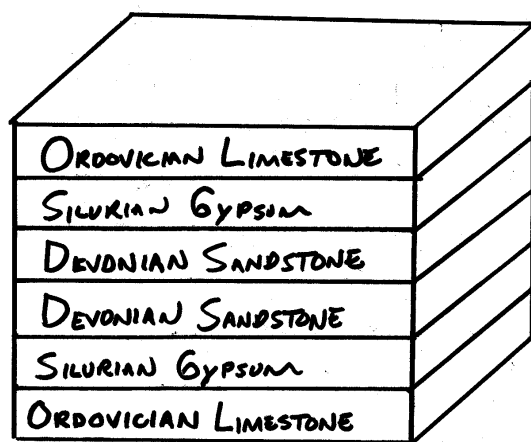


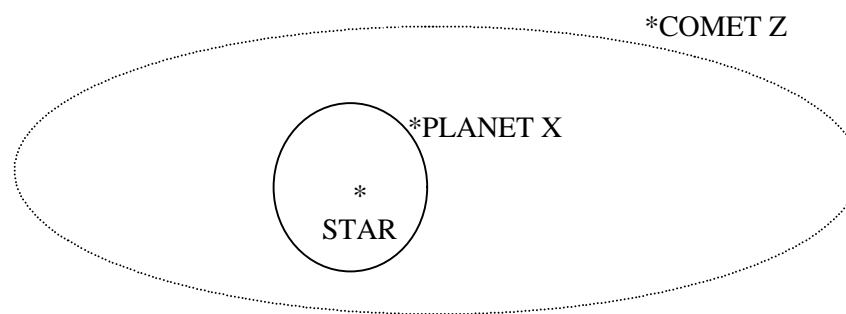
500. The diagram below represents an outcrop of rocks found in Upstate New York. The relative age of each rock layer is given.



Based on your knowledge of Earth Science and the *Earth Science Reference Tables*, what can be inferred about this outcrop?

- 1) faulting has occurred between the Devonian sandstone layers
- 2) **tectonic forces have overturned the sedimentary rock layers**
- 3) the youngest rock layer is on top
- 4) the oldest rock layers are found in the middle

501. The diagram below represents a planet and a comet traveling in their respective orbits around a star.



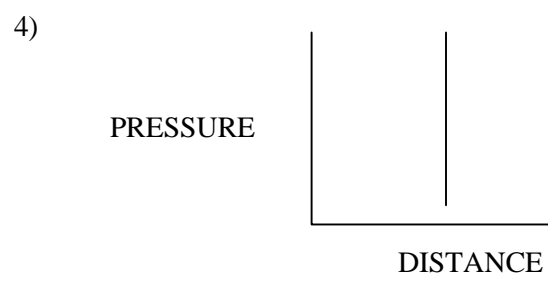
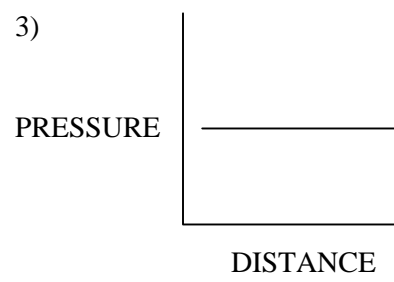
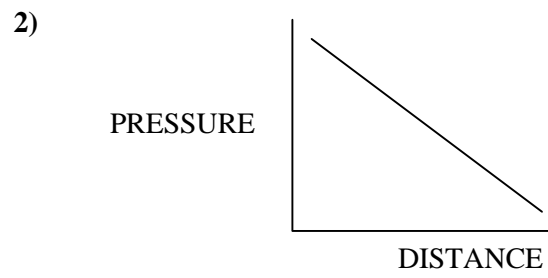
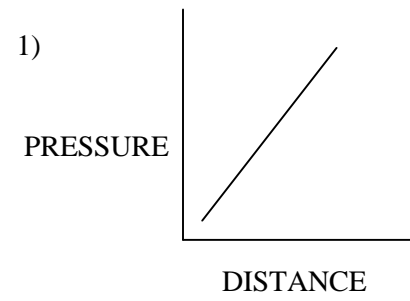
Compared to Planet X, Comet Z has a:

- 1) **more elliptical orbit and a higher eccentricity**
- 2) more elliptical orbit and a lower eccentricity
- 3) less elliptical orbit and a higher eccentricity
- 4) less elliptical orbit and a lower eccentricity

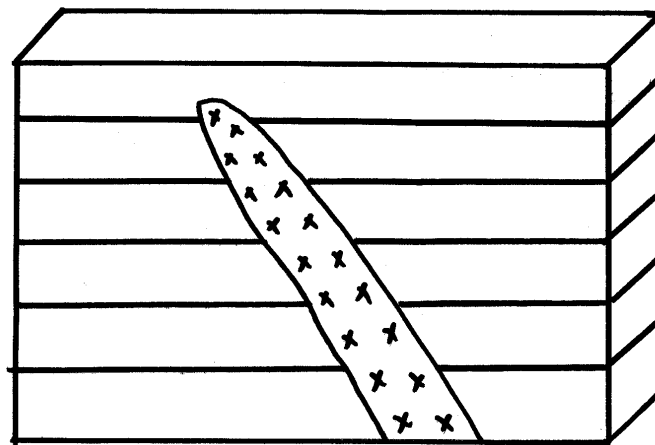
502. Compared to the terrestrial planets Mercury, Venus, Earth, and Mars, the Jovian planet Saturn is:

- 1) larger in size and more dense
- 2) **larger in size and less dense**
- 3) larger in size and has a shorter period of revolution
- 4) smaller in size and less dense

503. Which graph best illustrates the relationship between atmospheric pressure and distance from the center of the earth?



504. The igneous intrusion in the diagram below was dated and found to be younger in age than the surrounding rock layers. This finding supports the:



- 1) principle of superposition
- 2) principle of original horizontality
- 3) **principle of cross-cutting relationships**
- 4) principle of contact metamorphism

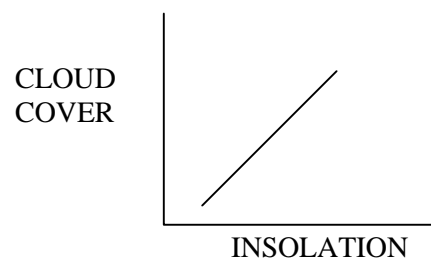
505. The following processes require a certain amount of time to complete. List the sequence of events in increasing order of time to complete.

- A. radioactive decay of 10 grams of carbon-14 into 5 grams of nitrogen-14
- B. the period of revolution of Pluto
- C. one complete moon phase cycle
- D. period of rotation of Jupiter

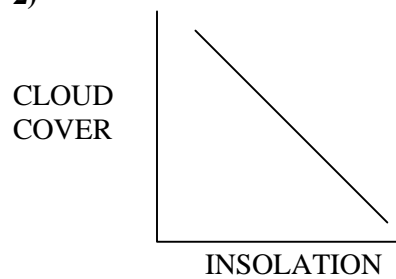
- 1) A, B, C, D
- 2) B, A, C, D
- 3) **D, C, B, A**
- 4) D, C, A, B

506. Which graph best illustrates the relationship between cloud cover and the amount of insolation that reaches the earth's surface:

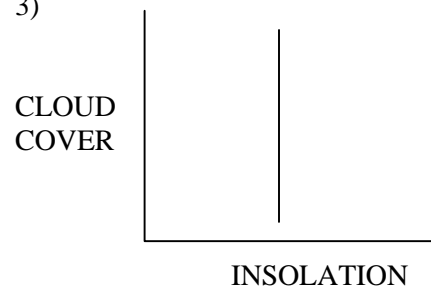
1)



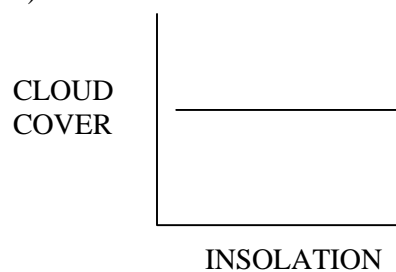
2)



3)



4)



507. Ancient inland seas existed in the continental United States during the Paleozoic and Mesozoic eras. As these seas warmed and evaporated, deposits of _____ formed.

- 1) shale and rhyolite
- 2) rock sale and schist
- 3) **dolostone and gypsum**
- 4) fossil limestone and obsidian

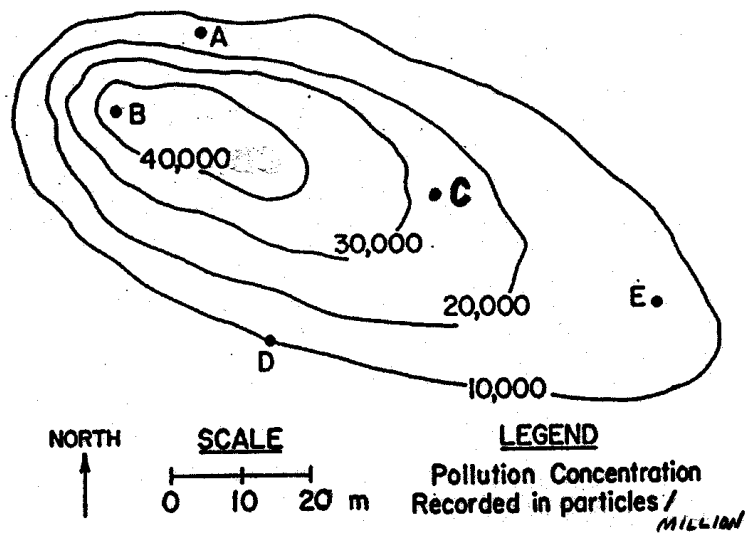
508. An unknown extrusive igneous rock is composed of approximately 60% plagioclase feldspar, 30% amphibole and 10% biotite. The unknown rock is most likely:

- 1) diorite
- 2) **andesite**
- 3) pumice
- 4) gabbro

509. Diamond and graphite are composed entirely of the element carbon. However, on Moh's scale of hardness, Diamond is rated 10 and graphite is rated 1. The most logical explanation for the differences in hardness is that:

- 1) diamond exhibits cleavage and graphite does not
- 2) **they have different internal crystal structures**
- 3) diamond streaks none to white and graphite streaks gray-black
- 4) graphite has a metallic luster and diamond does not

Base your answers to questions 510-511 on your knowledge of Earth Science and the groundwater pollution field map shown below. The isolines represent concentrations of pollutants in parts per million.



