National Science Olympiad 2011 Dynamic Planet Exam, Division B

Be sure to write your team number on each page.

For all multiple choice questions, write the letter of the correct answer on the blank to the left of the question number. Use capital letters and write legibly. Illegible answers will be marked incorrect.

Questions 1-9:   18 points (2 pts each) _____

Question 10:   6 points   _____

Question 11:   3 points   _____

Questions 12-17:   12 points (2 pts each) _____

Question 18:   4 points   _____

Question 19:   8 points   _____

Question 20:   4 points   _____

Question 21:   3 points   _____

Questions 22-23:   4 points (2 pts each) _____

Question 24:   6 points   _____

Question 25:   4 points   _____

Questions 26-27:   4 points (2 pts each) _____

Questions 28-30:   12 points (4 pts each) _____

TOTAL   **88 points**   _____

Questions 1-13 refer to maps found in the Atlas of Landforms, 2nd Edition.

New Haven, IL map on page 16 (blue tab)

_____1. The feature in the northeastern portion of the map named "Old Channel" was once the main channel of the Wabash River. Given the evidence from the map, what is the most likely time period when the Wabash River last flowed through Old Channel?
> A. 100 years ago
> B. 1,000 years ago
> C. 10,000 years ago
> D. 100,000 years ago
> E. 1,000,000 years ago

_____2. What type of feature is Clark Pond (W on the map)?
> A. natural levee
> B. oxbow lake
> C. cutoff
> D. kettle lake
> E. scar

Chief Mountain, MT on page 38 (yellow tab)

_____3. Whitecrow Lake and Sue Lake (point N on the map) are what type of lake?
> A. cirque
> B. tarn
> C. paternoster
> D. kettle
> E. crater

_____4. The chain of lakes in the center of the map (point P) which includes Crossley Lake, Glenns Lake, and Mokowanis Lake are what type of lakes?
> A. cirque
> B. tarn
> C. paternoster
> D. kettle
> E. crater

_____5. What is the primary agent responsible for the formation of the lakes mentioned above in question 4?
> A. terminal moraine
> B. humans
> C. faulting
> D. differential erosion
> E. volcanic action

_____6. What is the primary agent responsible for the formation of Lake Sherburne (large lake in southeastern portion of map)?
   A. terminal moraine
   B. humans
   C. faulting
   D. differential erosion
   E. volcanic action

Horse Cave, KY on page 61 (pink tab)

_____7. Based on the landforms on this map, what is the most likely type of bedrock found between 550 and 600 feet in elevation?
   A. limestone
   B. sandstone
   C. shale
   D. granite

_____8. The streams indicated by the letter X on the map are called disappearing streams. Why do these streams no longer flow on the surface?
   A. evaporation exceeds precipitation
   B. stream encounters high permeability sands
   C. stream flows through solution cavities in the subsurface
   D. water table is too low to sustain baseflow conditions

_____9. What is the primary acid responsible for karst formation?
   A. sulfuric acid (H_2SO_4)
   B. hydrochloric acid (HCl)
   C. carbonic acid (H_2CO_3)
   D. nitric acid (HNO_3)

10. What is the gradient of the river on the eastern edge of the map indicated with the arrow?
   Round to the NEAREST QUARTER OF AN INCH when measuring distance.
   There are 5,280 feet in a mile.
   Show your work for full credit and write your answer on the line below.

   _____ feet/mile

Anderson Mesa, CO on page 68 (purple tab)

11. The portion of the Delores River depicted on this map contains entrenched meanders. Identify the correct processes and their order of occurrence (1, 2, etc.) for the formation of entrenched meanders. Not all processes will be used.

___ increased evapotranspiration   ___ establishment of meanders
___ lowered local base level   ___ terrace formation
___ increased vertical erosion   ___ high dissolved load

Kokand, U.S.S.R. on page 75 (green tab)

____12. Two alluvial fans (X on map) are located on the southern portion of the map. What is the expected distribution of sediment sizes starting at the northern edge of the fans and moving southward?
        A. gravel, sand, silt, clay
        B. conglomerate, sandstone, siltstone, shale
        C. clay, silt, sand, gravel
        D. shale, siltstone, sandstone, conglomerate

____13. Which feature on the map controls the local base level?
        A. Salt Lakes (W on map)
        B. Syr-Dar'ya river
        C. Shor-Su (middle of southern edge on map)
        D. dunes in northeastern portion of map

Questions 14-18 are individual questions not referring to any additional maps or figures other than what is given for that question.

