SCIENCE OLYMPIAD™

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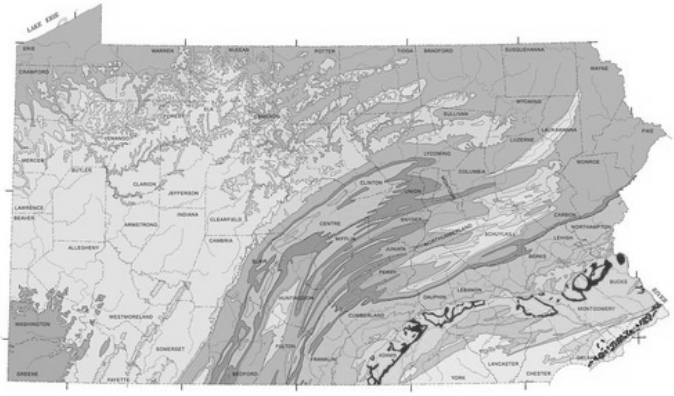
PENNSYLVANIA SCIENCE OLYMPIAD

SOUTHEAST REGIONAL TOURNAMENT 2014

GEOLOGIC MAPPING C DIVISION EXAM

MARCH 5, 2014



SCHOOL:_____ **TEAM NUMBER:**_____

INSTRUCTIONS:

1. **Turn in all exam materials at the end of this event. *Missing exam materials will result in immediate disqualification of the team in question*. There is an exam packet as well as a blank answer sheet.**

2. **You may separate the exam pages. You may write in the exam.**

3. ***Only* the answers provided on the answer page will be considered. Do not write outside the designated spaces for each answer.**

4. **Include school name and school code number at the bottom of the answer sheet. Indicate the names of the participants *legibly* at the bottom of the answer sheet. Be prepared to display your wristband to the supervisor when asked.**

5. **Each question is worth one point. Tiebreaker questions are indicated with a (T#) in which the number indicates the *order of consultation* in the event of a tie. Tiebreaker questions count toward the overall raw score, and are only used as tiebreakers when there is a tie. In such cases, (T1) will be examined first, then (T2), and so on until the tie is broken. There are 12 tiebreakers.**

6. **When the time is up, *the time is up*. Continuing to write after the time is up risks immediate disqualification.**

7. **In the BONUS box on the answer sheet, name the gentleman depicted on the cover for a bonus point.**

8. **As per the 2014 Division C Rules Manual, each team is permitted to bring "one three ring binder (any size) containing information in any form from any source."**

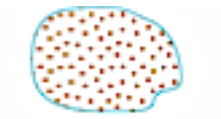
9. **Accessories may include "a protractor, a ruler, non-programmable calculator, colored pencils, and an equal-area projection stereonet with tracing paper and pin."**

10. **Nonsensical, mocking, or inappropriate answers WILL RESULT IN DISQUALIFICATION.**

1. (T10) A topographic map is in 1:24,000 scale. 1 inch on the map represents which of the following?

A) 24,000 feet B) 24 miles C) 2000 feet D) 288 miles E) 800 km

2. Consider the symbol shown at right. On a topological map, this symbol could indicate:



A) shrubland B) dry lake C) wooded marsh D) quarry E) intermittent river

3. Which of the following shapes best models the surface of the Earth?

A) sphere B) prolate spheroid C) oblate ellipsoid D) geodetic solid E) geovoid

4. Mass anomalies in the Earth cause the surface (even of the ocean) to deviate from the mean. This undulating surface is also called the:

A) geoid B) geovoid C) geodesic dome D) geosphere E) geodome

5. In the Universal Transverse Mercator coordinate system, how many longitudinal zones are there?

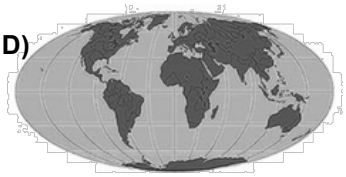
A) 6 B) 36 C) 60 D) 300 E) 360

6. Which of the following is the Mollweide projection?

A) 

B) 

C) 

D) 

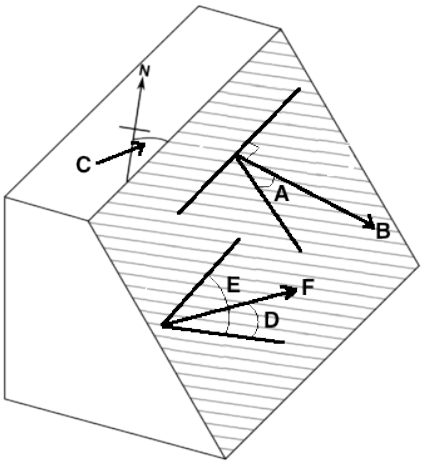
7. The Grand Canyon is located in standard UTM coordinates of 12N 400983 3995600. Which of the following best describes this notation?

