Short Answers

Show all set up and record answers in the spaces provided

I. Using **Figure A** – determine the slope of the stream in feet/mile from marker A to marker B. Assume a contour interval of 40 feet. Show set-up for full credit. (3 points – 1 for set up, 2 for correct answer)

Slope: _____

II. Using **Figure B** - determine the sinuosity of Sheep Creek from marker A to marker B. Show set-up for full credit.
(3 points – 1 for set up, 2 for correct answer)

Sinuosity:_____

III. GROUNDWATER CONTAMINATION (9 total points)

Background: Underlying a military base in northeastern Michigan is a shallow aquifer. The water table lies between 10 and 25 feet below the surface. A leak in a buried **storage drum** has allowed a toxic, organic liquid to enter the aquifer.

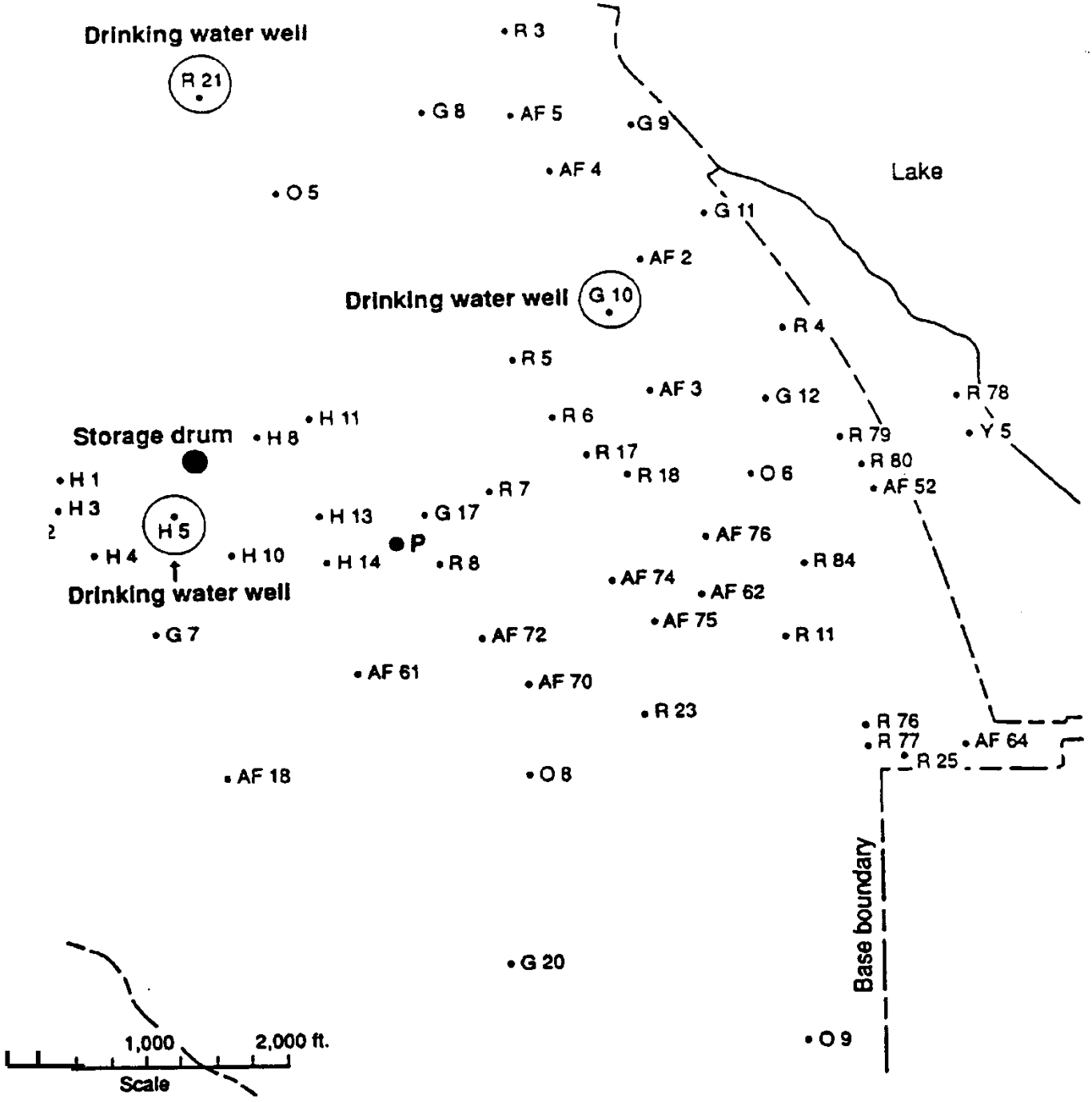
1) Using Table 1, calculate the elevation of the water table at each well.

Table 1: Ground-surface elevations and water-table depths for selected wells as the military base.

1. Well Number	2. Elevation of Well (ft*)	3. Depth to Water Table (ft)	4. Elevation of Water Table (ft)	1. Well Number	2. Elevation of Well (ft*)	3. Depth to Water Table (ft)	4. Elevation of Water Table (ft)
AF 2	613	24		H 10	619	19	
AF 3	616	24		H 11	618	19	
AF 4	614	25		H 13	618	19	
AF 5	611	22		H 14	618	19	
AF 18	617	18		O 5	616	19	
AF 52	611	20		O 6	615	23	
AF 61	619	21		O 8	615	19	
AF 62	613	20		O 9	611	19	
AF 64	611	20		R 3	609	21	
AF 70	615	18		R 4	612	23	
AF 72	615	18		R 5	615	22	
AF 74	615	20		R 6	617	24	
AF 75	615	20		R 7	617	22	
AF 76	614	21		R 8	616	20	
G 7	619	19		R 11	615	22	
G 8	616	24		R 17	617	23	
G 9	609	21		R 18	617	23	
G 10	615	26		R 21	618	20	
G 11	608	20		R 23	617	22	
G 12	614	23		R 25	613	21	
G 17	618	22		R 76	613	19	
G 20	615	20		R 77	613	20	
H 1	621	17		R 78	608	20	
H 2	621	17		R 79	614	24	
H 3	621	19		R 80	614	25	
H 4	621	19		R 84	613	21	
H 5	621	20		Y 5	608	19	
H 8	618	18					

* Elevations in feet above mean sea level.

Label the elevations on the map below and draw contour lines of the water table elevations at a contour interval of 1 foot. (5 points for correct contours and groundwater flow) **(3 points for correct contour lines)**



Analysis (1 point for set up and 1 point for correct response):

Assume a pollution plume 250' wide and less dense than water. Based on the direction of groundwater movement, which of the drinking water wells (H 5, R 21, and/or G 10) is most likely to be contaminated by the leaking storage drum?) _____

a. Determine the ***hydraulic gradient*** between the storage drum and the threatened well.

Hydraulic Gradient = _____

b. Calculate the velocity of ground water flow from the storage drum to the well in feet per day. For this Aquifer assume the ***hydraulic conductivity*** or **K = 100 feet per day and a porosity of 1**.

Answer V= _____

c. Determine how long it will take the contaminates to reach the well. (Assume no loss of contaminates by absorption.)
Give your answer in years.

Time in years= _____

Virginia Regional Science Olympiad

Division C

2012

Dynamic Planet

Name(s): _____

_____

School: _____

Team #: _____

Total Score: _____ / 75

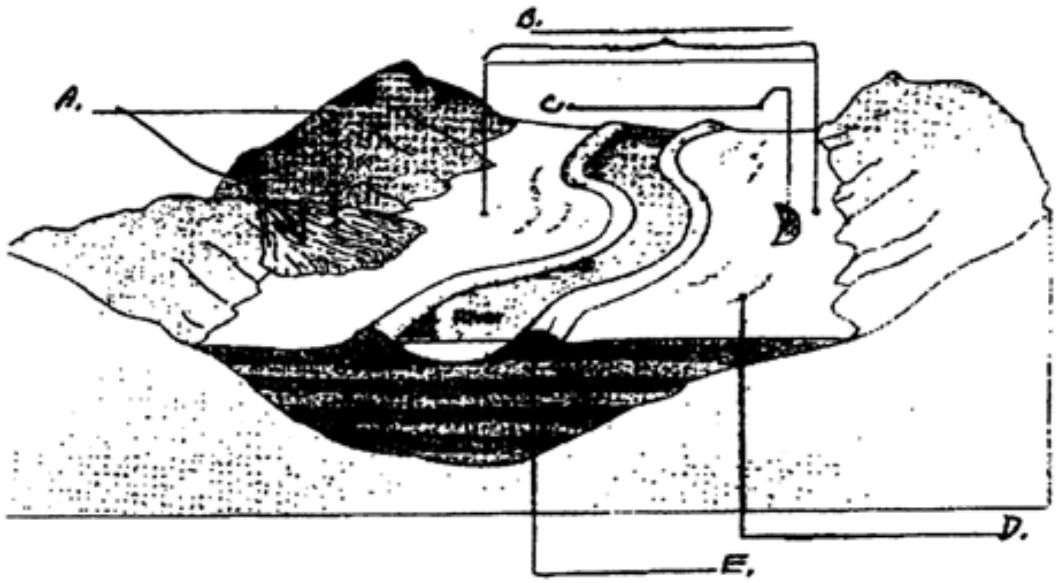
NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

Please answer questions 1-60 on the provided Answer Sheet. Assume each questions is worth 1 point unless otherwise noted. Short Answers I, II, and III should be answered on the question sheets.

Tie Breakers: #1 Short Answer III; #2 Short Answer II; #3 Short Answer I; #57; #29; #30.

