Name:_____

GIS in Water Resources Midterm Exam **Fall 2011**

There are 4 questions on this exam. Please do all 4.

1. Location on the Earth

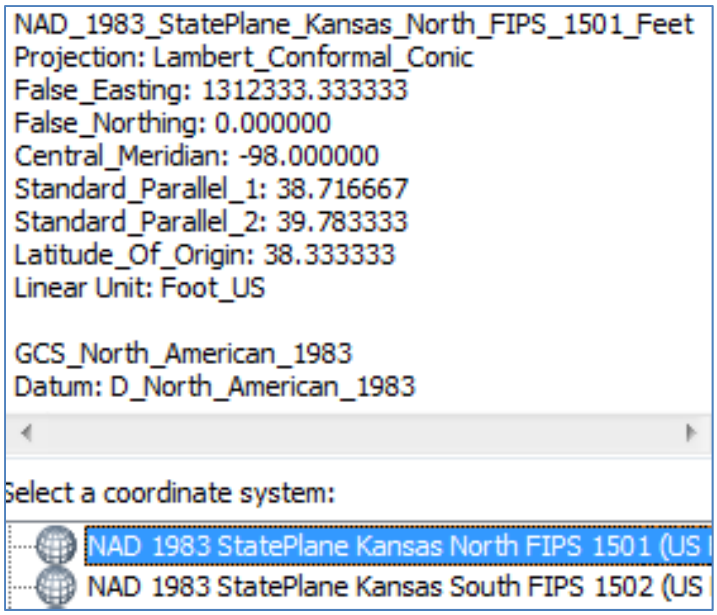
(a) Brownsville, Texas is located at (25º 55' 9"N, 97º 29' 25"W). If a line is drawn directly North from Brownsville, it will leave the United States at the 49th parallel, in northern North Dakota. Calculate the length of this line in km assuming a spherical earth with a radius of 6378 km.

(b) Define the term Longitude and use a diagram to illustrate your definition.

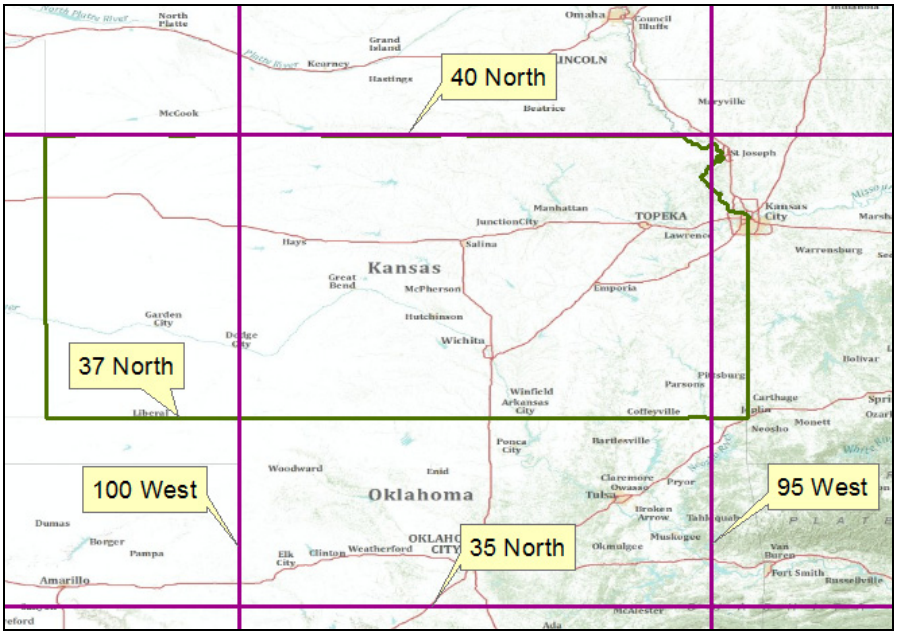
(c) Define the term Latitude and use a diagram to illustrate your definition.

