Earth Systems 3209
Grading Standards
June 2008

1. Pre-Marking Appraisal

Overall, the exam had a good sampling of unit outcomes. Multiple choice and constructed response questions were considered both fair and clear. The difficulty level was appropriate with an accurate mixture of level 1, 2 and 3 questions. The exam was well designed and of reasonable length.

2. Post Marking Report

Marking Standard and Consistency

Marker reliability was checked by obtaining a random sample of 50 papers. These papers were graded, marks were then assigned to each question and recorded on a separate sheet of paper. The 50 exams were put back into the original stack of exams and re-evaluated when they appeared during the marking process. The two values were compared and if there were discrepancies, the chief marker would review the scoring with the individual marker. Overall, marks from the random sample and re-evaluation process compared favourably.

Summary

It is essential that teachers complete all core labs to ensure that students are prepared for the examination. These core labs enrich material in each unit of the course. As in past years, performance on Earth Systems 3209 was lower for items that assessed higher order outcomes from the core labs To ensure that students are successful on these questions, teachers should also assess these outcomes at a higher order level throughout the year.

In addition to higher order assessment, teachers should encourage students to read questions carefully and critically. Very often on public exams, errors occur because students fail to read the whole question. As a result, they misrepresent what is being asked.

Part II
Total Value: 40%

Constructive Response

Value

2% 61.(a) Explain how the principles of superposition and cross-cutting relationships are applied when using relative dating.

Answer

Relative dating determines the chronological order of events by comparing the events. Both principals of superposition and cross-cutting relationships are examples of relative dating. Superposition compares undisturbed horizontal rock layers, stating that a rock layer is older than layers above and is younger than layers below. Cross-cutting states that a rock unit or geological event (fault) that cuts across other rock units will be relatively younger than the rocks it cuts across.

1 mark for relating superposition to relative dating.

1 mark for relating cross-cutting to relative dating.

1 mark for identifying that relative dating relates to arranging chronological order of events.

Commentary on Response

Many students confused the principal of cross-cutting with correlation.

Common Errors

Students

- suggested that cross-cutting is a process of cutting a rock sequence to view a cross-section of the rock.

Value

2% (b) The half-life of element X is 200 000 years. If a sample originally held 256 g of parent isotope and the rock sample has been determined to be 1 million years old, what mass of parent now remains? Show calculations.

> **NOTE:** Answers to this problem can be found using various methods. One solution is outlined below:
>
> Number of Half-lives:
>
> $$\text{Half-life} = \frac{1{,}000{,}000 \text{ years}}{200{,}000 \text{ years}} = 5 \text{ HL}$$
>
> Mass of parent remaining:
>
> 256g ➜ 128g ➜ 64g ➜ 32g ➜ 16g ➜ 8g

1 mark for showing how half life was found.

1 mark for showing how the mass of parent remaining was found.

Commentary on Response

Many students did not attempt this item.

Common Errors

Students

- incorrectly calculated the number of half-lives.
  (Ex. 2000,000 ÷ 1,000,000 = 1/5 HL).
- incorrectly calculated the mass of parent remaining. Stopped after 4 HL (16g).

Value

2% 62.(a) Briefly describe the evolution of our solar system according to the solar nebular hypothesis.

Answer

According to the nebula hypothesis, a huge rotating cloud of dust and gases began to contract (gravity) towards its center. As the nebular material contracted, it rotated faster and faster, which caused the material to flatten into a disk shape. The material then concentrated in the center and formed the proto-sun, which eventually formed the sun we see today. The remaining material within the flattened disk began to accrete to form the planets we see today. In time most of the remaining debris was added to the nine planets or was swept out into space by solar winds.

0.5 mark for identifying rotating mass of gases contracting under gravity.

0.5 mark for rotating material flattened into a disk shape.

0.5 mark for identifying proto-sun formed in center and proto-planets formed in flattened disk.

0.5 mark for stating remaining dust and gases were swept away by solar winds.

Commentary on Response

Many students did not attempt this item.

Common Errors

Students

- failed to identify all four stages of the evolution of a solar system.
- made reference to the geocentric and heliocentric models of the solar system. These outcomes are no longer a part of the curriculum outcomes for this course.

Value

2% 62.(b) Using an example, explain how a rock can be very porous, yet impermeable.

Answer

Porosity refers to the amount of open space within a rock: whereas, permeability refers to the ability of a rock to transmit water through the pore space within a rock which is interconnected. A rock such as shale exhibits pore space, yet it is impermeable because its pore space is not connected. Vesicular basalt is another rock that contains porosity and is impermeable. Also pumice and clay (not a rock) was accepted as suitable examples.

