

**Earth Systems 3209  
Grading Standards  
June 2005**

**Pre-Marking Appraisal**

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The June 2005 Earth Systems exam was considered a fair exam, well designed, and reasonable in length and difficulty

Notes on particular questions:

Following discussions between marking board members two answers were accepted for the following questions:

- #26: B and D were accepted.  
This decision was arrived at after discussion and with reference to the chart in the curriculum guide on page AB-23.
- #28: A and D were accepted.
- #35: A and B were accepted.  
This decision was arrived at after discussion and with reference to both the text (page 174), and other sources.

Other notes:

- #41: It was noted that the heading (arrow at the top) was reversed and should have read; “oldest → youngest and not youngest → oldest.” Because of this, this question was dropped from the exam and was not be included in determination of student marks.
- #45: It was noted that, line “X” in the diagram included both an angular unconformity and a nonconformity. After discussions with associate markers it was decided to accept answers A and D to be correct.
- #63(c)(i) After discussion with associate markers some concern was expressed as to the overall look of the diagram. With this in mind it was decided to accept both ocean - continent and ocean - ocean convergent boundaries as correct answers.

**Chief Markers Response:**

Although the questions were considered very fair, there were questions that a significant percentage of students omitted, these include 63 (b), 63 (d), and 63 (f ) part (iii).

## **Post Marking Report:**

### **Marking Standard and Consistency**

Marker reliability was checked by obtaining a random sample of 50 papers that went through the marker panel and marks were assigned to each question on a separate sheet of paper. The 50 exams were put back into the original stack of exams and corrected again when they appeared. The two values were compared and if there were discrepancies, the chief marker would review the scoring with the individual marker.

Throughout the marking process there were statistical analysis ran on item data to enhance reliability and consistency of marking.

**PART II**  
**Total Value: 40%**

**Value**

3%

61. The half life of uranium-235 is 713 million years. If a sample had 256 g of uranium-235 originally, how many grams of the parent material would remain after 2139 million years have passed? Show all workings.

Determine the number of half-lives.

$$“N” = \frac{\text{age of rock sample}}{\# \text{ of years per half-life}} = \frac{2139 \text{ million years}}{713 \text{ million years}} = 3 \text{ half lives}$$

**OR:**

*713 million years + 713 million years + 713 million years = 2139 million years.  
Thus, the sample went through 3 half-lives.*

Calculate the amount of parent material remaining. (1 mark)

$$\frac{\text{amount remaining}}{\text{original amount}} = \frac{1}{2^N}$$

$$\frac{\text{amount remaining}}{256 \text{ g}} = \frac{1}{2^3}$$

$$\frac{\text{amount remaining}}{256 \text{ g}} = \frac{1}{8}$$

$$\text{amount remaining} = \frac{256 \text{ g} \times 1}{8} = 32 \text{ g}$$

**OR:**

$$256 \text{ g} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 32 \text{ g}$$

**OR:**

$$256 \text{ g} \rightarrow 128 \text{ g} \rightarrow 64 \text{ g} \rightarrow 32 \text{ g}$$

(1 mark) *Answer is 32 g*

**Commentary on Response:**

The question was well done.

**Common Errors:**

- None noted.

**Value**

- 2% 62.(a) Explain how the composition of Earth's original atmosphere is different from its present composition.

**Answer:**

*Earth's original atmosphere is different from its present composition in a number of different ways. The original atmosphere contained high percentages of  $H_2O(g)$  and  $CO_2(g)$ , and other gases. Free  $O_2(g)$  was not available. Earth's present atmosphere contains high percentages of  $N_2(g)$  and trace gases such as  $Ar(g)$  and  $O_3(g)$ .*

(1 mark) *Description of the original atmosphere may include no free oxygen, high percentages of  $H_2O$  and  $CO_2$ , and other gases like methane.*

(1 mark) *Description of the present atmosphere may include higher percentages of nitrogen and free oxygen, lower percentages of  $CO_2$ , and the introduction of trace gases like argon and ozone.*