A) Zone 12, Northern Hemisphere, 400983 m easting, 3995600 m northing
B) 12° North of the equator, 400983 m northing, 3995600 m east of prime meridian
C) 12° North of the equator, 400983 m southing, 3995600 m west of prime meridian
D) Zone 12, Northern Hemisphere, 400983 m northing, 3995600 m easting

8. (T11) A quadrant bearing is listed as N25°W. What is the azimuth bearing?

A) 25° B) 65° C) 205° D) 295° E) 335°

Consider the diagram at right. For questions numbered 9 – 14, Match the numbered term with its illustration on the diagram.



9. Strike
10. Dip
11. Dip direction
12. Rake
13. Plunge
14. Plunge direction

Consider the full-page color map provided. Questions 15 – 22 are associated with this map. The map has been provided by the U.S. Geological Survey.

15. (T5) What quadrangle is represented by this map?

A) Malvern B) Valley Forge C) Chester Springs D) Royersford E) Phoenixville

16. What datum was used to create this map?

A) 7.5 minute B) mean sea level C) 4520 ft. D) 15' quadrangle E) Polyconic projection

17. (T4) What is the contour interval on this map?

A) 4520 ft B) 7.5' C) 40° D) 10 feet E) 1 inch ≈ ½ mile

18. What is the UTM Zone of this map?

A) 1955 B) 40° 07' 30" C) 75° 30' D) 18 E) 7.5 minute

19. According to the map, what is the latitude of Spring City?

A) 40° 10' 42" B) 75° 10' 40" C) 40° 07' 30" D) 40° 32' 50" E) 75° 32' 49"

20. According to the map, what is the longitude of Spring City?

A) 40° 10' 42" B) 75° 10' 40" C) 40° 07' 30" D) 40° 32' 50" E) 75° 32' 49"

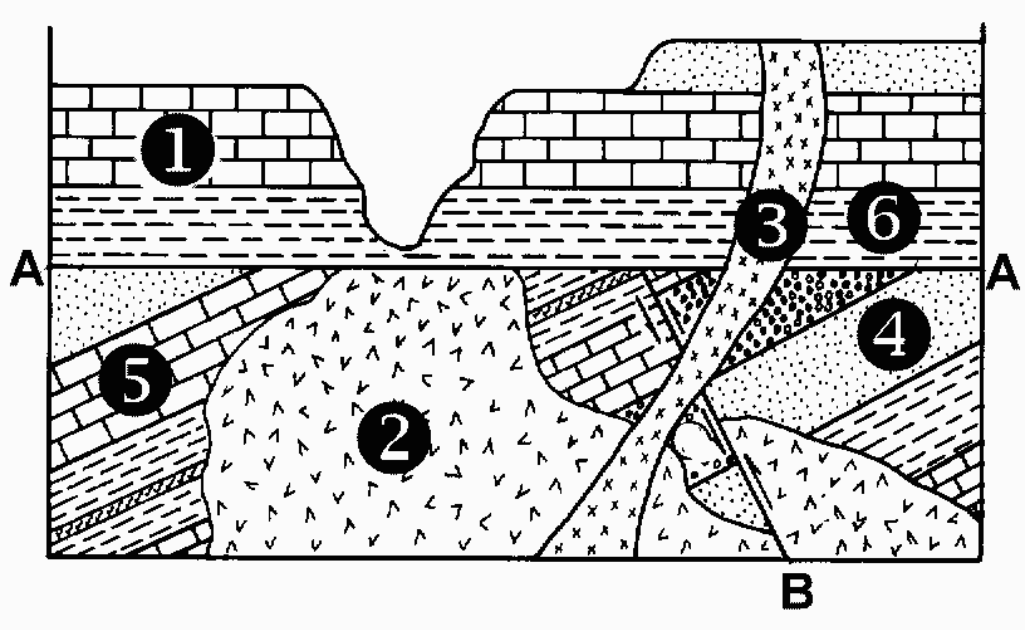
21. Which of the following is NOT found on an adjacent quadrangle?

A) Downingtown B) Malvern C) Collegeville D) Pottstown E) Reading

22. There is a prominent hill shown on the map in East Pikeland. What is the elevation of this hill?

A) 200 ft B) 32° 30' C) 325 ft D) 192 ft E) 75° 31'

Consider the geologic cross section shown below. Use this diagram for questions numbered 23 – 28.



23. An unconformity exists between which two rock layers?

A) 3 and 6 B) 5 and 6 C) 2 and 5 D) 2 and 4 E) 1 and 3

24. Which of the following statements is correct?

A) A long period of erosion took place before the deposition of layer 6.
B) Igneous intrusion 3 is older than igneous intrusion 2.
C) Fault B is older than igneous intrusions 2 and 3
D) Rock layers 4 and 5 were tilted after fault B took place
E) Deposition of layers 1 and 6 took place before tilting of layers 4 and 5

25. In which rock layer are fossils LEAST likely to be found?

A) 1 B) 6 C) 5 D) 4 E) 3

26. (T6) Which of the following sequences is most likely?