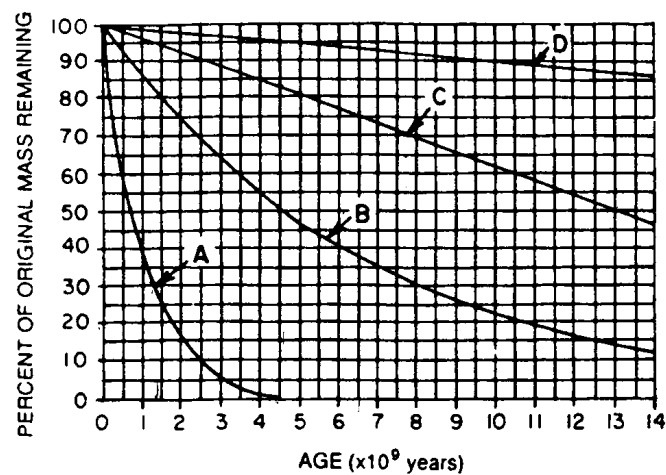
510. State the position on the map where the groundwater pollution was most likely spilled. [1]

Rubric: Allow 1 point for **location B**

511. State the compass direction in which the groundwater pollution is moving. [2]

Rubric: Allow 2 points for **Southeast or SE**
Allow 1 point for East or South

Base your answers to questions 512 and 513 on the diagram below which represents the decay rates of four different radioactive isotopes.



512. Based on the graph, what is the half-life of isotope B in years. [2]

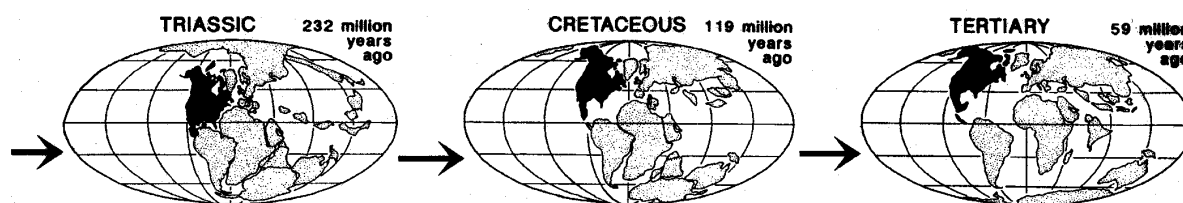
Rubric: Allow 2 points for **4.5 x 10⁹ years or 4,500,000,000 years.**
Allow 1 point for +/- 500,000 years.

513. State one reason why isotope A would be the best isotope to use for dating material that was less than 500,000 years old. [1]

Rubric: Allow 1 point for answers such as:

- Isotope A has the shortest half-life *or*
- Isotope A decays at a faster rate than the other isotopes

514. The diagram below represents the inferred positions of landmasses from the Triassic Period to the Tertiary Period.



Inferred Position of Earth's Landmasses
Oldest inference is Ordovician (458 million years ago) to most recent is Tertiary (59 million years ago).

State the compass direction in which North America migrated from the Triassic Period to the Tertiary Period. [2]

Rubric: Allow 2 points for **Northwest or NW**
Allow 1 point for west or north only

515. Answer questions 1-3 based on the caption below.

China is experiencing an “Industrial Revolution” similar to that of the United States in the Nineteenth Century. China has vast deposits of low-grade, sulfur-rich coal, which it plans to use to help fuel its economy in the 21st Century.

1) Explain how burning fossil fuels such as coal contributes to global warming. [1]

Rubric: Allow 1 point for answers such as:

- Burning fossil fuels adds greenhouse gases to the atmosphere.
- Some of the terrestrial (infrared) radiation is trapped by greenhouse gases causing global temperatures to slowly rise.

2) Explain how acid rain will become an environmental issue for China in the 21st Century. [1]

Rubric: Allow 1 point for answers such as:

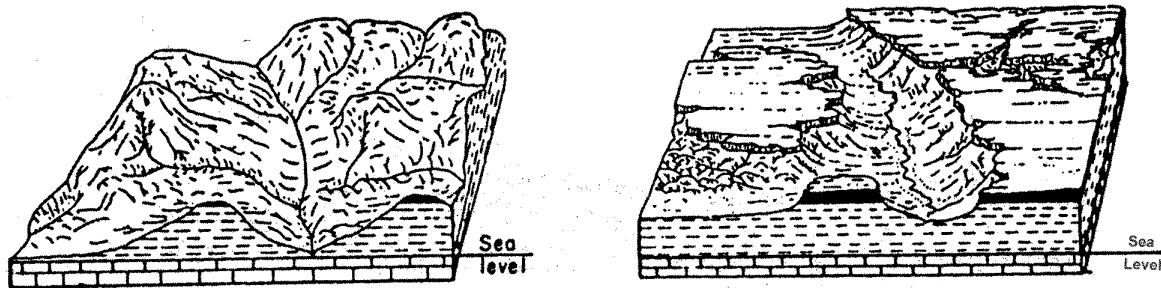
- The combustion of coal for energy causes the release of greenhouse gases such as SO₂ and NO₂. These gases combine with atmospheric moisture to form “acid rain”.
- Plants and animals are affected by excessive amounts of acid rain.

3) List 2 “renewable” resources that are currently being used to generate electricity for human needs. [2]

Rubric: Allow 2 points for answers such as:

- Wind, water, hydrothermal, or solar energy

516. Refer to the diagram below to answer questions 4-7. The diagram represents two different landscapes found in the United States. The significant difference in appearance is attributed to climate types.



Climatic Effects on Landscapes

4) Based on the shape of the topography, describe the type of climate at Location A. [1]

Rubric: Allow 1 point for answers such as:

- Location A is located in a humid climate because the landscape has gentle slopes and a rounded appearance.

5) Based on the shape of the topography, describe the type of climate at Location B. [1]

Rubric: Allow 1 point for answers such as:

- Location B is located in an arid climate because the landscape has steep slopes and an angular appearance.

- 6) What is the dominant type of weathering (chemical or mechanical) occurring at Location A and why? [1]

Rubric: Allow 1 point for answers such as:

- Chemical weathering is the dominant type of weathering at Location A because the rounded appearance of the landscape is caused by precipitation and chemical reactions at the Earth's surface.

- 7) What is the dominant type of weathering (chemical or mechanical) occurring at Location B and why? [1]

Rubric: Allow 1 point for answers such as:

- Mechanical weathering is the dominant type of weathering at Location B because the angular appearance of the landscape is caused by frost action and extreme heating and cooling of the Earth's surface.

517. How do terrestrial planets differ from Jovian planets?

- 1) **terrestrial planets are small and rocky; Jovian planets are large and gaseous.**
- 2) terrestrial planets are large and rocky; Jovian planets are small and gaseous.
- 3) terrestrial planets are small and gaseous; Jovian planets are large and rocky.
- 4) terrestrial planets are large and gaseous; Jovian planets are small and rocky.

518. How is water returned from the atmosphere to the surface of the Earth during the hydrologic (water) cycle?

- 1) **precipitation**
- 2) evaporation
- 3) infiltration
- 4) transpiration

519. Using a psychrometer and a chart, which weather variable can be measured?

- 1) temperature
- 2) air pressure
- 3) wind speed
- 4) **relative humidity**

520. A student examines a sample of the sedimentary rock conglomerate. Compared to the age of the rock, the age of the pebbles in the rock.

- 1) **are older**
- 2) are younger
- 3) are the same age
- 4) cannot be determined

521. How does the length of human existence on earth compare to the total length of geologic time?

- 1) human existence is more than 60% of geologic time
- 2) human existence is about 40% of geologic time
- 3) human existence is about 20% of geologic time
- 4) **human existence is less than 1% of geologic time**

522. The interior of the earth is inferred to be layers differing in composition and state of matter. This inference was made by analyzing:

- 1) ocean waves
- 2) **seismic waves**
- 3) light waves
- 4) water waves

523. New ocean crust is continually formed along:

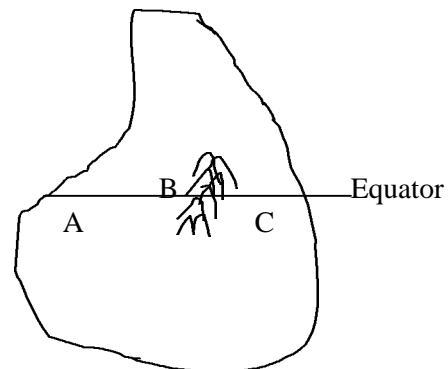
- 1) deep ocean trenches
- 2) transform faults
- 3) **mid-ocean ridges**
- 4) subduction zones

524. Beaches, sandbars and barrier islands are characteristic of which agent of erosion?

- 1) running water
- 2) moving ice
- 3) **wave action**
- 4) mass movements

525. Base your answer to the question below on the diagram provided and your knowledge of earth science.

How would the climate of location B differ from the climate of locations A and C?