**Commentary on Response:**

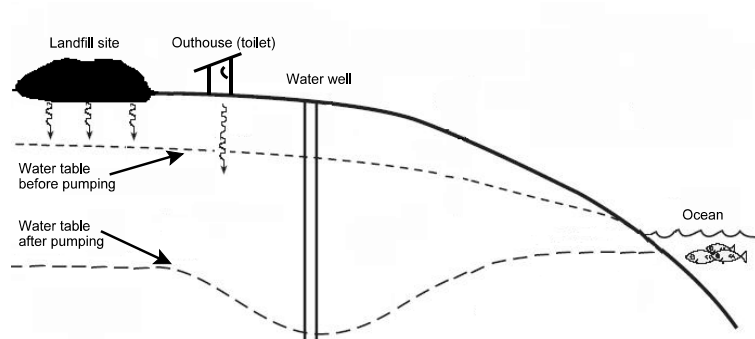
The question was fairly well done.

**Common Errors:**

- Students explained how the atmosphere changed from its original to present state

Value

3% 62.(b) The diagram below shows the underground view of a water well.



- (i) Describe two factors that would decrease the quality of this well water. (1 mark for any two descriptions)

*The quality of the well water would be decreased if there was leakage from the landfill or from the outhouse. It could also be decreased if ocean water leaked back into the area.*

- (ii) What could be done to prevent contamination of the water supply in the diagram above? (1 mark)

*Contamination of the water supply could be prevented by moving the landfill away from well*

*Other acceptable responses include:*

- *limiting the amount of dumping*
- *lining the landfill*
- *moving the well*
- *other reasonable responses.*

### Commentary on Response:

This question was very well done.

### Common Errors:

- Students referred to the over use of the well resulting in a drying up of the water supply.
- Students suggested that the well be placed up the hill from the landfill or outhouse. This needs more explanation as contaminated water may have been able to reach the well due to the cone of depression.
- Students referred to “placing the well upstream” where no stream seems to exit.

**Value**

- 3% 63.(a) Describe three pieces of geologic evidence that could be used to prove that two continents were once joined together.  
(½ mark for each piece of evidence and ½ mark for each description)

*Evidence could include any of the following:*

- *Fit of the continents*  
*Outlines of neighbouring continents appear to match if put back side by side. Continental shelves are the best areas to correlate because they are exposed to little erosion.*
- *Fossil correlation*  
*fossils (eg. Mesosaurus) are similar on neighbouring continents.*
- *Paleoclimatic evidence*  
*climatic features, such glacial deposits and coal deposits can be matched on separate continents when put back side by side.*
- *Mountain and rock type correlation*  
*the type of rock and mountain ranges appear to be continuous if continents are put back side by side.*
- *Seafloor spreading*  
*age of ocean rocks as they approach neighbouring continents are the same age.*
- *Paleomagnetic evidence*  
*magnetic pattern on opposite sides of a ridge are similar as they approach neighbouring continents.*

**Commentary on Response:**

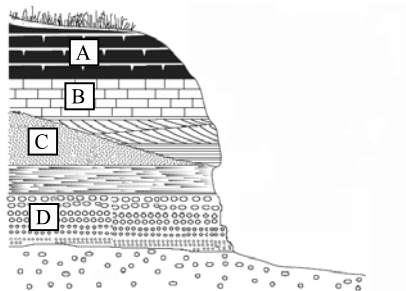
Students performed very well on this question.

**Common Errors:**

- Students explained the paleoclimatic idea, but failed to link it to why it provides evidence to support why continents were once joined.
- Students gave only two pieces of geologic evidence.
- Students did not connect between two continents being joined together. (e.g., coal beds in extreme Northern locations, linking them to tropical climate origins; lack of growth rings on trees in Northern locations.).

**Value**

- 2% 63.(b) The cross-section below shows a cliff face with sedimentary layers A, B, C, and D. Which layer has most likely been overturned? Explain.



(1 mark) *Layer D*

(1 mark) *This layer is overturned because the gravity normally causes coarse sediment to deposit first and grades to fine sediment near the top. In the diagram above, the opposite is seen with respect to the grading of sediment, fine on the bottom and coarse near the top.*

**Commentary on Response:**

- Many students did not attempt the question.

**Common Errors:**

- Students stated layer C because a fault was present in layer C.
- Students stated layer C because it was deposited at an angle.
- Students stated that the larger crystals should have been lower and the smaller crystals higher in the sequence due to cooling rates.