A) deposition – tilting – fault B – intrusion 2 – deposition – erosion – intrusion 3 – deposition
B) deposition – tilting – intrusion 2 – fault B – erosion – deposition – intrusion 3 – erosion
C) deposition – tilting – intrusion 3 – erosion – fault B – deposition – intrusion 2 – erosion
D) tilting – deposition – intrusion 2 – fault B – erosion – deposition – erosion – intrusion 3
E) deposition – tilting – fault B – intrusion 2 – erosion – deposition – intrusion 3 – deposition

27. Which of the following statements is correct?

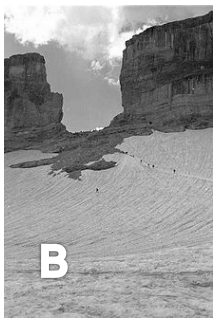
A) Layer 4 is older than layer 5
B) Intrusion 3 is older than layer 1
C) Intrusion 2 is younger than fault B
D) Layer 5 was deposited after intrusion 2
E) Layer 6 is older than fault B

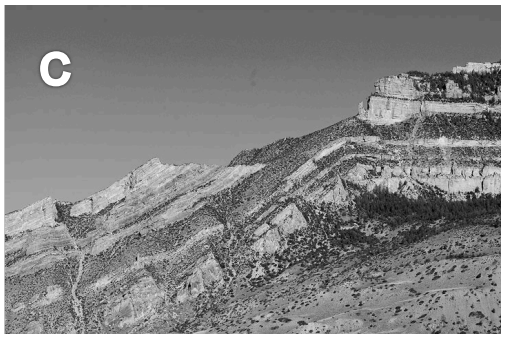
28. Which sequence of rock layers is most likely, oldest to youngest?

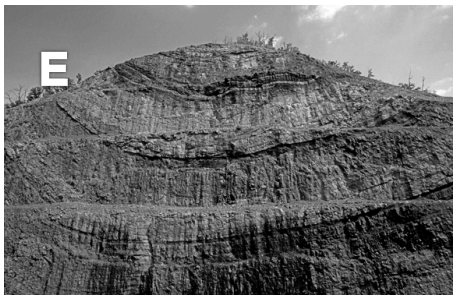
A) 1,2,3,4,5,6 B) 1,6,3,2,4,5 C) 2,4,5,1,6,3 D) 4,5,2,6,1,3 E) 5,4,2,3,6,1

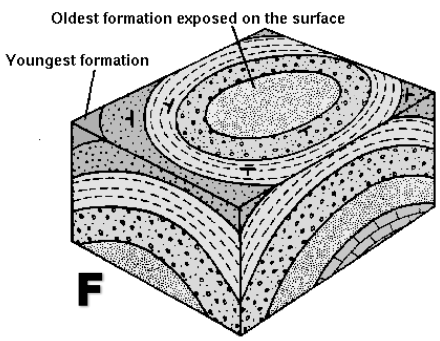
Questions 29 – 35: Match the numbered structural elements with the appropriate lettered image.

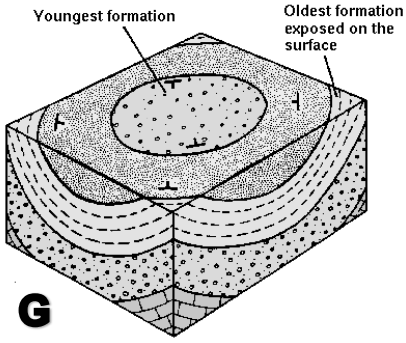
29. **syncline**
30. **anticline**
31. **basin**
32. **monocline**
33. **unconformity**
34. **dome**
35. **saddle**