- 1) B has a warmer climate with little variation
- 2) B has a warmer climate with a large variation
- 3) **B has a colder climate with a little variation**
- 4) B has a colder climate with a large variation

526. Some minerals form when atoms of existing minerals have been rearranged by conditions of high heat and pressure. This type of mineral would be most likely observed in:

- 1) volcanic rocks
- 2) sedimentary rocks
- 3) **metamorphic rocks**
- 4) organic rocks

Minerals are formed inorganically by the process of crystallization. The shape of minerals crystal is useful in identifying a mineral.

527. In a complete sentence, state one way in which a mineral may crystallize.

Rubric: Allow 1 credit for a sentence that includes any one:

- cooling and/or solidification of magma/lava
- precipitation from water
- evaporation of water
- chemical reactions
- high heat and/or pressure

528. In a complete sentence, state one other physical or chemical property that can be used to identify a mineral.

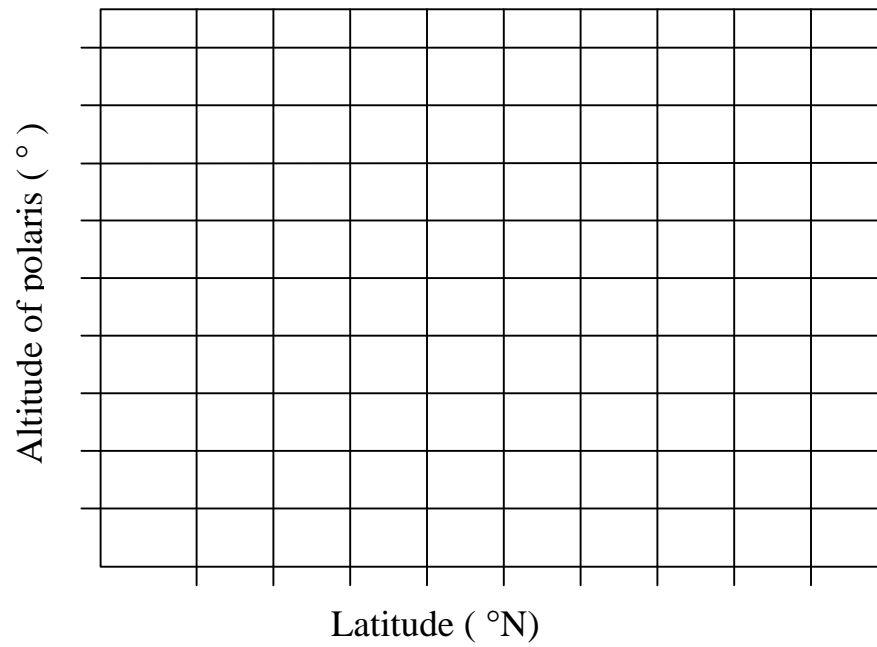
Rubric: Allow 1 credit for a sentence that includes any one:

- cleavage
- fracture
- density
- reaction with acid
- hardness
- streak
- luster
- color

Base your answers to the questions below on the data table and your knowledge of Earth Science.

Latitude (°N)	Observed Attitude of Polaris (°)
0	0
23	23
45	45
67	67
90	90

Construct a graph to illustrate the relationship between the observer's latitude and the altitude they observe Polaris.

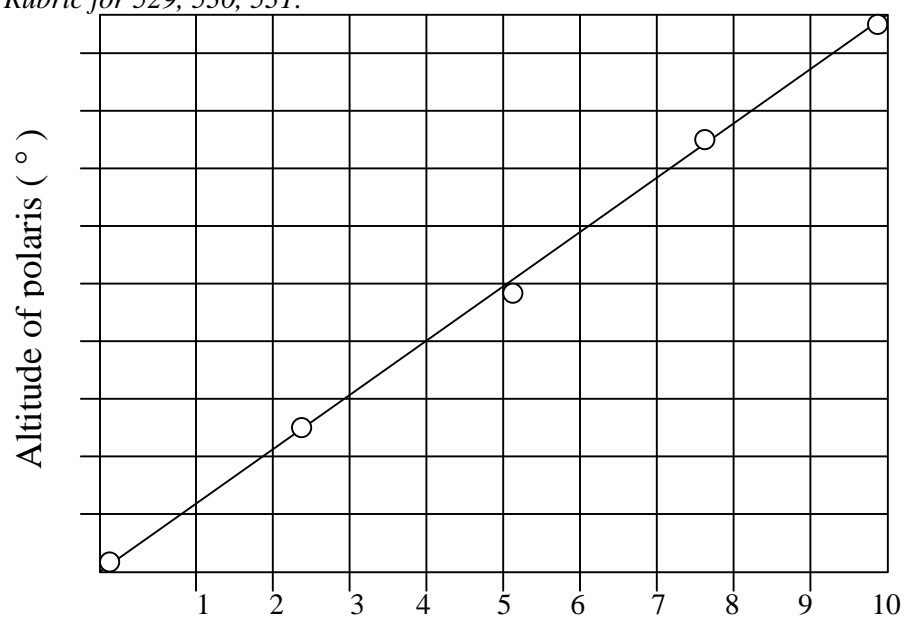


529. Construct an appropriate scale on each axis [1]

530. Plot the data and draw a line connecting the points [1]

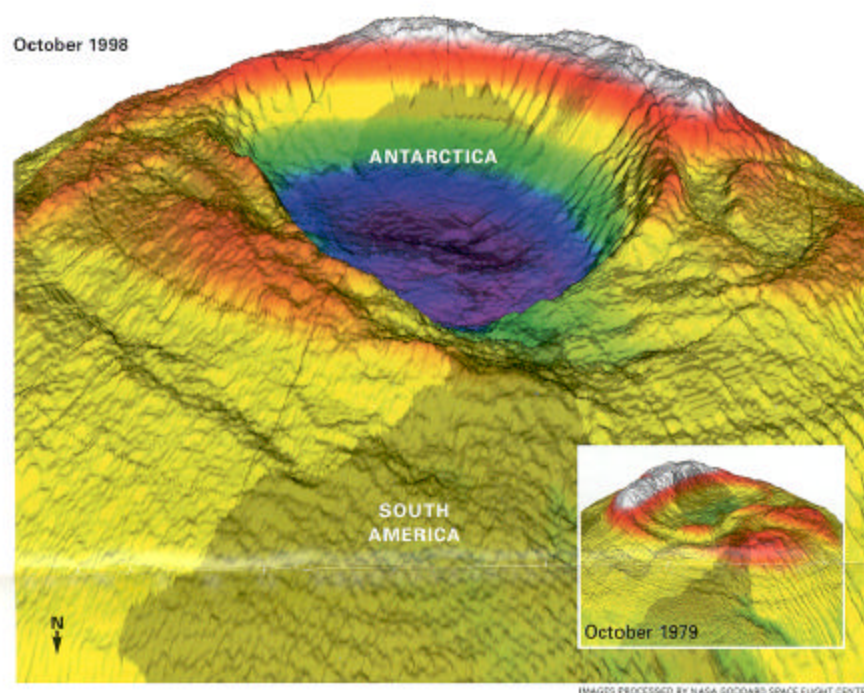
531. In one or more complete sentences state the relationship between the latitude of an observer and the altitude they observe points.

Rubric for 529, 530, 531:



529. Allow 1 credit for an appropriate scale on each axis.
530. Allow 1 credit for plotting 4 of the 5 data points correctly $\pm 2^\circ$ and connecting all points in a line.
531. Allow 1 credit for describing the correct relationship between the latitude of the observer and the altitude they observe Polaris.
- There is a direct relationship between the latitude of the observer and the altitude they observe Polaris.
 - The higher the latitude the higher the altitude of Polaris.
 - As latitude increases the altitude of Polaris also increases.

Study the diagram and article provided.



An Ominous Ozone Hole Looms Above Antarctica

Maps usually depict familiar, visible features like mountains and cities. But maps can also reveal invisible—and sometimes disturbing—phenomena.

What appears to be a crater (above) is actually a 3-D image of the Antarctic ozone hole. Created by NASA's Goddard Space Flight Center, the image depicts low atmospheric ozone levels (the so-called hole) as purple depths and high levels as snowcapped peaks.

For over 20 years a satellite instrument called TOMS (Total Ozone Mapping Spectrometer) has mapped the annual ebb and

flow of the ozone layer. Since 1979 (inset) TOMS has shown the hole growing steadily larger.

Ozone levels above Antarctica have been monitored since the 1950s, but the rapid growth of the hole during the 1970s and early '80s caught scientists by surprise. The experts knew that chemicals such as chlorofluorocarbons (CFCs), used as refrigerants, react with sunlight in the upper atmosphere to release chlorine atoms. They also knew that those atoms destroy the ozone that protects Earth from harmful solar radiation. But all that was supposed to happen in

bright sunshine, not in the winter gloom above Antarctica.

By the late 1980s scientists had an explanation: After doing initial damage to ozone, chlorine atoms become chemically locked within harmless molecules. Some of these collect over Antarctica, where during the winter they come into contact with icy polar clouds and change into less benign forms. The return of sunlight in the Antarctic spring spurs another reaction, setting the chlorine atoms free to continue their destructive cycle.

TEXT BY ALLEN CARROLL
Chief Cartographer

OCTOBER 1999

532. State one difference in the ozone hole that you observe from the diagram between 1979 and 1998. Write your answer in a complete sentence. [1]
533. If the trend were to continue for the next 50 years, explain how the incoming solar radiation received in Antarctica might be different. Give a scientifically correct reason for your prediction. [2]

Rubric:

532. Allow 1 point for any observable difference:

- The size of the ozone hole has increased
- The depth of the ozone hole has increased
- The ozone hole is deeper in 1998

533. Allow 1 point for the incoming solar radiation would include more ultraviolet wavelengths.

Allow 1 point for any valid scientific reason.

