns and severe storms
   a. Fronts
      1) Cold
      2) Warm
      3) Stationary
   b. Tornadoes
   c. Thunderstorms
   d. Cyclones and hurricanes

9. Climate
   a. Climate system
   b. Classification
      1) Humid
      2) Dry
         a) Arid
         b) Semi-arid
      3) Polar
   c. Global climate distribution
   d. Climate change and its consequences
      1) Feedback mechanisms
      2) Increasing carbon dioxide levels
      3) Global warming
      4) Effect of aerosols

10. Problems
    a. Ozone depletion
    b. Greenhouse effect
    c. El Niño and La Niña
    d. Air pollution
V. Geologic Hazards

20 PERCENT OF EXAM | 27 HOURS OF STUDY

Tarbuck
Ch. 5, Running Water and Groundwater
Ch. 8, Earthquakes and Earth's Interior
Ch. 9, Volcanoes and Other Igneous Activity
Ch. 19, Weather Patterns and Severe Storms

A. Earthquakes

1. Definition
2. Elastic rebound
3. Types of seismic waves
   a. P wave
   b. S wave
   c. Surface wave
4. Earthquake location
   a. Focus
   b. Epicenter
5. Foreshocks and aftershocks
6. Measurement scales
   a. Intensity
   b. Magnitude
     1) Richter scale
     2) Moment magnitude scale
7. Global distribution
8. Earthquake hazards
   a. Ground shaking
   b. Amplification
   c. Liquefaction
   d. Tsunami
9. Prediction
   a. Short term
   b. Long term
     1) Probability
     2) Uniform building code
B. Mass wasting (see IIIE6)
C. Floods

D. Volcanic hazards

1. Lahar (mudflow)
2. Nuée ardente (pyroclastic flow)
3. Lava flow (see IIIID5a)
4. Volcanoes and climate change

E. Coastal hazards

1. Hurricanes (see also IVH8d)
   a. Storm surge
   b. High winds
   c. Flooding
2. Tsunami (see also VA8d)
3. Shoreline erosion (see also IVG5e)

VI. Earth History

10 PERCENT OF EXAM | 14 HOURS OF STUDY

Tarbuck
Ch. 1, Introduction to Earth Science
Ch. 11, Geologic Time
Ch. 12, Earth's Evolution Through Geologic Time

A. Origins of the earth and solar system

1. Nebular hypothesis
2. Age of the earth

B. Geologic time

1. Principles of relative dating
   a. Law of superposition
   b. Original horizontality
   c. Cross-cutting relations
d. Inclusions

e. Unconformities

2. Radiometric dating

a. Isotopes (see also IIIA1f)
b. Radioactive decay
   1) Parent atoms
   2) Daughter atoms
c. Half-life

3. Fossils

a. Means of preservation
b. Principle of fossil succession
c. Index fossils

4. Methods of correlation

a. Fossil assemblages
b. Numerical ages
c. Layer sequence (strata)

5. Geologic time scale

a. Precambrian
   1) Early atmosphere (outgassing)
   2) Stromatolites
   3) Shields
b. Paleozoic
   1) Age of invertebrates
   2) Age of fishes
   3) Age of amphibians
   4) First appearance of reptiles
   5) Assembly of Pangaea
   6) Mass extinction
c. Mesozoic
   1) Breakup of Pangaea
      a) Gondwana
      b) Laurasia
   2) Age of reptiles
   3) First birds
   4) First flowering plants
   5) First mammals
   6) Dinosaur extinction
   7) Cenozoic
      1) Age of mammals
      2) Age of flowering plants
      3) Ice ages
      4) Extinction of large mammals
      5) First humans

VII. Earth and Energy Resources

5 PERCENT OF EXAM  |  7 HOURS OF STUDY

Tarbuck

Ch. 2, Matter and Minerals
Ch. 3, Rocks: Materials of the Solid Earth
Ch. 13, The Ocean Floor

A. Resource versus reserve

B. Renewable and nonrenewable

C. Mineral resources

1. Formation of metallic and nonmetallic minerals
   a. Igneous processes
   b. Metamorphic processes
   c. Weathering and sedimentary processes
   d. Hydrothermal solutions

2. Rocks and aggregates

3. Resources from the ocean (for example: sulfide deposits)

D. Energy resources

1. Fossil fuels
   a. Oil
   b. Natural gas and gas hydrates
   c. Coal
   d. Oil shales
   e. Oil sands

2. Alternative energy resources

NOTE: The rapid pace of development in this area makes textbook references unreliable. We recommend that you search the Web for "alternative energy" or the specific energy
source (for example, “geothermal energy”) and use good information literacy skills in selecting and filtering the search results to get reliable, up-to-date information about these resources.

a. Solar
b. Geothermal
c. Wind
d. Nuclear
e. Hydroelectric
f. Tidal
Sample Questions

The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

Rationales for the questions can be found on pages 19−22 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study.

