

Earth Systems 3209 Chief Marker's Report

Pre-Marking Appraisal

Following a general discussion, all markers were in agreement that the exam length was appropriate and students should have no difficulty completing the exam in the scheduled time.

The multiple choice questions were considered fair, well written, and clear in terms of what was being asked. There was some debate concerning Question # 48. Choice C was considered the more acceptable answer, however in referencing the text (Pgs. 298 and 304) it could be argued choice B is also acceptable. Both answers were accepted.

The written response questions were also considered very fair. There was some concern however with the possible student interpretation of Question 51(b). There was also some concern with the term “color” in Question 52(d). Although this was considered a good question and was phrased correctly, the way the term “color” is addressed in the text may cause some problems.

Commentary on Responses:

Although the questions were considered very fair there were several questions a significant percentage of students omitted. See individual markers report for further commentary.

Part II

Constructed Response

- 2% 51.a) *Calculate the age of a rock using $K - 40 \rightarrow Ar - 40$ (half - life 1.3 billion years) if you know that 12.5% of the parent material now remains in the sample. (Show your workings.)*

The correct answer to this question is:

$100\% \rightarrow 50\% \rightarrow 25\% \rightarrow 12.5\% = 3 \text{ half lives}$
 $3 \times 1.3 \text{ billion years} = 3.9 \text{ billion years}$

Commentary on Response:

This question was not even attempted by the majority of students. If students determined the incorrect number of half lives, yet applied that number to the half life, they were given 1 mark.

The most common errors for this question included:

- a few students followed the halving procedure in reverse; doubling the half life three times
- students took one half the time for one half-life that many times (ex. 1.3 billion yrs. $\times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 0.1625$ billion yrs. Should have multiplied the number of half lives by the time for one half-life, 3×1.3 billion yrs.

- 2% b) *With the aid of a specific example, explain how uniformitarianism can be used to understand past catastrophic events.*

The correct answer to this question is:

The principle of uniformitarianism states that processes (biological, physical, etc.) that acted on Earth in the past act upon Earth today. It proposes that geological processes occur over long periods of time. An example of this would be rocks found on mountain tops containing fossils of organisms that lived in the sea more than 15 million years ago.

Commentary on Response:

In answering the question, any example that took some present happenings and applied it to some event/action long ago was accepted.
This question was omitted by nearly half the students.

The most common errors for this question included poor understanding of the concept of catastrophism

2% c) *Explain the origin of the solar system using the Solar Nebula hypothesis.*

The correct answer to this question is:

A rotating cloud of dust and gases began to contract due to its own gravitational influence. This material started to rotate and flattened out into a disk. At the centre the sun was eventually formed. Within the disk more contractions took place eventually forming planets

Commentary on Response:

The most common errors for this question included:

- students would not include all stages of formation of the solar system
- students confused solar nebula with big bang.

2% d) *Explain how porosity influences permeability.*

The correct answer to this question is:

In general material with high porosity will have a high permeability. This means water can flow through the material easily. A material with low porosity will have a low permeability and water can not flow through the material easily.

Commentary on Response:

The most common errors for this question included:

- students provided definitions and did not explain how porosity influenced permeability

2% 51.e) *Explain how contaminated ground water can be purified by passing through Earth's materials.*

The correct answer to this question is:

As ground water percolates slowly through rock of relatively low permeability and porosity some contaminants are filtered from the water as they become trapped in the pore space.

Other acceptable explanations could include:

Contaminants are removed when neutralized by materials in soil; when taken up by plants; or when water flows through bogs and other natural systems.

Commentary on Response:

The most common errors for this question included:

- students lacked an explanation of how the water is purified (filtered).