- Ozone absorbs ultraviolet radiation, therefore if there's a hole in the ozone more ultraviolet radiation will be part of the incoming solar radiation.

534. An earth science student is studying the apparent motion of the sun in class. The teacher comments on how an object's shadow length changes from sunrise to sunset due to sun's apparent motion.

The student wants to observe and investigate this relationship. Design an experiment the student might conduct. Include these elements in your response:

- identify the materials used [1]
- describe a procedure that could be used. use complete sentences. [2]
- construct a data chart that could be used to collect the data. [2]

Rubric: Allow 1 point for list that includes:

- any object
- clock or watch

Allow 2 points for a clearly described procedure that could be used to show the pattern.

- measure the objects shadow every hour from sunrise to sunset

Allow only 1 point if complete sentences are not used.

Allow 2 points for any kind of chart that has spaces for time of day and length of shadow.

Time (hrs)	Length (m)	Time (hrs)	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm
7 am		Length Of shadow													
8 am															
9 am															
10 am															
11 am															
12 pm															
1 pm															
2 pm															
3 pm															
4 pm															
5 pm															
6 pm															
7 pm															

535. The orbits of which pair of planets in our solar system are most nearly the same shape?

- 1) **Jupiter and Uranus**
- 2) Venus and Earth
- 3) Saturn and Pluto
- 4) Mercury and Mars

536. Which motion best explains why certain constellations are seen only during the winter?

- 1) **Earth's revolution**
- 2) Earth's rotation
- 3) Sun's rotation
- 4) Galactic rotation

537. By which process is water transferred from the atmosphere to the Earth's surface?

- 1) **precipitation**
- 2) infiltration
- 3) evaporation
- 4) transpiration

538. The breathable oxygen in Earth's atmosphere resulted from which phenomenon?

- 1) **organic activity**
- 2) meteorite impacts
- 3) volcanic activity
- 4) lightning

539. Which instrument is used to measure a weather variable?

- 1) **psychrometer**
- 2) seismometer
- 3) hydrometer
- 4) gravinometer

540. Which phenomenon causes the earth's lithospheric plates to move?

- 1) **convection currents in the mantle**
- 2) ocean currents
- 3) rotation of the earth
- 4) gravitational pull of the moon

541. What must be added to weathered rock material in order to produce soil?

- 1) **organic material**
- 2) minerals
- 3) water
- 4) sand, silt, and clay

542. By which process have humans noticeably altered climates?

- 1) **deforestation**
- 2) farming
- 3) exploration of polar regions
- 4) shipping by ocean

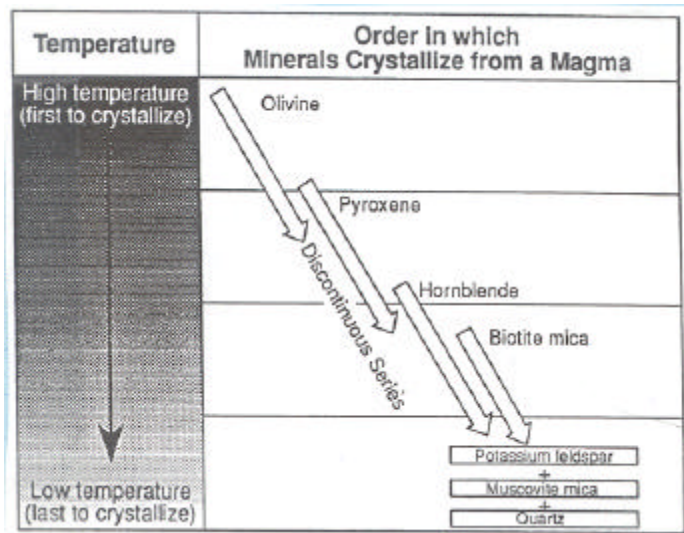
543. Which property of a mineral sample is directly related to the arrangement of its atoms?

- 1) **hardness**
- 2) color
- 3) volume
- 4) luster

544. Which could result in the precipitation of a mineral from water?

- 1) **chemical reaction**
- 2) magmatic crystallization
- 3) extreme pressure
- 4) increased relative humidity

Use the diagram below and the “Earth Science Reference Tables” to answer questions 545 and 546:



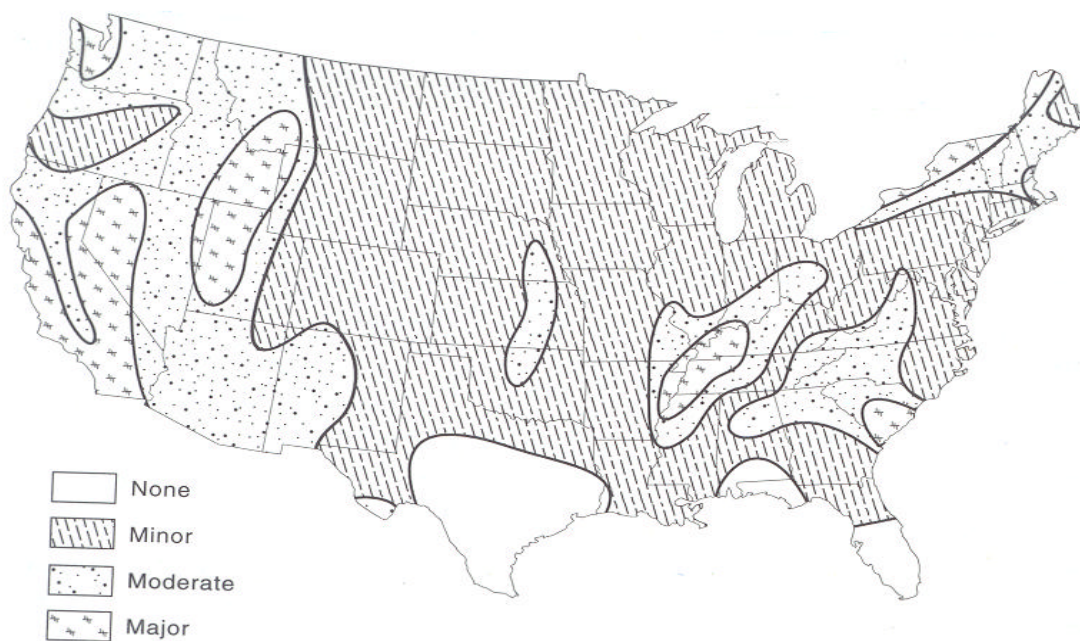
545. Name the intrusive igneous rock, which would be the last to crystallize from magma.

_____ (one credit for stating “granite”)

546. The “scheme for igneous rock identification” found in the earth science reference tables indicates that extrusive rocks containing only olivine and pyroxene are “rare”. Explain in one or more complete sentences why this is so.

One credit for a scientifically correct response. For example: “Olivine and Pyroxene have all ready crystallized by the time magma reaches the surface”.

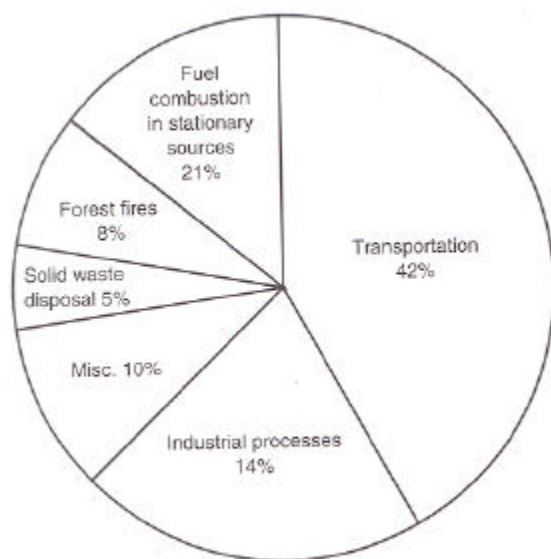
EARTHQUAKE RISK IN THE U.S.



547. From the map at left, determine the relative risk of earthquake in your area, and give one possible reason explaining your level of risk. [2]

Rubric: 1 credit for correctly I.D.'ing area "none", "minor", "moderate", "major"
 1 credit for a scientifically correct reason; ex. "presence of faults"

548.



Sources of air pollution in the United States

How might the total amount of air pollution due to transportation be reduced in the future?

Rubric: One credit for a logical/reasonable answer.
 Ex: "drive less", "car pool", "develop cleaner transportation", etc.

549. While walking through a cemetery, a student notices that some gravestones are more difficult to read than others. The stones are evenly divided by rock type, half are marble and half are granite. He wonders if this has something to do with his ability to read them. He collects data, which is shown in the table below. Assume all letters on the gravestones were originally carved to equal depth, and that all the stones have remained in their original position facing west.

STONE #	ROCK TYPE	DATE PLACED	LETTER DEPTH (mm)
1	Granite	1800	1.6
2	Granite	1850	1.9
3	Granite	1900	2.5
4	Marble	1800	0.9
5	Marble	1850	1.1
6	Marble	1900	1.8

- 1) State the student's hypothesis. [1]
- 2) Identify the rock type which weathered at a faster rate. [1]
- 3) In a complete sentence, give one reason why the rocks appear to have weathered at different rates. [1]

- Rubric:*
1. Allow 1 credit for correct hypothesis
Ex: "Marble weathers faster than granite"
"Rocks wear at different rates, depending on type"
 2. Allow 1 credit for stating "marble"
 3. Allow 1 credit for a scientifically correct answer.
Ex: "Granite is harder than marble"
"Changes in the environment changed rates of weathering"

Use the following information to answer Questions 550 through 552.

Visitor to Earth's neighborhood will trespass on our territory

■ But asteroid won't hit us — this time around.

KNIGHT RIDDER

WASHINGTON — In the cosmic equivalent of a bullet whizzing by Earth's ear, a half-mile-wide asteroid looks as though it will come closer to smashing into our planet than any other space rock astronomers have tracked.