1. When can a theory be termed a paradigm?
   After the theory has been
   1) tested then rejected as a scientific hypothesis
   2) accepted by the scientific community as a natural law
   3) successfully tested on a narrow range of natural phenomena
   4) successfully used to explain a wide range of natural phenomena

2. What is the largest layer by volume of the earth?
   1) crust
   2) mantle
   3) outer core
   4) inner core

3. What is the most probable appearance of the East African rift in 20 million years?
   1) Basin and Range Province
   2) long linear sea similar to the Red Sea
   3) long chain of volcanoes like the Andes
   4) wide ocean similar to the Atlantic Ocean

4. Which element is an essential constituent of pyroxenes?
   1) iron
   2) oxygen
   3) phosphorus
   4) zinc

5. Which structure forms when (1) silica-rich magma rises to the earth’s surface, (2) an eruption ejects huge volumes of lava and ash, and (3) the roof of the magma chamber collapses over a broad area?
   1) a caldera
   2) a laccolith
   3) a pluton
   4) a volcanic neck

6. What is the most common product of chemical weathering of feldspar?
   1) quartz
   2) calcite
   3) iron oxides
   4) clay minerals
7. Why are mafic lavas more abundant at island arcs than at arcs developed on the continents?
   1) The mantle underneath island arcs is more mafic.
   2) Assimilation of silica-rich crust by island arc magmas is less.
   3) Island arc lavas form predominantly through decompression melting.
   4) Island arc magmas are formed solely by melting of mafic oceanic crust.

8. An accreted terrane must have which rock characteristic?
   1) rocks that are older than rocks in the surrounding areas
   2) rocks that are younger than rocks in the surrounding areas
   3) rocks that have a different geological history than the rocks in the surrounding areas
   4) rocks that are comprised of different rock types than the rocks in the surrounding areas

9. What best explains why the elevations of the ocean basins are lower than the elevations of the continents?
   1) The mantle is thinner under the oceans.
   2) The oceanic crust is thinner than the continental crust.
   3) The weight of the oceans forces the oceanic crust downward.
   4) The greater buoyancy of the continents results from their higher temperature.

10. What is a consequence of isostatic adjustment accompanying erosion?
    1) exposure of the earth’s mantle at the surface of the earth
    2) increase of erosion rates as material is removed from mountains
    3) exposure of high-grade metamorphic rocks on mountain summits
    4) rebound of continental slopes in response to sediment deposition

11. Where is the second most plentiful source of the world’s fresh water?
    1) in lakes
    2) in the ground
    3) in the atmosphere
    4) in streams and rivers

12. Which energy source drives the hydrologic cycle?
    1) gravity
    2) the sun
    3) the moon
    4) radioactive decay

13. Which process contributes least to the hydrologic cycle?
    1) condensation
    2) evaporation
    3) precipitation
    4) sublimation

14. Why do ice crystals consume water droplets in water-saturated air at temperatures below 0°C (32°F)?
    1) Supercooled water is more stable under these conditions.
    2) Supercooled ice crystals will melt under these conditions.
    3) The degree of supersaturation is less for ice than for liquid water.
    4) The degree of supersaturation is greater for ice than for liquid water.

15. If a house is built on location Y, what will happen over time to the edge of the river that is nearest the house?
    1) move toward the house and eventually destroy it.
    2) transform into a braided stream and form an island.
    3) remain in the same place, so things remain the same.
    4) move away from the house, so the yard will get larger.
16. Which statement describes porosity and permeability of rock/sediment?
   1) Porosity and permeability of rock or sediment have identical meanings.
   2) Rock or sediment may be very porous yet still prevent water from moving through it.
   3) A poorly sorted cemented sandstone has greater porosity than a well sorted uncemented sandstone.
   4) The quantity of groundwater that can be stored depends on the permeability of the rock or sediment.