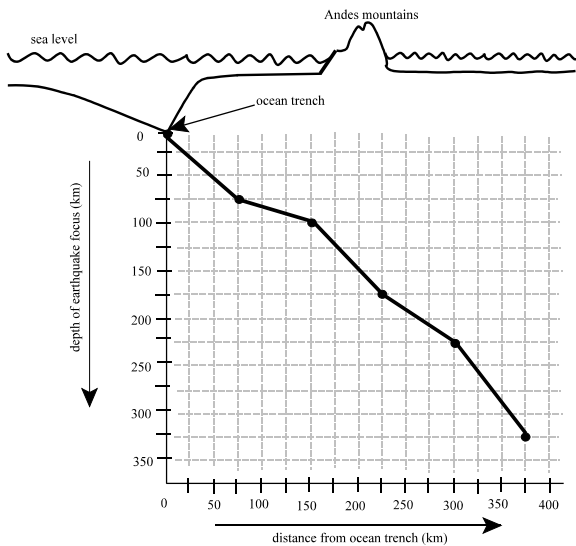
**Value**

- 4% 63.(c) Earthquakes occurred in a deep ocean trench that runs parallel to the west coast of South America. The table below shows the earthquakes' distance from the ocean trench and the depth.

Distance from Ocean Trench (km)	Depth of Earthquake Focus (km)
0	0
75	75
150	100
225	175
300	250
375	325

(1 mark)

- (i) On the grid below, plot the values from the table and draw a line to show the relationship between the distance from the ocean trench and the depth of earthquake focus. (See graph below)



(3 marks)

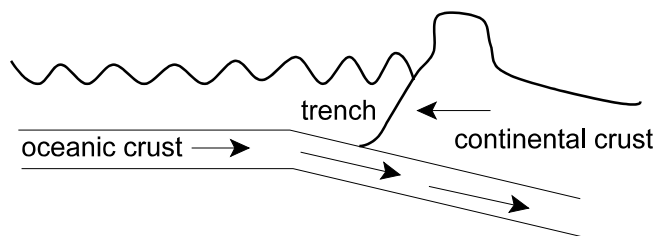
- (ii) Draw a labelled diagram of this boundary. Indicate the type of boundary, corresponding crustal plates and direction of motion arrows.

**Type of boundary:**

(1 mark)

*Oceanic - continental convergent boundary, or;  
Ocean - ocean convergent boundary was also accepted  
because the diagram in part (i) may be confused with a  
volcanic island.*

(2 marks)



**Commentary on Response:**

This question was poorly done .

**Common Errors:**

- Students plotted the first point (0,0) at (0,3.75) causing errors on the graph.
- Students confused divergent with convergent and therefore, labelled diagram incorrectly.
- Students omitted labels from diagram.



**Value**

2% 63.(d) For earthquake A, the arrival time between the P and S waves is 4 minutes. For earthquake B, the arrival time between the P and S waves is 7 minutes. Which earthquake is furthest from the seismic station? Justify your answer.

(1 mark) *Earthquake B*

(1 mark) *P-waves travel faster than s-waves. Thus, the greater the interval between the arrival time between the P and S waves the further the earthquake is away.*

**Commentary on Response:**

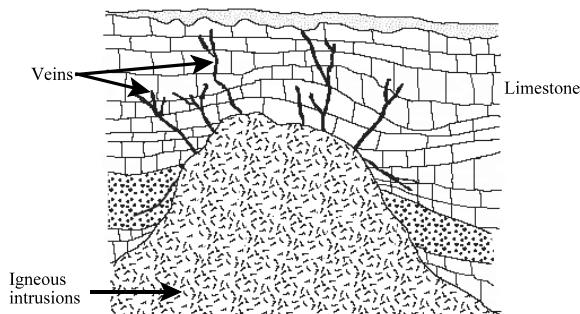
This question was well done.

**Common Errors:**

- Students did not identify two different rates of speed for P & S waves.

**Value**

3% 63.(e) The diagram below shows a section through an igneous intrusion containing veins with copper mineralization.



(i) Describe the method by which copper became concentrated in the veins?

(1 mark) *Copper was concentrated by hydrothermal activity.*

(1 mark) *Hot copper rich fluids moved through the surrounding rock and as the fluids cooled minerals rich in copper were precipitated.*

(ii) Name one other metal that could be concentrated in a similar way.

