

Part I
Total Value: 50%

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. Which branch of Earth Science focuses on the study of fossils?
 - (A) astronomy
 - (B) meteorology
 - (C) paleontology
 - (D) seismology

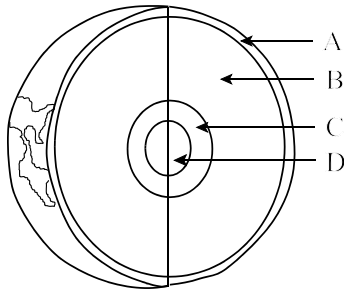
2. Which instrument has provided the greatest amount of information concerning the internal structure of Earth?
 - (A) drill rig
 - (B) radar
 - (C) satellite
 - (D) seismograph

3. Based on the habits of modern day corals, a geologist assumes a fossil coral once lived in a warm, shallow marine environment. What principle of geology is illustrated when this assumption is made?
 - (A) catastrophism
 - (B) correlation
 - (C) superposition
 - (D) uniformitarianism

4. Which geological time span is referred to as the “Age of Reptiles”?
 - (A) Cenozoic
 - (B) Mesozoic
 - (C) Paleozoic
 - (D) Proterozoic

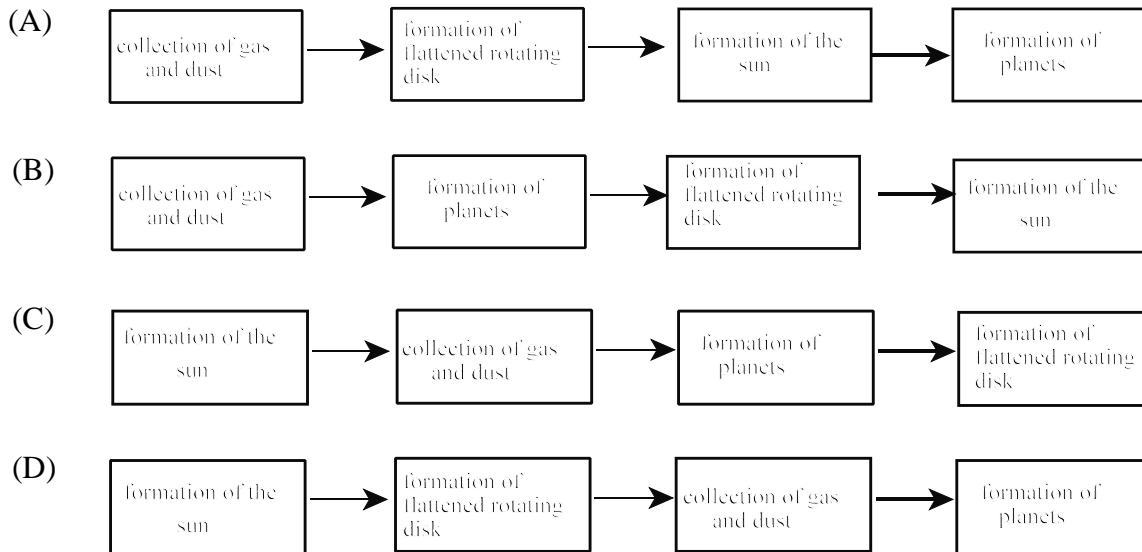
5. Which type of evidence would indicate relative time?
 - (A) radiometric dating
 - (B) superposition
 - (C) tree rings
 - (D) varve deposits

6. Which general trend regarding the density of Earth's interior would be evident as one moves toward Earth's centre?
- (A) alternating increase and decrease
 - (B) decrease
 - (C) increase
 - (D) no change
7. Which statement best describes how Earth's earliest oceans formed?
- (A) Earth was first a sphere of water and solid Earth formed at a later time.
 - (B) Large chunks of interstellar ice hit Earth and melted.
 - (C) Plant life released water vapor billions of years ago.
 - (D) Steam from volcanic gases condensed and accumulated over time.
8. In the diagram below, which layer of Earth is composed of molten nickel and iron?



- (A) A
- (B) B
- (C) C
- (D) D

9. According to the Solar Nebular Hypothesis, what is the correct sequence of events leading to the formation of our solar system?



10. What is the upper limit of ground water?

- (A) capillary zone
- (B) infiltration point
- (C) porous zone
- (D) water table

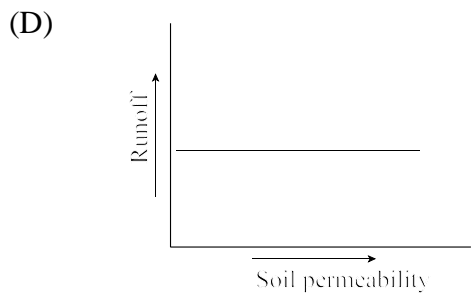
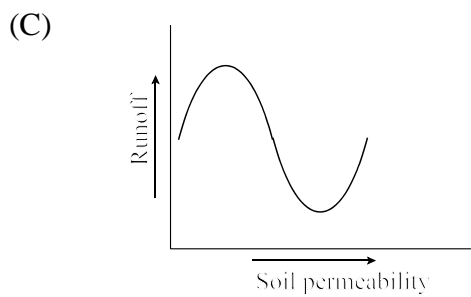
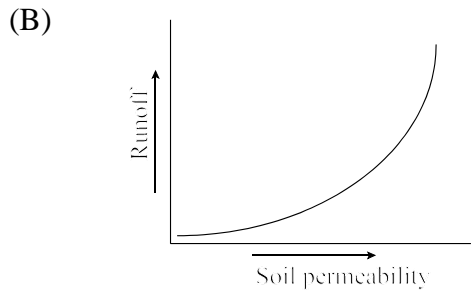
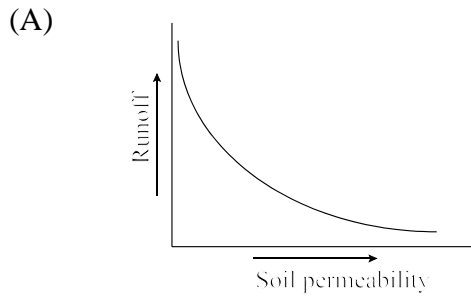
11. What is the correct arrangement of the layers of Earth's atmosphere in order of increasing altitude from the surface?

