Geology 12

August 2007 — Form A

Provincial Examination — Multiple-Choice Key

Note: The PLOs are coded using the 1995 IRP

Cognitive Processes
- **K** = Knowledge
- **U** = Understanding
- **H** = Higher Mental Processes

Question Type
- **64** = Multiple Choice (MC)
- **11** = Written Response (WR)

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Earth Materials	A, B, C, D, E, F	30%
2. Time and Fossil Record	G, H, I, J	20%
3. Internal Processes and Structures	K, L, M, N, O	30%
4. Surficial Processes	P, Q, R, S	15%
5. Comparative Planetology	T	5%

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	D	U	1	1	A6	MC
2.	A	U	1	1	B1	MC
3.	C	U	1	1	B2	MC
4.	B	U	1	1	B3	MC
5.	C	U	1	1	B3	MC
6.	B	U	1	1	B2, B3	MC
7.	D	K	1	1	C6	MC
8.	D	U	1	1	C6	MC
9.	A	U	1	1	C8	MC
10.	A	U	1	1	C2, C1	MC
11.	B	H	1	1	C3, C4	MC
12.	D	U	1	1	D2	MC
13.	C	U	1	1	E1	MC
14.	C	H	1	1	D3; E1, E5	MC
15.	D	H	1	1	E6	MC
16.	B	U	1	2	H2	MC
17.	D	H	1	2	H4	MC
18.	B	U	1	2	G3	MC
19.	B	U	1	2	I1	MC
20.	B	U	1	2	I2	MC
21.	A	H	1	2	J6	MC
22.	D	U	1	2	J4	MC
23.	C	U	1	2	J2	MC
24.	D	H	1	2	G2	MC
25.	B	U	1	2	J5	MC
26.	C	K	1	2	I1	MC
27.	B	H	1	3	O6	MC
28.	B	H	1	3	O7	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
29.	A	U	1	5	T4	MC
30.	D	U	1	2	G2	MC
31.	C	U	1	2	G5	MC
32.	D	H	1	2	H3	MC
33.	A	K	1	3	K4	MC
34.	A	K	1	3	K3, L5	MC
35.	C	U	1	3	K6	MC
36.	C	U	1	3	K7, L5	MC
37.	B	U	1	3	K8	MC
38.	C	U	1	3	L1	MC
39.	D	U	1	3	L2, L5	MC
40.	C	K	1	3	L3	MC
41.	D	U	1	3	N1	MC
42.	A	U	1	3	N3	MC
43.	D	U	1	3	N3, N2	MC
44.	D	K	1	3	O2	MC
45.	A	U	1	3	O5	MC
46.	D	U	1	3	O4	MC
47.	C	K	1	5	T3	MC
48.	A	K	1	5	T3	MC
49.	C	U	1	4	R2	MC
50.	B	K	1	4	R1	MC
51.	C	U	1	4	R1	MC
52.	A	K	1	4	R1	MC
53.	A	U	1	4	P5	MC
54.	D	U	1	4	P4	MC
55.	C	U	1	4	P2	MC
56.	D	U	1	4	P3	MC
57.	D	U	1	4	Q1	MC
58.	C	U	1	1	F1	MC
59.	B	K	1	1	F4	MC
60.	D	K	1	1	F3	MC
61.	B	U	1	1	F7	MC
62.	D	K	1	1	D4	MC
63.	C	H	1	4	Q2	MC
64.	D	U	1	4	Q4	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	–	U	2	1	B2	WR
2.	–	K	2	1	F3	WR
3.	–	U	2	1	F1	WR
4.	–	U	4	1	E1	WR
5.	–	H	3	3	O9, O6	WR
6.	–	U	3	2	G5	WR
7.	–	U	2	2	H3	WR
8.	–	U	2	3	O3, O7	WR
9.	–	U	2	4	Q1, Q2, Q3	WR
10.	–	U	2	4	S3, S4	WR
11.	–	U	2	3	K6	WR

Refer to the Percentage of Minerals in Igneous Rocks on page 7, the Properties of Common and Important Minerals table on page 9, and the Geological Map on page 13 of the Data Pages to answer question 1.

Data
Page 7
Page 9
Page 13

1. The geological map shows a hydrothermal vein that intrudes from granite into the country rock. Inside the vein, there is a rich deposit of a silvery-grey mineral that has good cleavage and a metallic lustre.