1 mark for providing an explanation.

1 mark for identifying an example.

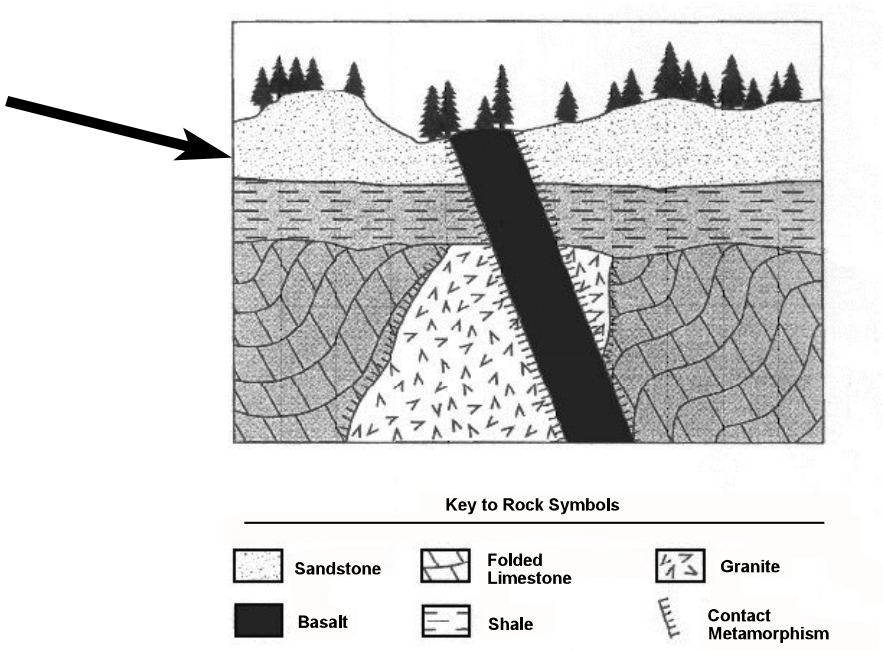
Common Errors

Students

- often did not provide an example.
- failed to identify why rocks can be porous, yet impermeable. (i.e. pore spaces not connected)

Value

3% 63.(a) (i) Interpret the geological history of this area by arranging the letters of the sequence of events in order from oldest to youngest.



Answer

Youngest

E	A	Deposition of Shale
F	B	Folding of pre-existing Limestone
G	C	Intrusion of Granite
A	D	Deposition of Limestone
C	E	Erosion of present day surface
B	F	Intrusion of Basalt
D	G	Deposition of Sandstone

Oldest

0.5 mark for each letter in the proper sequence.

2 marks were given if the correct sequence was reversed.

Common Errors

Students

- put igneous rock units as the oldest.
- reversed order of the sequence of letters.

3% (ii) Draw an arrow on the diagram to show where an unconformity is located and explain how it formed.

Answer

Refer to the arrow in the diagram above. The arrow indicates an angular unconformity where folded limestone was eroded and later buried by a horizontal layer of shale (clay).

1 mark for arrow pointing to angular unconformity.

1 mark for identifying erosion of folded limestone.

1 mark for indicating the eroded surface was buried by shale.

Common Errors

Students

- identified the igneous rock units or the contact metamorphism as the unconformity.
- failed to identify either erosion and / or deposition (burial) when explaining how the unconformity formed.

Value

2% 63.(b) Explain how Moh's scale and items of known hardness are used to assist in the identification of an unknown mineral.

Answer

Moh's scale ranks the hardness of a mineral from softest, value of one (1), to hardest, value of ten (10) and assigns a mineral to each hardness value. When identifying an unknown mineral, hardness is a property often used. Items of known hardness, such as a finger nail (2.5), copper penny (3.5), iron nail (4.5), steel knife (5.5), and glass (>6.0) can be used to identify the hardness of the mineral. These objects can be scratched across the mineral and if it scratches the mineral, the mineral is softer than the hardness value assigned to each object. The relative hardness can be narrowed down by scratching the mineral repeatedly by the different items of known hardness.

Also, the hardness of a mineral can be determined by scratching the mineral with minerals of known hardness as identified by Moh's hardness scale. If the mineral of known hardness fails to scratch the unknown mineral it is softer and the next hardest mineral on Moh's scale can be used until a scratch is made in the unknown mineral. (This method fails to identify objects of known hardness).

1 mark for referencing Moh's hardness scale and items of known hardness.

1 mark for explaining how items can identify the hardness of an unknown mineral using Moh's scale.