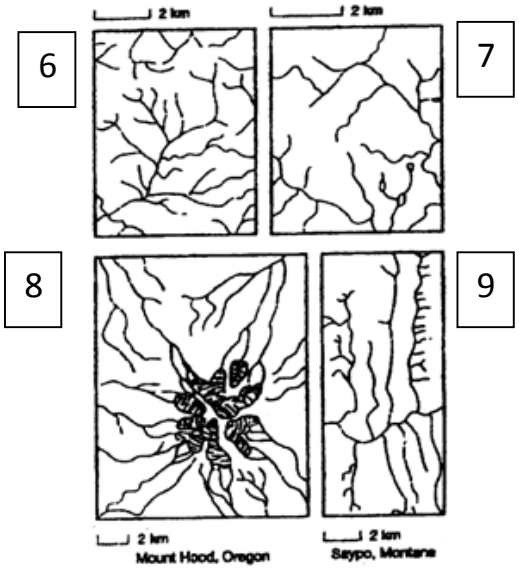
Materials provided: approximately 15" string

#1 – 5 Please identify the features on the diagram. (1 point each)



1) Feature A?
2) Feature B?
3) Feature C?
4) Feature D?
5) Feature E?

#6 -9 Identify the drainage patterns shown below (1 point each)



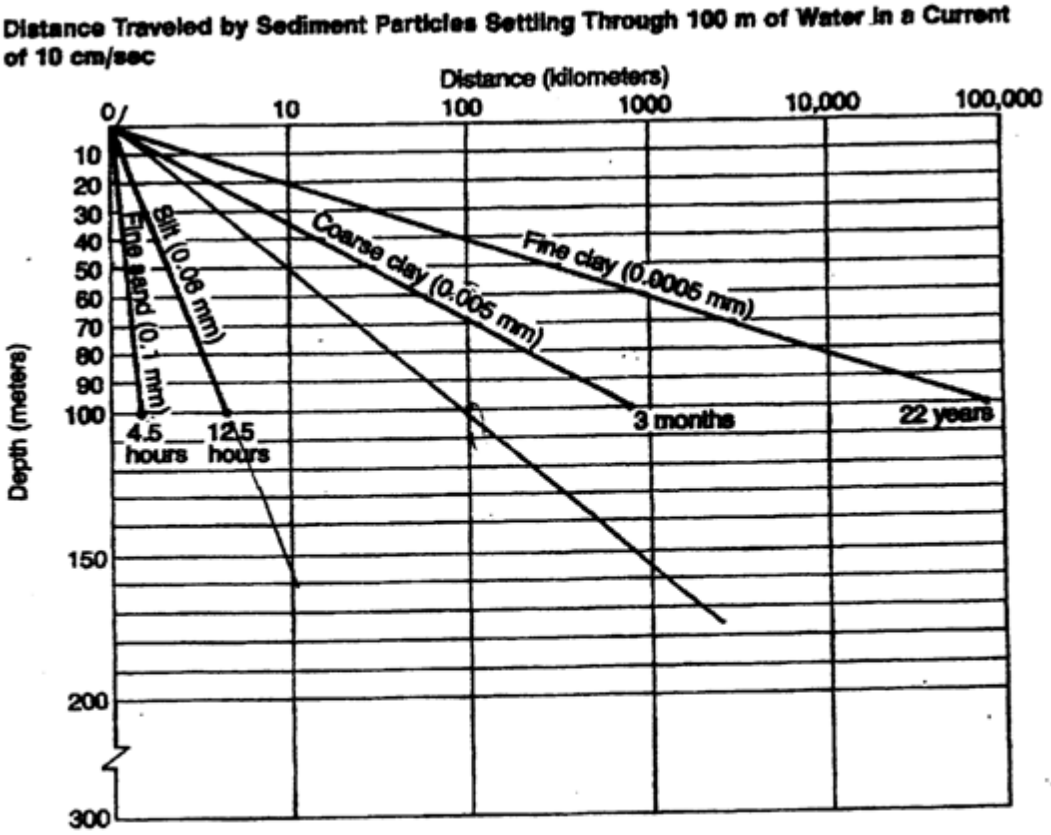
#10 – 17 Place the following steps in proper order. The first step is the answer for # 10, the second is the answer for question #11, and the final step is the answer for question #17. Please use the letters A – H for your response. (1 point each)

A. Runoff from several slopes collects in low places.
B. Rain falls to the Earth's Surface.
C. Water tumbles in broad sheets.
D. Branch gullies develop and then become tributaries.
E. A gully is formed.
F. A V-shaped valley with streams, waterfalls and rapids form.
G. Erosion lengthens the gullies.
H. The gully gets larger and collects more water.

Label the following as characteristics of a MATURE or IMMATURE river (1 point each)

18. U-shaped Valley
19. V-shaped Valley
20 Flat Land
21. Oxbow Lake
22. Waterfalls
23. Greater Turbidity
24. Meanders
25. Steep Sides
26. Greater Oxygenation

Use the following graph to answer questions 27 – 30 (1 point each)



from Prentice-Hall, Dynamic Planet, Activity Book, p. 193

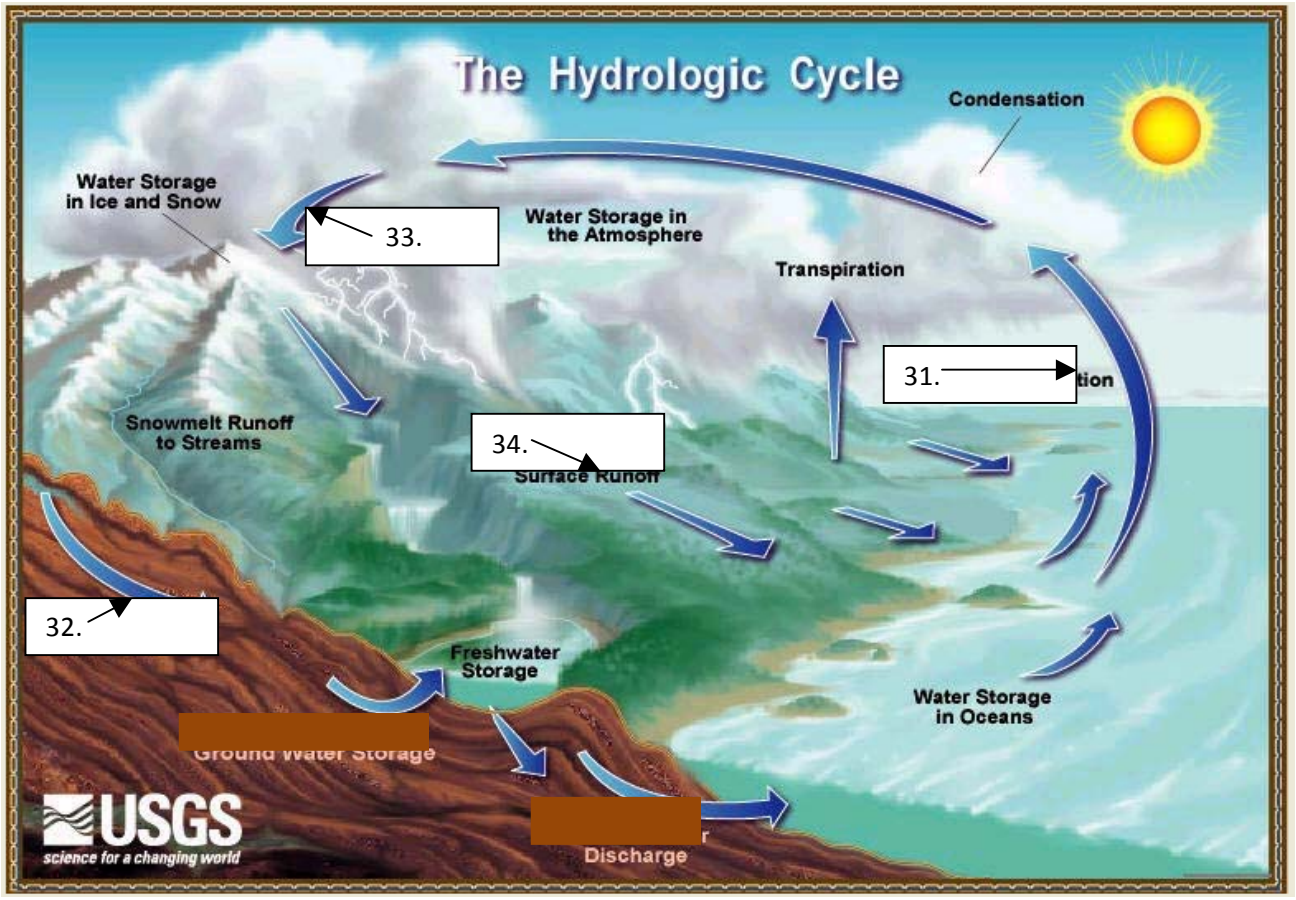
27. List the Four different sized particles in order of INCREASING rate of settling

28. How long would it take fine sand to settle to a depth of 50 meters?

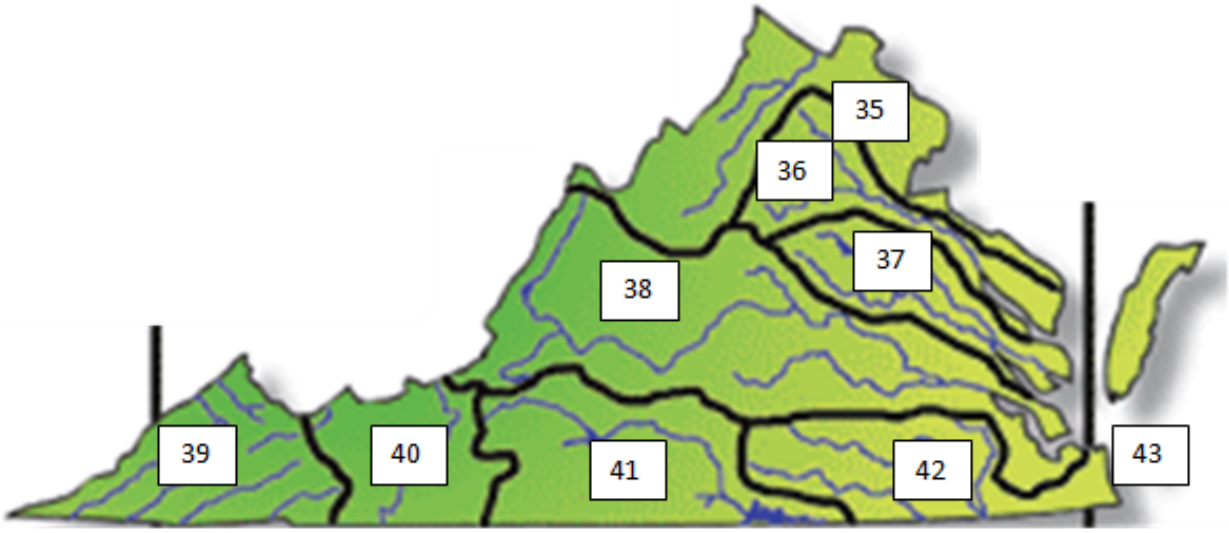
29. To what depth would a silt particle have settled by the time it had traveled 10km from shore?