   Describe a test or observation that could be made to determine if the mineral is galena or molybdenite. Describe the expected difference in results for each of the minerals. **(2 marks)**

KEY

1 mark for description
$\frac{1}{2}$ mark for observations for each mineral

Description of test or observation used to decide if the mineral is galena or molybdenite	Difference in results of test or observation between galena and molybdenite	
	Galena	Molybdenite
Observe the number and direction of the cleavage planes	has three cleavages at 90° to each other	has one cleavage
Measure the hardness against known materials	has a hardness of 2.5	has a hardness of 1 – 1.5
Measure/estimate the relative density	has a density of 7.6	has a density of 4.7
Observe the form	has cubes	has flakes

Refer to the Geological Map on page 13 of the Data Pages to answer question 2.

Data Page 13

2. Name the metal that is obtained from galena and describe what it is used for. **(2 marks)**

KEY

One mark for each:

Name of metal: **Lead**

Description of use: **Lead is used for car batteries, solder, TV glass, ammunition, paint, fishing lines or weights, shields around radioactive material.**

Refer to the Geological Map on page 13 of the Data Pages to answer question 3.

Data Page 13

3. Describe how hydrothermal activity may produce a galena deposit. **(2 marks)**

KEY

When the granite magma cools and crystallizes, it leaves behind/concentrates a hot, water-rich (hydrothermal) solution that often contains metal sulphides such as galena. Eventually the hydrothermal liquid is injected into country rock, cools and deposits minerals such as galena. ← *2 marks*

OR

The quartz and associated galena in the veins were likely deposited from a hydrothermal solution. When a granite magma crystallizes, a concentration of hot watery fluid containing dissolved quartz and other minerals is left over. The hydrothermal solution may be injected into the surrounding country rock where it cools and the quartz and other minerals crystallize out. ← *2 marks*

Refer to the Geological Map on page 13 and Photograph 1 on page 14 of the Data Pages to answer question 4.

Data
Page 13
Page 14

4. Photograph 1 shows the Precambrian metamorphic rock shown on the geological map. The rock contains quartz, feldspar and biotite mica.

   Describe the metamorphic rock. In your description include the name of the metamorphic rock, the nature of the parent rock, the physical conditions under which it would have formed, and the type of plate tectonic boundary at which it would have formed. **(4 marks)**

KEY

The metamorphic rock is gneiss. ***(Half marks could be given for schist.)***

The sedimentary parent rock was most likely a shale, however it could have been a clay-rich siltstone or sandstone, or diorite, or granite, or conglomerate.