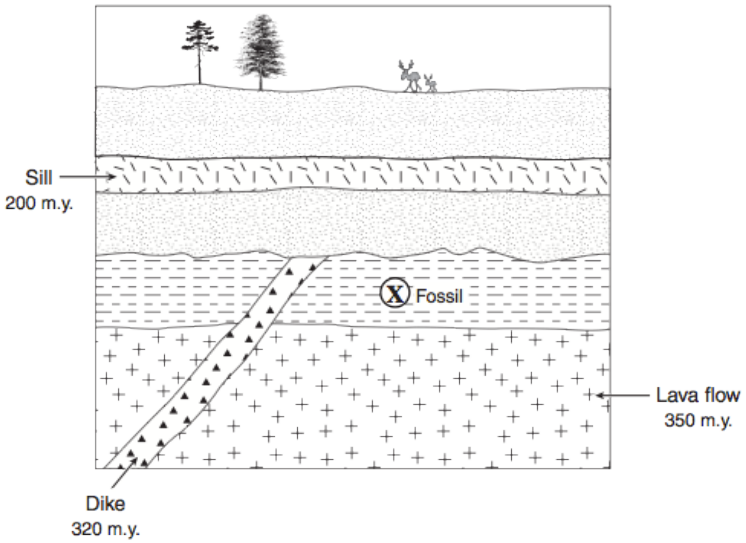




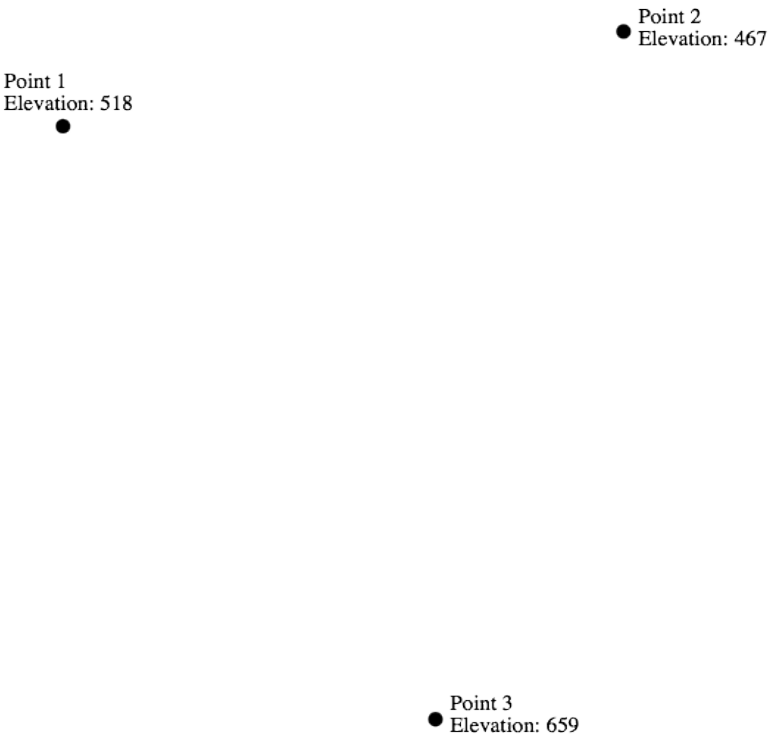


36. **A fossil is found at location X in the profile shown at right. From what period is the fossil?**

    A) Silurian
    B) Devonian
    C) Carboniferous
    D) Triassic
    E) Jurassic
    F) Ordovician



Consider the three points below. An outcrop of a thin layer of sandstone appears at each of the points. Elevations are in meters, and the scale is 1.0 cm = 50 m. Use for questions 37 – 39.



37. (T1) What is the azimuthal strike angle?

A) 100° B) 80° C) 325° D) 15° E) 260°

38. What is the dip angle?

A) 170° B) 22.2° C) 10° D) 30.6° E) 80°

39. What is the azimuthal dip direction?

A) 80° B) 325° C) 260° D) 10° C) 67.8°

40. During which period did the continents unite into the supercontinent Pangaea?

A) Cambrian B) Proterozoic C) Ordovician D) Cretaceous E) Permian

41. Which epoch includes the present?

A) Cenozoic B) Phanerozoic C) Holocene D) Quaternary E) Oligocene

42. Orogeny refers to which of the following?

A) atmospheric levels of CO_2 B) sea-floor magnetism C) mountain-building D) glacial advance

43. Which of the following statements is true?

A) All synforms are synclines, but only some synclines are synforms.
B) All synclines are synforms, but only some synforms are synclines.
C) All synclines are synforms and all synforms are synclines
D) Some synclines are synforms and some synforms are synclines

44. Two rock layers have the same thickness. Layer A dips with a steeper angle than layer B. Which layer has the broadest outcrop at the surface, assuming the surface is horizontal?

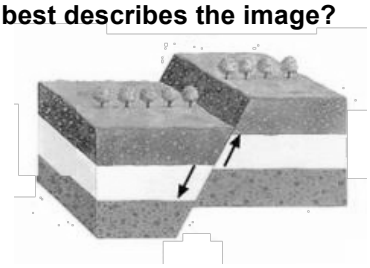
A) Layer A B) Layer B C) Neither D) Either

45. Consider the block diagram below right. Which of the following best describes the image?

A) normal dip-slip fault B) reverse dip-slip fault

C) thrust fault D) strike-slip fault

E) oblique-slip fault



46. (T12) The vertical component of fault displacement is also called:

A) dip B) heave C) slip D) strike E) throw

47. Which of the following is true of a reverse fault?

A) the hanging wall moves up relative to the footwall due to compression
B) the hanging wall moves up relative to the footwall due to extension
C) the hanging wall moves down relative to the footwall due to compression
D) the hanging wall moves down relative to the footwall due to extension