Common Errors

Students

- did not identify the hardness of the items (objects) used to perform hardness test.
- did not explain how the hardness test was carried out on an unknown mineral.
- referenced other mineral properties, such as, color and streak.
- generally referred to minerals as "hard" and "soft."
- only referenced the hardness scale or the hardness items and failed to reference both in the answer.

Value

3% 63.(c) Describe two things that can be determined by examining the crystal size of minerals in igneous rocks.

Answer

Crystal size of minerals in igneous rocks can indicate the following:

1) The environment in which the molten rock cooled, intrusive (plutonic) or extrusive (volcanic).

2) The cooling rate (history) of the molten rock. Large crystals suggest a slow cooling rate and small crystals suggest a faster cooling rate.

1.5 marks for identifying igneous environment (plutonic / intrusive vs volcanic / extrusive) and identifying appropriate crystal size with each environment.

1.5 marks for identifying the cooling rate / history (slow vs fast) and identifying appropriate crystal size with each cooling rate.

Common Errors

Students

- related mafic verses felsic to crystal size.
- talked about age of rock.
- talked about porosity and /or permeability of rock.
- mentioned texture, but not in the correct context.
- mixed up cooling rate and crystal size.

Value

2% 63.(d) Describe two depositional features of glaciation that can be used to determine the direction of ice movement.

Answer

Two depositional features that indicate direction of ice movement may include drumlins and moraines (terminal, lateral, or medial). A drumlin is a symmetrical hill with a steep slope and gentle slope on the ends of the hill. The steep side of the hill faces the direction from which the ice advanced. All three moraines are formed from the movement of alpine (valley) glaciers. Medial and lateral moraines extend along the same (parallel) direction as ice movement. Terminal (end) moraines exist at the farthest advance of the ice sheet and positioned perpendicular to the direction of ice movement.

0.5 mark for each depositional feature.

0.5 mark for description of each feature.

Common Errors

Students

- indicated incorrect direction of ice movement in relation to drumlins.
- listed erosional features instead of depositional features (i.e. striations).

Value

4% 63.(e) Using an example for each, describe the formation of clastic / detrital and chemical sedimentary rocks.

Answer

i) clastic / detrital:
Example: sandstone, shale, conglomerate, etc.
Sediment such as pebbles, sand, silt, or clay can be lithified (compacted or cemented) to form solid sedimentary rock.

ii) chemical:
Example: limestone, gypsum, rock salt, etc.
Dissolved chemicals in solution (water) can form solid minerals by precipitating out of solution or when the water evaporates and leaves minerals behind.

1 mark for providing an example of clastic / detrital sedimentary rock.

1 mark for describing the formation of clastic / detrital sedimentary rock.

1 mark for providing an example of chemical sedimentary rock.

1 mark for describing the formation of chemical sedimentary rock.

Commentary on Response

Many students did not attempt this item.

Common Errors

Students

- related processes to formation of igneous and metamorphic rock.
- provided incorrect examples.

Value

63.(f) A pencil lead contains the mineral graphite which is composed of pure carbon. A diamond is also composed of pure carbon.

1% (i) How do their values for hardness compare on Moh's Scale?

Answer

Diamond (hardness of 10) has a higher value of hardness than graphite (hardness of 1).

2% (ii) Explain why the difference in hardness exists between diamond and graphite.

Answer

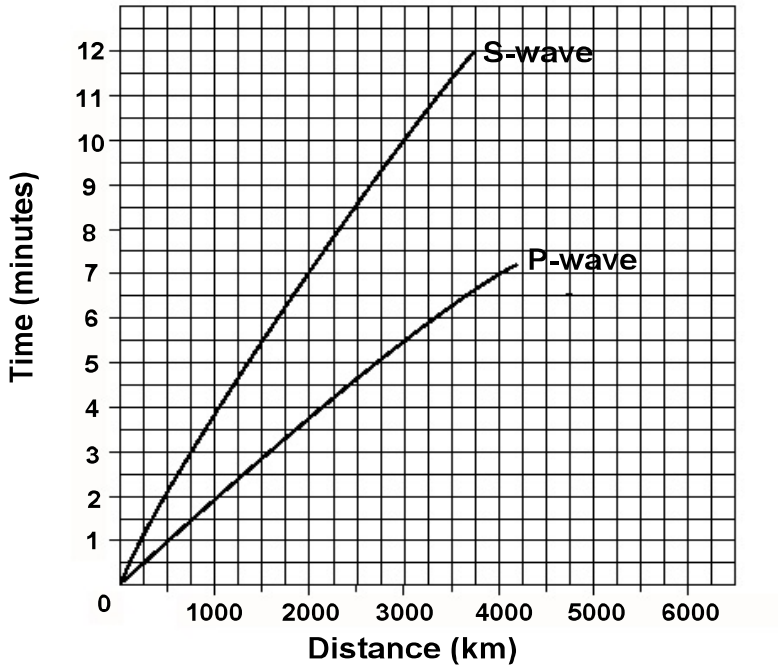
Diamond and graphite both contain carbon but have very different hardness because of the strength of bonding between carbon atoms and the arrangement of carbon atoms. The carbon atoms in diamond are arranged in a tetrahedral pattern and exhibit stronger bonding; whereas, the carbon atoms in graphite are arranged in a hexagonal layers with weak bonding between the layers. The high hardness of diamond on Moh's hardness scale in comparison to graphite is mainly due to the stronger bonding and the more stable atomic structure.