2% f) *Explain how the addition of Earth's biosphere was responsible for changing the composition of Earth's atmosphere over time.*

The correct answer to this question is:

Plant photosynthesis took in atmosphere CO_2 and released O_2 . Cell respiration by all living organisms took in atmospheric O_2 and released CO_2 . There has been an increase in O_2 and a decrease in CO_2 during the evolution of the primitive atmosphere to present day atmosphere

Commentary on Response:

The most common errors for this question included:

- students explained that humans change earth's atmosphere (pollution) at present and failed to mention the change in composition over time

2% 52.a) *Diamond and graphite have identical chemical composition (both are composed of carbon). Explain why the cleavage of these two minerals is different.*

The correct answer to this question is:

Cleavage is the ability of a mineral to break along planes of weak chemical bonding. The strength of the bonds between carbon atoms in graphite planes are weaker than they are in diamond. carbon atoms in graphite are arranged in a different structural pattern than diamond (sheets as opposed to macromolecule, tetrahedral)

Commentary on Response:

The most common errors for this question included:

- students failed to mention atomic arrangements of atoms, sheets vs network tetrahedron arrangement

- 3% b) *With reference to Moh's Scale and some common objects of known hardness, explain how a geologist would determine the hardness of an unknown mineral.*

The correct answer to this question is:

Moh's scale uses a series of ten minerals as a standard to determine hardness of materials (Example: fingernail (2.5), copper penny (3.5), iron nail (4.5), glass (5.5 - 6), steel file (6.5). To determine hardness attempt to scratch the mineral with objects of known hardness. If the object scratches the mineral, then the object is harder than the mineral. If the object does not scratch the mineral then the mineral is harder than the object.

Commentary on Response:

The most common errors for this question included:

- students confused the hardness of common objects (ex. students may mention that a knife is harder than glass, whereas the opposite is true)

- 2% 52.c) *Citing two differences, distinguish between a rock and a mineral.*

The correct answer to this question is:

Chemical elements are the building blocks of minerals whereas minerals are the building blocks of rocks. Minerals are pure solids, where all the molecules have the same definite chemical composition and structure, whereas rocks are a mixture often appearing multicolored.

Commentary on Response:

The most common errors for this question included:

- students provide definitions for mineral and rock and fail to cite differences between the two.

- 4% d) *Explain how texture and color could be used to classify igneous rocks.*

The correct answer to this question is:

Texture:	If the igneous rock has fine (small crystals) it is classified as volcanic (extrusive). If the igneous rock has coarse (large crystals) it is classified as plutonic (intrusive)
Color:	If the igneous rock is light it is classified as felsic (granitic) If the igneous rock is dark it is classified as mafic (basaltic)

Commentary on Response:

The most common errors for this question included:

- students confused the concept of color as a poor property to identify minerals (which is true), whereas color can be used and is a good identification to classify igneous rocks

2% 53.a) *Using examples, distinguish between foliated and nonfoliated metamorphic rocks.*

The correct answer to this question is:

Foliated: show layering or banding of different minerals created by the alignment of minerals during metamorphism (Ex: schist, gneiss, slate)

Non foliated: a mass or network of intergrown crystals consisting of one mineral with no layering or banding (Ex: marble, quartzite, hornfels)

Commentary on Response:

The most common errors for this question included:

- students did not know examples of the metamorphic rock textures for the most part

2% b) *A geologist examines a rock outcrop and finds it to contain a layer of gypsum, a layer of conglomerate, and a layer of sandstone with ripple marks. Explain the depositional environment for any two layers.*

The correct answer to this question is:

Gypsum comes from a shallow marine environment where there has been evaporation of the water body. Conglomerate comes from any environment where there has been a drastic change in water speed. Examples include: mouth of river where delta forms, or a high energy environment near shore. Sandstone comes from a low energy environment such as shallow water or windblown sand in the desert. There must be motion to produce ripple marks.

Commentary on Response:

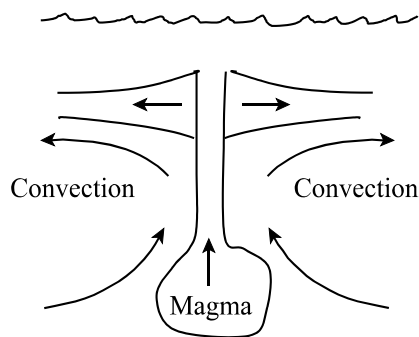
The most common errors for this question included:

- few students described gypsum
- few mentioned environmental conditions necessary to form the rock layers.

- 4% 53.c) With the aid of well labelled diagrams, explain what happens at:
- (i) a divergent plate boundary, **and**
 - (ii) any one of the convergent plate boundaries.