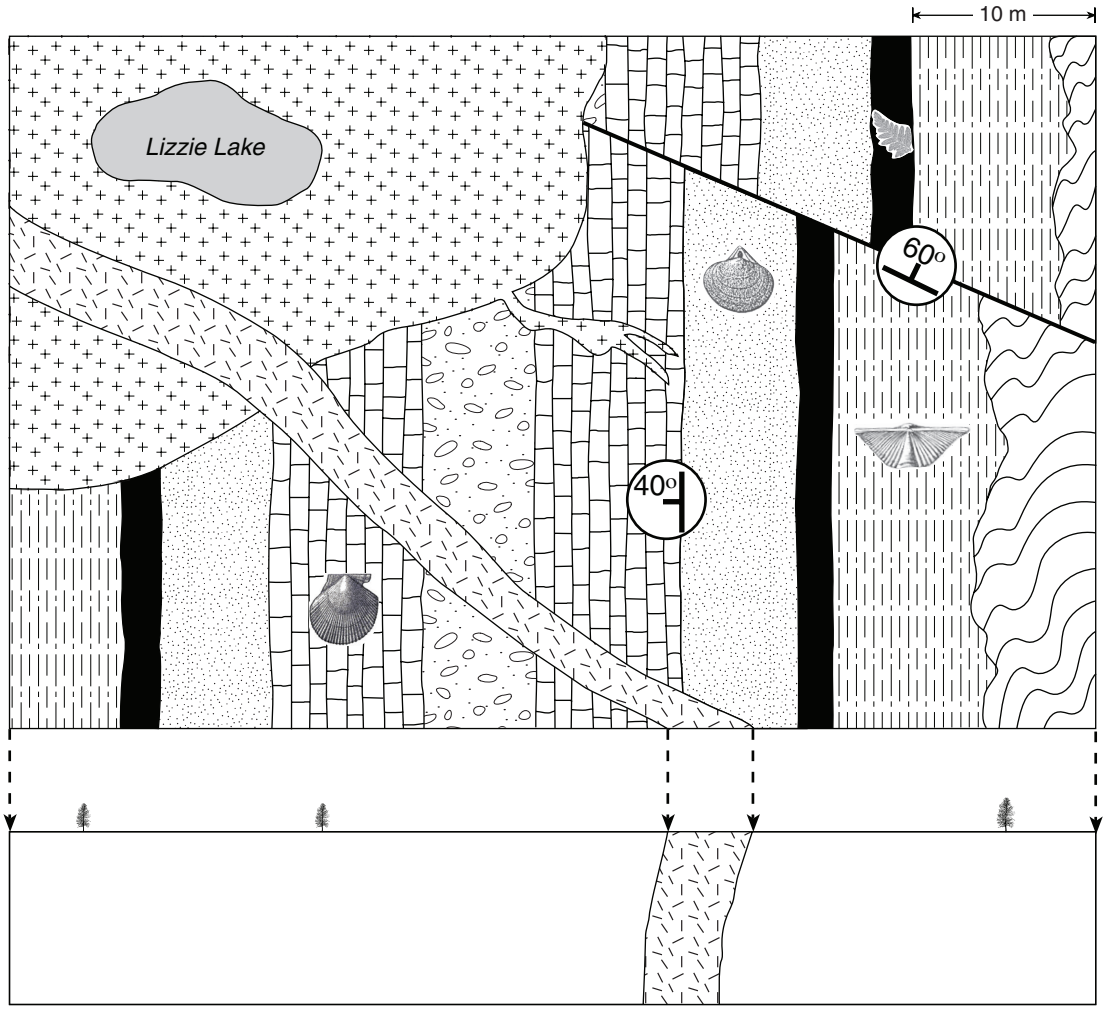
The metamorphic rock was formed at high temperatures (600-700°) and pressure conditions (25-40 km) deep within the Earth. The rock is foliated and folded and thus must also have been subjected to directed pressure.

The metamorphic rock was likely formed above a subduction zone where two tectonic plates were colliding.

Refer to the Development of Life through Time on page 3, the Geological Time Scale on page 4, and the Geological Map on page 13 of the Data Pages to answer questions 5 to 7.