30. If a particle settles to a depth of 100m and comes to rest 100km from shore, to what depth has it settled when it is 5km from shore?

31 – 34 Label the following parts of the Hydrologic Cycle (1 point each)



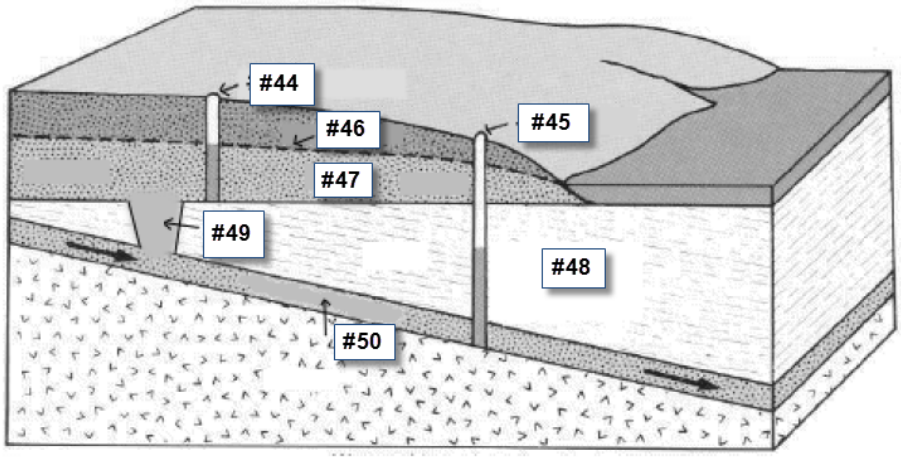
35 – 43 Name the following major watersheds in Virginia:



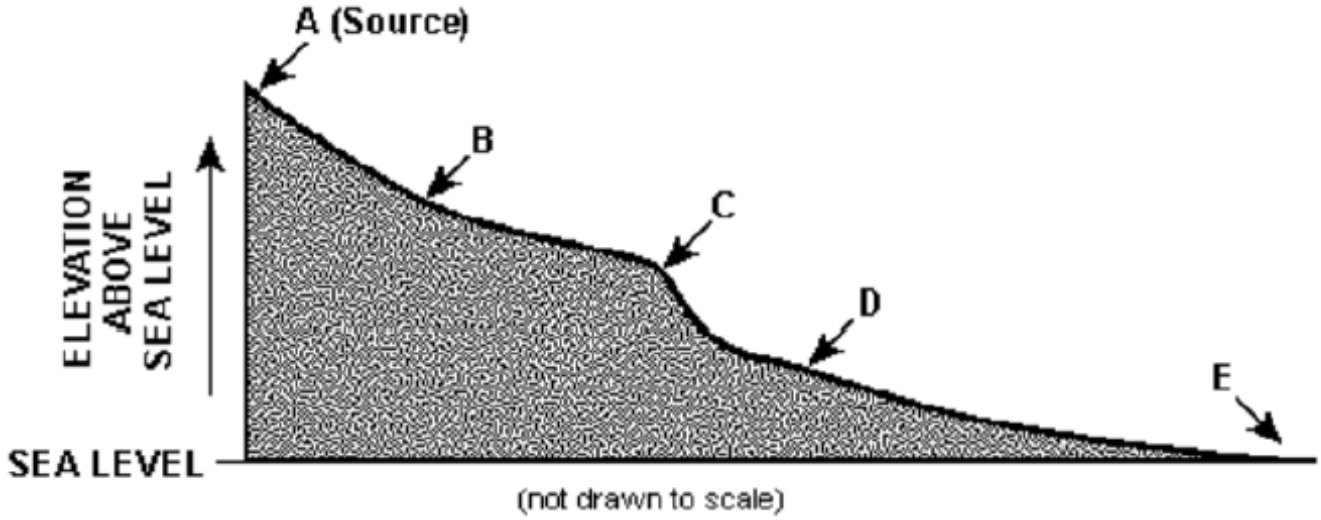
NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

#44 – 50 (1 point each)

Labeling: Label the parts of the following diagram. When naming aquifers, specify what kind it is (just "aquifer" will not be accepted).

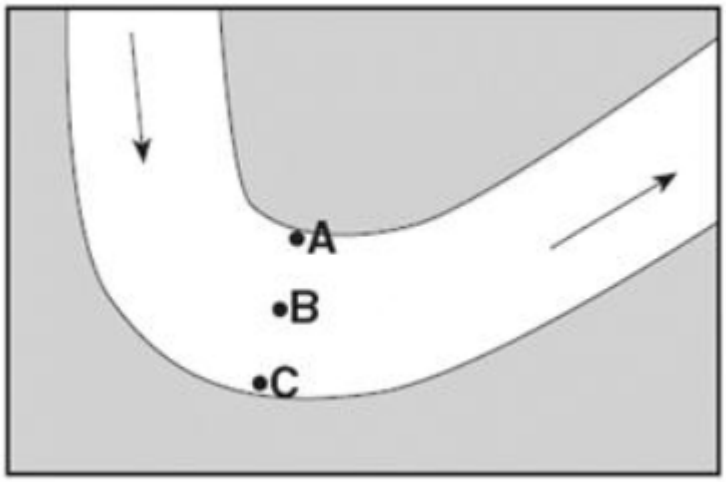


51. The diagram represents a profile of a stream. Points A through E are locations along the stream.



At which location would the amount of deposition be greatest?

52. The map below shows the bend of a large meandering stream. The arrows show the direction of stream flow. Letters A, B, and C are positions on the streambed where erosion and deposition data was collected.



Which table best represents the locations where erosion and deposition are dominant and where equilibrium exists between the two processes?

a)

	Erosion	Equilibrium	Deposition
A		✓	
B			✓
C	✓		

b)

	Erosion	Equilibrium	Deposition
A			✓
B	✓		
C		✓	

c)

	Erosion	Equilibrium	Deposition
A	✓		
B		✓	
C			✓

d)

	Erosion	Equilibrium	Deposition
A			✓
B		✓	
C	✓		

53. What kind of river channel is this?

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

54. What is the name of the largest watershed in the United States?

55. Large sinkholes have formed in parts of Florida. These holes are formed when
    a) Rivers erode away their banks
    b) Caves formed by groundwater collapse
    c) River meanders form new channels
    d) Flood waters infiltrate permeable rocks.

56. _____ are smaller streams or rivers that flow into larger ones.
    a) Divides
    b) Drainage Basins
    c) Channels
    d) Tributaries

57. What is the order of the river at the spot marked "*X*" (assume river streams follow according to the arrows) (1 point)

58. An endorheic (seepage) lake is one that is:
    a) Created by flooding land behind a dam or artificial barrier
    b) Seasonal; only exists for part of the year
    c) Formed in the caldera or crater of an inactive volcano
    d) Does not have an inlet or outlet

59. Which of the following is useful for measuring discharge?
    a) Tensiometer
    b) Lysimeter
    c) Weir
    d) Secchi disk

60. Water from a nearby lake is sample and the salt concentration is found to be 2%. Which category would it fall under?

a) Fresh water
b) Brackish water
c) Saline water
d) Briny water

Virginia Regional Science Olympiad

Division C

2012

Dynamic Planet

Answer Key for Questions 1 – 60

Name(s): _____

_____

School: _____

Team #: _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____

Score: _____/75

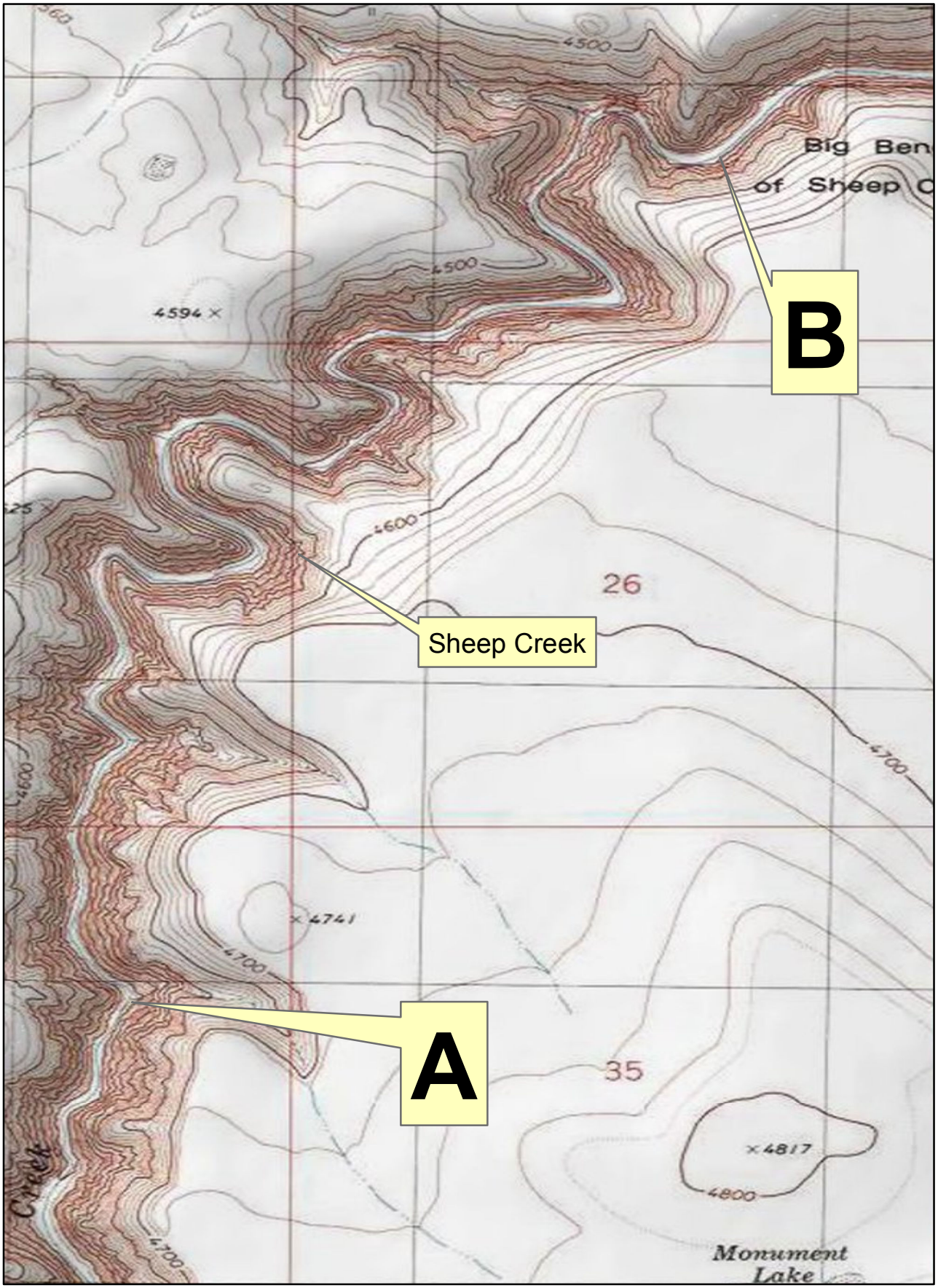
Tie Breakers (if needed)