The correct answer to this question is:

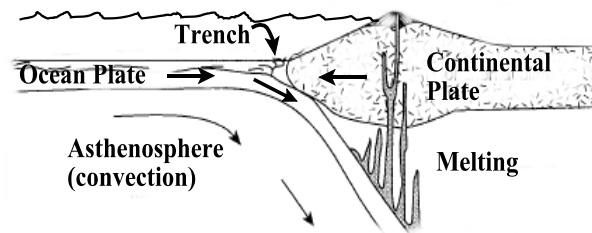
(i) Divergent Plate Boundary



At a divergent plate boundary:

- plates move apart
 - generation (creation) of new ocean floor
 - magma moves up between the plates
- Ex: ocean ridge and rift areas

(ii) Convergent Plate boundary (shown below is ocean - continental)



At a convergent plate boundary:

- plates collide
- oceanic crust subducts and the other plate (continental or oceanic) rises over top

Diagram should show; subduction and trench, and destruction of lithosphere

Commentary on Response:

The most common errors for this question included:

- students failed to draw well labeled diagrams. many drew block diagrams with arrows only

- 2% d) *Earthquakes commonly occur at plate boundaries.*
(i) *With reference to elastic rebound, what causes an earthquake?*

The correct answer to this question is:

There is a build up of stress (energy) within the tectonic plates, where it reaches the elastic limit. The plates then rupture (snap) and the stored energy is released. Plates then move (snap) back to unstressed positions releasing the stored energy as seismic waves. (Earthquake)

Commentary on Response:

The most common errors for this question included:

- students understand the concept, but failed to explain elastic rebound idea in their answer

- 2% (ii) *What do P-waves and S-waves tell us about earth's internal structure?*

The correct answer to this question is:

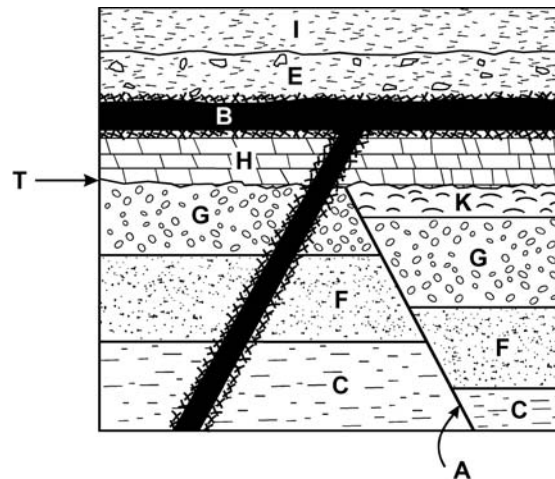
- density increases with depth
- Composition layering (layers of Earth) determined by density and seismic wave speed
- Earth has a liquid outer core (no S-wave transmission) and a solid inner core (P-waves refract)

Commentary on Response:

The most common errors for this question included:

- students described the internal structure of Earth, but failed to describe how P- and S-waves indicate facts about the internal structure

54.a) Use the diagram below to answer the following questions.



2%

- (i) Is layer "B" extrusive or intrusive? Explain your answer.

layer "B" extrusive or

The correct answer to this question is:

"B" is an intrusive layer. This is determined because there is contact metamorphism on the top and bottom of "B". (All around "B")

Commentary on Response:

The most common errors for this question included:

- Students said that layer "B" was intrusive simply because it was beneath the surface. They failed to explain why, due to presence of contact metamorphism surrounding layer "B"

2%

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

OLDEST → **YOUNGEST**

The correct answer to this question is:

C → F → G → K → A → T → H → E → B → I

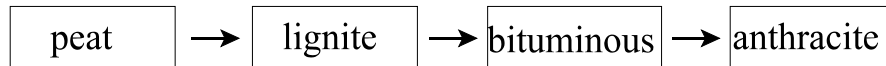
Commentary on Response:

The most common errors for this question included:

- students arranged rock layers in order from oldest to youngest and often left out the letters indicating the fault (A) and the unconformity (T)

- 2% b) *Use a diagram to explain the four stages involved in the formation of anthracite coal.*

The correct answer to this question is:



From peat to lignite there is burial and compaction.
From lignite to bituminous there is greater burial.
From bituminous to anthracite there is metamorphism.