(1 mark) *either one of the following: gold, lead, zinc, silver*

### Commentary on Response:

Part (i) This question has been poorly done.

Part (ii) This was done well, most students chose base metals.

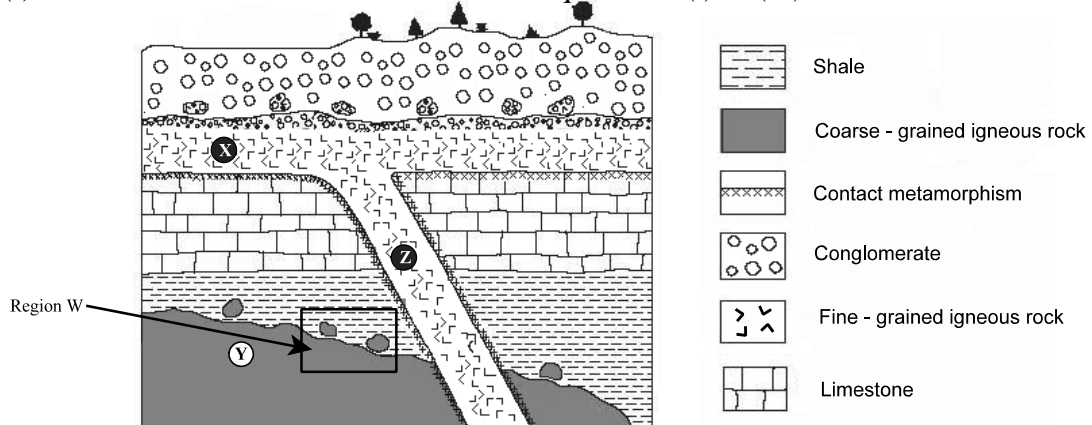
### Common Errors:

Part (i) Students stated that molten copper or magma was deposited in the veins leaving copper.

Part (ii) Students answered with aluminum.

### Value

6% 63.(f) Use the cross-section below to answer questions (i) to (iii).



- (i) What relative dating principle is indicated in region W? Explain how this indicates that the contact between rock unit Y and the shale is an erosion surface.

(1 mark) *The relative dating principle indicated in region W is the principal of inclusion.*

(1 mark) *As rock unit "Y" is eroded, pieces of "Y" are eroded and included in the shale. Also, the irregular boundary between unit "Y" and the shale and the absence of contact metamorphism in the shale suggest an erosional surface between the two rock units.*

- (ii) Rock unit Z shows a difference in crystal sizes across its width. Describe a specific location where the smallest crystals would be found and explain why they would be found there.

(1 mark) *The crystals in Unit "Z" would be smallest on the outside and largest near the middle.*

(1 mark) *The smallest crystals are found near the sides because as the magma comes in contact with the host rock it cools quickly. Thus, not enough time for the crystals to form which results in a fine texture.*

- (iii) Which metamorphic rock would form at the contact between the limestone and rock unit X? Describe the change in texture that occurs to form this rock.

(1 mark) *Marble forms at the boundary between the limestone and rock unit "X".*

(1 mark) *The rock would become more coarse grained as a result of recrystallization during metamorphism.*

#### Commentary on Response:

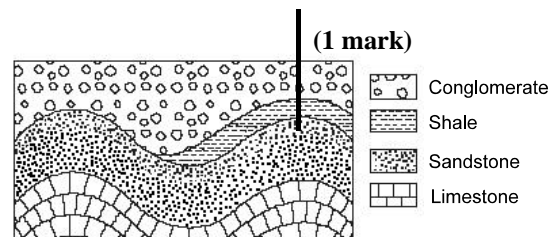
- Part (i) This item was well done.  
 Part (ii) This item was fairly well done.  
 Part (iii) This item was poorly done.

#### Common Errors:

- Part (i) Students stated that the principal of original horizontality of cross cutting relationships was evidence for the erosional surface.  
 Part (ii) Students stated that the top of the intrusion would have the smallest crystals. This is true but does not answer the question.  
 Part (iii) Students did not recognize marble as the metamorphic equivalent of limestone.

#### Value

- 3% 63.(g) Draw a line in the cross section below to represent a drill hole that would most likely strike oil or gas and give two reasons why you chose this drill site location.