- (A) thermosphere → stratosphere → mesosphere → troposphere
- (B) thermosphere → troposphere → stratosphere → mesosphere
- (C) troposphere → mesosphere → stratosphere → thermosphere
- (D) troposphere → stratosphere → mesosphere → thermosphere

12. Which atmospheric layer contains the greatest concentration of ozone?

- (A) mesosphere
- (B) stratosphere
- (C) thermosphere
- (D) troposphere

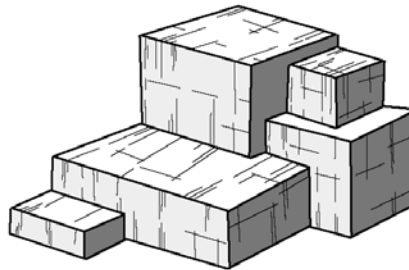
13. Which graph shows how soil permeability affects the amount of runoff in an area?



14. Which atmospheric gases have the greatest effect on global warming?

- (A) argon and nitrogen
- (B) carbon dioxide and water vapour
- (C) nitrogen and carbon dioxide
- (D) water vapour and oxides of sulfur

15. Which two elements are the most abundant in Earth's continental crust?
- (A) magnesium and iron
 - (B) magnesium and silicon
 - (C) oxygen and iron
 - (D) oxygen and silicon
16. To which rock-forming mineral group does a mineral with the chemical formula PbS belong?
- (A) carbonate
 - (B) halide
 - (C) sulfate
 - (D) sulfide
17. How many cleavage planes are shown in the sample of a broken piece of halite given below?

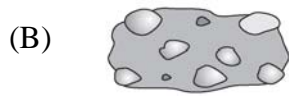


- (A) 3
 - (B) 6
 - (C) 15
 - (D) 21
18. Which mineral property is tested using an unglazed porcelain tile?
- (A) cleavage
 - (B) lustre
 - (C) specific gravity
 - (D) streak
19. What is the most common chemical structure found in the silicate mineral group?
- (A) silicon - aluminum octahedron
 - (B) silicon - aluminum tetrahedron
 - (C) silicon - oxygen octahedron
 - (D) silicon - oxygen tetrahedron

20. Where would you most likely find the largest crystals in a lava flow?

- (A) at the bottom
- (B) at the top
- (C) near the bottom
- (D) near the centre

21. Which rock sample best shows the physical properties normally associated with a foliated texture formed during metamorphism?



22. Which process results in the formation of clastic (detrital) sedimentary rocks?

- (A) physically deposited particles of sediment
- (B) precipitation of sediments from sea water
- (C) rapid cooling of molten sediments
- (D) re-crystallization of carbonate sediments

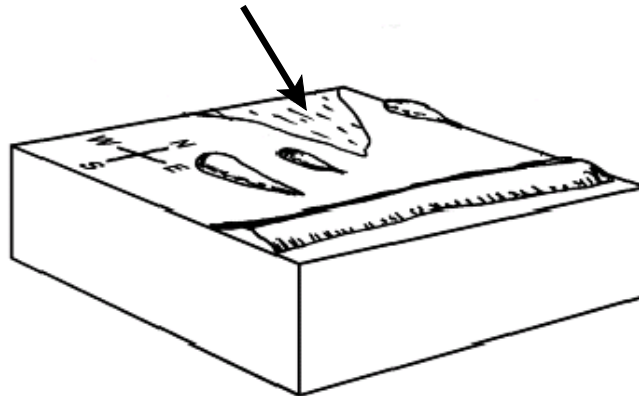
23. Where is most deposition of sediments likely to occur?

- (A) at a site where glacial ice scrapes bedrock
- (B) at the mouth of a river where it enters the ocean
- (C) on the side of a sand dune facing the wind
- (D) on the top of a steep slope in a streambed

24. Which process is likely to cause regional metamorphism?
- (A) faulting of rock layers during mountain building
 - (B) injection of hot fluids through fractures in rock layers
 - (C) intrusion of a large body of magma during mountain building
 - (D) lava flowing on the surface of rock layers
25. Which sequence of change in rock type occurs as shale is subjected to increasing heat and pressure?
- (A) shale → schist → slate → phyllite → gneiss
 - (B) shale → schist → phyllite → slate → gneiss
 - (C) shale → slate → phyllite → schist → gneiss
 - (D) shale → slate → schist → phyllite → gneiss
26. If particles shown in the table below are of equal volume and are dropped into a column of water, which would usually settle most rapidly?

	Shape	Density (g/mL)
(A)	flat	2.5
(B)	flat	3
(C)	round	2.5
(D)	round	3

27. Which glacial feature is indicated by the arrow in the diagram below?



- (A) drumlins
- (B) esker
- (C) moraines
- (D) striations

28. Which feature and description are correctly paired?

feature	description of inferred environment
(A) cross-beds	small layers created by the deposition of debris at the base of a glacier
(B) mud cracks	rounded mounds created by saturation of sediments
(C) ripple marks	small ridges produced by wave and current action
(D) stratification	movement of a rock unit along a crack in the rock

29. Which texture is most often seen in plutonic igneous rocks?

- (A) coarse-grained
- (B) fine-grained
- (C) foliated
- (D) glassy

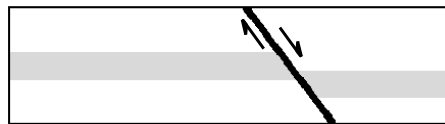
30. What happens at a transform plate boundary?

- (A) Major mountain belts are produced by continental collision.
- (B) New oceanic crust is produced.
- (C) Plates are subducted into the mantle.
- (D) Plates move past each other along a fault.

31. At which kind of boundary would you expect to find the highest percentage of basaltic rock?

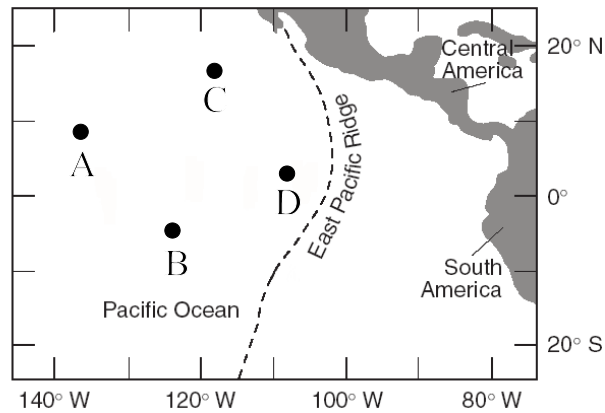
- (A) convergent
- (B) divergent
- (C) subduction
- (D) transform