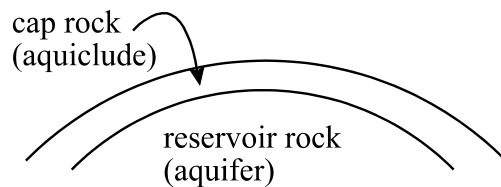
Commentary on Response:

The most common errors for this question included:

- students failed to associate the process of metamorphism which is responsible for the formation of anthracite coal

- 2% 54.c) *With the aid of a labelled diagram describe a typical oil trap.*

The correct answer to this question is:



NOTE: it is not necessary to show reservoir rock as gas, oil, and water

- Oil rises due to its low density and is trapped by the cap rock, which is impervious.

NOTE: this is only one example(anticline). Others include fault trap, salt dome, and stratigraphic (pinch-out) trap.

Commentary on Response:

The most common errors for this question included:

- students failed to provide accurate and well labeled diagrams

4% 55.a) *Fossils are commonly formed by the following methods:*

- *formation of molds and casts*
- *petrification by replacement*

Describe these, including in your description, the conditions necessary for fossilization to occur.

The correct answer to this question is:

Molds and Casts: Organisms with hard parts get rapidly buried in sediment. The sediment compresses and hardens, the organism dissolves/decays, and an impression (mold) is left. For a cast, an impression (mold) fills with sediment and hardens/compacts, forming a solid representation of the organism

Petrification: Porous material (organism) takes in water (fluid) which dissolves the material and replaces it with minerals (ex: calcite, silica, pyrite) to produce a solid replica of the organism, preserving details

Commentary on Response:

The most common errors for this question included:

- students failed to include the conditions necessary for fossil formation in their explanation

3% b) *With the aid of a labelled diagram explain how the Hawaiian Island Chain formed.*

The correct answer to this question is:

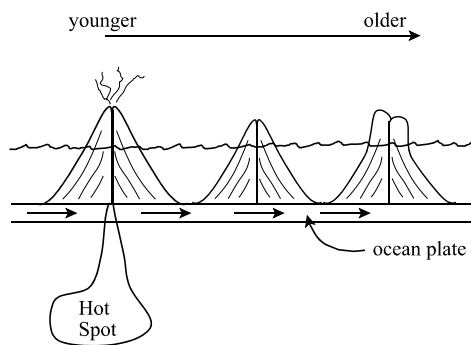


Plate moves over a stationary hot spot, forming new volcanic islands directly over the hot spot. Over a period of time a chain of islands form. The older islands are no longer fed by the hot spot and therefore become dormant (extinct) or inactive volcanic islands.

Commentary on Response:

The most common errors for this question included:

- some students used divergent boundary to explain the concept instead of a hot spot

TABLE 3
EARTH SYSTEMS 3209
PART 1
SELECTED - RESPONSE ITEM ANALYSIS

Item	Responses				
	Multiple Answers or No Response	A	B	C	D
	%	%	%	%	%
1. Correct answer is C	0.0	16.6	1.7	63.3	18.4
2. Correct answer is B	0.0	54	28	15.6	2.4
3. Correct answer is B	0.0	12.5	62	21	4.5
4. Correct answer is D	0.7	7.5	19.3	14.3	58.2
5. Correct answer is C	0.0	9.5	6.2	75.1	9.2
6. Correct answer is C	0.0	1.1	10.8	52	36.1
7. Correct answer is B	0.0	4.5	79.2	12.7	3.5
8. Correct answer is D	0.1	10.9	10.6	12.7	65.6
9. Correct answer is C	0.0	2	2.7	61.8	33.6
10. Correct answer is C	0.0	5	20.4	66.4	8.2
11. Correct answer is C	0.1	3.3	2.3	83.1	11.2
12. Correct answer is B	0.3	26.1	57.9	14	1.7
13. Correct answer is D	0.1	4	2.1	1.7	92.1
14. Correct answer is C	0.0	6.7	5.9	66	21.4
15. Correct answer is D	0.3	22.8	21	17.1	38.8
16. Correct answer is D	0.1	16	33.6	15	35.3
17. Correct answer is C	0.4	14.7	6.2	71.4	7.2
18. Correct answer is B	0.0	5.2	88.2	5	1.6
19. Correct answer is B	0.1	1.1	73.7	22.1	3
20. Correct answer is B	0.0	18.8	49	24.5	7.6
21. Correct answer is C	0.0	10.5	12.6	51.7	25.2
22. Correct answer is C	0.3	6.1	7.9	77.1	8.6
23. Correct answer is B	0.3	33.9	41.8	10.9	13.2
24. Correct answer is C	0.3	13	34.3	43.1	9.3
25. Correct answer is B	0.3	15.3	63.9	7.6	12.9
26. Correct answer is D	0.0	1.7	3.8	0.8	93.6
27. Correct answer is C	0.0	9.9	7.2	63.2	19.7