____14. An aquifer must be:
        A. nonporous and nonpermeable
        B. nonporous and permeable
        C. porous and nonpermeable
        D. porous and permeable

____15. A flood having a 100-year recurrence interval….
        A. …has a 100 % chance of occurrence in any given year.
        B. …occurs once every 100 years.
        C. …has a 1 in 10 chance of occurrence in any given year.
        D. …has a 1% chance of occurrence in any given year.
        E. …has a 1 in 2 chance of occurrence in any given year.

____16. A 50-year storm of 30-minutes duration occurs over 2 drainage basins.
Information on these drainage basins is provided in the table below.

Drainage Basin	Area (mi^2)	Average Slope (ft/mi)	Type of Bedrock	Stream cross-sectional area at basin exit (ft^2)
A	2	100	granite	15
B	20	10	sandstone	100

What can be said about flooding in the streams as they exit the basins?
      A. Stream exiting drainage basin B is more likely to flood than stream exiting drainage basin A.
      B. Stream exiting drainage basin A is more likely to flood than stream exiting drainage basin B.
      C. Streams in drainage basins A and B are equally likely to flood.
      D. Neither streams in drainage basins A or B are likely to flood.

17. Below is a cross section of a river at its normal stage.
Draw a line on the cross section to indicate the flood stage for this river.
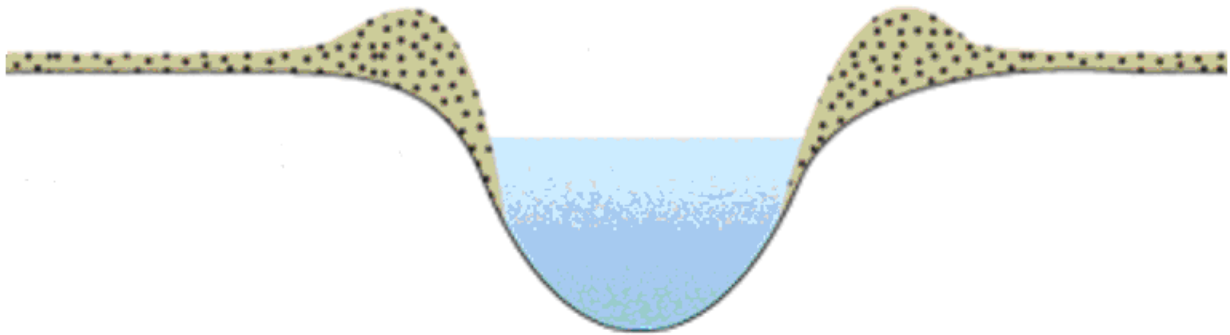

18. Consider a river with a width of 7 m, depth of 2m, and a mean velocity of 45 cm/s.
Calculate the discharge of this river in m^3/s.
Show your work for full credit and write your answer on the line below.