32. What type of fault is illustrated in the diagram below?



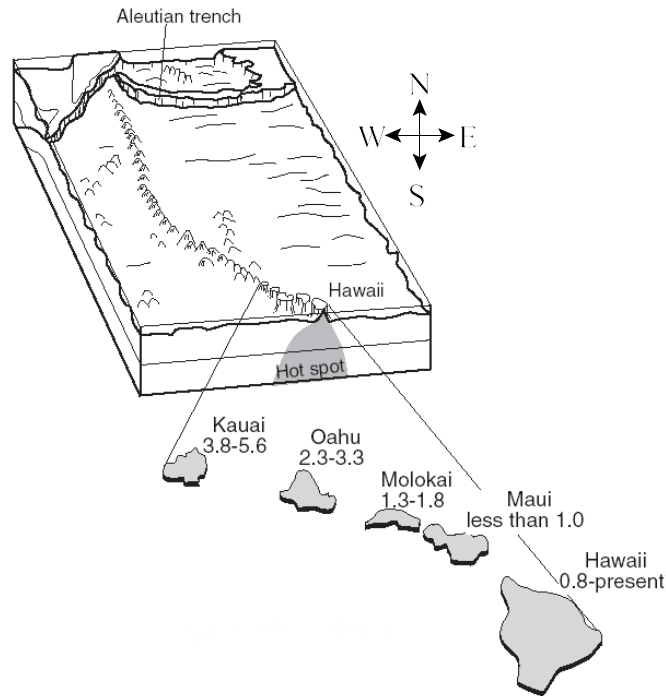
- (A) normal
- (B) reverse
- (C) strike-slip
- (D) thrust

33. How many times more energy is released by an earthquake measuring 7 on the Richter scale than is released by an earthquake measuring 4 on the Richter scale?
- (A) 3
(B) 90
(C) 1000
(D) 27 000
34. In the diagram below, at which drilling site would the oldest igneous rock most likely be found?

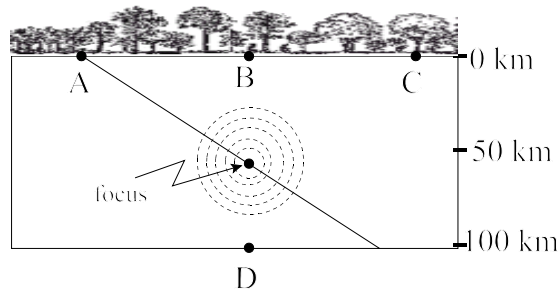


- (A) A
(B) B
(C) C
(D) D

35. The diagram below shows the bedrock age (in millions of years) as well as the present location of part of the Hawaiian Island chain. Evidence from the diagram would suggest the Pacific Plate is moving toward which direction?

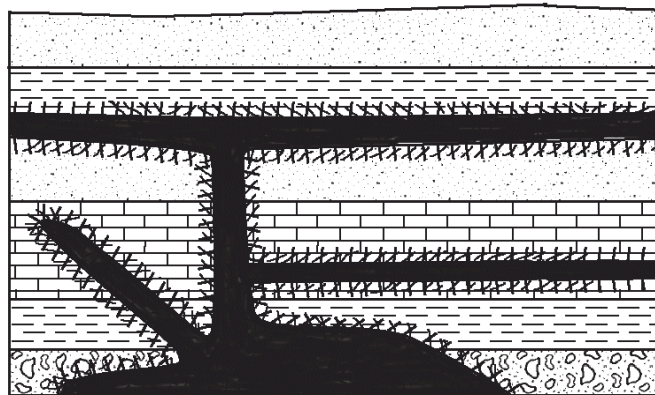


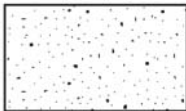
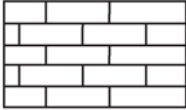


- (A) east
 (B) northwest
 (C) south
 (D) southeast
36. In the diagram below, where is the epicentre of the earthquake located?



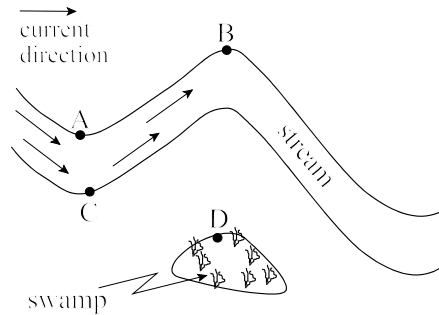
- (A) A
 (B) B
 (C) C
 (D) D

37. How many seismograph stations are needed to locate the epicenter of an earthquake?
- (A) 2
 (B) 3
 (C) 4
 (D) 5
38. Which feature of sedimentary rock allows the correlation of rock layers over long distances?
- (A) color of rock
 (B) foliation bands
 (C) fossil content
 (D) thickness of layers
39. In the diagram below, which rock type is the oldest?



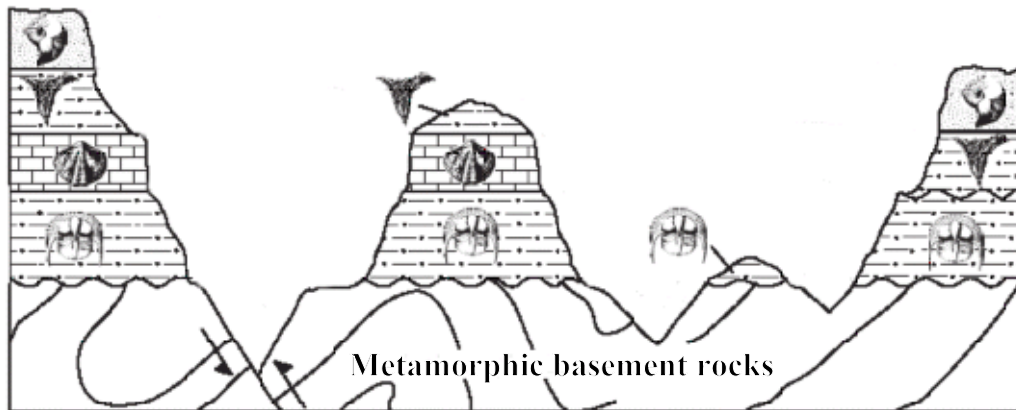
- (A) 
- (B) 
- (C) 
- (D) 

40. What are the stages in the formation of coal, from the first material deposited to the type of coal formed under the greatest temperature/pressure conditions?
- (A) peat → bituminous → anthracite → lignite
 (B) peat → bituminous → lignite → anthracite
 (C) peat → lignite → anthracite → bituminous
 (D) peat → lignite → bituminous → anthracite
41. At which point would placer deposits most likely form?