TABLE 3 (Continued)
EARTH SYSTEMS 3209
PART 1
SELECTED - RESPONSE ITEM ANALYSIS

Item	Responses				
	Multiple Answers or No Response	A	B	C	D
	%	%	%	%	%
This section covers Units 1, 2, 3, 6 and 10					
28. Correct answer is A	0.0	37	43.6	12	7.4
29. Correct answer is A	0.1	43.6	31.3	3.4	21.7
30. Correct answer is D	0.6	15.6	33.7	9.2	40.9
31. Correct answer is D	0.0	9.9	6.1	18.3	65.7
32. Correct answer is D	0.0	7.5	6.2	6.8	79.5
33. Correct answer is D	0.3	21.5	10.6	6.8	60.8
34. Correct answer is B	0.3	18.1	43.3	29.9	8.4
35. Correct answer is A	0.1	55.2	34.4	4.8	5.4
36. Correct answer is B	0.7	46.2	32	13.3	7.8
37. Correct answer is C	0.1	13.6	16.7	52.4	17.1
38. Correct answer is A	0.0	78.5	14.6	3.8	3.1
39. Correct answer is C	0.1	19.5	21.8	47	11.5
40. Correct answer is A	0.0	26.3	32.3	21.2	20.1
41. Correct answer is B	0.4	30.9	37.1	18	13.6
42. Correct answer is A	0.1	32.6	42.2	9.8	15.3
43. Correct answer is A	0.7	22.8	29.2	25.5	21.8
44. Correct answer is B	0.4	9.8	54.2	24.4	11.2
45. Correct answer is D	0.1	13.9	22.2	21.4	42.4
46. Correct answer is D	0.3	21.8	9.5	28.6	39.8
47. Correct answer is C	0.1	17.1	16.6	51.6	14.6
48. Correct answer is B or C	0.0	17.6	58.1	13	11.3
49. Correct answer is B	0.3	10.5	42.4	22	24.9
50. Correct answer is D	0.4	14.3	7.8	10.6	66.9

TABLE 3 (Continued)
EARTH SYSTEMS 3209
PART 11
SHORT AND CONSTRUCTED - RESPONSE ANSWERS
ITEM ANALYSIS

Item	Students Completing Item	Value	Average	Average % Per Item
PART II - Do <u>ALL</u> questions in this section				
51.(a)	709	2	0.76	38.01
51.(b)	709	2	0.64	31.84
51.(c)	709	2	0.79	39.56
51.(d)	709	2	1.04	52.01
51.(e)	709	2	1.21	60.40
51.(f)	709	2	0.92	46.02
52.(a)	709	2	0.57	28.28
52.(b)	709	3	1.73	57.55
52.(c)	709	2	0.92	45.80
52.(d)	709	4	1.27	31.75
53.(a)	709	2	0.27	13.68
53.(b)	709	2	0.66	32.97
53.(c)(i)	709	2	1.03	51.45
53.(c)(ii)	709	2	1.08	54.20
53.(d)(i)	709	2	0.91	45.42
53.(d)(ii)	709	2	0.47	23.36
54.(a)(i)	709	2	0.96	48.21
54.(a)(ii)	709	2	1.07	53.28
54.(b)	709	2	0.55	27.40
54.(c)	709	2	0.48	23.87
55.(a)	709	4	1.63	40.85
55.(b)	709	3	0.98	32.53