It won't hit Earth. ^{several} But the rock's arrival in ~~27~~ years will be a visible reminder that space can be a dangerous place.

After computing a new path for the dangerous rock, NASA scientists and other astronomers determined ~~(this wee)~~ that the asteroid will come close — but definitely not hit — Earth on Aug. 7, 2027.

Close encounter of the asteroid kind

When it passes Earth in 2027, a recently discovered asteroid may miss us by 600,000 miles — or it may come much closer:

Knight Ridder Tribune

550. Name a planet in our solar system which is more likely than earth to have encounters like those described in the article. [1]
551. In a complete sentence, explain why the planet above has a greater likelihood of such encounters. [2]
552. Describe how earth-asteroid collisions in prehistory may have affected life on earth. Include at least one example of when this event may have occurred, and which life forms were affected. [3]

Rubric: 1. Allow 1 credit for a scientifically correct answer: “Mars”, “Jupiter”, or any large planet.
2. Allow 1 credit for any valid answer.
Ex: “The planet is close to the asteroid belt”
“The planet has a strong gravitational pull”
Allow 1 credit if the given explanation applies to the planet selected.
3. Allow 1 credit for valid explanation of what an impact would do to life on earth.
Ex: “A collision would fill the sky with debris and kill plants by blocking the sun”.
Allow 1 credit for stating an era/period boundary.
Ex: “Mass extinction occurred at the end of Permian time”
“Life was largely killed off 65 million years ago”.
Allow 1 credit for including a group that likely became extinct due to an impact.
Ex: “Dinosaurs” or “Trilobites”

553. Index fossils are used to find:
- 1) angular unconformities
 - 2) correlations between rock layers**
 - 3) half-life
 - 4) radioactive dates
554. The largest particles a stream can carry is cobble sized. What is the probable velocity of this stream?
- 1) 100 cm/sec
 - 2) 150 cm/sec
 - 3) 250 cm/sec**
 - 4) 450 cm/sec
555. The minimum number of seismic stations needed to locate the epicenter of an earthquake is?
- 1) 1
 - 2) 2
 - 3) 3**
 - 4) 4
556. Which one is not a natural agent of erosion?
- 1) streams
 - 2) wave-action
 - 3) wind
 - 4) evaporation**

557. If the rock dolomite is put under extreme heat and pressure, without melting, what will it become over time?

- 1) Quartzite
- 2) Schist
- 3) **Marble**
- 4) Rhyolite

558. An igneous rock produced by an underwater volcano will have a texture that is?

- 1) coarse
- 2) fine
- 3) **glassy**

559. What is the “driving-force” behind all erosion?

- 1) glacier
- 2) stream
- 3) wind
- 4) gravity

560. The “load” of a stream refers to?

- 1) how much water is passing a given point
- 2) the slope of the stream
- 3) the material a stream carries
- 4) the number of tributaries

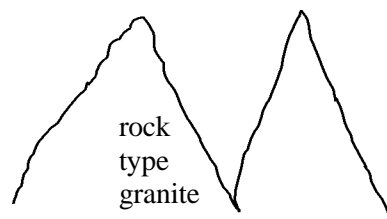
561. A student finds a red sandstone layer while looking at rock strata. What is the most probable reason this sandstone layer is red?

- 1) **oxidation**
- 2) hydration
- 3) carbonation
- 4) abrasion

562. The boundary found between the Indian-Australian Plate and the Antarctic Plate is a:

- 1) transform plate boundary
- 2) complex or uncertain
- 3) **divergent plate boundary**
- 4) convergent plate boundary

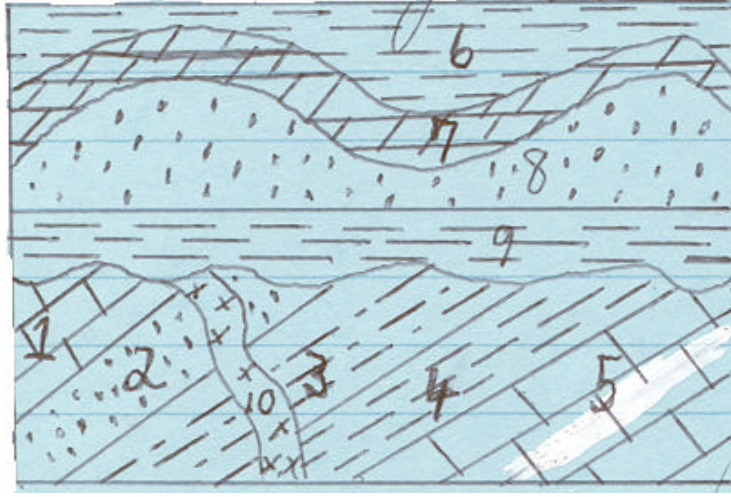
563.



- 1) What type of landscape region is represented in the diagram?
- 2) What is the most probable agent of erosion that formed the valley in the diagram?

Rubric: Allow 1 point for Question 1 for correct answer “mountain”.
 Allow 1 point for Question 2 for correct answers “stream” or “water”

Layers have not been overturned. Use the diagram to answer Questions 564, 565, 566.



564. Order the different rock layers in the geologic cross section above from oldest to youngest.

_____ oldest → _____ → _____ → _____ → youngest

10 out of 10 = 3 points
 08 out of 10 = 2 points
 06 out of 10 = 1 point

565. State the number that represents an igneous intrusion. [1]

566. What “principle” did you use to determine the age of these rocks? [1]

Rubric: Maximum score 5 points

1. 5 4 3 2 1 10 9 8 7 6
 oldest → → → → → youngest

2. Allow 1 point for correct answer “10”.

3. Allow 1 point for correct answer “principle of superposition or relative dating or relative age or any definition of superposition”.

567. The moon cycles through its phases in approximately one month. During this month observations show that the moon “appears” to vary in diameter. In a paragraph, explain why this phenomenon of varying diameter occurs. [3 points]

Rubric: Allow 1 credit for an acceptable explanation for this phenomenon.

Allow 1 credit for scientifically correct terms in the explanation.

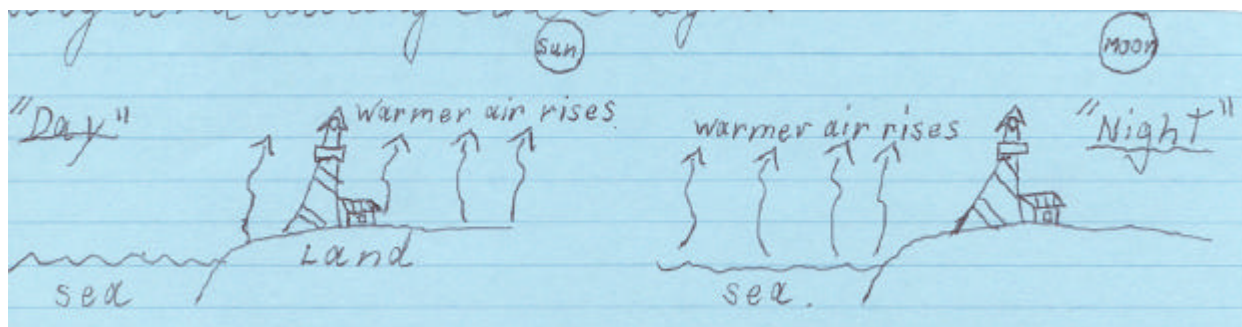
Ex: - elliptical

- perigee

- apogee

Allow 1 credit for complete sentences

The diagrams below show the same coastal area during the day and during the night. Use these diagrams to answer Questions 568, 569 and 570.



568. Compare and explain the difference in heating and cooling rates of land and water. [1]

569. Explain how winds are formed by discussing:

- a. temperature differences [1]
- b. density differences [1]
- c. pressure gradient [1]

570. Label the diagrams with an arrow indicating the direction of the wind during the day and night.





Rubric: 568. Allow 1 credit for an acceptable explanation of heating and cooling rates.

Ex: - water has a higher specific heat than land, conversely water cools more slowly
 - water requires more heat energy than land to raise its temperature the same amount

569. Allow a total of 3 credits for an acceptable explanation of how winds form (1 credit for each correct part)

570. Allow 1 credit only if both diagrams are labeled correctly.

571. Which present weather symbol does not refer to a form of precipitation?

- 1)  2) 
- 3)  4) 

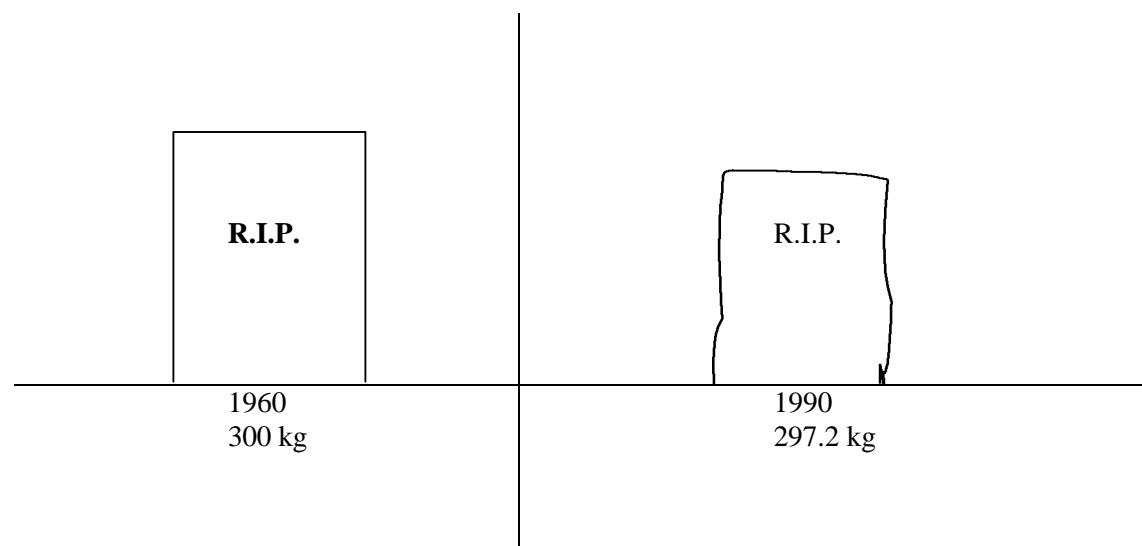
572. A station in San Francisco receives P and S waves from a recent earthquake. Determining the difference in arrival times between these two seismic waves can be used by itself to calculate:
 _____.