- (A) A
 (B) B
 (C) C
 (D) D
42. Which best describes an ore mineral?
- (A) composed entirely of iron
 (B) contains many different varieties of useful elements
 (C) contains useful elements that can be profitably mined
 (D) large deposit
43. In which rock type would oil and gas be found?
- (A) igneous
 (B) metamorphic
 (C) sedimentary
 (D) volcanic
44. Which life form occurred first in the geological record?
- (A) amphibians
 (B) invertebrates
 (C) land plants
 (D) mammals

45. Which factor is the most important for aiding in the formation of a fossil?
- (A) burial in coarse sediment
 - (B) high rates of mechanical weathering
 - (C) presence of hard body parts
 - (D) slow burial in deep water environment
46. What is an example of a trace fossil?
- (A) carbon outlines of plant fossils
 - (B) insects preserved in amber
 - (C) petrified wood
 - (D) tracks and trails
47. What “Super Continent” existed before Pangaea?
- (A) Atlantis
 - (B) Gondwanaland
 - (C) Laurasia
 - (D) Rodinia
48. Which type of environment is indicated by the fossils found in the sedimentary rock layers below?



- (A) glacial
- (B) marine
- (C) mountain
- (D) terrestrial plateau

49. What type of volcano would most likely exist at an oceanic plate - continental plate convergent boundary?
- (A) cinder cone
 - (B) composite cone
 - (C) hot spot volcano
 - (D) shield volcano
50. Which is an example of a non-renewable resource?
- (A) forest
 - (B) hydro-electricity
 - (C) minerals
 - (D) solar energy

Part II
Total Value: 50%

Instructions: Complete ALL questions in the space provided. Some answers require diagrams. You may use diagrams in any question to aid in your answer.

Value

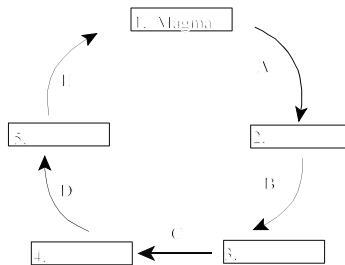
- 2% 51(a) Compare the geocentric and heliocentric models of the solar system, using a diagram to illustrate each model.
- 2% (b) Given the half-life of U-235 is 0.7 billion years, determine the age of a sample of U-235 if 1/16 of the starting material remains. (SHOW YOUR WORKINGS)
- 2% (c) Briefly describe the change in atmospheric composition brought about by:
- (i) a major volcanic eruption
 - (ii) burning of fossil fuels
- 3% (d) Explain how volcanic outgassing contributed to the formation of Earth's original oceans.
- 3% (e) Characteristics of a rock determine whether it acts as an aquifer or an aquiclude.
- (i) With reference to porosity and permeability, compare a rock which acts as an aquifer and one which acts as an aquiclude.
 - (ii) Give an example of a rock type that acts as an aquifer and a rock type that acts as an aquiclude.
- 3% 52(a) Explain how the specific gravity of a mineral is determined.

Value

4%

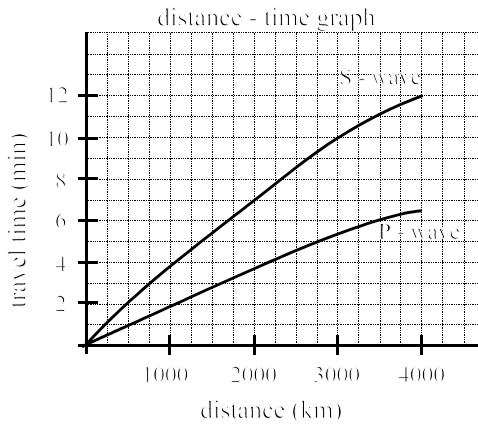
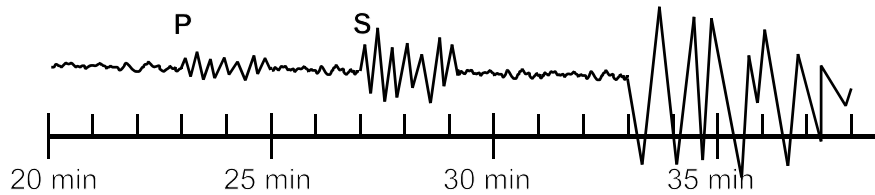
52(b) In the diagram below, rocktypes/materials are indicated by numbers and processes are indicated by letters. Indicate the rock types/materials and processes for the rock cycle diagram by completing the table below.

Rock Cycle



<u>Rock Type / Materials</u>	<u>Process</u>
1 magma	A.
2	B. weathering and erosion
3	C.
4	D.
5	E.

(c) As a result of an earthquake, the seismogram below was obtained.



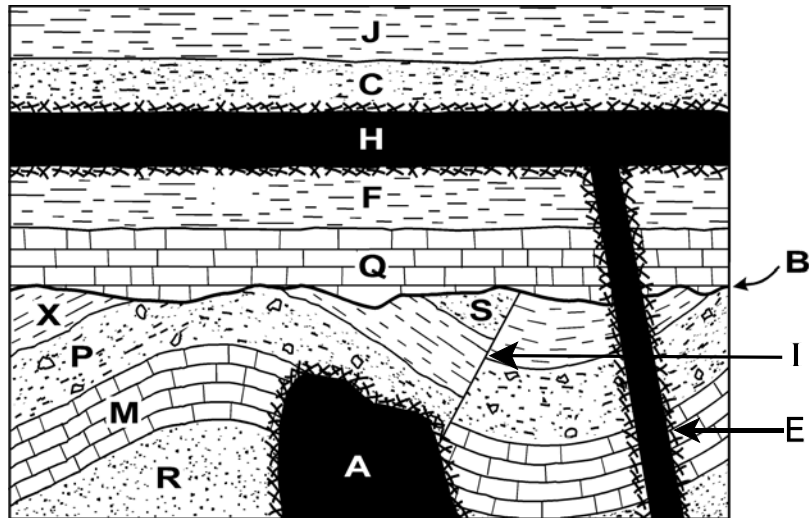
Value

- 2% (i) What is the distance from the recording station to the epicentre?
- 2% (ii) A second recording station located 3000 km from the epicenter recorded the P-wave arrival time at 10:00 AM. At what time did the S-wave arrive at this station?

2% 53(a) Explain why color is **NOT** a reliable property for identifying minerals.

4% (b) Using a labelled diagram, briefly describe what happens at a mid-ocean ridge.

2% (c) Use the diagram below to answer the questions that follow.



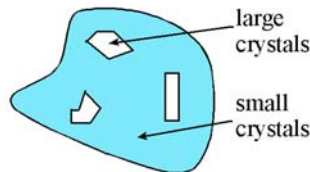
2% (i) Arrange the letters in the order they occur, beginning with the oldest event and ending with the youngest event.

1% 53(c) (ii) What evidence is provided to indicate that H is **NOT** a buried lava flow?

1% (iii) What is represented by the letter B?

4% 54(a) Explain two ways that economic mineral deposits are concentrated within Earth.

2% (b) An igneous rock is found to contain both large and small crystals, as shown below. What conditions were necessary for this rock to form?