1- Short Answer III: _____
2- Short Answer II: _____
3- Short Answer I: _____
4- 57: _____
5- 29: _____
6- 30: _____

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

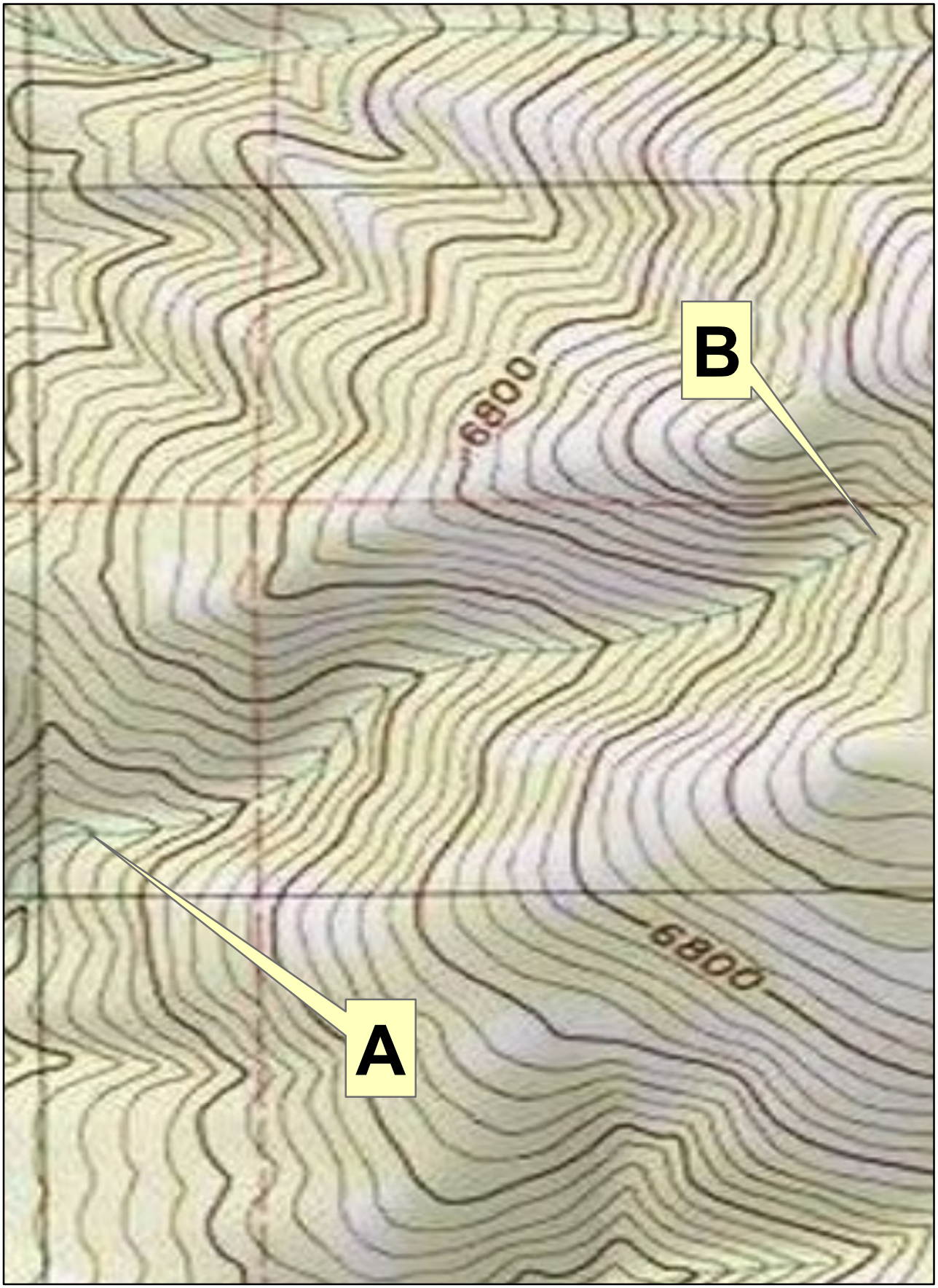
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____
35. _____
36. _____
37. _____
38. _____
39. _____
40. _____
41. _____
42. _____
43. _____
44. _____
45. _____
46. _____
47. _____
48. _____
49. _____
50. _____
51. _____
52. _____
53. _____
54. _____
55. _____
56. _____
57. _____
58. _____
59. _____
60. _____

Science Olympiad Division C
Dynamic Planet - Figure B



NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

Science Olympiad Division C
Dynamic Planet - Figure A



NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

Virginia Regional Science Olympiad

Division C

2012

Dynamic Planet

Name(s): Key

School: _____

Team #: _____

Total Score: _____ / 75

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

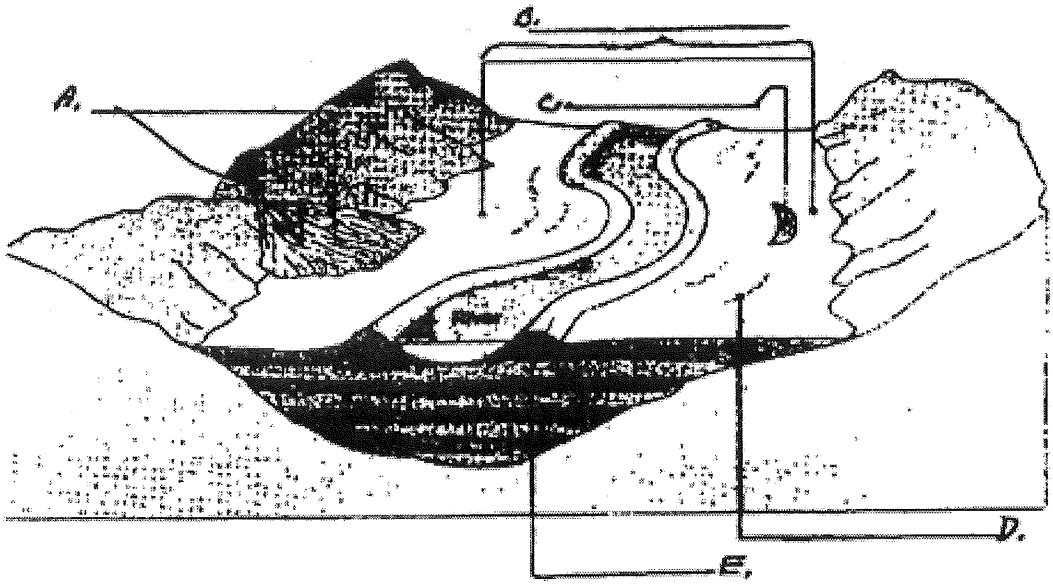
Key

Please answer questions 1-60 on the provided Answer Sheet. Assume each questions is worth 1 point unless otherwise noted. Short Answers I, II, and III should be answered on the question sheets.

Tie Breakers: #1 Short Answer III; #2 Short Answer II; #3 Short Answer I; #57; #29; #30.