Data
Page 3
Page 4
Page 13

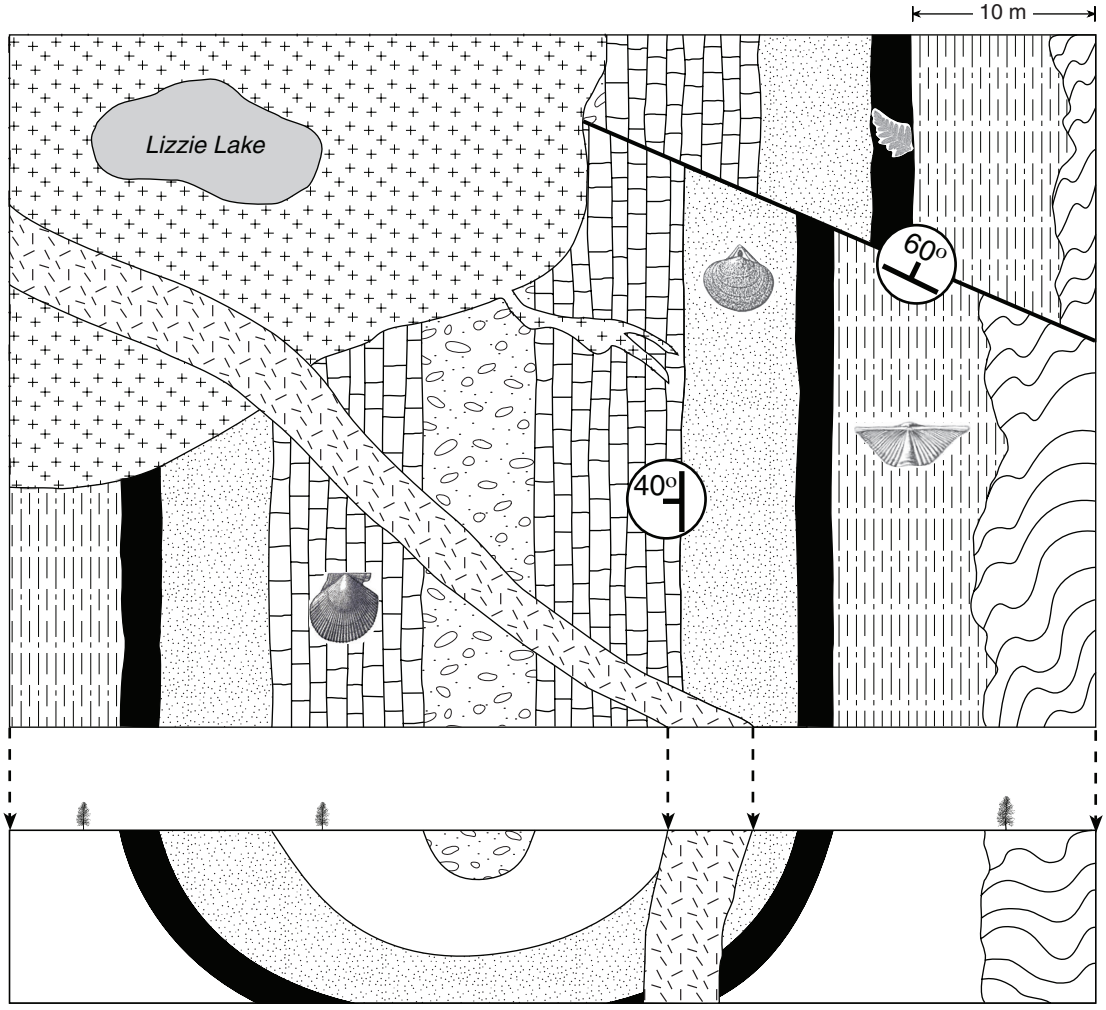
Use the following geological map from the Data Pages to answer questions 5 to 7.



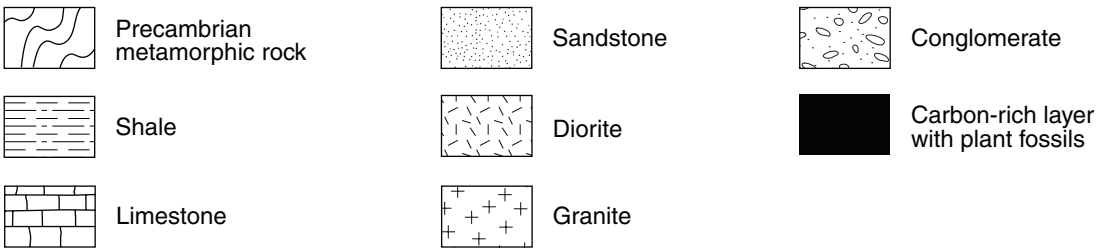
Note: The units below are arranged in random order

Precambrian metamorphic rock
Sandstone
Conglomerate
Shale
Diorite
Carbon-rich layer with plant fossils
Limestone
Granite

5. Draw an accurate cross section in the box provided below the geological map. **(3 marks)**



Note: The units below are arranged in random order



KEY

Look for: **a syncline, correctly placed contacts, uniform thickness of each layer.**
The contact between the sedimentary rock layers and the gneiss could be oriented in any direction.

6. Arrange the following features shown on the geological map in order of their relative ages. (Features are listed in random order.) **(3 marks)**

- limestone layer
- granite intrusion
- dike
- shale layer
- fold
- fault

KEY _____

1 mark for correct intrusion order
1 mark for correct faulting and folding
1 mark for correct sedimentary order

youngest	**dike**
	granite intrusion
	fault
	fold
	limestone layer
oldest	**shale layer**

7. A radiometric analysis of potassium-40/argon-40 was made on a sample of one of the rocks in this map area. Describe **two** reasons why the estimated radiometric age of the rock sample might be inaccurate. **(2 marks)**