_____ m^3/s

Use the following diagram to answer questions 19-23. Solid circles/points are water table elevations in feet above mean sea level (ft amsl). Open circles labeled A, B, C are locations asked about in the questions. The thick black line is a river. The thin black line is sea level.
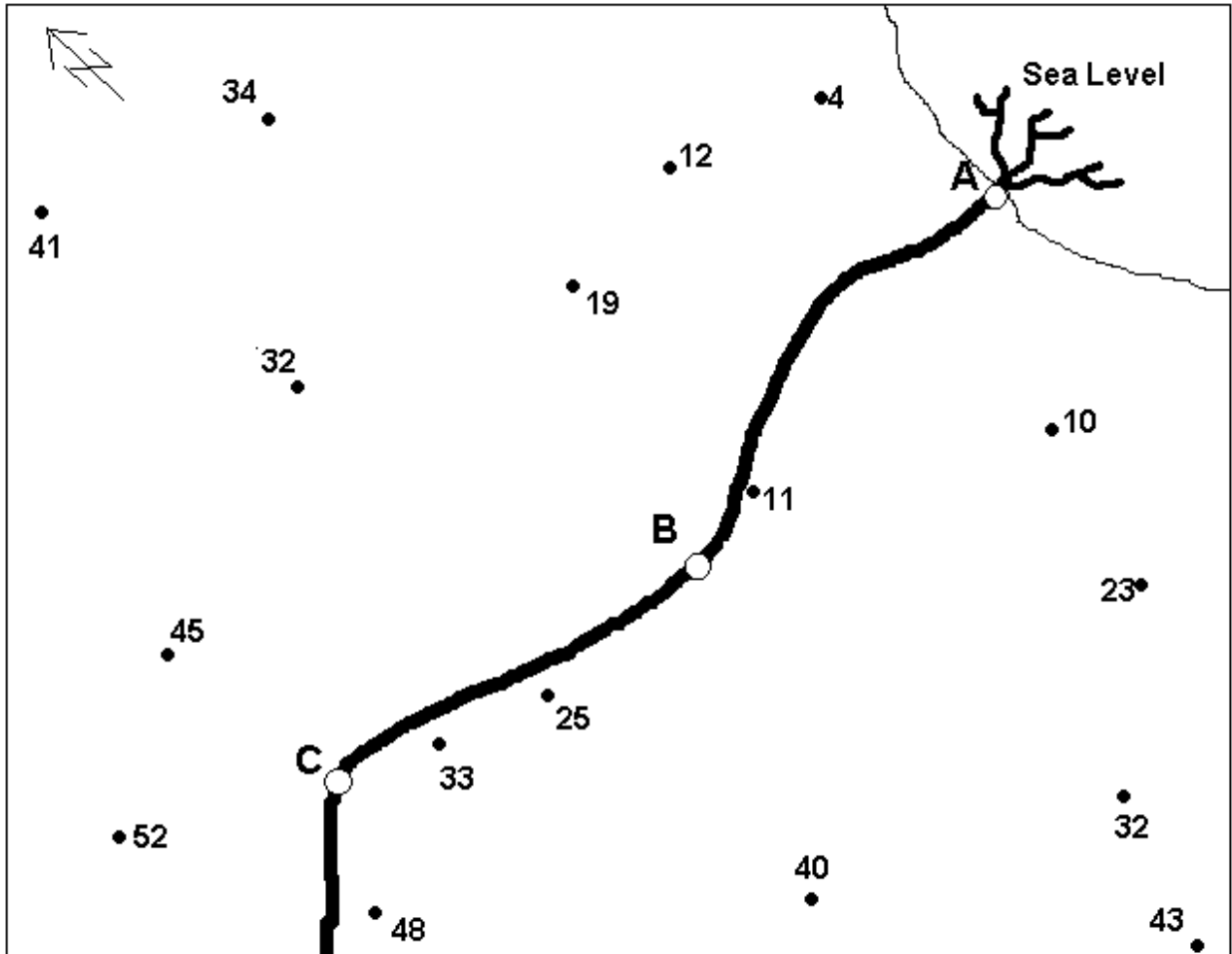
19. Construct a water table elevation map on the above diagram using a 10-ft contour interval.

20. Draw 2 flow lines on the map, one on either side of the river.
     Be sure to draw several arrows on each line to indicate direction of groundwater flow.

21. What is the approximate water table elevation at each of the points on the river?

     A _____ ft amsl   B _____ ft amsl   C _____ ft amsl

____22. Observe the contour lines from point A to point B and from point B to point C. Which
     of the following statements best describes the gradient.
               A. The gradient is steeper from A to B than from B to C.
               B. The gradient is steeper from B to C than from A to B.
               C. The gradient is the same from A to B and from B to C.
               D. The gradient cannot be determined from this map.