17. Which force forms oceanic ridges?
   1) contractional
   2) compressional
   3) tangential
   4) tensional

18. Which differences in global cooling effects followed the most recent eruptions of Mount St. Helens and Mount Pinatubo? Select the two that apply.
   1) the differing sizes of the two volcanoes
   2) the differing amounts of gas injected into the stratosphere
   3) the differing amounts of volcanic ash released into the atmosphere
   4) the differing compositions of the volcanic gases injected into the atmosphere

19. Which hazard associated with hurricanes can occur hundreds of kilometers from the location of landfall?
   1) storm surge
   2) warm fronts
   3) inland flooding
   4) inland snowfall

20. During radioactive decay of uranium-238, what is the unstable daughter nucleus produced directly by the alpha decay of thorium-230?
   1) lead-214
   2) radium-226
   3) thorium-234
   4) uranium-234

21. Where are the best locations to find chromium?
   1) shield areas
   2) ocean floors
   3) stable platforms
   4) young mountain belts
Rationales

1. (IC2)
   1) Although testing and rejection of hypotheses and theories is vital, it does not conform to the definition of a paradigm.
   2) A law explains a narrow range of phenomena and does not meet the definition of a paradigm.
   3) This statement applies to a theory; a paradigm applies to a wide range of phenomena.
   *4) A paradigm is a theory that explains a wide range of natural phenomena.

2. (IE1b)
   1) The crust is the relatively thin outer skin of the earth.
   *2) The mantle is over 82% of the earth’s volume.
   3) The inner and outer cores are 18% of the earth’s volume.
   4) The inner and outer cores are 18% of the earth’s volume.

3. (IIC1c)
   1) The Basin and Range Province represents a different type of continental extension, distributed instead of localized, not an advanced stage of continental rifting.
   *2) Assuming an average rate of divergence of 5 cm/yr., the East African rift region will be 1,000 km wider with a long linear sea parallel to the Great Lakes region.
   3) Volcanic activity will form new oceanic lithosphere.
   4) The spreading rate required to form a 5,000 km ocean like the Atlantic Ocean is approximately 25 cm/yr., which is unrealistic.

4. (IIB3a1)
   1) Iron is present in many, but not all, pyroxenes.
   *2) Being silicates, pyroxenes are composed of silicate tetrahedra that contain silicon atoms surrounded by oxygen.
   3) Phosphorus is not present in pyroxenes.
   4) Zinc is not an essential component of pyroxenes.

5. (IID5d2)
   *1) This is how a caldera is formed.
   2) A laccolith is a type of intrusive igneous feature.
   3) A pluton is a type of intrusive igneous feature.
   4) Although they are a volcanic feature, necks do not form from collapse.

6. (IIIIE2)
   1) Quartz is resistant to chemical weathering and not a by-product of it.
   2) Calcite is not a by-product of chemical weathering.
   3) Iron oxides are not a product of chemical weathering.
   *4) Clay minerals are the most common product of weathering of feldspars.

*correct answer
7. (IIIH4a)
1) Mantle compositions are essentially the same beneath oceanic and continental crust.

*2) The abundant intermediate and felsic lavas of continental arcs result from assimilation of felsic continental crust, which is far less abundant in the environment of island arcs.

3) Magmas giving rise to lavas at continental and island arcs are formed by melting of the mantle, not of the crust. Melting mafic crust forms intermediate lavas.

4) Melting at arcs does not result from decompression melting.

8. (IIIH4c)
1) Accreted terranes can be younger or older than surrounding rocks.

2) Accreted terranes can be younger or older than surrounding rocks.

*3) Accreted terranes are identified by the presence of rocks indicating a different geologic history, for example, rocks of oceanic origin juxtaposed next to continental rocks.

4) Rock types vary dramatically within individual terranes and on the continents, so this is an insufficient criterion to identify a region as an accreted terrane.

9. (IIIH4f)
1) The mantle is somewhat thinner under the continents.

*2) The greater thickness of continental crust elevates these areas relative to oceanic crust.

3) The mass of the oceans is too small to cause the relatively dramatic elevation difference between the continents and the oceans.

4) Heat flow is higher in oceanic crust and any effect on buoyancy is offset by the greater density of the oceanic crust. These effects are minor compared to the effect of crustal thickness.

10. (IIIH4f)
1) The decrease in erosion potential and increase in sedimentary deposition as elevation decreases prevents direct exposure of the mantle at the surface.

2) Erosion rates are proportional to the energy gradients. Gradients on mountains decrease as mountain elevation is lost through erosion.

*3) The coupling of erosion and uplift as a consequence of isostasy frequently leads to the exposure of high grade metamorphic rocks (formed deep in the crust) at Earth's surface on the tops of mountains.

4) The continental slopes undergo subsidence in response to sediment loading as a consequence of isostasy.