Materials provided: approximately 15" string

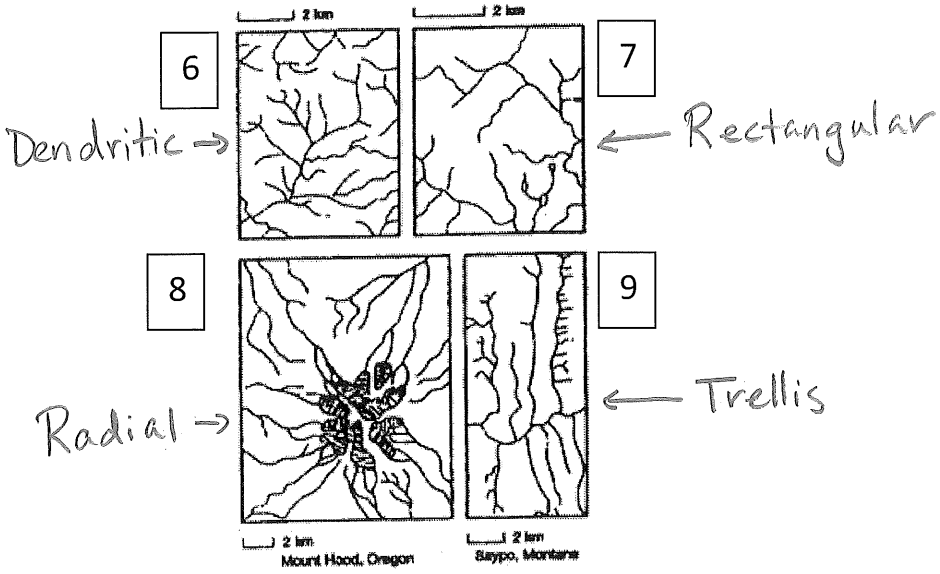
#1 – 5 Please identify the features on the diagram. (1 point each)



1) Feature A? Alluvial Fan
2) Feature B? Flood Plain
3) Feature C? Ox-bow Lake
4) Feature D? Meander Scar
5) Feature E? Levee

Key

#6 -9 Identify the drainage patterns shown below (1 point each)



#10 – 17 Place the following steps in proper order. The first step is the answer for # 10, the second is the answer for question #11, and the final step is the answer for question #17. Please use the letters A – H for your response. (1 point each)

A. Runoff from several slopes collects in low places.
B. Rain falls to the Earth's Surface.
C. Water tumbles in broad sheets.
D. Branch gullies develop and then become tributaries.
E. A gully is formed.
F. A V-shaped valley with streams, waterfalls and rapids form.
G. Erosion lengthens the gullies.
H. The gully gets larger and collects more water.

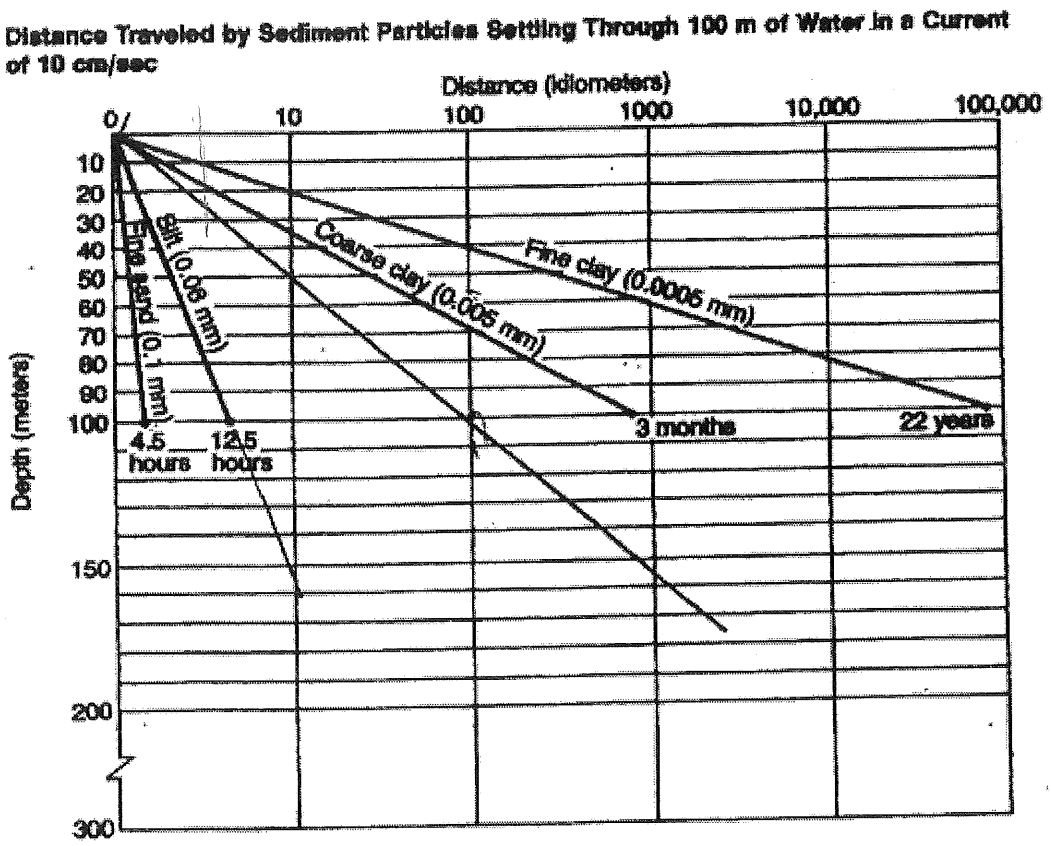
10. B
11. C
12. A
13. E
14. H
15. D
16. G
17. F

Label the following as characteristics of a MATURE or IMMATURE river (1 point each)

18. U-shaped Valley Mature
19. V-shaped Valley Immature
20 Flat Land Mature
21. Oxbow Lake Mature
22. Waterfalls Immature
23. Greater Turbidity Mature
24. Meanders Mature
25. Steep Sides Immature
26. Greater Oxygenation Immature

Key

Use the following graph to answer questions 27 – 30 (1 point each)



from Prentice-Hall, Dynamic Planet, Activity Book, p. 193

27. List the Four different sized particles in order of INCREASING rate of settling

Fine Sand, Silt, Coarse Clay, Fine Clay

28. How long would it take fine sand to settle to a depth of 50 meters?

2.25 hrs.

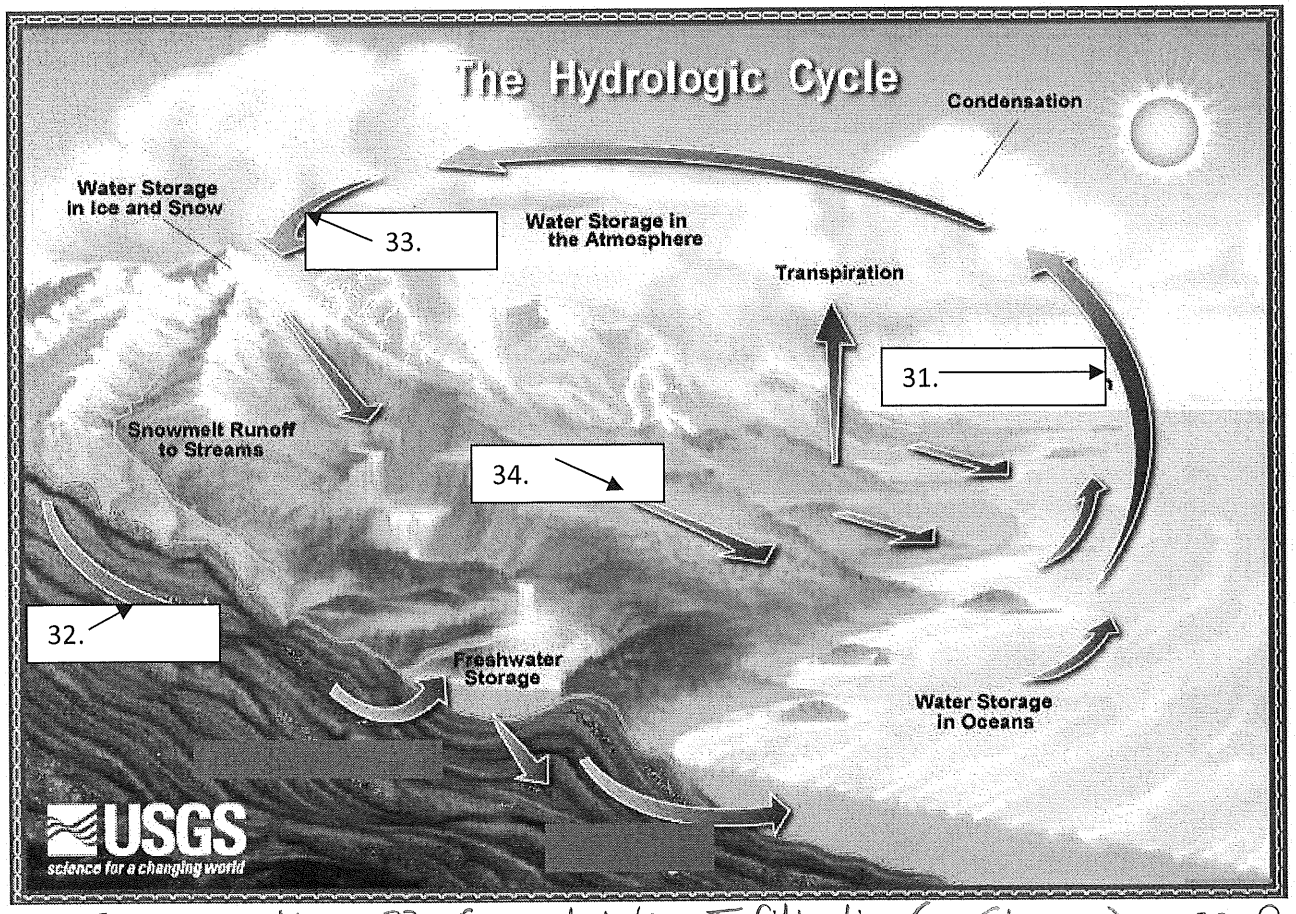
29. To what depth would a silt particle have settled by the time it had traveled 10km from shore?

160 m

30. If a particle settles to a depth of 100m and comes to rest 100km from shore, to what depth has it settled when it is 5km from shore?