2. ArcGIS as a Geographic Information System

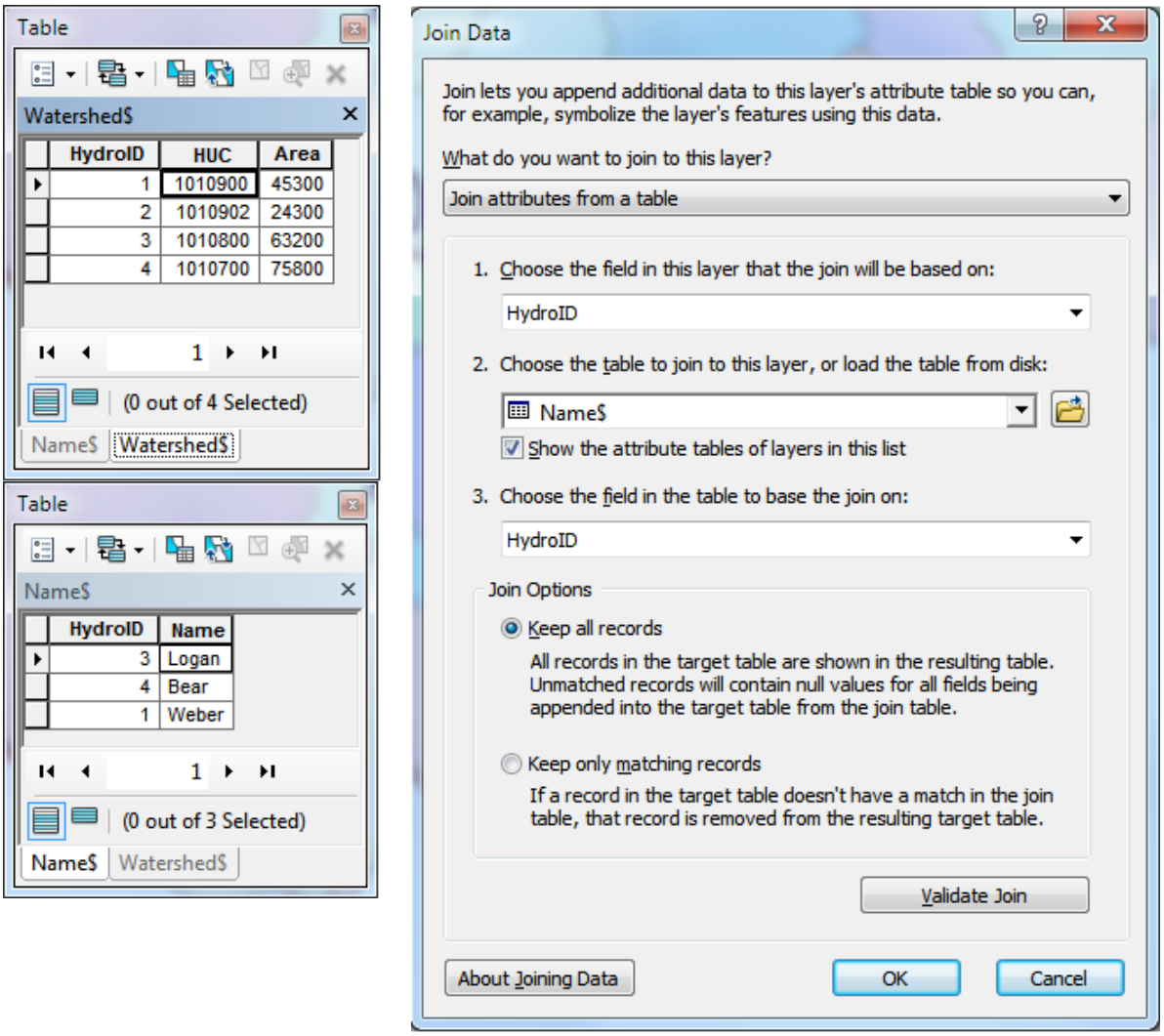
Here are the parameters of one of the zones of the Kansas State Plane Coordinate System. Beside each line in the table below, briefly explain what it means.



Draw the lines representing (ϕo, λo) on the map below and label their intersection with the numerical values of (Xo, Yo) in the projected coordinate system. Also, draw the standard parallels on the map. What happens along the standard parallels?