48. In an eroded symmetrical anticline:

A) the youngest bed outcrops in the center, with successively older beds to either side of the center
B) the beds outcrop in a series that may be repeated due to overfolding
C) the beds outcrop out of temporal sequence due to suppression of beds
D) the oldest bed outcrops in the center, with successively younger beds to either side of the center
E) the widths of the outcrops on either side of the fold will be drastically different

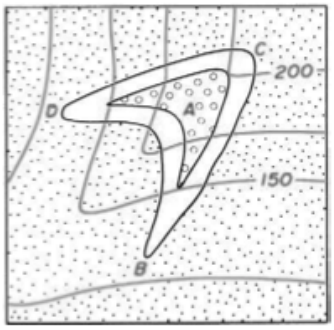
One limb of a fold has a dip of 207/60 and the other limb has a dip of 100/30. Questions 49 and 50.

49. What is the plunge of the fold axis?

A) 107° B) 30° C) 26° D) 3.6° E) 46°

50. What is the direction of the plunge of the fold axis?

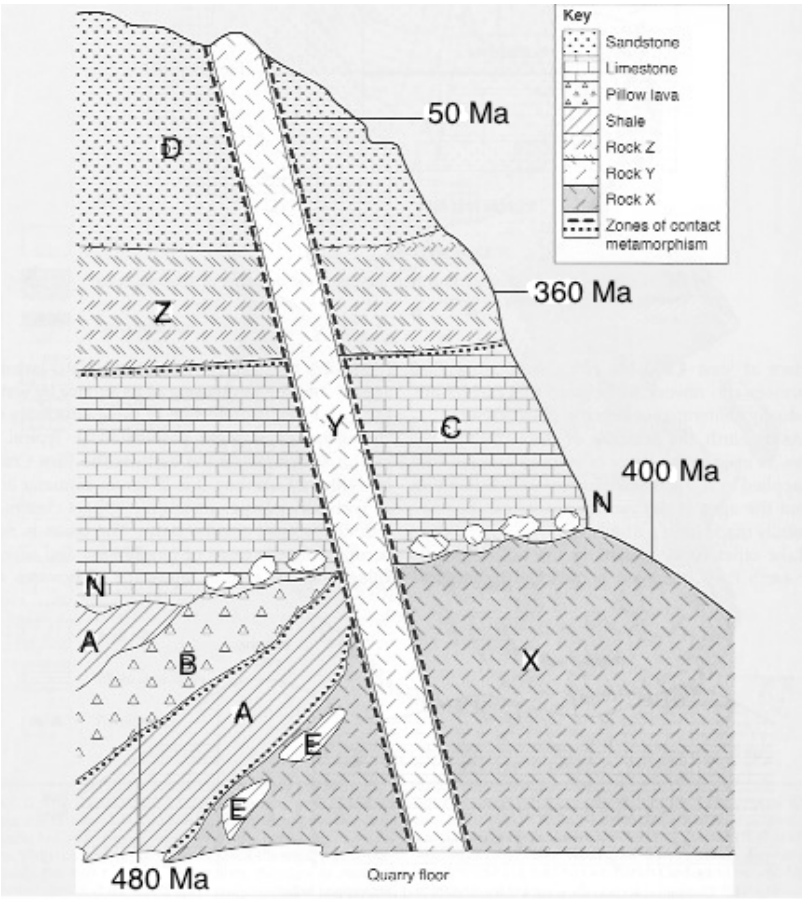
A) 107° B) 138° C) 307° D) 48° E) 57°



51. Consider the outcrop shown in white in the image at right. At which location(s) is the curvature of the outcrop due to a fold?

A) A B) B C) C D) D E) A and C F) B and D

Consider the following diagram of a quarry face for questions 52 – 57.



52. Which letter in the diagram indicates an intrusive pluton?

A) Y B) B C) Z D) E E) X

53. Which letter in the diagram indicates a lava flow?

A) A B) X C) Y D) C E) Z

54. Which letter in the diagram indicates a dyke?

A) Y B) B C) Z D) E E) X

55. (T7) What is the most likely nature of rock B?

A) It is a sill that intruded on a fault in layer A
B) It is an intrusion that was exposed on the seafloor
C) It is a dyke that was eroded at the interface N-N
D) It is a pyroclastic flow that was tilted and eroded
E) It is an intrusive pluton

56. (T8) What is the most likely geological age for rock layer C?

A) Ordovician B) Silurian C) Carboniferous D) Devonian E) Cretaceous

57. What is the nature of interface N-N?

A) angular unconformity B) nonconformity C) disconformity D) paraconformity E) biconformity

Questions 58 – 63: Match the numbered fault type with the appropriate lettered image.