Value

- 2% 54(c) Explain two ways in which a stream can transport materials?
- 2% (d) Draw a labelled diagram to illustrate the continental margin.
- 2% 55(a) What information can be gathered from the study of molds and casts but not from petrification?
- 2% (b) Oil is generally considered a non-renewable resource. Explain why oil sometimes may be considered a renewable resource.
- 3% (c) Explain how the theory of Plate Tectonics accounts for the distribution of earthquakes, volcanoes, and mountain ranges.

CHIEF MARKERS REPORT

Earth Systems 3209

1. Pre-Marking Appraisal

Following a general discussion, all markers were in agreement that the exam length was appropriate and students should have no problem completing the exam in the scheduled time. Markers also felt that the level of difficulty and the quality of questions was fair.

The multiple choice questions were considered fair, well written, and clear in terms of what was being asked. Markers noted that Question #7 was repetitive with Question 51(d). There was also some concern regarding the conditions necessary for regional metamorphism during mountain building in Question #24. Choice (C) was considered to be the more acceptable answer, however after some discussion with markers and consultation with other texts (Blue Planet, pg. 179), it could be argued choice (A) is also acceptable. Both answers were accepted.

The written response questions were also considered very fair. There was some concern however with the possible interpretation on Question 54(a). The question uses the phrase “within Earth”, which could be interpreted as those economic mineral deposits that form inside Earth. After careful consideration by the markers, it was decided to accept any two ways economic mineral deposits are concentrated on and within Earth. There was also some concern regarding Question 55(a). To obtain the desired answer the terms “mold and cast” and “petrification” must be in reverse order, for this reason a correct answer could not be written and Question 55(a) was omitted resulting in the written response section of the exam being marked out of 48%.

2. Post-Marking Report

(a) Marking Standard and Consistency

On the second day of the board, 50 exam papers were circulated and marked according to the marking scheme agreed to the previous day. These marks were recorded on separate tabbed paper which was used for comparison after the exams were actually corrected. The 50 papers corrected in the trial run was circulated with the other papers over the five days of correcting. Once the paper returned, it was once again circulated through the markers with the tabbed sheet to allow the markers to check their accuracy and consistency in marking as compared to the first day.

Another consistency check was completed using statistical analysis. It was noted that an alpha of above 0.8000 was appropriate and the Earth Systems 3209 board recorded an alpha of 0.8960, which supported the consistency checks of the pre-circulated papers.

(c) **Commentary on Response**

Although the questions were considered very fair their were questions that a significant percentage of students omitted. Each marker prepared an accepted written response, commentary on response, and a list of common errors to each question.

(d) **Recommmentdations**

- The process currently in place for setting and validating examinations is a good. Exams need to pass through a minimum of three groups of people to narrow errors and omissions with regard to questions and validity of questions.
- When diagrams are used on an exam, a point of view should also be included to aid in the question. For example, side view, top view, etc....
- More lines should be provided for written response items. Students are cramming their responses because there is not enough space.

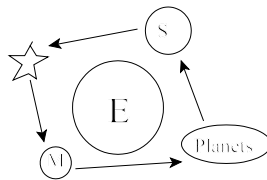
Constructive Response/Common Errors

Value

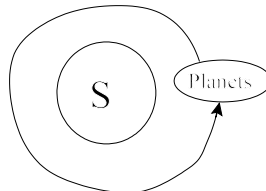
2% 51(a) Compare the geocentric and heliocentric models of the solar system, using a diagram to illustrate each model.

The correct answer to this question is:

Geocentric - Earth is the centre of the universe; planets revolve a stationary Earth.



Heliocentric - Sun is the centre of the universe; planets revolve around the sun in circular paths.



Commentary on Response:

- well done

Common Errors:

- explained the models in reverse.

2% 51(b) Given the half-life of U-235 is 0.7 billion years, determine the age of a sample of U-235 if 1/16 of the starting material remains. **(SHOW YOUR WORKINGS)**

The correct answer to this question is:

$$\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16} \quad \text{Therefore, 4 half lives.}$$

Or

# of half lives	fraction of parent
0	1
1	3/622
2	4
3	3/628
4	3/636

0.7 billion years x 4 half lives = 2.8 billion years

Commentary on Response:

- Students must first calculate the number of half lives to calculate the correct answer.

Common Errors:

- calculated an incorrect number of half lives.
- did not show workings.
- used the U-235 in their calculations.

Value

2% 51(c) Briefly describe the change in atmospheric composition brought about by:

(i) a major volcanic eruption

The correct answer to this question is:

(i) A major volcanic eruption would change the atmospheric composition by adding dust and ash as particulate matter and CO₂, N₂, SO₂ and H₂O as gaseous matter.

Commentary on Response:

- Students failed to answer what the question was asking, “the change in composition of the atmosphere.”
- Most students mentioned that dust is added to the atmosphere.

Common Errors:

- mentioned that CO₂ destroyed the ozone layer.
- did not make reference to sulfur oxides and nitrogen oxides being added to atmosphere.
- mentioned that O₂ was added to the atmosphere through volcanic outgassing.

(ii) burning of fossil fuels

The correct answer to this question is:

(ii) The burning of fossil fuels would change the atmospheric composition primarily by adding CO₂ and other minor gases like CO, H₂O and SO₂.

Commentary on Response:

- Students should recognize that the CO₂ levels in the atmosphere would increase as fossil fuels are burned.
- Students failed to make reference to sulfur oxides and nitrogen oxides being added to atmosphere

Common Errors:

- did not describe the change in composition of the atmosphere.
- Students mentioned that CO₂ destroyed the ozone layer.

Value

- 3% 51(d) Explain how volcanic outgassing contributed to the formation of Earth's original oceans.

The correct answer to this question is:

When volcanoes erupt, water vapor (steam) is released. Initially as Earth's surface began forming, large amounts of water vapor was outgassed from volcanoes and entered the atmosphere. As it rose upward, it cooled and condensed forming clouds which eventually released the water allowing it to fall back to the surface of Earth as rain. At or near the surface it vaporized again. Over time, the rains cooled the surface enough so that accumulation of water in deep and low lying areas began. This formed Earth's first oceans.

Commentary on Response:

- Students performed fairly well on this question, while not all students described the complete process to explain the origin of Earth's first oceans.

Common Errors:

- Students did not mention the cooling of Earth.

Value

- 3% 51(e) Characteristics of a rock determine whether it acts as an aquifer or an aquiclude.

- (i) With reference to porosity and permeability, compare a rock which acts as an aquifer and one which acts as an aquiclude.
- (ii) Give an example of a rock type that acts as an aquifer and a rock type that acts as an aquiclude.