Consider the following two tables in ArcGIS and the **Join Data** operation illustrated operating on the table "Watershed$"



Give the full table that results from this join data operation

Give the Area of the watershed with name "Logan" in the joined table

3. Working with Raster Data

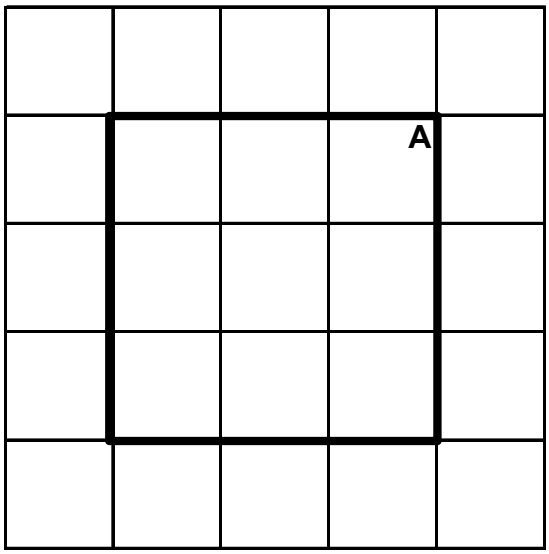
Following is a grid of elevations in a 200 m digital elevation model.

30	58	37	16	24
50	45	38	36	35
85	60	37	41	42
78	33	34	54	40
62	46	41	44	40

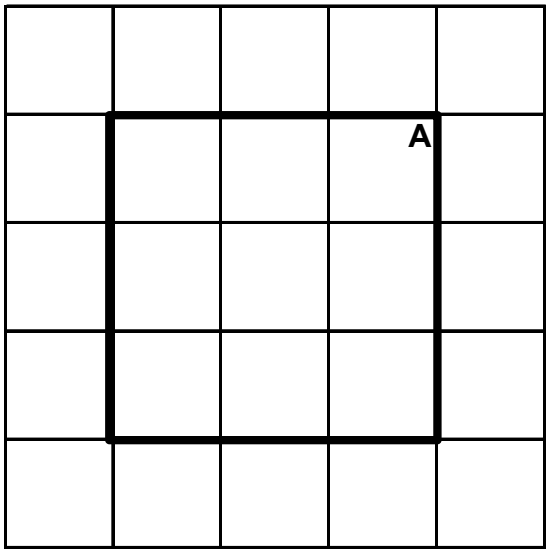
a) On the above grid, for the cells within the boldface highlighted box, determine **which grid cells are pits** and indicate the elevation to which they need to be raised to **fill** them.

b) For the inner block of 3 x 3 grid cells indicated by the bold box determine the **D8 flow direction** and indicate this using an arrow on the diagram below.

c) Calculate the **flow accumulation** for all grid cells in the inner 3 x 3 block indicated by the bold box. Write your answers (reported in terms of the number of grid cells flowing into each grid cell) in the diagram below. In this calculation do not consider inflow from any cells outside the boldface box. Indicate on the diagram the watershed draining into grid cell A and calculate its area. [Note grid cell size is 200 m x 200 m]



d) Assume that this is an area where the precipitation is elevation dependent. Assume an annual precipitation elevation relationship given by $P = 20 + 0.4\ z$, where z is elevation in m and P is precipitation in cm. Assume also that this is an area where the runoff coefficient is 0.25, meaning that 25% of precipitation appears as runoff and the balance is lost to infiltration and evapotranspiration. Calculate the depth in cm of **runoff generated** at each grid cell in the inner 3 x 3 box and write your answers on the diagram below. [note 1 cm = 0.01 m. Grid cell size 200 m x 200 m]



e) Describe how you would implement the calculation in (d) in ArcGIS.

f) Given your results in (d) calculate the volume of flow entering grid cell A. Report your answer in m^3.

[Note. These numerical values are artificial to reduce the problem to a scale where it is doable by hand. In reality, while the concept of precipitation related to elevation is sound, the value of 0.4 cm of precipitation increase for each m in elevation increase used in the equation above is unrealistic.]

4. Connecting Raster and Vector Data

(a) A geometric network has three basic components. Briefly explain what each of these consists of.

Geometry Model

Logical Model

Addressing Model

(b) When modeling the flow of water through the landscape, there are two basic approaches, each of which creates elementary areas and connects them in a flow sequence. Briefly explain each of them with a diagram

Raster Approach

Vector Approach

How are they connected in GIS?

In the United States, national coverage of the water features of the landscape is provide by the following datasets. Give a brief explanation of the contents of each dataset.

National Hydrography Dataset

National Elevation Dataset

Watershed Boundary Dataset

NHDPlus