____23. Which direction is the river flowing?
        A. North   E. Northeast
        B. South   F. Northwest
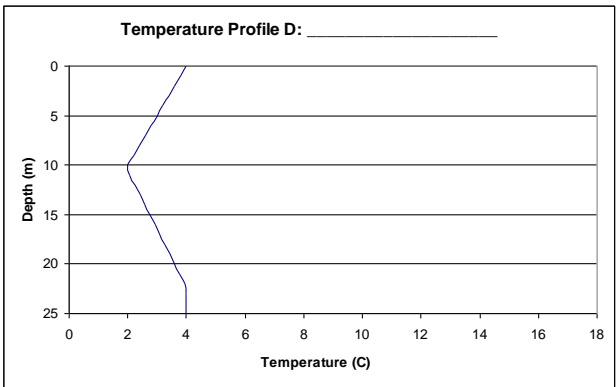   C. East   G. Southeast
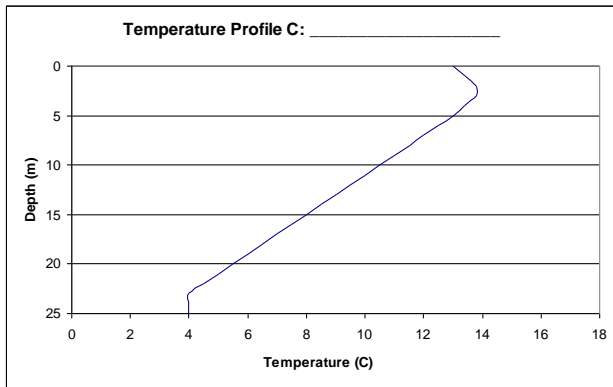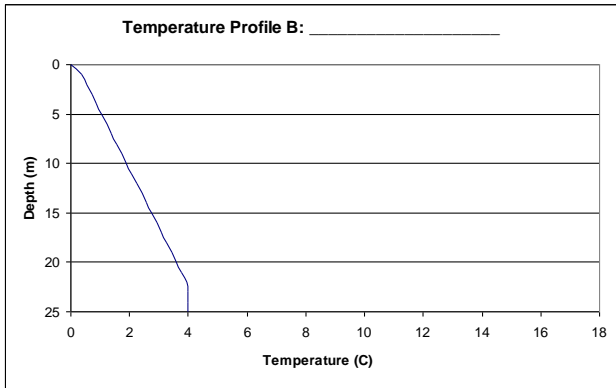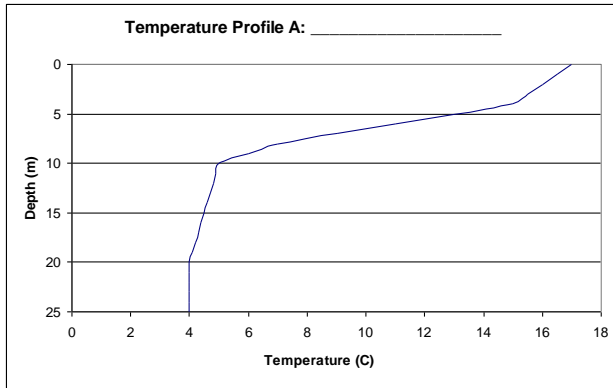   D. West   H. Southwest

Use the following cartoon of a lake cross section to answer questions 24-27.