- 1) **the epicenter distance**
- 2) the direction to the epicenter
- 3) the focal distance
- 4) the exact location of the epicenter

573. Our solar system includes the Sun, nine planets, their moons and:

- 1) other stars
- 2) a constellation
- 3) **asteroids and comets**
- 4) a galaxy

574. Refer to the diagram below. This shows the same tombstone at two different times in its history. The year the picture is taken, along with the tombstone's mass at that time is shown below each picture.



The changing appearance and mass of the tombstone over the 30 years most likely occurred due to:

- 1) **weathering and erosion**
- 2) radioactive decay
- 3) glacial action
- 4) an elevation increase

575. Dunite most likely formed by:

- 1) quick cooling of lava at earth's surface
- 2) extreme pressure without melting
- 3) dewatering, compacting, and cementation
- 4) **slow solidification of magma inside the earth**

576. Which of the following provides evidence of the earth's rotation?

- 1) the changing seasons
- 2) the moon's phases
- 3) the sling psychrometer
- 4) **the Foucault Pendulum**

577. Pyroxene's unique physical properties were primarily determined by its:

- 1) age
- 2) size

- 3) present temperature
- 4) **crystal structure and chemical composition**

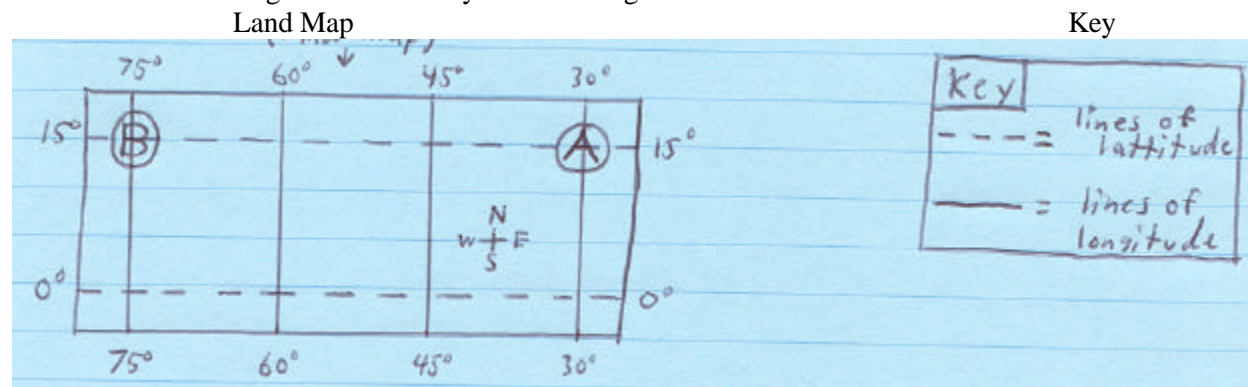
578. Humans have varying uses for certain rocks and minerals based on their:

- 1) location
- 2) origin time
- 3) **physical and chemical properties**
- 4) size and shape alone

579. If the summer sun beat down equally on each of the following objects, which would likely feel the most hot to the touch?

- 1) **a dull black-top driveway**
- 2) a metal bike painted shiny yellow
- 3) water in a swimming pool
- 4) a white tee-shirt

580. Refer to the diagram below and your knowledge of Earth Science.



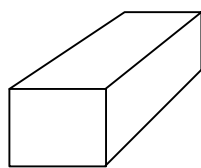
If the sun appears to be directly overhead of location “A” at the present time, in how many hours will it appear to be over location “B”?

- 1) 4 hours
- 2) 45 hours
- 3) **3 hours**
- 4) 21 hours

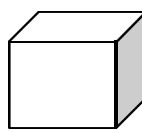
Refer to the diagram below to answer Questions 581 and 582.



Sample
A



Sample
B



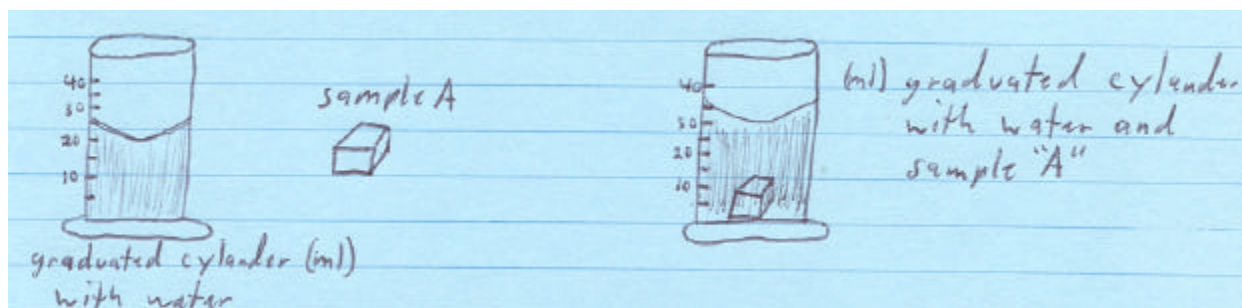
581. Sample “B” is an object with the exact composition, but half the volume and mass of Sample “A”. If the densities of both samples were 4.5 g/cm^3 , describe and compare what would occur if both were dropped into a vertical column of water at the same time. [1]

Rubric: Allow 1 point for a scientifically correct answer which states that both samples would drop and Sample “A” would fall faster.

582. If a third sample has the exact density, mass and volume as Sample "A", what characteristic must it have for it to fall faster in a column of water? [1]

Rubric: Allow 1 point for stating that the object must be, or be close to, a perfect sphere.

Refer to the diagram below and your knowledge of Earth Science to answer Questions 583 and 584.



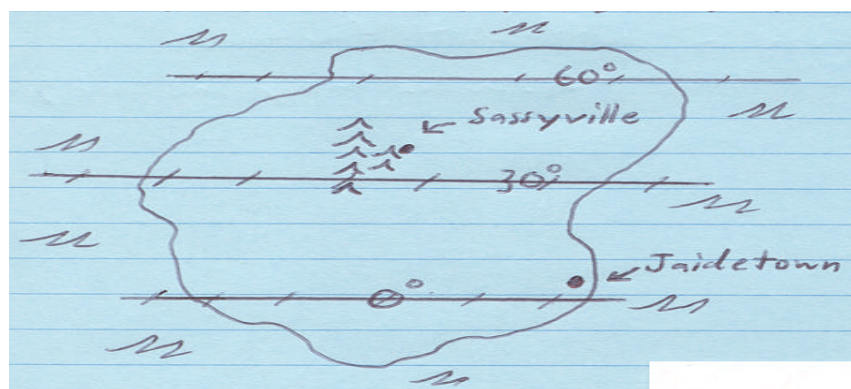
583. What is the value (with units) for the volume of Sample A? [2]

Rubric: Allow 2 points for a number within the range of 9.9 - 10.1 and (ml) for units.
Allow 1 point for correct units or #.

584. If the density of Sample "A" were 4.2g/ml, determine its mass. Include formula, substitutions, answer and units. [3]

Rubric: Allow 1 point for $D = m/v$ or density = mass/volume.
Allow 1 point for correct substitution $4.2 = x/10$ or # from 583.
Allow 1 point for correct answer and units 42g or calculated answers using # from 583.

585. Refer to the diagram below to answer both parts of Question 585. The drawing represents an imaginary continent on the Earth's surface.



A) Using complete sentences [1], identify 2 factors that will influence the climate in Jaidetown and explain how both will affect it. [2]

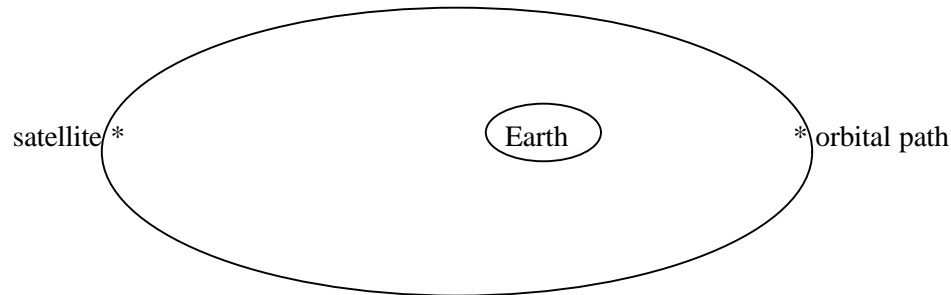
B) Using complete sentences, identify 2 additional factors (different from A) that will influence the climate of Sassytown, and explain how both will affect it. [2]

Rubric: A) Allow 2 points for A if the student correctly chose 2 factors (shown below) and provided scientifically correct explanations as to how both affect the climate.

- nearness to coastline - ocean current modifies temperature
 - latitude - closer to equator = high temperature
 - elevation - closer to surface = warm, up in troposphere = cold
 - prevailing wind direction - winds converge = wet
- Allow 1 credit for 1 correct factor and explanation or 2 correct factors without appropriate explanations.