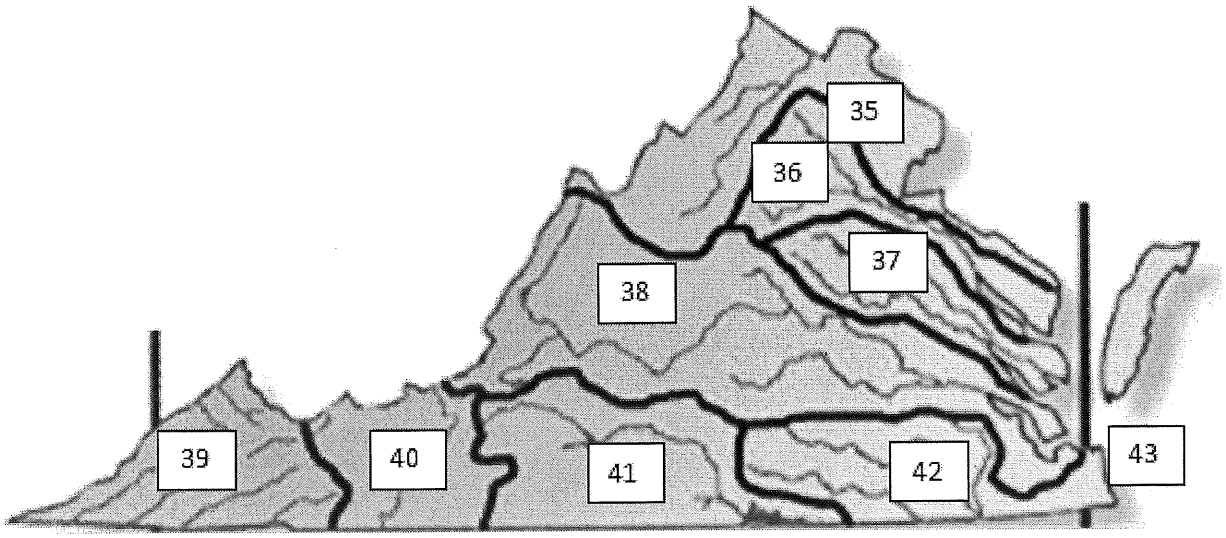
25 m.

31 – 34 Label the following parts of the Hydrologic Cycle (1 point each)



31. Evaporation 32. Groundwater Infiltration (or Storage) 33. Precipitation
34. Runoff

35 – 43 Name the following major watersheds in Virginia:



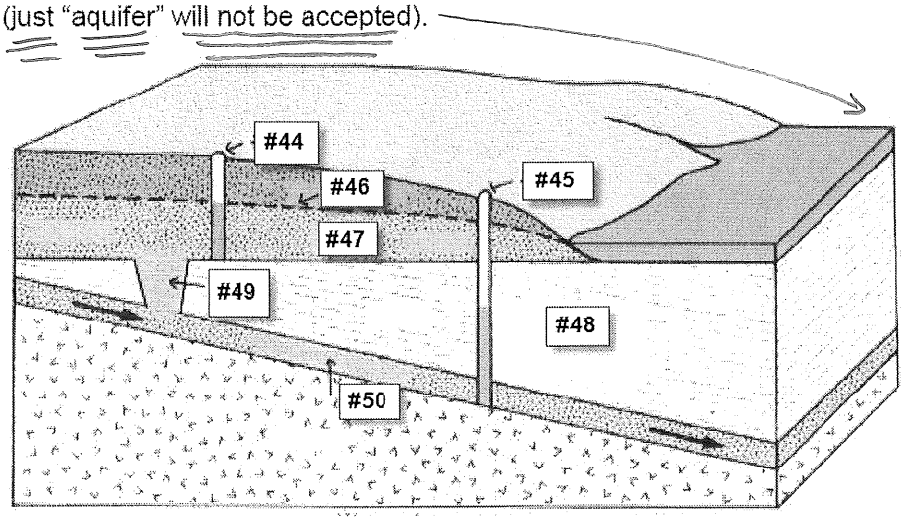
35. Shenandoah - Potomac
36. Rappahannock
37. York
38. James
39. Tennessee - Big Sandy
40. New
41. Roanoke
42. Chowan
43. Eastern Shore of Chesapeake Bay & Coastal Rivers

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope of topics covered here.

Key

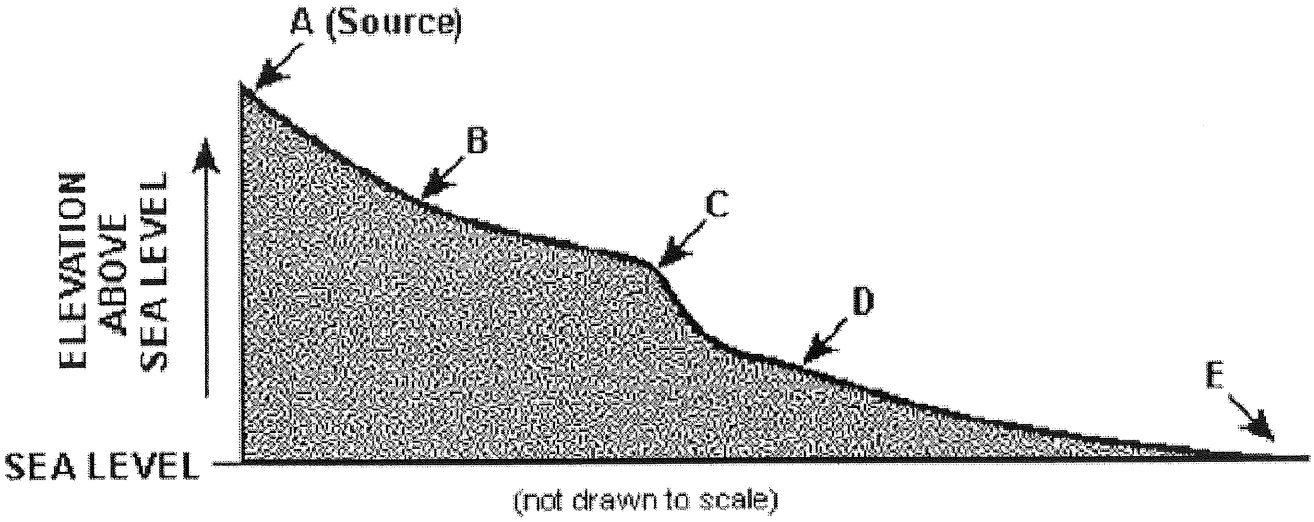
#44 – 50 (1 point each)

Labeling: Label the parts of the following diagram. When naming aquifers, specify what kind it is (just "aquifer" will not be accepted).



44. Water Table Well
45. Artesian Well
46. Water Table
47. Unconfined aquifer
48. Confining Bed or Impermeable layer or Confining Layer
49. Window
50. Confined Aquifer or Artesian Aquifer

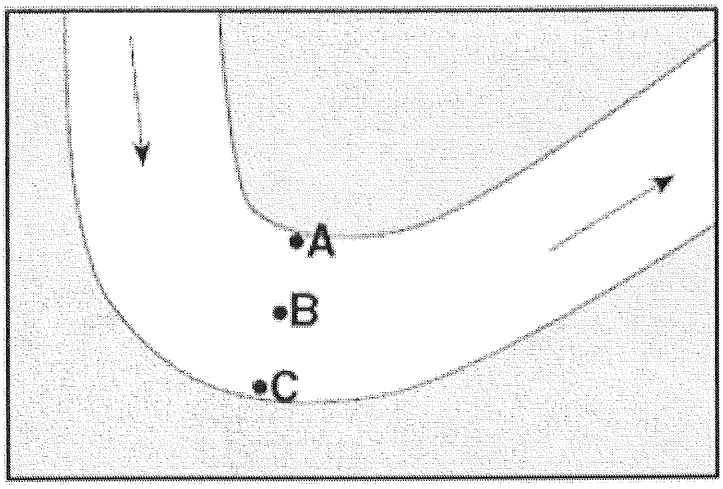
51. The diagram represents a profile of a stream. Points A through E are locations along the stream.



At which location would the amount of deposition be greatest? D

Key

52. The map below shows the bend of a large meandering stream. The arrows show the direction of stream flow. Letters A, B, and C are positions on the streambed where erosion and deposition data was collected.



Which table best represents the locations where erosion and deposition are dominant and where equilibrium exists between the two processes?

a)

	Erosion	Equilibrium	Deposition
A		✓	
B			✓
C	✓		

b)

	Erosion	Equilibrium	Deposition
A			✓
B	✓		
C		✓	

c)

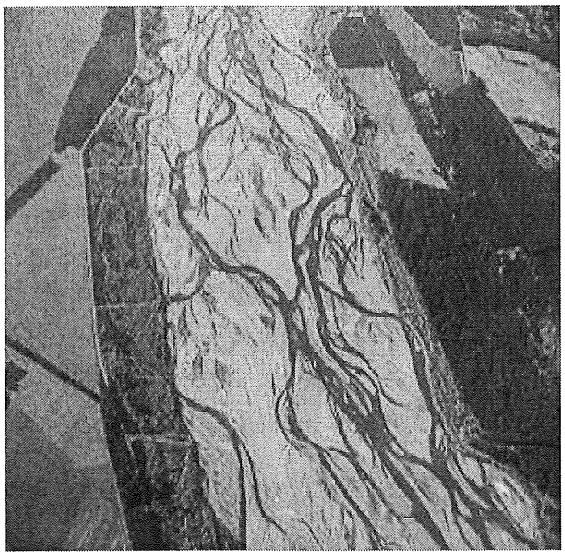
	Erosion	Equilibrium	Deposition
A	✓		
B		✓	
C			✓

d)

	Erosion	Equilibrium	Deposition
A			✓
B		✓	
C	✓		

D

53. What kind of river channel is this?



Braided

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

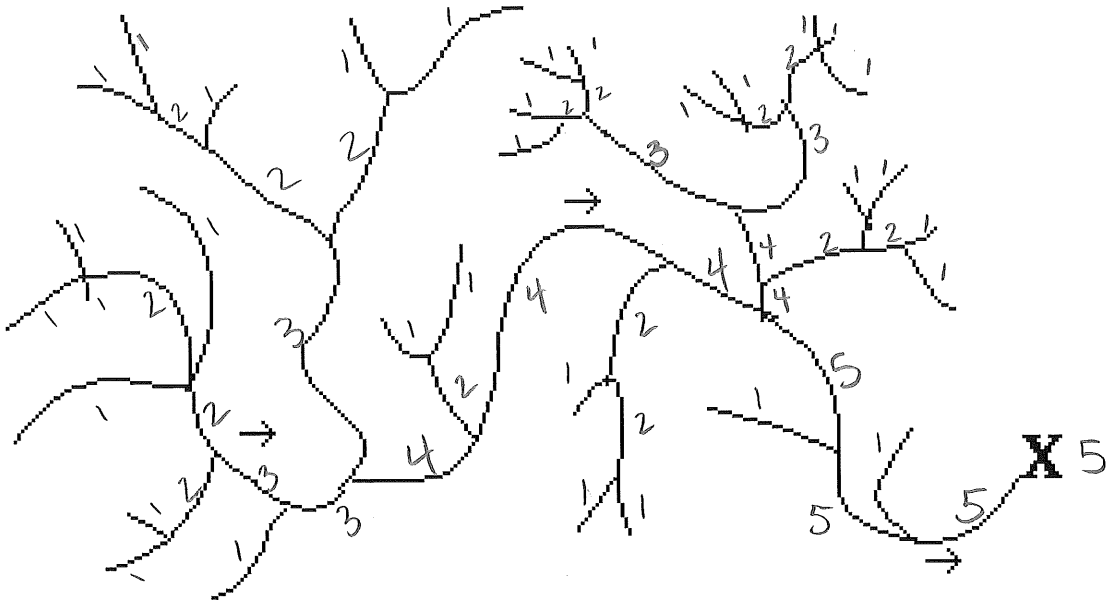
Key

54. What is the name of the largest watershed in the United States? Mississippi River

55. Large sinkholes have formed in parts of Florida. These holes are formed when
    a) Rivers erode away their banks
B   b) Caves formed by groundwater collapse
    c) River meanders form new channels
    d) Flood waters infiltrate permeable rocks.