1 mark for stating diamond is harder than graphite.

2 marks for stating any of the following two; different atomic structure, different strength of bonding, different environment of formation, different presser and temperature conditions, and different history of formation.

Value

63.(g) A seismic station is known to be 3000 km away from an earthquake's epicenter.



1% (i) What is the difference in arrival time of the P and S waves?

Answer

4.5 minutes (4 minutes and 30 seconds)

1% (ii) Explain why a difference in arrival time exists between the P and S waves.

Answer

The difference in arrival times between the P-wave and the S-wave is due to the fact that P-waves travel with a greater velocity (faster) than S-waves and arrive at seismic stations faster.

2% (iii) During another earthquake, at a station located 750 km from the epicenter, the P waves arrived at 8:42:00 a.m. At what time would the first S wave arrive?

Answer

8:43:30 a.m.

Common Errors

Students

- did not know how to read the travel-time graph associated with the question.

- who displayed an understanding of the travel-time graph, misread the vertical scale. Often the vertical scale was read as one block equal to one minute; whereas, two blocks is equal to one minute.

- in part (ii), described what a P- and S-wave was and failed to see the relevance in arrival time between the two waves. Also students stated that the S-wave arrived first.

- in part (iii), failed to convert 1.5 minutes to 1:30 seconds. Also, students used the end of the graph lines for the calculations. As well, students added the answer to part (i) to 8:42:00 and arrived at an incorrect answer of 8:46:30.

Value

2% 63.(h) A company has discovered a mineral deposit and is assessing its economic potential. Many factors must be considered before the site can go into production. Describe two factors that could determine if the mine gets started.

Answer

The potential of a site to be developed into an active mine depends on a number of factors some of which include:

1) mineral mined for profit, economically feasible

2) mineral is in high demand and there is a need for the mineral

3) mine site meets all environmental criteria, environmental impact study completed on the site

4) location

5) cost of operation

6) availability of skilled work force

Common Errors

Students

- discussed question in relation to oil and not minerals.

Value

2% 64.(a) A caribou dies and is laying on the edge of a river. Describe two conditions that favour the preservation of the remains of this specimen.

Answer

Preservation of an organism is greatly increased when certain conditions are met. The organism has hard body parts and is buried rapidly by sediment. The absence of scavengers and microbes along with an environment which is low in oxygen also promotes the preservation of organisms. In a cold environment, the caribou could also be preserved (frozen) in snow and ice.

2 marks for stating any two of the following: rapid burial, hard body parts, preservation (freezing), and low oxygen environment.

Common Errors

Students

- failed to reference two conditions. Few students made reference to rapid burial of organism.

- described methods of fossilization, such as, cast & mold, petrification, etc.

Value

2% 64.(b) A current theory that explains the mass extinction at the end of the Mesozoic era involves the impact of a meteorite with Earth. Describe two resulting environmental changes that led to this extinction.

Answer

The impact of the meteorite with Earth would cause a large explosion upon impact and cause dust and rock particles to be blasted into the upper atmosphere. This dust would be circulated around the world and cause the sun's energy to be blocked resulting in the lowering of global temperatures for a period of years. Dust in the atmosphere would also increase cloud formation, cause heavy rains, and promote acid rain as the composition of the atmosphere is altered. As a result of less sunlight reaching the Earth's surface, plants would die out and the food chain would collapse. This would increase carbon dioxide levels in the atmosphere over time. Carbon dioxide is known as a green house gas which promotes global warming.

Common Errors

Students

- explained how extinction occurred with no reference to change in climate.

- generally failed to discuss resulting environmental changes.