KEY _____

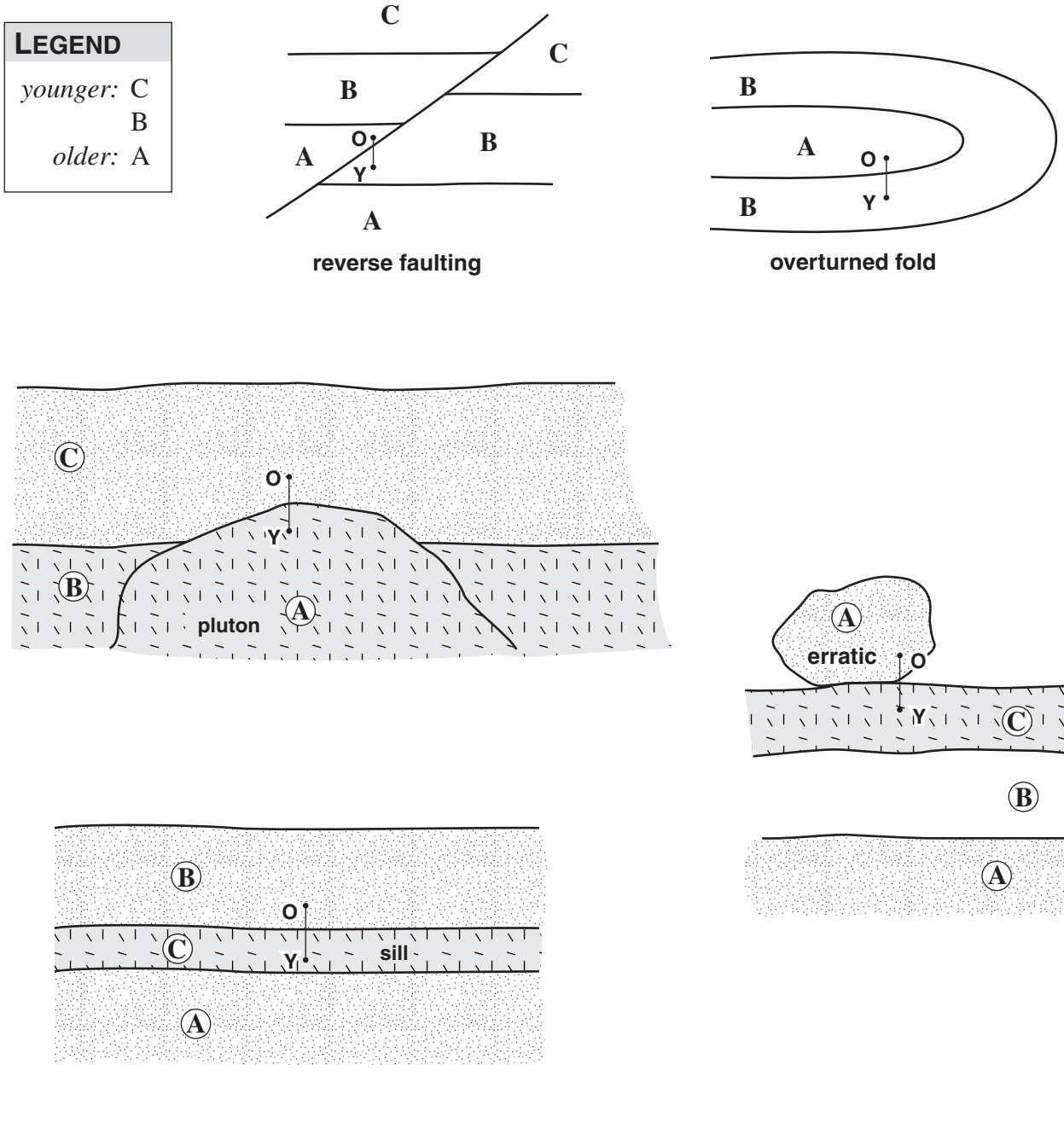
Any two for 1 mark each:

- **heating, perhaps from contact metamorphism from the dike or metamorphism of the gneiss causing a resetting of the "atomic clock"**
- **loss of contamination of parent or daughter due to weathering, leaching or diffusion of argon**
- **age of intrusive was either significantly (more or) less than the length of K40 half-life**
- **radiometric age of a sediment does not indicate the age of deposition/lithification**