11. (IVA)
1) Lakes contain a very minor amount of the world’s fresh water.

*2) Groundwater accounts for almost all of the world’s non-frozen fresh water.

3) The atmosphere contains a minor amount of the world’s fresh water.

4) Streams and rivers contain a minor amount of the world’s fresh water.

12. (IVB)
1) Gravity plays a role in part of the hydrologic cycle by pulling water down hill, but gravitational potential energy does not drive the hydrologic cycle.

*2) The sun causes evaporation to occur.

3) The moon plays no role in the hydrologic cycle.

4) The amount of energy that radioactive decay contributes to the total earth budget is miniscule.

13. (IVC)
1) Condensation is important in cloud formation and the resulting precipitation.

2) Evaporation drives the hydrologic cycle.

3) Precipitation is critical to the hydrologic cycle.

*4) Sublimation can occur in high latitudes, but it is a very minor contributor to the hydrologic cycle as a whole.

*correct answer
14. (IVC3)
1) Supercooled water is unstable with respect to ice in these conditions.
2) Ice crystals grow, not melt, under these conditions.
3) The degree of supersaturation is greater for ice in these conditions.
4) Ice crystals grow at the expense of water droplets, which evaporate as the ice crystals grow.

15. (IVD5a)
1) Erosion occurs at the cut bank, moving the river bank toward the outer edge of the bend in the river channel. A house at location X would be destroyed.
2) A meandering stream occurs on a shallow gradient; a braided stream forms on very steep gradients. A braided stream would not form.
3) The patterns of water velocity in meandering rivers produce dynamic landscapes where river bands migrate significantly over time.
4) Point bars migrate toward the existing river channel, increasing the amount of land between location Y and the river's bank.

16. (IVE2a)
1) Porosity is the percentage of the total volume of rock/sediment that consists of pore spaces. Permeability is the ease/ability of material to transmit fluid.
2) Some sediments, such as clay, are quite porous, but water cannot move because the pore spaces between particles are too small.
3) Cementation or the presence or mixture of small particles (poorly sorted) can reduce the open pore spaces (and thus the porosity) of sandstone.
4) The quantity of groundwater that can be stored depends on the porosity of the rock or sediment.

17. (IVG1c)
1) Contractional is not a term used to describe force, but it has the same general meaning as compressional.
2) Compressional force forms mountain ranges on land and subduction zones but does not produce rifting and so, does not form oceanic ridges.
3) Tangential force acts at a few plate tectonic boundaries but does not produce rifting and so, does not produce oceanic ridges.
4) Tensional forces at divergent plate boundaries form rift valleys on land and rifting in ocean crust that leads to extensive volcanism and formation of oceanic ridges.

18. (VD4)
1) Mount St. Helens and Mt. Pinatubo are about the same size. Size does not matter, but the amount and nature of the material erupted does.
2) Mount St. Helens (1980) injected mainly ash, not gas, and it affected primarily the atmosphere level. Mount Pinatubo (1991) injected mainly sulfur dioxide gas into the stratosphere. The gas content is the major difference.
3) Mount Pinatubo did release some ash, but not nearly as much as Mount St. Helen's did.
4) Both volcanoes produced primarily sulfur dioxide gas (same composition), but only Mount Pinatubo was powerful enough to inject significant amounts of gas into the stratosphere.

19. (VE1c)
1) A storm surge only occurs in the coastal region near the location of hurricane landfall.
2) Warm fronts are not related to hurricanes.
3) Inland flooding can occur hundreds of kilometers from the location of landfall of a hurricane.
4) Inland snowfall is not related to hurricanes.

*correct answer
20. (VIIb2b2)
1) Lead-214 is an unstable daughter atom produced after thorium-230 has formed in the decay series as indicated by mass loss of 16 units (not a direct step in the series).

2) Radium-226 is an unstable daughter atom produced directly by alpha decay of thorium-230 as indicated by the mass loss of 4 units due to alpha decay.

3) Thorium-234 is an unstable daughter atom produced before thorium-230 is formed within the uranium-238 decay series. So, it cannot be produced directly by decay of thorium-230.

4) Uranium-234 is an unstable daughter atom produced before thorium-230 is formed within the uranium-238 decay series. So, it cannot be produced directly by decay of thorium-230.

21. (VIIc1)
1) Economic reserves of chromium are found only in Precambrian rocks that make up the shields of the continents.

2) Economic reserves of chromium are not found on the ocean floor.

3) Economic reserves of chromium are not found in stable platforms.

4) Economic reserves of chromium are not found in young mountain belts.
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