- B) Allow 2 credits if the student chose 2 different factors and explanations from those in (A) additional answers may include:
- nearness to center of landmass = large temperature range
 - leeward side of landmass = dry
 - wind direction = diverging = dry
- Allow 1 credit if complete sentences throughout (A) and (B).

586. Refer to the diagram below to answer Question 586. Depicted is a new television station's satellite, recently boosted into an orbit around the Earth.



- A) Using complete sentences, describe and give reasons for the changes in velocity and gravitational attraction as the satellite completes one revolution around the earth. [3]
- B) Calculate the eccentricity of the satellite's orbit. Be sure to include the formula. [2]

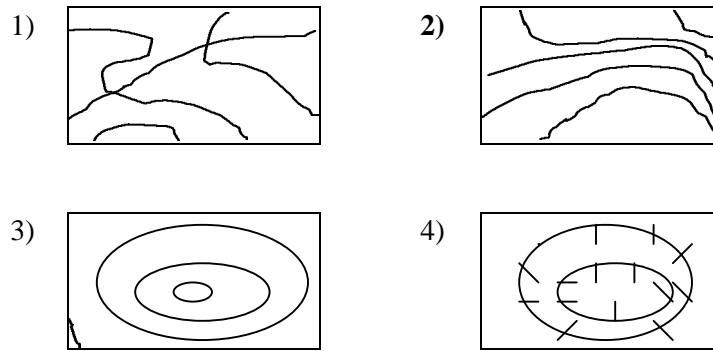
Rubric: A) Allow 2 points for stating that the velocity and attraction will first increase and then decrease due to becoming closer to then further from the center of gravity (Earth).
Allow only 1 point if either the reason or pattern is wrong.
Allow 1 additional point if complete sentences were used.

- B) Allow 2 points if the formula is written ($e = d.b.f./l.m.a.$ or $e = \text{eccentricity} = \text{distance between foci}/\text{length of major axis}$) and the answer is correct without units ($e = 2$)
Allow 1 point if only one of the two are incorrect.

587. Plate movements are due to convection currents in which aspect of the earth?

- 1) lithosphere
- 2) **athensphere**
- 3) stiffer mantle
- 4) inner core

588. Which of the following topographic maps includes a cliff?



589. Erosion by a stream could be increased by decreasing which of the following:

- 1) discharge
- 2) velocity
- 3) gradient
- 4) **number of straight sections**

590. Which of the following statements best describes a mineral?

- 1) **naturally occurring, inorganic elements and compounds**
- 2) materials produced from dead organisms
- 3) solids formed from rapidly cooling magma
- 4) naturally compacted and cemented rock material

591. Rocks with a distorted structure and contain alternate bands of light and dark minerals are classified as which type of rock?

- 1) chemical
- 2) **igneous**
- 3) metamorphic
- 4) sedimentary

592. A fine-grained igneous rock which is mafic in nature and contains olivine and pyroxene could be:

- 1) obsidian
- 2) gabbro
- 3) **basalt**
- 4) peridoite

593. In various parts of the earth like the mantle or atmosphere, convection currents form. What is the cause of this motion?

- 1) size differences
- 2) **density differences**
- 3) mass differences
- 4) time differences

594. What do Jovian planets have in common?

- 1) small size and low density
- 2) large size and high density

- 3) medium size and no density
- 4) **large size and low density**

595. Divisions of the geologic time scale are based on:

- 1) radioactive dating
- 2) fossil evidence
- 3) climate changes
- 4) superposition

596. In New York State what general direction do you need to face to observe Polaris?

- 1) north
- 2) south
- 3) east
- 4) west

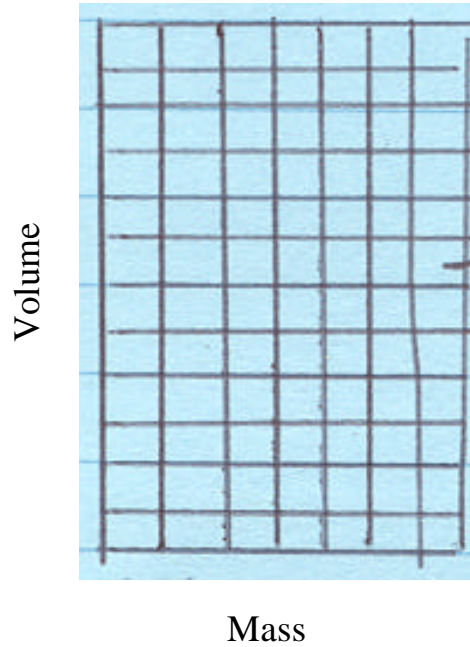
A student is given several pieces of quartz and determined their density to be 2.8 g/cm³.

597. Use the previous student's work and the formula $D = m/v$ to create a data table for three other pieces of quartz with a density of 2.8 g/cm³.

Mass g	Volume cm ³

Rubric: 2 points for 3 plausible answers
 1 point for 1 or 2 plausible answers
 Plausible if it fits:
 $\frac{\text{St. mass}}{\text{St. vol}} = 2.8$

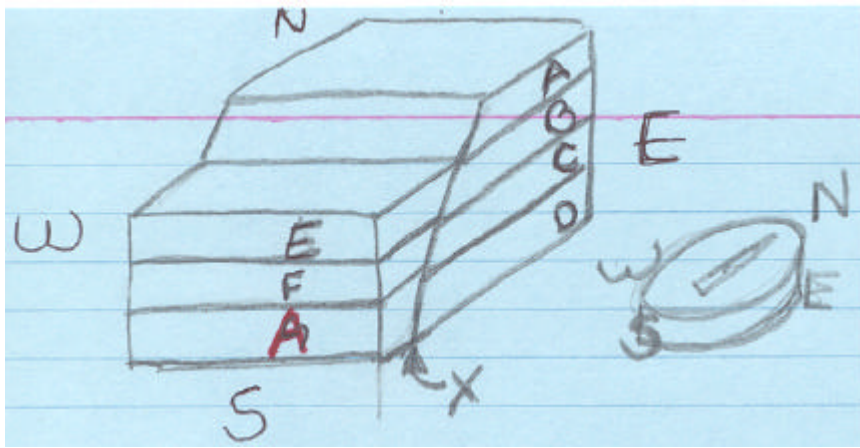
598. Scale the axis of the grid below according to your data in Question #597.



Rubric: +1 for appropriate scale

599. Plot your data from Questions 597 on your graph and connect the points with a line.

Rubric: +1 for a correct plot
+1 for the best line based on student plots



600. The structure labeled "X" is a _____

Rubric: +1 correct answers: fault
break in rock

601. On which side of the ridge (using cardinal directions) are the rocks the oldest? _____

Rubric: +1 correct answer: N or NE

602. Order the layers from oldest to youngest: _ _ _ _ _

Rubric: +2 for 6 correct
+1 for 4 or 5 correct

In 1988 the Exxon Valdez ran aground 70 feet off the coast of Prince William Sound, Alaska. The oil carried by the tanker spilled and eventually hit Alaska causing the 2nd largest oil spill on record.

603. State one reason that the oil slick spread predominantly towards the coast. [1]

Rubric: 1 point for science correct answer:

- ocean currents
- North Pacific currents
- wave action
- land breeze

604. If a similar spill were to occur off the coast of South Carolina, list one reason why the oil spill may affect a wider geographic area.

Rubric: 1 point for ocean currents, prevailing westerlies

605. State two social implications resulting from Valdez:

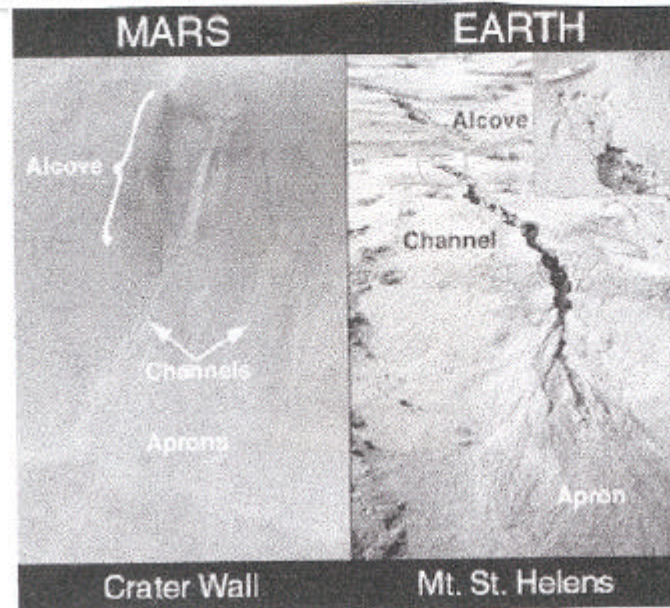
Social

- pollution
- death of sea life
- drinking water

Science

The basic features of a Martian gully. The figure on the left is an example from Mars; the figure on the right is a gully on Earth. In the Earth picture, rainwater flowing under and seeping along the base of a recently deposited volcanic ash layer has created the gully. For Mars, water is not actually seen but is inferred from the landforms and their similarity to examples on Earth. Credit: NASA/JPL/Malin Space Science Systems

The basic features of a martian gully. The figure on the left is an example from Mars, the figure on the right is a gully on Earth. In the Earth picture, rain water flowing under and seeping along the base of a recently-deposited volcanic ash layer has created the gully. For Mars, water is not actually seen but is inferred from the landforms and their similarity to examples on Earth. [\[more information about this picture\]](#) Credit: NASA/JPL/Malin Space Science Systems



Based on the above reading and the associated diagram, answer the following questions.

606. On your answer sheet sketch a cross-section of the channel which was carved by a stream. [1]

Rubric:  or 

Answer 607 and 608 in complex sentences.