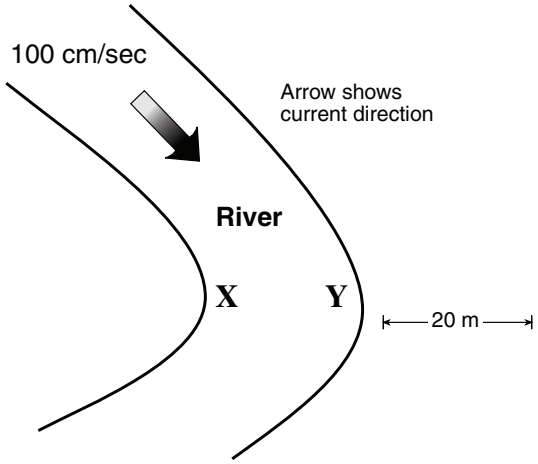
8. The principle of superposition describes a typical situation where younger rock overlies older rock. With the aid of a diagram, describe a geological process that would result in older rock overlying younger rock. **(2 marks)**

KEY _____

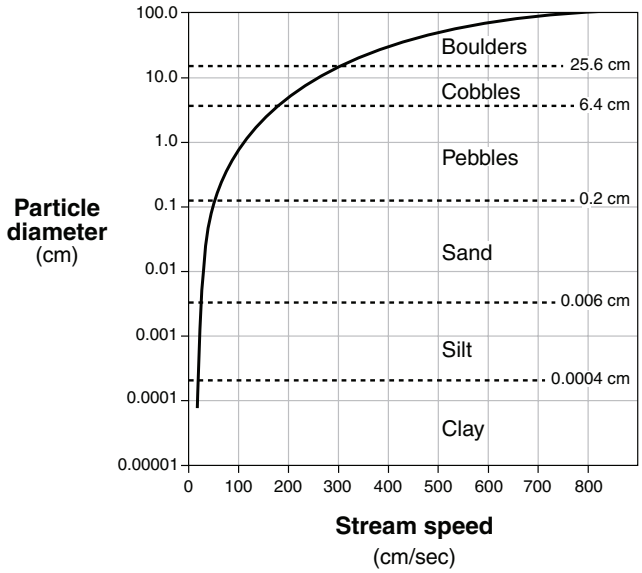
- **reverse faulting (thrust)**
- **overturned fold**
- **sill underlying a sedimentary rock**
- **pluton**
- **erratics**
- **ejecta**



Use the following diagrams to answer question 9.



Graph showing particle diameter and stream speed



9. Refer to the diagram and graph and compare the sediment load carried by the river at positions **X** and **Y**, and explain why there is a difference. **(2 marks)**

KEY _____

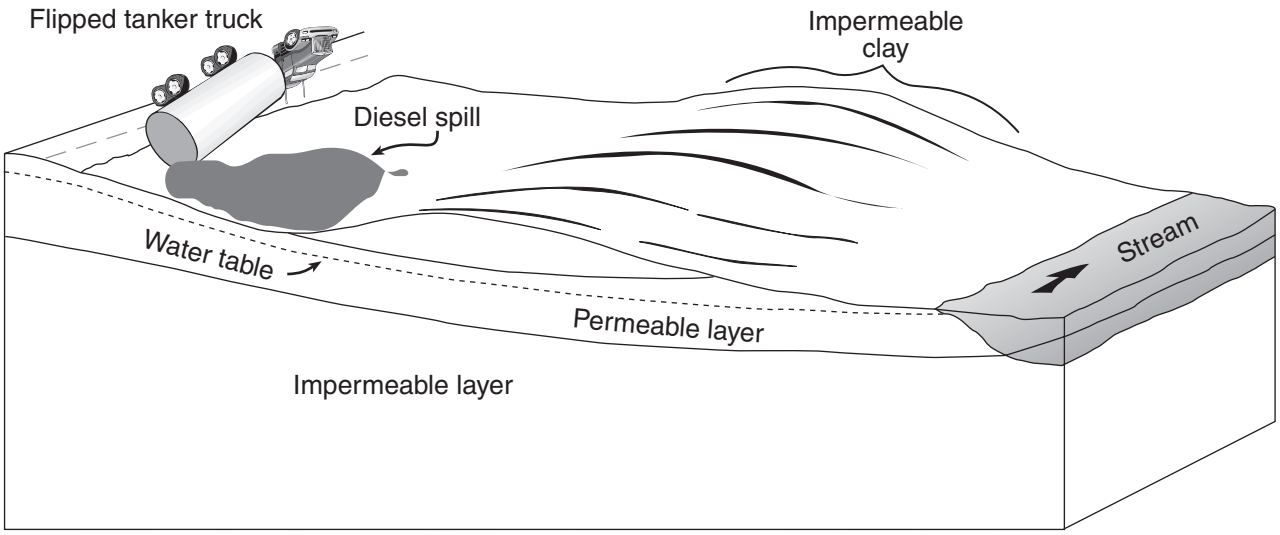
Sediment at X would be pebble-sized or smaller ***(1 mark***