The correct answer to this question is:

- (i) Aquifers have the ability to transmit and hold groundwater, thus an aquifer must have high porosity and high permeability.
Aquicludes tend to restrict groundwater movement, thus an aquiclude has low porosity and low permeability.
- (ii) Aquifer rock type: sandstone
Aquiclude rock type: shale

Commentary on Response:

- poorly done

Common Errors:

- only gave definitions of porosity and permeability.
- did not show how porosity and permeability determines an aquifer or aquiclude.
- confused the terms aquifer and aquiclude, explained in reverse.
- used minerals, not rock types as examples of an aquifer and aquiclude.

Value

3%

52(a) Explain how the specific gravity of a mineral is determined.

The correct answer to this question is:

Specific gravity compares weight of mineral to weight of equal volume of H₂O.

- (i) find the mass of the mineral; using a weigh scale or balance
- (ii) find the volume of the mineral; water displacement method
- (iii) find the weight of mineral in water; suspend mineral from spring scale and weigh immersed in water
- (iv) use the formula;
S.G. = density = m/v or;
S.G. = $\frac{\text{weight of mineral in air}}{(\text{weight in air}) - (\text{weight in H}_2\text{O})}$

Commentary on Response:

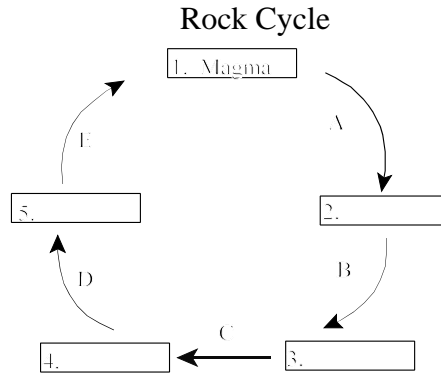
- poorly done

Common Errors:

- described partial details to explain how the specific gravity of a mineral is obtained.

Value
4%

52(b) In the diagram below, rock types/materials are indicated by numbers and processes are indicated by letters. Indicate the rock types/materials and processes for the rock cycle diagram by completing the table below.



The correct answer to the question is:

	<u>Rock Type / Materials</u>	<u>Process</u>
1	<u>magma</u>	A. <u>cooling and crystallization or solidification</u>
2	<u>igneous rock</u>	B. <u>weathering and erosion</u>
3	<u>sediment</u>	C. <u>compacting or cementing or lithification</u>
4	<u>sedimentary rock</u>	D. <u>heat and pressure; (chemical fluids)</u>
5	<u>metamorphic rock</u>	E. <u>melting</u>

Commentary on Response:

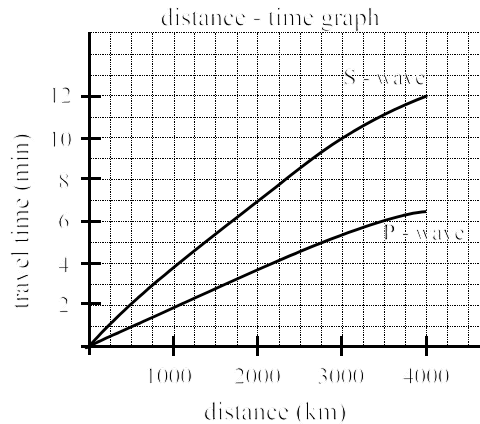
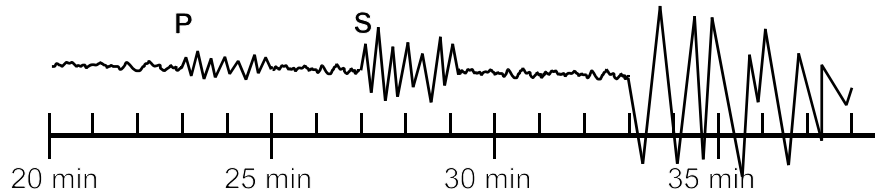
- fairly well done

Common Errors:

- did not differentiate between sediment and sedimentary (#3 and #4 in answer), sedimentary was accepted for both in the table.
- completed the rock cycle diagram in the reverse order (counterclockwise instead of clockwise).

Value
4%

52(c) As a result of an earthquake, the seismogram below was obtained.



- What is the distance from the recording station to the epicentre?
- A second recording station located 3000 km from the epicenter recorded the P-wave arrival time at 10:00 AM. At what time did the S-wave arrive at this station?

The correct answer to the question is:

- To find the distance you first find the difference in arrival times of the P-wave and S-wave.

P-wave → 27 minutes

S-wave → 23 minutes

Difference → 4 minutes

Therefore, at **2500 km** the difference in arrival times between P-wave and S-wave is 4 minutes.

Commentary on Response:

- Students answers ranged from 1000 km to 4000 km.
- Students knew how to find the difference in arrival times between P-wave and S-wave, but had no recollection on how to apply it to the graph.

Common Errors:

- interpolated horizontally from the graph at 4 minutes and read the values off of the P-wave line and S-wave line respectively.
- (ii) To find the answer you find the difference in the arrival times of the P-wave and S-wave at 3000 km. From the graph the S-wave arrived 4 minutes and 30 seconds after the P-wave. You then add this time to the time when the P-wave arrived at the second seismic station (10:00 AM). The answer is 10:04:30 AM.

Common Errors:

- subtracted 4 minutes and 30 seconds from 10:00 AM.
- interpolated the time when the S-wave was at a distance of 3000 km from the epicenter.

Value

2%

53(a) Explain why color is **NOT** a reliable property for identifying minerals.**The correct answer to this question is:**

A single mineral may have different colors due to the presence of impurities. Examples include various colors of quartz, fluorite, calcite, etc.... Also different minerals can have the same color. Examples include minerals such as halite, gypsum, calcite, etc....

Commentary on Response:

- Students explained that oxidation can change the color of minerals and marks were assigned for this response.

Common Errors:

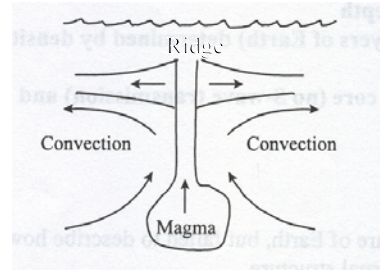
- did not mention that different minerals can have the same color.

4% 53: (b) Using a labelled diagram, briefly describe what happens at a mid-ocean ridge.