58. Normal slip fault

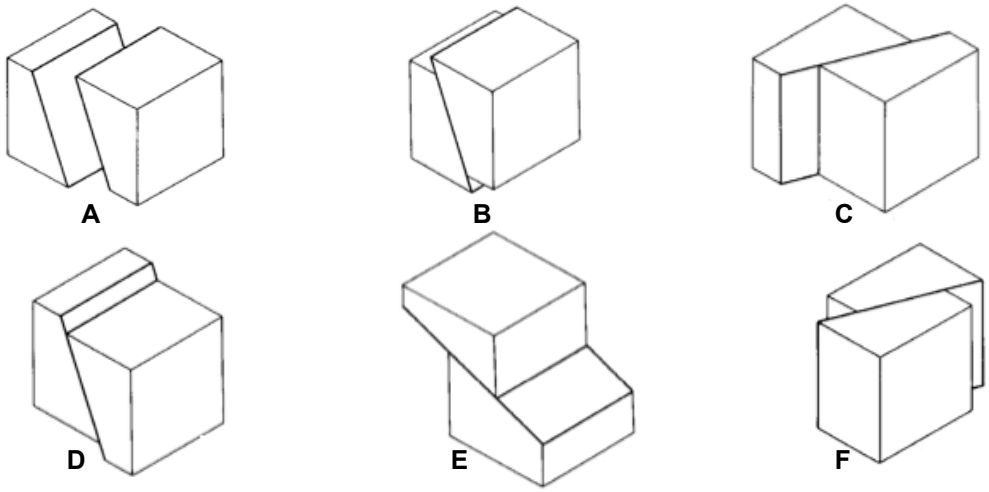
59. Reverse slip fault

60. Thrust fault

61. Sinistral strike fault

62. Dextral strike fault

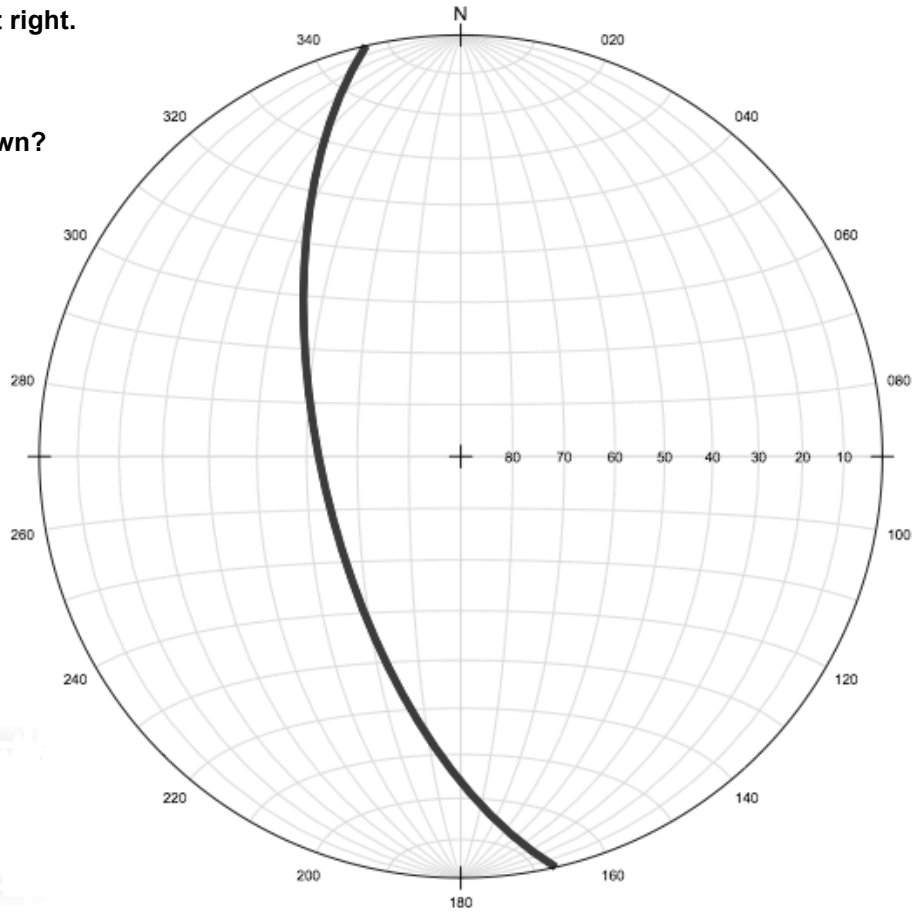
63. Oblique slip fault



64. A topological profile is drawn with a vertical exaggeration of three. A series of dipping strata on the profile is shown with a dip of 52.0°. What is the true dip?

A) 17.3° B) 23.1° C) 15.2° D) 78.2° E) 75.4°

Consider the stereonet projection shown at right. Use for questions 65 and 66.



65. (T2) What is the strike of the plane shown?