Value

2% (c) Advancements in Global Positioning Systems, Computer Mapping and Satellite Imagery have permitted geoscientists to examine Earth in great detail. Briefly describe two benefits of these advancements to society.

Answer

The introduction of various technologies have benefitted geoscientist to examine Earth in the following ways;

1) GPS provides highly accurate reading to measure the motion of tectonic plates.

2) Satellite imagery and computerized mapping have improved geologic mapping techniques. More detailed topographic maps, aerial photographs, and mapping of the ocean floor.

3) Technologies may also benefit society by providing an early warning system for natural phenomena as tsunami's, earthquakes, and volcanic activity.

Common Errors

Students

- related GPS to finding / locating lost persons /ships.
- talked about space and planets.
- failed to relate technologies to "examining Earth."

Earth Systems 3209
Item Analysis
Multiple Choice (Part I)

Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
1	D	8.1	26.3	12.7	52.8
2	D	0.1	0.9	1.6	97.4
3	B	19.3	67.5	5.3	7.7
4	B	3.8	84.7	7.3	4.1
5	D	10.4	0.8	16.8	72
6	D	3.9	13.4	10.2	72.5
7	D	30.2	2.3	7.1	60.1
8	A	89.1	3.1	6	1.7
9	B	13.5	74.3	5.7	6.5
10	C	18.4	5.7	75.3	0.6
11	A	80.3	11.6	6	2.2
12	B	6.8	79.4	9.6	4.2
13	B	7.3	88.7	2.5	1.4
14	B	22.5	64.4	5.3	7.7
15	A	76.7	5.8	9.2	8.4
16	B	23	64.5	11.8	0.7
17	D	14	14.5	13.2	58.4
18	D	14.1	5.3	3.6	77.1
19	C	6.4	20.5	65	8.1
20	A	62.7	7.8	1.8	27.6
21	D	14.1	20.6	7	58.4

Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
22	C	3.8	6.3	68.3	21.5
23	B	19.5	37.1	19.6	23.9
24	B	11.2	47	13.2	28.4
25	A	43.9	23	22	11.1
26	A	73.7	2.8	6.5	17.1
27	B	24.4	47.5	11	16.9
28	C	5.4	3.6	84.8	6.2
29	A	68.1	13.7	7.1	11.1
30	B	8.2	67.5	7.2	17.1
31	D	1.4	12	20.7	65.9
32	A	67.2	10.5	20.5	1.8
33	B	4.7	87	3.8	4.6
34	A	66.9	5.4	11.7	16
35	D	4.7	2.6	25.9	66.8
36	A	61.4	25.6	6.8	6.1
37	A	63	27	3.3	6.6
38	C	14.3	7.2	68.2	10.3
39	D	2.8	7	10.4	79.9
40	A	73.5	15.5	2.9	8.2
41	C	20.5	18.8	26.2	34.3
42	C	6.5	6	75.3	12.2

Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
43	A	58.9	14.8	2.4	23.7
44	B	16.1	61.7	15.7	6.5
45	D	5.8	8.6	8.2	77.4
46	A	55.6	16	23	5.3
47	A	59.6	11.1	10	19.2
48	A	43.4	21.6	13.6	21.4
49	A	62.8	24.9	6.1	6.1
50	A	51.5	18.1	19.6	10.5
51	A	61.1	13.4	13.5	12
52	D	7.2	8.5	3.1	81.1
53	B	8	80.4	4.1	7.4
54	C	9.4	12.4	56	22.3
55	B	17.3	54.1	17.2	11.2
56	A	84.6	8.6	0.8	5.8
57	A	60	3.3	19.3	17.2
58	A	93.9	2.6	2.2	1.1
59	B	2.1	90.3	5	2.5
60	C	9.5	14	67.5	8.9

NOTE: Percentages may not add to 100% due to multiple answers or missing values.

Earth Systems 3209
Item Analysis
Constructed Response (Part II)

Item	Students Completing Item	Value	Average
61.(a)	874	2%	1.2
61.(b)	874	2%	1.2
62.(a)	874	2%	0.9
62.(b)	874	2%	0.6
63.(a)(i)	874	3%	1.3
63.(a)(ii)	874	3%	0.5
63.(b)	874	2%	1.6
63.(c)	874	3%	0.5
63.(d)	874	2%	0.8
63.(ei)	874	2%	0.8
63. (eii)	874	2%	0.5
63.(f)	874	3%	2.4
63.(g)	874	4%	1.9
63.(h)	874	2%	1.5
64.(a)	874	2%	0.7
64.(b)	874	2%	1.1
64.(c)	874	2%	1.1