- (2 marks) *To pool oil you need a structure which contains a cap rock and a reservoir rock, in this diagram the structure is an anticline. Shale is an impermeable rock and serves as a cap rock to hold the oil down. Sandstone is a porous and permeable rock and serves as a reservoir rock which stores the oil.*

### Commentary on Response:

This was done well.

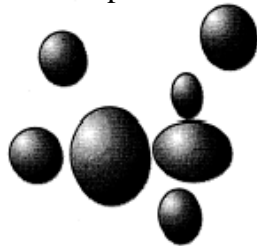
### Common Errors:

Students stated that the syncline would trap oil and the oil would sink under the water.

#### Value

2%

- 63.(h) The diagram below shows a collection of sedimentary samples. Describe the environment in which these samples were formed and explain why they are smooth and have rounded shapes.



- (1 mark) *The sedimentary samples in the diagram above would have formed in a high energy environment such as a river, beach, intertidal zone, delta, and desert.*
- (1 mark) *The sedimentary samples are extremely round and smooth which is indicative of sediment transportation in a high energy environment. The high energy environment relates to water movement, however, it could also relate to wind, which could transport sediment which in turn causes sediment samples like those above to become rounded and smooth.*

### Commentary on Response:

The question was done very well.

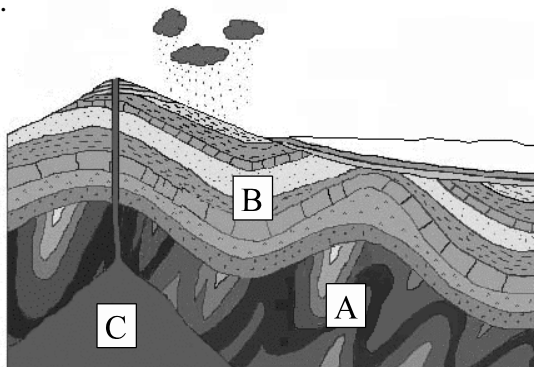
### Common Errors:

- Students referenced a deep ocean environment in their answer. A deep ocean environment is indicative of a low energy environment, which is not capable of transporting sediment in a manner that could round them as was evident in the picture.
- Students stated that the diagram represented crystals that crystallized from a magma. Since the sediment grains were relatively large, students expressed that they were crystals that cooled slowly in a plutonic/intrusive environment.

**Value**

3%

- 63.(i) What types of rock (igneous, sedimentary, or metamorphic) could form in areas A, B, and C in the diagram below? Justify your answer by describing a feature from each area in the diagram.



(½ mark for each type of rock and ½ mark for each description of the feature)

- A: *metamorphic - features include folding (bending), foliation, recrystallization, contact and regional metamorphism.*
- B: *sedimentary - features include layering, bedding, stratification, and symbols for sedimentary rocks.*
- C: *igneous - features include magma, molten rock, vent, volcano, and lava layers*

**Commentary on Response:**

This question was fairly well done. Sedimentary and metamorphic were accepted for A if it was justified with an appropriate feature.

**Common Errors:**

- Students stated C was metamorphic due to the high heat and pressure provided by the magma.
- Students stated B was metamorphic because of the layers above, which could exert great amounts of pressure and heat.
- Students stated the bottom of B was volcanic due to the presence of the volcano on top.

**Value**

4%

64. Climate patterns have changed significantly throughout Earth's history. Describe one way in which the global climate has been influenced by each of the following:

**(1 mark for each example and 1 mark for each description)**

- (i) natural phenomenon

One of the following:

*volcanoes*

*volcanic out gassing, can have a two fold effect;*

- (i) increase  $CO_2$  and  $H_2O$  cause an increase in global temperatures.*
- (ii) particulate matter ejected into the atmosphere block sunlight and cause a decrease in global temperatures.*

*photosynthesis*

*remove  $CO_2$  and global temperatures may decrease due to a reduction in greenhouse gases.*

*forest fires*

*adds  $CO_2$  and other oxides to the atmosphere (greenhouse gases) which may cause an increase in global temperatures.*

*meteorite impact*

*impact causes dust to be blown into the atmosphere which blocks out the sun and causes global temperatures to decrease.*

*cellular respiration*

*adds  $CO_2$  to the atmosphere (greenhouse gas) which may cause an increase in global temperatures.*

- (ii) human activity

One of the following:

*burning of fossil fuels*

*adds  $CO_2$  and other oxides to the atmosphere (greenhouse gases) which may cause an increase in global temperatures.*

*industrialization*

*adds  $CO_2$  and other oxides to the atmosphere (greenhouse gases) which may cause an increase in global temperatures.*

*deforestation*

*removing trees causes less photosynthesis and  $CO_2$  levels (greenhouse gas) increase in the atmosphere which may cause an increase in global temperatures.*

methane (farming)

cattle on farms release methane (greenhouse gases) which may cause an increase in global temperatures.