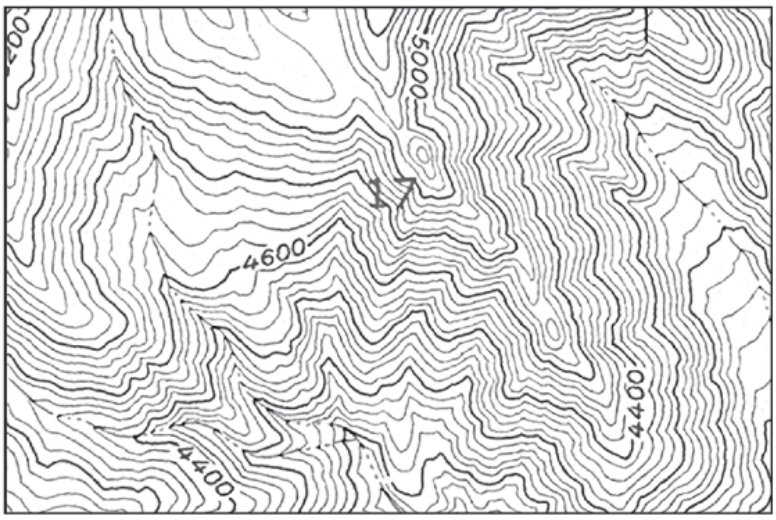
A) 347°
B) 167°
C) 27°
D) 63°
E) 193°

66. What is the dip of the plane shown?

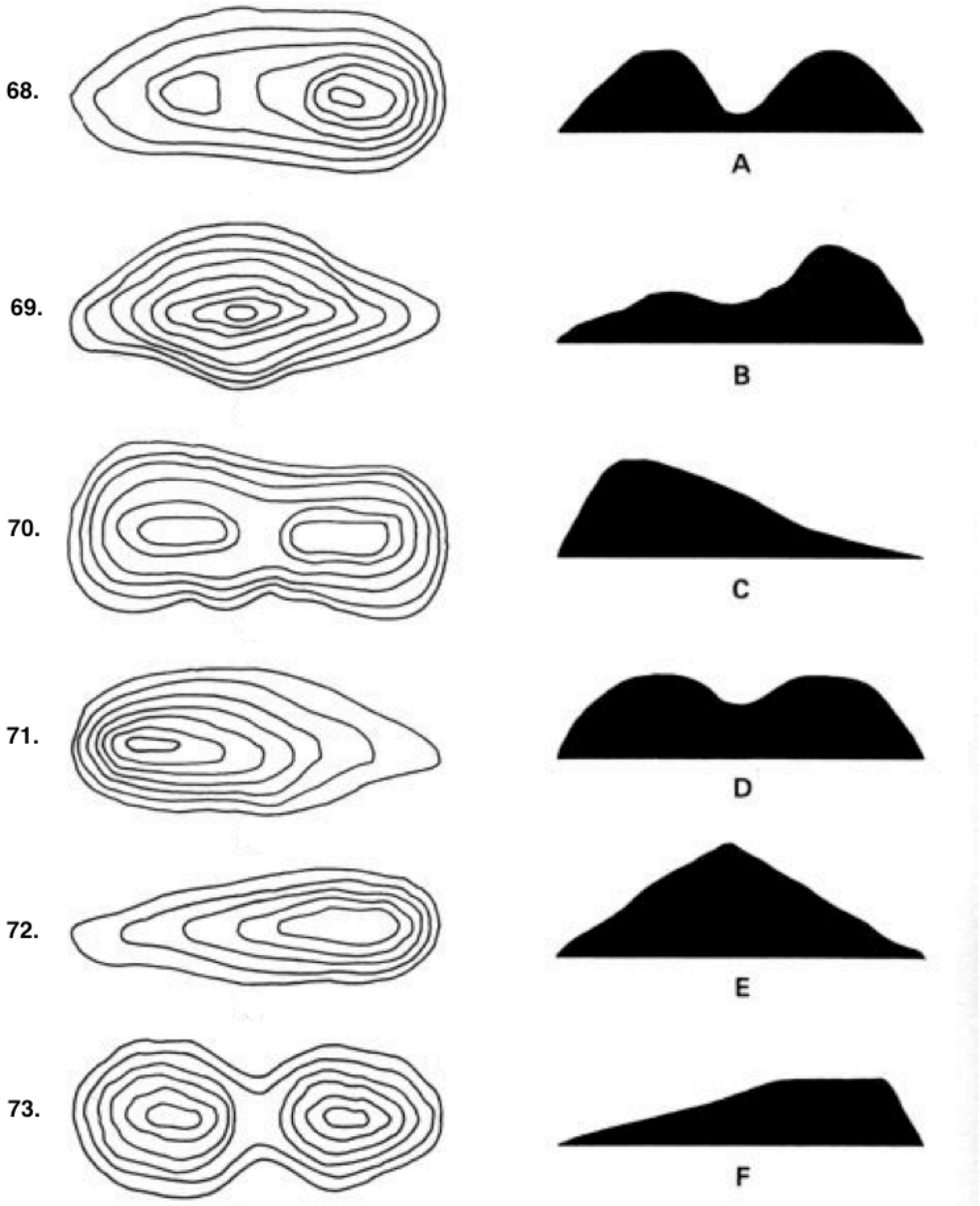
A) 13°
B) 117°
C) 27°
D) 63°
E) 77°

67. (T3) What is the contour interval on the map shown at right?