OR

Sediment at Y would be cobble-sized or smaller

Explanation: **The speed at Y is greater.** ***(1 mark)***

Use the following sketch to answer question 10.



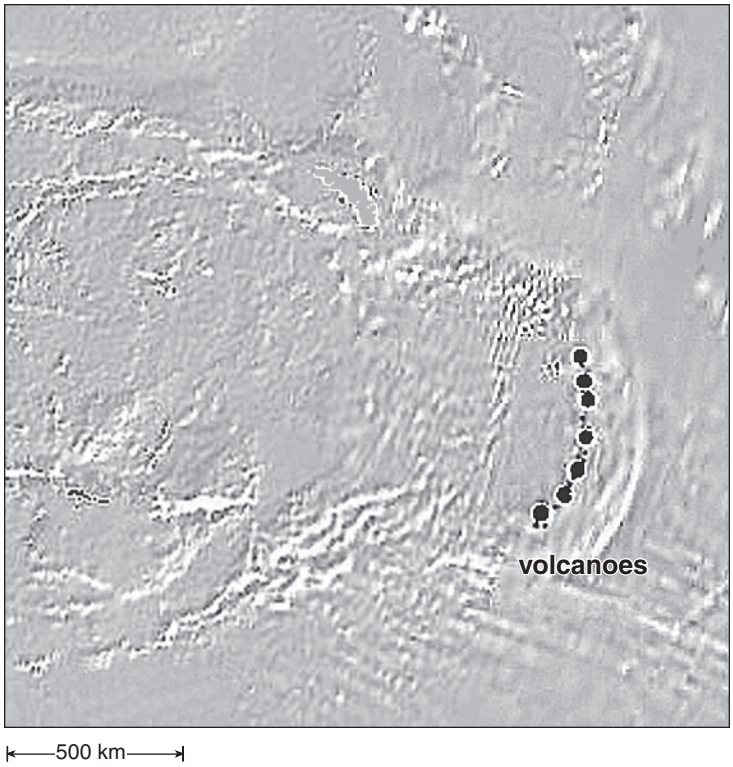
10. The sketch above shows the location of an accident with a fuel tanker. A large quantity of diesel spilled from the tanker and formed a pool against a hill of impermeable shale. In a very short time, biologists discovered fish in a nearby stream were contaminated with diesel.

    Complete a labelled cross section showing the subsurface conditions that would be necessary in order for the spilled diesel to pollute the stream. Label any permeable or impermeable layers, as well as the water table. **(2 marks)**

KEY _____

1 mark for correct layering, including water table
1 mark for correct labelling

Use the following photograph to answer question 11.



11. A spacecraft travelling to another planet returned the image seen above. A geologist identifies a chain of volcanoes from this image. With reference to plate tectonic theory, explain how these volcanoes could have formed and describe what evidence would need to be gathered by a future geological expedition to support your hypothesis. **(2 marks)**

KEY _____

How the volcanoes formed (*1 mark for any one*)	Description of evidence (*1 mark for any one*)
1. From processes at a convergent or divergent boundary	**If the ages of the volcanoes were determined, they would all be of a similar age.**
2. Volcanism at a mantle hotspot as the lithosphere is moved across the hotspot	**If the ages of the volcanoes were determined, the ages would increase progressively along the chain.**
3. The volcanoes formed at a divergent boundary	**If the type of eruptions were observed, quietly erupted plateaus composed of mafic rock would be seen.**
4. The volcanoes formed at a convergent boundary	**If the type of eruptions were observed, explosively erupted composite cone/strato volcanoes of intermediate or silicic composition would be seen.**