**Commentary on Response:**

This question was well done.

**Common Errors:**

- Students misrepresented global warming and ozone depletion.
- Students stated that volcanic dust blocks the sun causing global cooling.

**EARTH SYSTEMS 3209 ITEM ANALYSIS  
SELECTED - RESPONSE (PART I)**

Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
1	B	2.9	94.6	1.4	1.1
2	A	90.6	2.3	4.6	2.4
3	D	11.2	3.9	10.7	74
4	B	8.5	90.5	0.9	0.1
5	B	21.9	61.1	10.3	6.5
6	D	6.8	6.7	27.6	58.7
7	B	10.5	75.4	4.4	9.6
8	C	7.6	11.3	73.6	7.2
9	D	3.4	4.7	7.2	84.7
10	A	48	11.2	3.8	36.5
11	C	6	0.8	85.2	8.1
12	C	0.9	22.8	68.3	7.9
13	D	8.6	24.7	10.7	55.8
14	D	19.1	7.7	25.2	47.7
15	A	40.2	21.7	7.5	30.7
16	B	3.3	88.5	7.9	0.4
17	B	8.1	75.9	6.6	9.3
18	C	15.2	9.5	57	17.9
19	D	2.4	2.4	15.3	79.9
20	B	14.3	59.1	7.2	19
21	D	8.6	8	7	75.9
22	C	8.8	24	54.3	13.1
23	B	4.1	69.7	20.7	5.5
24	A	90.8	7.7	1.3	0.3
25	A	55.5	9.4	23.8	11.2



Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
26	B & D	3.9	27.5	10	58.4
27	D	6.6	16.6	26.6	49.7
28	A & D	22.8	6.5	7.6	62.9
29	A	75	11.2	10.5	3.3
30	A	54.8	27.9	6.5	10.9
31	D	18	25	15.2	41.7
32	B	28.9	53.5	9.8	7.6
33	D	8.1	19	26	46.8
34	B	42.6	37.9	12	7.2
35	A & B	33.6	23.1	22.8	20
36	B	9.3	80.7	7.4	2.7
37	C	10.4	2.3	80.6	6.7
38	B	8.6	63.2	4.7	22.9
39	B	1.9	80.5	2.3	15.3
40	A	55	16.9	18.3	9.6
41	ITEM OMITTED				
42	D	20.3	5.6	30.8	43.4
43	A	38.7	20.5	32.7	8
44	B	4.8	69.6	10.9	14.3
45	A & D	54.3	7.4	6.5	31.7
46	B	2	95.2	1.5	1.3
47	B	4.8	55.8	29.5	9.9
48	D	18.8	21.6	14.1	45.3
49	A	48.5	22.4	24.2	4.8
50	C	1	21.4	68.3	9.3
51	A	73.8	4.7	2.9	18.4

Item	Answer	Responses			
		A	B	C	D
		%	%	%	%
52	A	42.3	4.4	33.5	19.7
53	A	80	7	3.2	9.9
54	A	54.1	19.5	10.5	15.5
55	B	4.6	27.4	58.9	9
56	D	11.4	3.6	67.4	17.4
57	A	60.2	32.8	2.7	4.1
58	C	10.5	5.8	73.1	10.4
59	D	7	1.1	9.4	82
60	B	2.4	93.2	2.5	1.8

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	789	3	1.9
62.(a)	789	2	1.1
62.(b)	789	3	2.7
63.(a)	789	3	2.6
63.(b)	789	2	0.9
63.(c)	789	4	2.5
63.(d)	789	2	1.7
63.(e)	789	3	1
63.(f)	789	6	2.2
63.(g)	789	3	1.6
63.(h)	789	2	1.2
63.(i)	789	3	2.1
64	789	4	2.0

## Earth Systems 3209 Provincial Results June 2005