water table
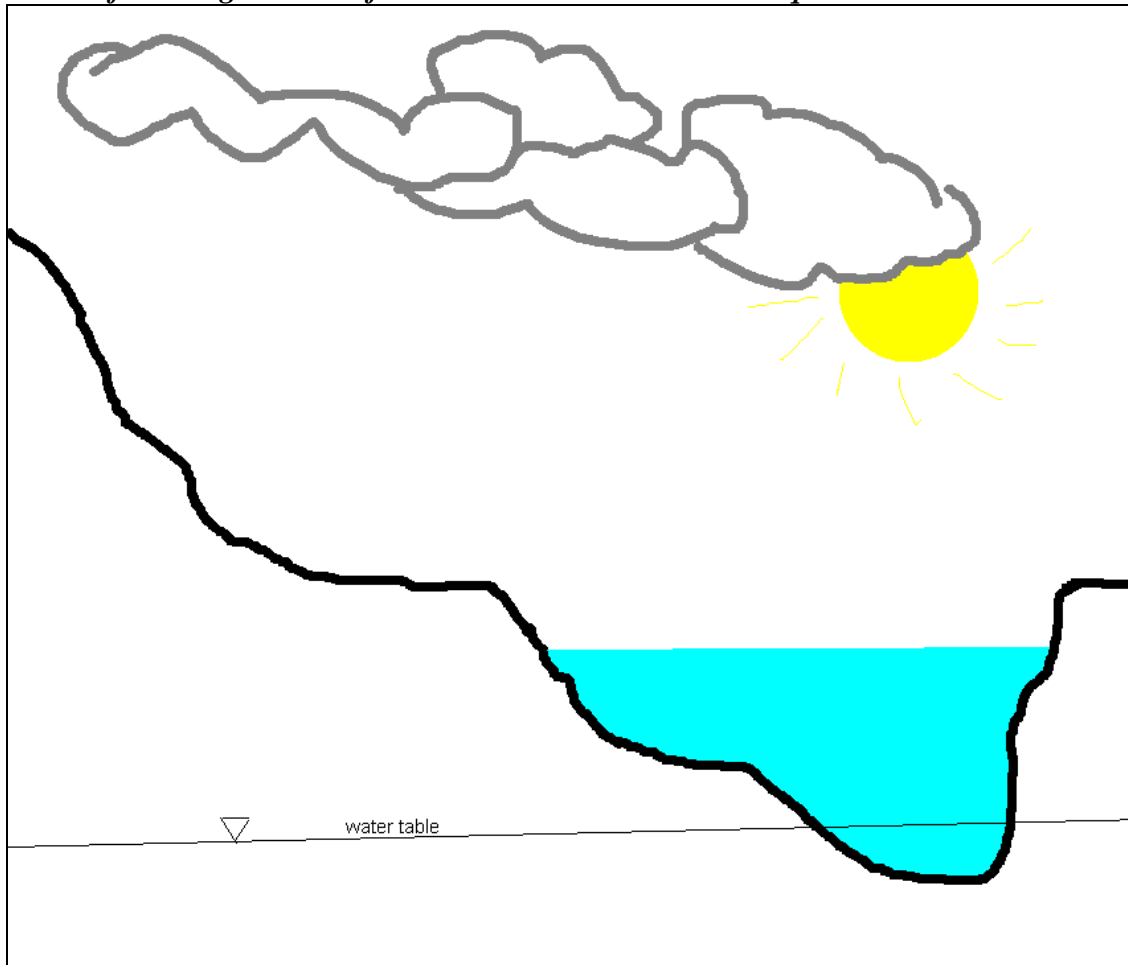
24. Considering the hydrologic cycle and the above cartoon, list inputs and outputs for this lake.

Inputs	*Outputs*

25. This lake is located in a temperate climate (similar to that here in Wisconsin).
     Below are four temperature profiles, one for each season. Fill in the title blank with the
     name of the season that corresponds to that profile (spring, summer, fall, winter).

Temperature Profile A: _____

Depth (m) / Temperature (C)

Temperature Profile B: _____

Depth (m) / Temperature (C)

Temperature Profile C: _____

Depth (m) / Temperature (C)

Temperature Profile D: _____

Depth (m) / Temperature (C)

26. Assuming this lake is in a rural area, name one likely source of pollution that may
contaminate the lake.

____27. The lake has high concentrations of calcium (Ca^{+2}) and magnesium (Mg^{+2}) ions,
        indicating it is a _____.
                A. hardwater lake
                B. softwater lake
                C. anaerobic lake
                D. eutrophic lake
                E. oligotrophic lake

Use the following diagram and description to answer questions 28-30.

Location of Proposed Dam
Approximate extent of reservoir created by dam
Approximate location of levees and structural supports
Areas with wildlife that may be affected by river changes

Community A is a larger city located near the headlands of the river that would like to build a hydroelectric dam which will create a large reservoir. Community B is a village located along a meander that is close to being naturally cut off from the rest of the river. They would like to add structural supports to stop this from happening and also put levees along the river to reduce their flooding risk. The farmers are an agricultural community that would like to drain the wetlands in order to have more land available for farming. Community C is a smaller city only a few feet above sea level and located near the delta.

28. Using the tables below, list 1 positive and 1 negative impact for the construction of the dam near community A, indicating which community/communities will be impacted by each of these.

Positive Impact of the Dam	Communities this will affect

Negative Impact of the Dam	Communities this will affect

29. Using the tables below, list 1 positive and 1 negative impact for the construction of the levees/support structure near community B, indicating which community/communities will be impacted by each of these.

Positive Impact of the Levees/Support Structures	Communities this will affect

Negative Impact of the Levees/Support Structures	Communities this will affect

30. Using the tables below, list 1 positive and 1 negative impact for the draining of the wetlands between the farmers and community C, indicating which community/communities will be impacted by each of these.

Positive Impact of draining wetlands	Communities this will affect

Negative Impact of draining wetlands	Communities this will affect