56. _____ are smaller streams or rivers that flow into larger ones.
    a) Divides
D   b) Drainage Basins
    c) Channels
    d) Tributaries

57. What is the order of the river at the spot marked "*X*" (assume river streams follow according to the arrows) (1 point)



5

58. An endorheic (seepage) lake is one that is:
    a) Created by flooding land behind a dam or artificial barrier
D   b) Seasonal; only exists for part of the year
    c) Formed in the caldera or crater of an inactive volcano
    d) Does not have an inlet or outlet

59. Which of the following is useful for measuring discharge?
    a) Tensiometer
C   b) Lysimeter
    c) Weir
    d) Secchi disk

Key

60. Water from a nearby lake is sample and the salt concentration is found to be 2%. Which category would it fall under?

B

a) Fresh water
b) Brackish water
c) Saline water
d) Briny water

Virginia Regional Science Olympiad

Division C

2012

Dynamic Planet

Answer Key for Questions 1 – 60

Name(s): Key

School: _____

Team #: _____

1. Alluvial Fan
2. Flood Plain
3. Ox-bow Lake
4. Meander Sear
5. Levee
6. Dendritic
7. Rectangular
8. Radial
9. Trellis
10. B
11. C
12. A
13. E
14. H
15. D
16. G
17. F
18. Mature
19. Immature
20. Mature
21. Mature
22. Immature
23. Mature
24. Mature
25. Immature
26. Immature
27. Fine Sand, Silt, Coarse Clay, Fine Clay

Score: _____/75

Tie Breakers (if needed)

1- Short Answer III: _____
2- Short Answer II: _____
3- Short Answer I: _____
4- 57: _____
5- 29: _____
6- 30: _____

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

28. 2.25 hours
29. 160 meters
30. 25 meters
31. Evaporation
32. Groundwater Infiltration (or Storage)
33. Precipitation
34. Runoff
35. Shenandoah - Potomac
36. Rappahannock
37. York
38. James
39. Tennessee - Big Sandy
40. New
41. Roanoke
42. Chowan
43. Eastern Shore of Chesapeake Bay & Coastal Rivers
44. Water Table Well
45. Artesian Well
46. Water Table
47. Unconfined Aquifer
48. Confining Bed or Impermeable Layer or Confining Layer
49. Window
50. Confining Aquifer or Artesian Aquifer
51. D
52. D
53. Braided
54. Mississippi River
55. B
56. D
57. 5
58. D
59. C
60. B

Key

Short Answers

Show all set up and record answers in the spaces provided

I. Using **Figure A** – determine the slope of the stream in feet/mile from marker A to marker B. Assume a contour interval of 40 feet. Show set-up for full credit. (3 points – 1 for set up, 2 for correct answer)

lenght of stream = 1.1 miles

6960' - 6080' = 880'

$\frac{880 \text{ ft}}{1.1 \text{ mi.}}$

Slope: 800 ft/mi

II. Using **Figure B** - determine the sinuosity of Sheep Creek from marker A to marker B. Show set-up for full credit.
(3 points – 1 for set up, 2 for correct answer)

length of stream = 7.2 miles (actual path)

distance as crow flies = 3.84 miles (shortest path)

$\frac{\text{actual path}}{\text{shortest path}} = \frac{7.2 \text{ miles}}{3.84 \text{ mile}} = 1.875 = 1.88$

Sinuosity: 1.88

III. GROUNDWATER CONTAMINATION (9 total points)

Background: Underlying a military base in northeastern Michigan is a shallow aquifer. The water table lies between 10 and 25 feet below the surface. A leak in a buried **storage drum** has allowed a toxic, organic liquid to enter the aquifer.

1) Using Table 1, calculate the elevation of the water table at each well.

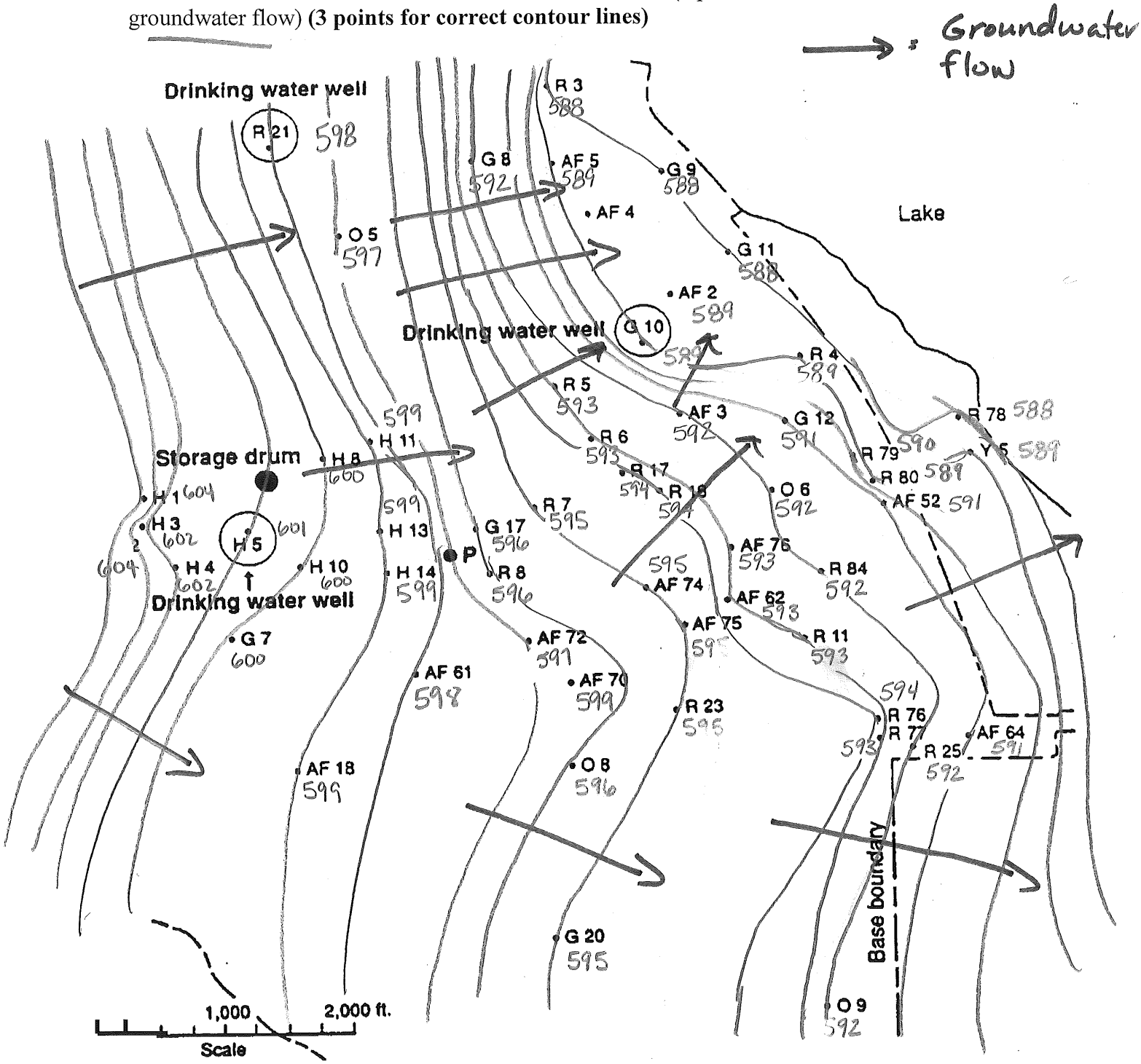
Table 1: Ground-surface elevations and water-table depths for selected wells as the military base.

1. Well Number	2. Elevation of Well (ft*)	3. Depth to Water Table (ft)	4. Elevation of Water Table (ft)	1. Well Number	2. Elevation of Well (ft*)	3. Depth to Water Table (ft)	4. Elevation of Water Table (ft)
AF 2	613	24	589	H 10	619	19	600
AF 3	616	24	592	H 11	618	19	599
AF 4	614	25	589	H 13	618	19	599
AF 5	611	22	589	H 14	618	19	599
AF 18	617	18	599	O 5	616	19	597
AF 52	611	20	591	O 6	615	23	592
AF 61	619	21	598	O 8	615	19	596
AF 62	613	20	593	O 9	611	19	592
AF 64	611	20	591	R 3	609	21	588
AF 70	615	18	597	R 4	612	23	589
AF 72	615	18	597	R 5	615	22	593
AF 74	615	20	595	R 6	617	24	593
AF 75	615	20	595	R 7	617	22	595
AF 76	614	21	593	R 8	616	20	596
G 7	619	19	600	R 11	615	22	593
G 8	616	24	592	R 17	617	23	594
G 9	609	21	588	R 18	617	23	594
G 10	615	26	589	R 21	618	20	598
G 11	608	20	588	R 23	617	22	595
G 12	614	23	591	R 25	613	21	592
G 17	618	22	596	R 76	613	19	594
G 20	615	20	595	R 77	613	20	593
H 1	621	17	604	R 78	608	20	588
H 2	621	17	604	R 79	614	24	590
H 3	621	19	602	R 80	614	25	589
H 4	621	19	602	R 84	613	21	592
H 5	621	20	601	Y 5	608	19	589
H 8	618	18	600				

* Elevations in feet above mean sea level.