The correct answer to the question is:

At a mid-ocean ridge:

- plates move apart
- magma moves up between the plates
- generation (creation) of new ocean floor
- Magnetic signature is preserved in the new oceanic crust



Commentary on Response:

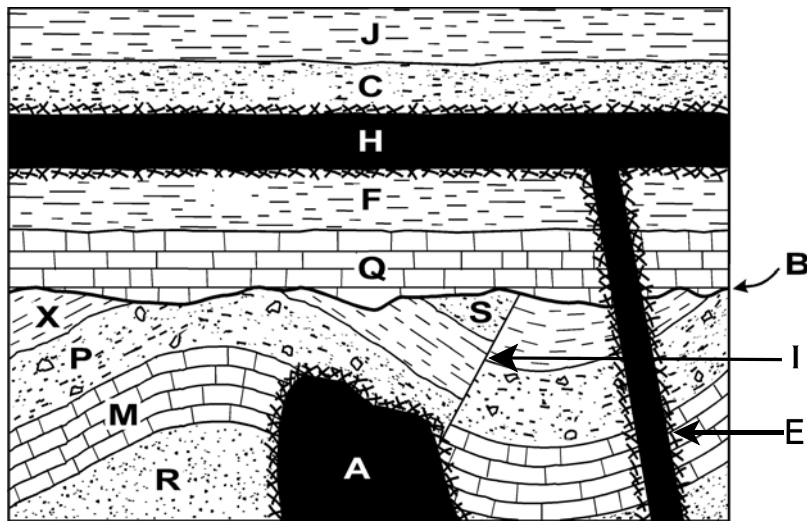
- Students did not draw well labeled diagrams. Many drew block diagrams with arrows only.
- Students only repeated what was drawn in the diagram, they did not mention the generation of new ocean floor.

Common Errors:

- explained and drew a convergent boundary instead of a divergent (ridge) boundary.
- provided a divergent diagram demonstrating magnetic reversal patterns on the ocean floor. Marks were given for this response.

Value

53(c) Use the diagram below to answer the questions that follow.



2%

- (i) Arrange the letters in the order they occur, beginning with the oldest event and ending with the youngest event.

Oldest \longrightarrow Youngest

The correct answer to this question is:

R, M, P, X, S, I, A, B, Q, F, C, J, H, E

Commentary on Response:

- Different arrangement of letters could give a correct answer. With respect to rock units “A” and “H” and the contact metamorphism “E”, these letters could be arranged differently in the sequence and still give a correct answer. Letter “A” could be included at any point after letter “I”. Letters “H” and “E” could be included at any point after letter “C”.

Common Errors:

- arranged rock units in order from oldest to youngest and at times failed to include letters “B”, “I” and “E” in their answer.

Value

1%

- (ii) What evidence is provided to indicate that H is **NOT** a buried lava flow?

The correct answer to this question is:

Contact metamorphism (baking, burning, etc...) between rock units “H” and “C” implies that rock unit “C” existed and rock unit “H” intruded.

Commentary on Response:

- Students said that rock unit “H” was an intrusion simply because it is below the surface, they failed to explain why.
- Some students did not understand what is meant by a buried lava flow.

Common Errors:

- did not state evidence to explain why rock unit “H” is not a buried lava flow.
- did not mention the contact metamorphism surrounding rock unit “H”.

(iii) What is represented by the letter B?

The correct answer to this question is:

Angular unconformity or period of erosion.

Commentary on Response:

- Students clearly understood what was indicated by letter “B” but failed to mention angular unconformity or a period of erosion. Some described it as a gap in geologic time which was also accepted.

Common Errors:

- referred to the unconformity as a fault or other geologic feature.

Value

4%

54(a) Explain two ways that economic mineral deposits are concentrated within Earth.

The correct answer to the question is:

An explanation of any two of the following was accepted.

A) hydrothermal deposits - minerals concentrated by hot, aqueous solutions flowing through fractures and pore spaces of crustal rocks.

B) magmatic deposits - minerals concentrated by magmatic processes such as, fractional crystallization within a body of igneous rock.

C) sedimentary deposits - minerals concentrated by precipitation or evaporation of lake water or seawater.

D) placer deposits - minerals concentrated by flowing surface water in streams and along the shoreline where dense minerals accumulate.

E) residual deposits - minerals are concentrated by weathering processes where soluble materials are removed leaving behind the less soluble residue.

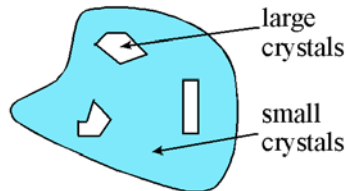
Commentary on Response:

- Poorly done and was not attempted by most. Approximately half of the students who answered this question had some idea of the processes involved in the concentration of economic mineral deposits within Earth. A supplement to aid in answering this question can be found in the text, “Blue Planet, pages 446 - 458.”

Common Errors:

- Few common errors were observed due to few students attempting to answer the question.

2% 54: (b) An igneous rock is found to contain both large and small crystals, as shown below. What conditions were necessary for this rock to form?



The correct answer to the question is:

The conditions necessary for a rock to be formed as shown relate to different environments of cooling. Initially the molten material must have been in an intrusive/plutonic environment where slow cooling allows for larger crystal growth. A change then occurred and the molten material moved to an extrusive/volcanic environment where rapid cooling allowed for the smaller crystal growth.

Commentary on Response:

- fairly well done

Common Errors:

- did not mention that the molten material experienced a change in environment which determined the change on cooling rate.

Value

2% 54(c) Explain two ways in which a stream can transport materials?

The correct answer to the question is:

Two ways that a stream transports materials include;

- A) the dissolved load in which the water carries materials that are found in solution.
- B) the suspended load in which materials are carried within the water column for great distances.
- C) the bed load in which materials are pushed, rolled, bounced, etc... along the stream bottom as a result of high velocity stream flow.

Commentary on Response:

- fairly well done

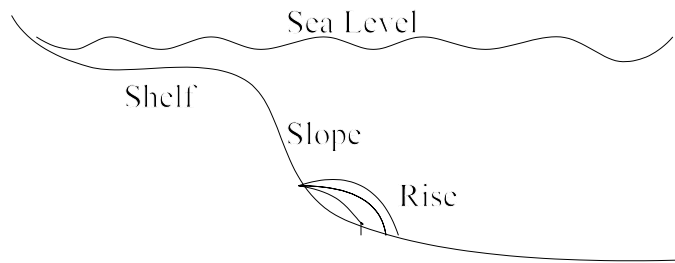
Common Errors:

- did not mention the size of materials moved by stream.
- mentioned the mechanisms but did not mention the different ways materials are moved by streams

2% 54(d) Draw a labelled diagram to illustrate the continental margin.

The correct answer to the question is:

Side View }



Commentary on Response:

- Students failed to provide a labeled diagram and the question scored poorly.
- A high percentage of students did not attempt this question.

Common Errors:

- provided a labeled diagram of convergent and divergent boundaries, mainly ocean - continent convergence.