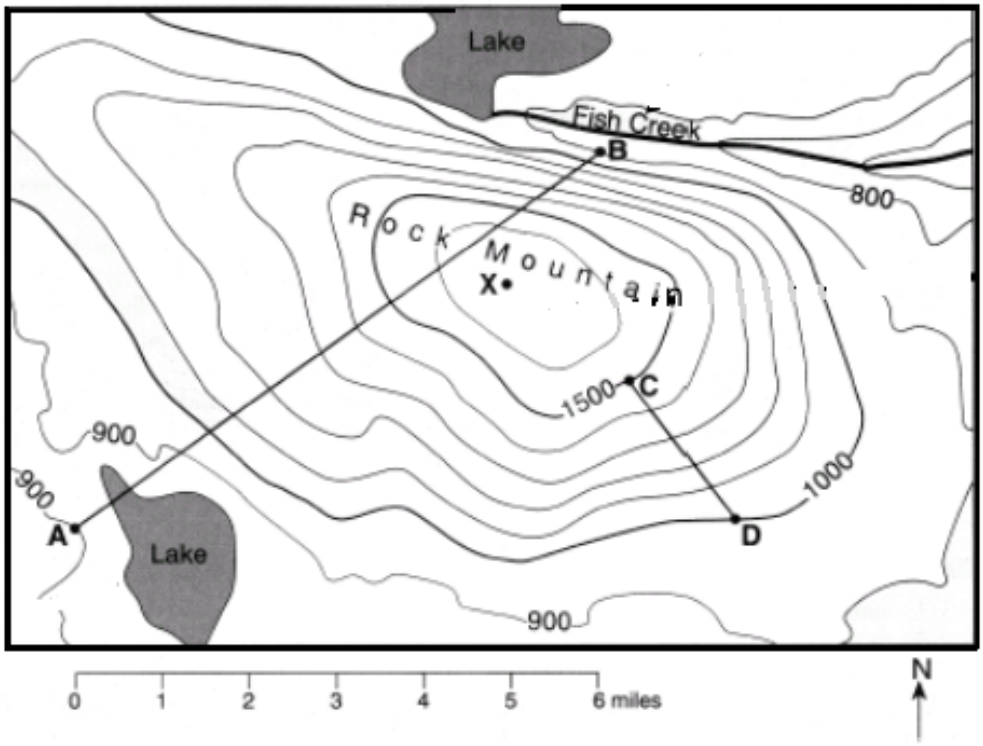
A) 4600 ft
B) 400 ft
C) 200 ft
D) 50 ft
E) 40 ft



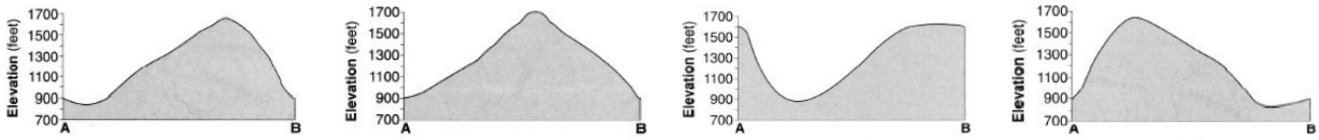
For questions 68 – 73, match the numbered contours with the appropriate terrain profiles shown on the right.



Questions 74 – 77 refer to the following topological map. Elevations in feet.



74. (T9) Which of the following represents the profile across AB?



A) **B)** **C)** **D)**

75. What is the highest possible elevation for point X?

A) 1500 ft **B) 1600 ft** **C) 1601 ft** **D) 1599 ft** **E) 1699 ft**

76. What is the gradient across CD?

A) 500 ft/mile **B) 250 ft/mile** **C) 750 ft/mile** **D) 1000 ft/mile** **E) 125 ft/mile**

77. Does Fish Creek flow into or out of the lake?

A) into the lake **B) out of the lake** **C) impossible to tell**

78. Consider the quartzite/schist contact shown at right. The quartzite is known to be older than the schist. Which of the following is true?

A) the quartzite is an antiform outlier
B) the quartzite is a synform outlier
C) the quartzite is an antiform inlier
D) the quartzite is a synform inlier