KEY

Label the elevations on the map below and draw contour lines of the water table elevations at a contour interval of 1 foot. (5 points for correct contours and groundwater flow) **(3 points for correct contour lines)**



Analysis (1 point for set up and 1 point for correct response):

Assume a pollution plume 250' wide and less dense than water. Based on the direction of groundwater movement, which of the drinking water wells (H 5, R 21, and/or G 10) is most likely to be contaminated by the leaking storage drum?) G10

a. Determine the ***hydraulic gradient*** between the storage drum and the threatened well.

$$\frac{\Delta H}{\Delta L} = \frac{12'}{3250'} = 0.0037\ Ft/Ft$$

Hydraulic Gradient = 0.0037 Ft/Ft

b. Calculate the velocity of ground water flow from the storage drum to the well in feet per day. For this Aquifer assume the ***hydraulic conductivity*** or **K = 100 feet per day and a porosity of 1**.

$$V = K(\Delta H/\Delta L)$$

$$= 100\ Ft/da \left(\frac{12\ Ft}{3250\ Ft}\right) = 0.37\ Ft/day$$

Answer V= 0.37 Ft/day

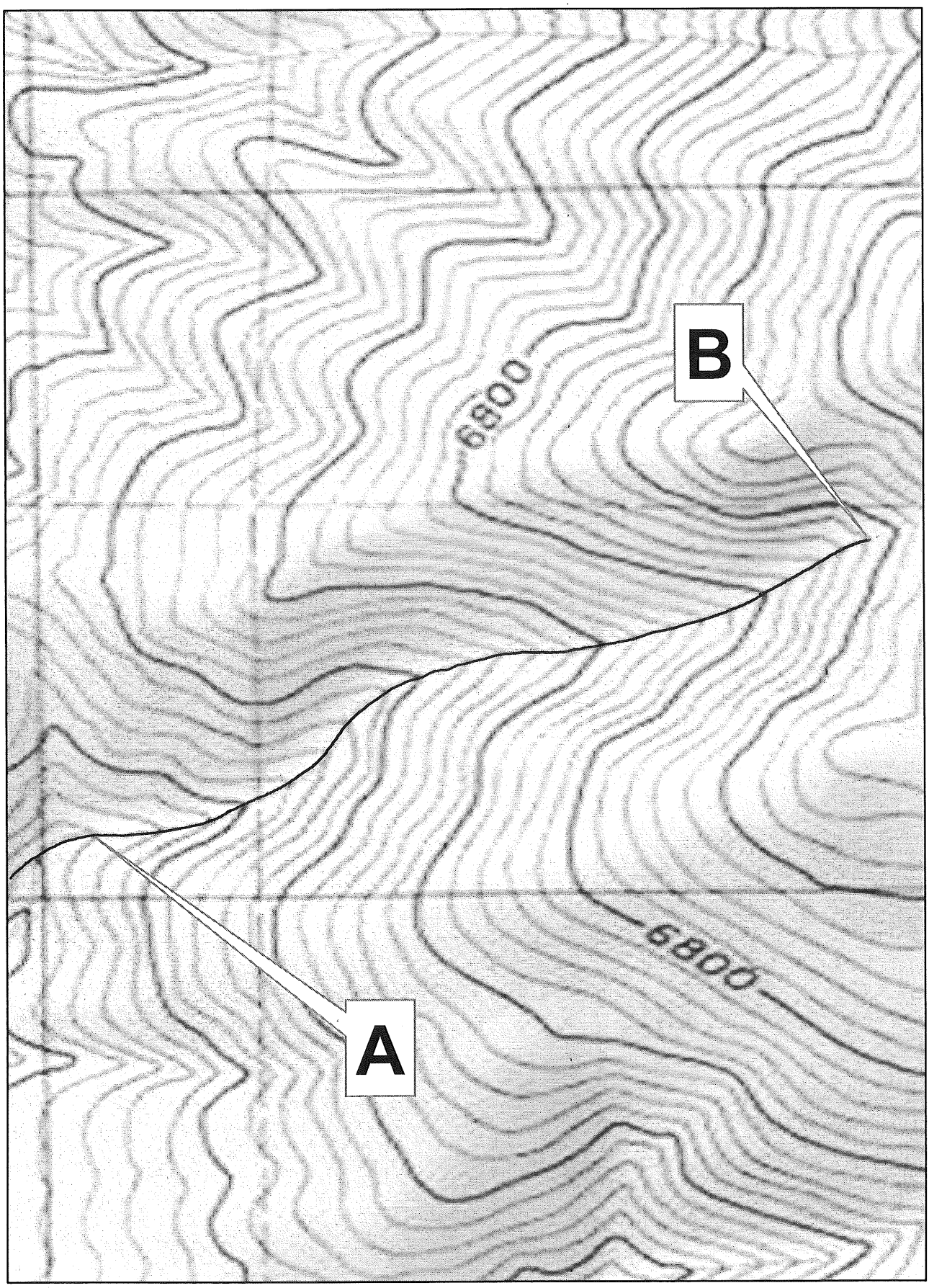
c. Determine how long it will take the contaminates to reach the well. (Assume no loss of contaminates by absorption.)
Give your answer in years.

$$Time = \frac{distance}{velocity} = \frac{3250\ Ft}{0.4\ Ft/day}$$

$$= 8{,}783.8\ days \cdot \frac{1\ yr}{365\ days}$$

Time in years= 24 years

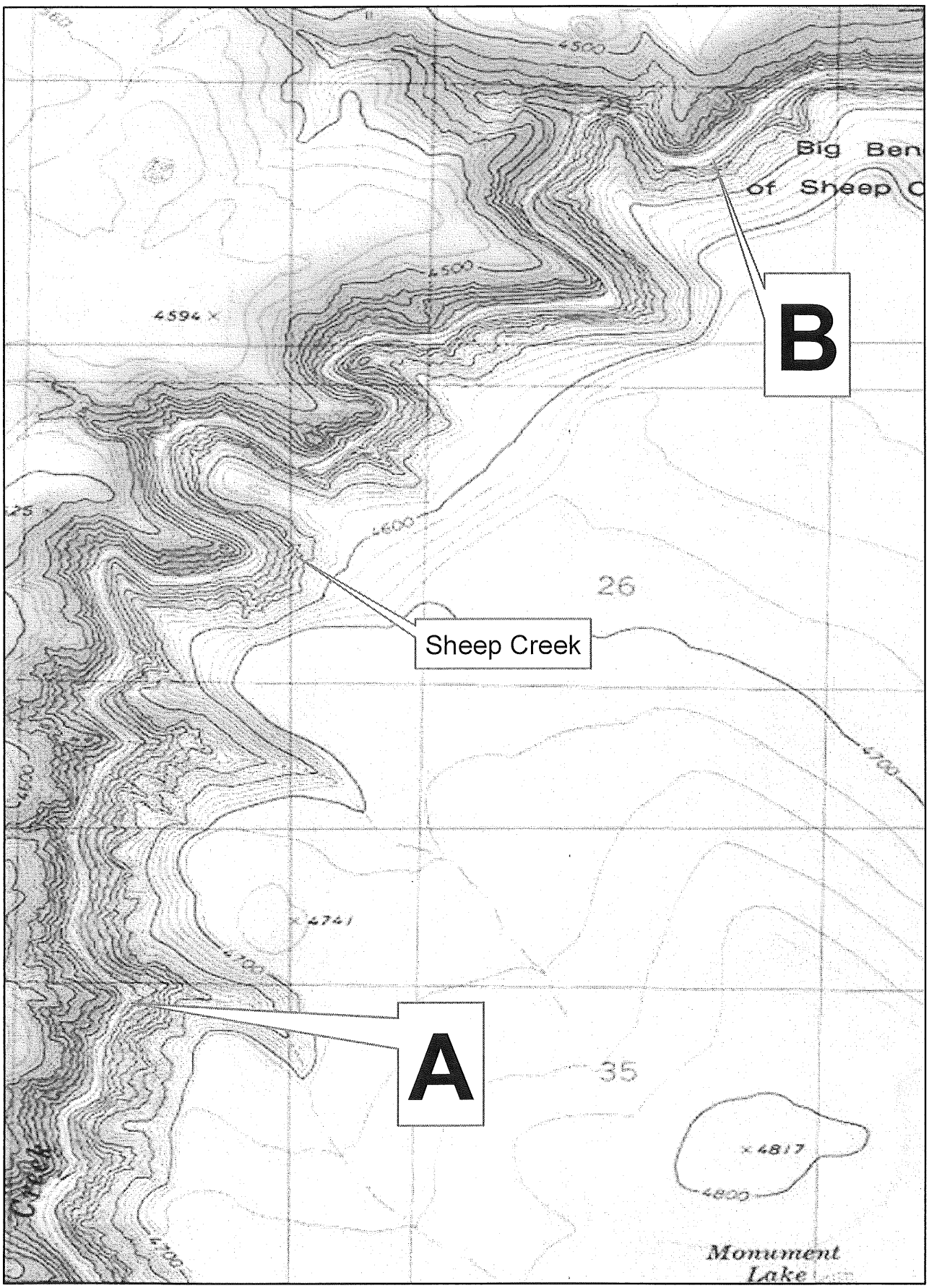
Science Olympiad Division C
Dynamic Planet - Figure A



0 0.2 0.4 0.8 Miles

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.

Science Olympiad Division C
Dynamic Planet - Figure B



0 0.45 0.9 1.8 Miles

NOTE: This is just one example of information that may be included on an exam. Information on future exams is not limited to the scope or topics covered here.