607. Make a statement about the distribution of different sized sediments in the apron. [1]

Rubric: - sorted
- horizontal sorted
- narrow at mouth

- wide at bottom

608. Why do scientists infer water was present on Mars?

Rubric: - similar structure
- both contain apron or channels
- any scientifically correct answer

609. Which instruments are used to measure wind variables?

- 1) barometer, thermometer
- 2) psychrometer, anemometer
- 3) wind vane, barometer
- 4) **anemometer, wind vane**

610. Mineral crystals can be found in:

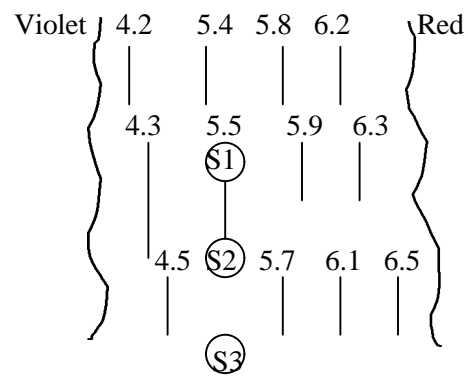
- 1) igneous rocks but not in metamorphic nor sedimentary rocks
- 2) igneous and metamorphic rocks but not in sedimentary rocks
- 3) **igneous, metamorphic and sedimentary rocks**
- 4) igneous and sedimentary rocks but not in metamorphic rocks

611. As measured by an observer on Earth over the course of 2 years, the apparent diameter of the sun will:

- 1) decrease only
- 2) increase only
- 3) remain the same
- 4) **vary in a predictable manner**

612. The following diagram compares the light spectrum of our sun, S1 and two stars located in other galaxies. The spectra of S2 and S3 have been red-shifted. This is evidence of which of the following:

- 1) stars differ in size
- 2) **the universe is expanding**
- 3) our galaxy contains billions of stars
- 4) the universe contains billions of galaxies

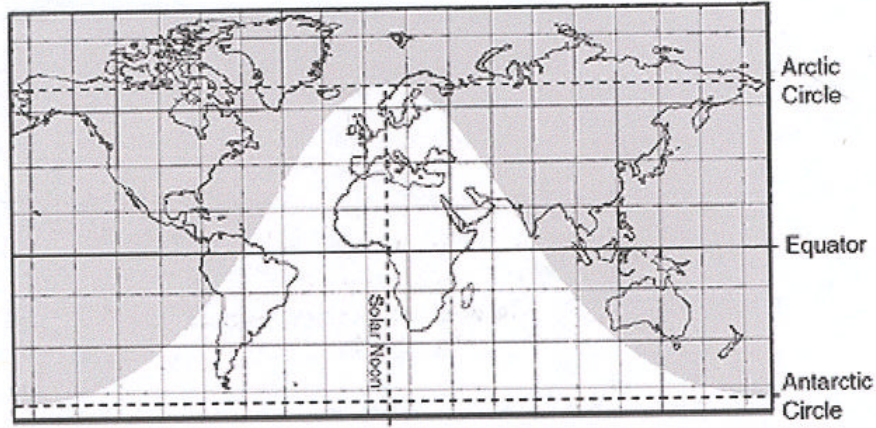


Wavelengths $\times 10^{-7}$ M

613. From the stars listed on the Luminosity and Temperature of Stars diagram, which star is closest to the Earth?
- 1) Alpha Centauri
 - 2) Polaris
 - 3) Sun**
 - 4) Sirius
614. Which list correctly orders planets from those with more circular orbits to those with less circular orbits?
- 1) Mercury, Earth, Jupiter, Uranus
 - 2) Mercury, Mars, Uranus, Jupiter
 - 3) Earth, Saturn, Mercury, Pluto**
 - 4) Jupiter, Saturn, Neptune, Pluto
615. Equal masses of basalt, granite, iron, and lead were heated. Each sample increased 10°C . The temperature of which sample absorbed the most heat energy?
- 1) basalt**
 - 2) granite
 - 3) iron
 - 4) lead
616. Which statement correctly indicates the general direction of flow of surface ocean currents in the northern and southern hemispheres.
- 1) currents located in the northern hemisphere generally flow clockwise while those in the southern hemisphere generally flow counter-clockwise**
 - 2) currents in both hemispheres generally flow clockwise
 - 3) currents in the northern hemisphere generally flow counter-clockwise while those in the southern hemisphere generally flow clockwise
 - 4) currents in both hemispheres generally flow counter-clockwise
617. Which of the following sedimentary rocks, formed from precipitation, must contain carbon?
- 1) rock salt and rock gypsum
 - 2) rock gypsum and dolostone
 - 3) dolostone and limestone
 - 4) limestone and rock salt
618. Which two elements are common to all of the minerals used to make glass?
- 1) (K and Al) Potassium and Aluminum
 - 2) (Na and O) Sodium and oxygen
 - 3) (Si and O) Silicon and oxygen**
 - 4) (Ca and Si) Calcium and Silicon

Refer to the map below to answer Questions 619 and 620. The shaded portion of the map indicates areas of night and the unshaded portion indicates areas of daylight.

The shaded portion of the map indicates areas of night and the unshaded portion indicates areas of daylight.



619. What day of the year is best represented by the map?

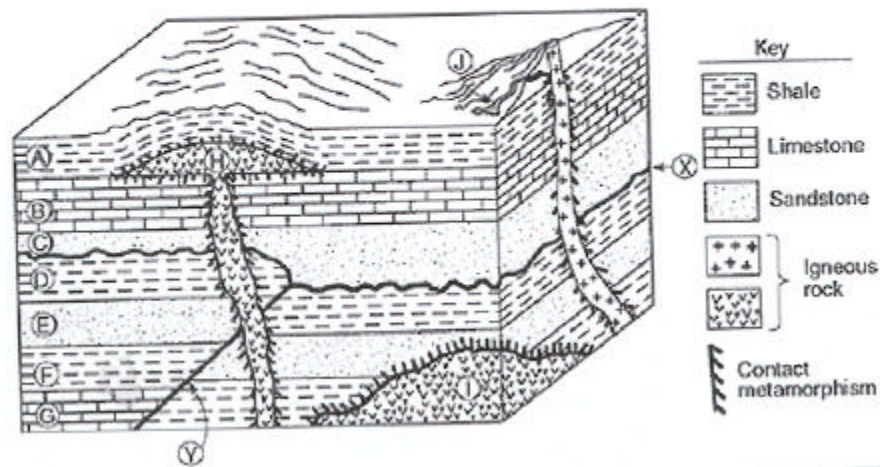
Rubric: Allow 1 point for the correct answers December 21; December 22.

620. During the next month state the general direction in terms of latitude that the top (peak) of the lighted curve will move.

Rubric: Allow 1 point for answer that indicates increase, more north or any combination or single word that indicates either answer. Also # > 66° N.

Refer to the diagram below to answer Questions 621 and 622. Base your answers to the questions on the cross section shown, and your knowledge of Earth science. Letters A through J represent rock units. An unconformity is shown at letter X. A fault is shown at letter Y.

Base your answer to the question on the cross section shown, and your knowledge of Earth science. Letters A through J represent rock units. An unconformity is shown at letter X. A fault is shown at letter Y.



A student has made the following conclusion:
 Rock Unit H was formed before Layer A, Fault Y and Unconformity X.

621. Do you support or reject his conclusion? Circle or underline your choice. [1]

Rubric: Allow 1 point for correct answer reject.

622. In one or more complete sentences, give evidence for your answer to 621.

Rubric: Allow 1 point for any scientifically correct answer.
Allow 1 point for a complete sentence supporting Question 621.
Ex: contact metamorphism shows A older than H
cross cutting relationship shows Y older than H
cross cutting relationship shows X older than H

Choose 2 stars listed on the Luminosity and Temperature of Stars diagram and answer the following questions in one or more complete sentences.

Star 1: _____
name

Star 2: _____
name

623. Describe two differences between Star 1 and Star 2.

Rubric: Allow 1 point for each correct answer (up to 2 points)
Ex: Polaris has a luminosity greater than the sun.
Polaris is larger than the sun.
Polaris is bigger.
Rigel is hotter than Betelgeuse.
Rigel is blue/white and Betelgeuse is red.
Allow 0 points for answer it is bigger.

624. Describe one similarity between Star 1 and Star 2.

Rubric: Allow 1 point for each correct answer.
Ex: Polaris and the Sun are both yellow.
Rigel and Betelgeuse are both supergiants.
They are yellow.
They are supergiants.
They are stars.
They have fusion.
Allow 0 points for the answer yellow.

625. Using the table below and your knowledge of earth science, answer the following question in one or more complete sentences.

The following table lists the agents of erosion along with descriptions of the sediments transported.

Running Water	- rounded, sorted
Glaciers	- rounded, sorted - melt water - angular, unsorted - ice
Waves	- rounded, sorted (?)
Wind	- angular, frosted and pitted, small
Gravity	- angular, unsorted, various sizes

A student is asked to identify the agent of erosion responsible for transporting sediments found in a profile (field observation).

Indicate the agent(s) she eliminated based on an observation she made of one or more properties of the sediment. [3]

You must include the observation and the agent eliminated for complete credit.

Rubric: Allow 3 points for the following answers:

- The sediments were rounded therefore gravity was not the direct agent of erosion.
- The sediments were sorted. Gravity could not be the agent of erosion.
- The sediments were angular and unsorted. Running water could not be an agent of erosion.

Allow 2 points for the following answers:

- Rounded sediments; not gravity
- The sediments were rounded so it was water.

Allow 1 point for the following answers:

- Gravity breaks rocks
- Water smooths rocks

The reason (agent) and observation should match. The answer should be in complete sentences. Take off one point for incomplete sentences. Give no credit for scientifically incorrect answers. Ex: water, round, brown, can't tell.