Value

2% 55(a) What information can be gathered from the study of molds and casts but not from petrification?

A correct answer to this question could not be written because of an error in the phrasing of the question. This question was omitted from the marking scheme.

- 2% 55(b) Oil is generally considered a non-renewable resource. Explain why oil sometimes may be considered a renewable resource.

The correct answer to the question is:

In most cases oil is considered a non-renewable resource because when used, it's gone. From a geological sense an argument can be made that oil may be considered a renewable resource. Keeping in mind the idea of uniformitarianism, the processes that created oil in the past are still occurring today. This suggests that oil will be produced in the future although the time span for this process is extremely long.

Commentary on Response:

- Some students grasped the idea that oil can be regenerated over extended periods of time.

Common Errors:

- did not mention time frame with respect to considering oil as a renewable resource.

Value
3%

- 55(c) Explain how the theory of Plate Tectonics accounts for the distribution of earthquakes, volcanoes, and mountain ranges.

The correct answer to the question is:

The theory of Plate Tectonics helps to explain where most of the earthquakes, volcanoes, and mountain ranges are found. Plate tectonics shows a number of plates moving on the surface of Earth. These plates meet at places called boundaries. Depending on the type of boundary, convergent, divergent, and transform, geologic features such as earthquakes, volcanoes, and mountain ranges are formed. Thus, the distribution of such geologic features are seen mainly at the boundaries of plates, as in the "ring of fire," surrounding the Pacific plate.

Commentary on Response:

- Poorly done.

Common Errors:

- only explained the theory of plate tectonics with no or very little mention of earthquakes, volcanoes, and mountains
- did not mention that earthquakes, volcanoes, and mountains are located at the plate boundaries

**EARTH SYSTEMS 3209
PART 1
SELECTED - RESPONSE ITEM ANALYSIS**

Item	Correct Answer	Cognitive Level	Responses				
			Multiple Answers or No Response	A	B	C	D
			%	%	%	%	%
1	C	1	0	2.4	3.4	93.6	0.6
2	D	1	0.9	11.6	5.4	3.9	78.4
3	D	3	0	10.5	23.8	9.6	56.1
4	B	1	0.4	14.3	53.3	27.8	4.1
5	B	1	0	18.8	56.5	16.9	7.7
6	C	1	0	26.3	11.1	59.5	3
7	D	1	0	9.2	6	3.2	81.6
8	C	1	0	3.4	13.9	43.3	39.4
9	A	1	0.2	73.4	8.4	6.9	11.1
10	D	1	0	8.6	6.2	10.1	75.2
11	D	1	0	22.9	7.3	22.5	47.3
12	B	1	0	15.8	59.1	13.5	11.6
13	A	3	0	44.5	45.2	6.6	3.6
14	B	1	0	4.3	24.4	65.5	5.8
15	D	1	0.2	14.8	8.1	16.9	60
16	D	1	0.2	6.2	13.5	35.1	45
17	A	2	0.2	22.3	22.5	47.5	7.5
18	D	1	0	3.2	9.2	0.9	86.7
19	D	1	0.2	5.6	18.6	15.4	60.2
20	D	1	0.2	38.5	21.2	23.3	16.7
21	A	2	0.2	73.4	7.9	4.5	13.9
22	A	1	0.4	50.5	11.8	27	10.3
23	B	1	0	11.1	74.9	7.1	6.9
24	A or C	1	0	31.9	12.6	37.3	18.2
25	C	2	0	13.1	9.9	42.4	34.7
26	D	2	0	3.9	6.4	12	77.7
27	D	1	0.2	10.1	16.7	18.2	54.8

**EARTH SYSTEMS 3209
PART 1
SELECTED - RESPONSE ITEM ANALYSIS**

Item	Correct Answer	Cognitive Level	Responses				
			Multiple Answers or No Response	A	B	C	D
			%	%	%	%	%
28	C	1	0	7.9	3.6	83.9	4.5
29	A	1	0	49.9	22.1	5.1	22.9
30	D	1	0	12.6	9.9	9.4	68.1
31	B	1	0.4	27	52.5	16.1	4.1
32	A	1	0	52.2	24.8	18.2	4.7
33	D	2	0.2	12.2	26.8	21	39.8
34	A	2	0	62.7	7.9	3.4	25.9
35	B	3	0	6.4	43	6.2	44.3
36	B	1	0	15.6	71.1	2.1	11.1
37	B	1	0	21.8	69.4	8.1	0.6
38	C	1	0	6	20.3	42	31.7
39	D	1	0.2	2.4	0.9	5.8	90.8
40	D	1	0.2	11.8	19.3	16.1	52.7
41	A	2	0.2	23.8	23.1	37.9	15
42	C	1	0	4.7	9.4	81.2	4.7
43	C	1	0.6	16.5	21.4	52	9.4
44	B	1	0.2	10.7	59.7	28.3	1.1
45	C	1	0.2	14.3	4.5	71.7	9.2
46	D	1	0.2	32.1	8.8	6	52.9
47	D	1	0	8.1	19.7	10.9	61.2
48	B	1	0	8.6	67.2	18.4	5.8
49	B	1	0.4	21	29.8	22.7	26.1
50	C	1	0	5.1	9	74.1	11.8

**EARTH SYSTEMS 3209
PART 11
SHORT AND CONSTRUCTED - RESPONSE ANSWERS
ITEM ANALYSIS**

Item	Cognitive Level	Students Completing Item	Value	Average	Average % Per Item
PART II - Do <u>ALL</u> questions in this section					
51(a)	2	528	2	1.4	72.2
51(b)	2	528	2	1	48.3
51(c)(i)	2	528	1	0.8	77.7
51(c)(ii)	2	528	1	0.7	66.3
51(d)	2	528	3	1.7	56.1
51(e)	2	528	3	1.7	55.4
52(a)	2	528	3	1.5	50.2
52(b)	3	528	4	2.2	54.3
52(c)(i)	3	528	2	0.5	25.8
52(c)(ii)	3	528	2	0.9	43.7
53(a)	2	528	2	1.3	67
53(b)	2	528	4	1.2	30.1
53(c)(i)	3	528	2	1.4	70.3
53(c)(ii)	2	528	1	0.5	50.9
53(c)(iii)	2	528	1	0	0
54(a)	2	528	4	0.5	13.7
54(b)	2	528	2	1.3	64.1
54(c)	2	528	2	1.2	57.9
54(d)	2	528	2	0.5	25.1
55(a)	Question Omitted				
55(b)	3	528	2	1.2	59.1
55(c)	2	528	3	1.7	56.6

**EARTH SYSTEMS 3209
PROVINCIAL SUBTESTS RESULTS**

