Dynamic Planet Division C

This is the Dynamic Planet Division C test.

You may divide up this test, but if you do so please put your team number on every page.

You are allowed four double-sided pages of notes and two non-graphing calculators.

Good luck!

Section A.: 15 points _____ Final tiebreaker is score on this section

Section B: 15 points _____ Third tiebreaker is score on this section

Section C: 30 Points _____ First tiebreaker is score on this section

Section D: 25 Points _____ Second tiebreaker is score on this section

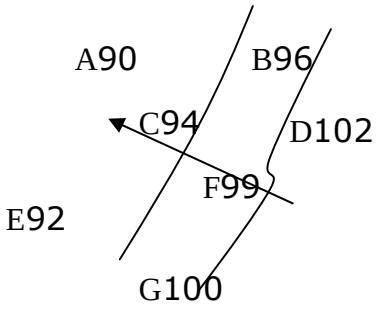
Section E: 15 points _____ Fourth tiebreaker is score on this section

Total: _____

A. Groundwater flow (15 points)

The table below shows eight groundwater gauges, giving the height above sea level and the gauge reading. Contour the resulting hydraulic head and show which way the groundwater is moving.

Site	Height above sea level	Watertable (feet below ground)
A	125	35
B	113	17
C	117	23
D	108	6
E	126	34
F	109	10
G	100	2



Key point is that the hydraulic head is the height of the water table relative to sea level. So one takes the height of the land and subtracts the depth of the water table to get the hydraulic head.

B. Important lakes/reservoirs (15 points)

For each of the following lakes (each one is one of the top ten lakes or reservoirs on earth in terms of volume or area), identify where it is (1 point) and how it was formed (2 points).

Lake Baikal: Siberia, old rift valley (tectonic)

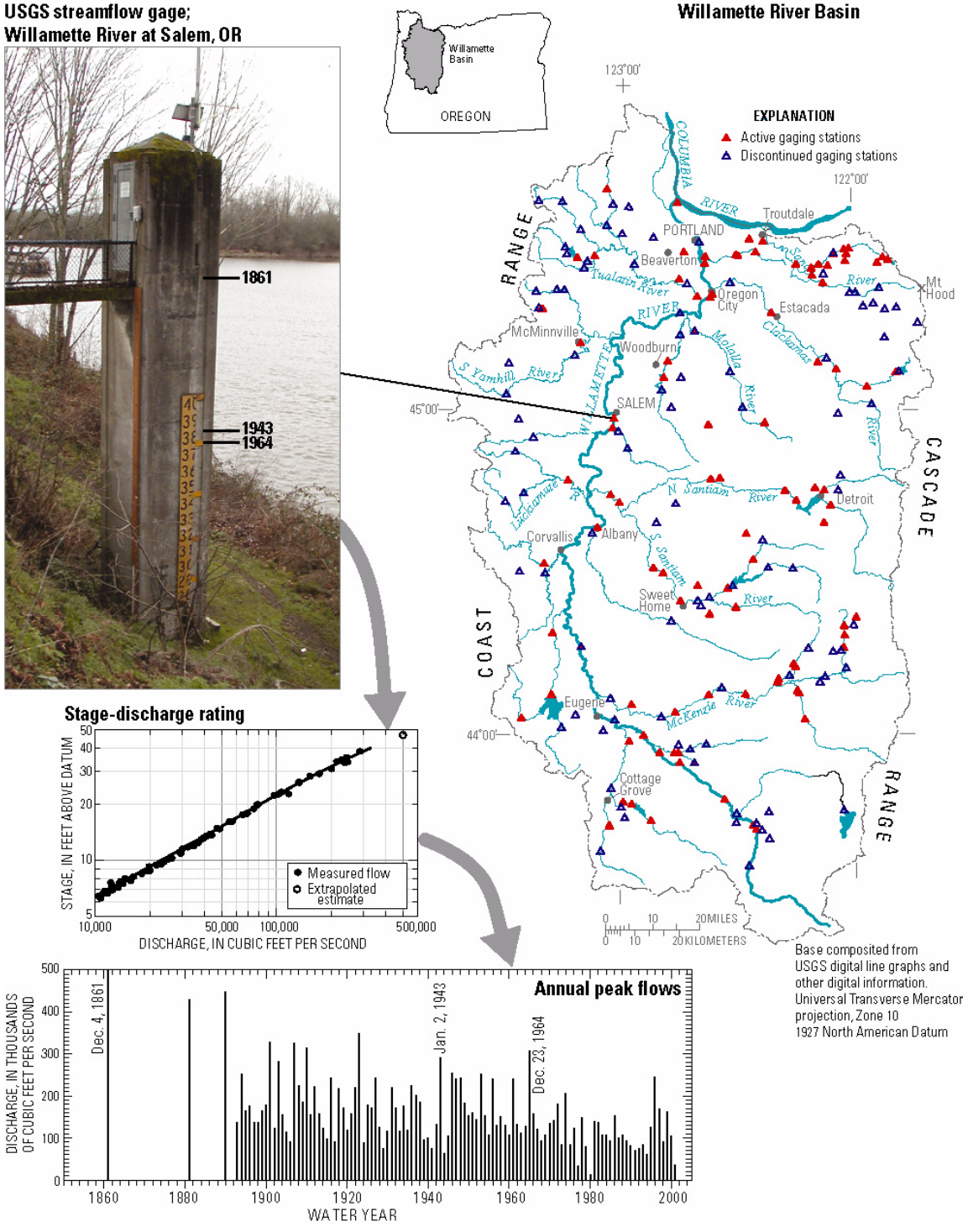
Lake Victoria: East Africa (Kenya/Uganda). Tectonic uplift.

Lake Michigan-Huron:Between US and Canada, Glacial scour.

Lake Vostok: Antarctica, subglacial lake.

Manicougan Reservoir: Canada, impact lake

Figure 2: From O'Connor and Costa, USGS Circular 1245



C. Floods (30 points)

1. What is the definition of a flood? (5 points)

A flood occurs when a river or stream overflows its banks.

2. Figure 2 shows a streamflow gage on the Willamette river at Salem Oregon. Estimate the drainage area in km^2 for this gage. (5 points)

The fraction of the basin that drains past this point is about 60km across and 80 km north to south, so between 4000-5500 km would be acceptable.

3. Suppose 5 cm of rain falls over this region and takes 1 day to drain away. Estimate the rate of discharge past Salem (note, 1 cubic meter is 35.3 cubic feet) and stage height (5 points)

Discharge 60,000mx80,000mx0.05mx35.3 cf/m^3/86400 sec=98,056 cfs

Stage height: About 20 feet.

4. Estimate the functional relationship between stage height and discharge. (5 points)

At 10 feet the flow is about 20,000 cfs, at 20 it is around 80,000 cfs and at 40 it is around 300,000 cfs. So a doubling of height leads roughly to a quadrupling of flow, so that

Discharge=20,000*$(stage/10)^2$

5. Estimate the height of the 30-year flood for this point for the 20^{th} century (5 points)

This is a somewhat tricky question, as the magnitude of the 30 year flood appears to decrease over the course of the century. However, it should have a volume of about 300,000 cfs corresponding to a height of around 40 feet.

6. What sort of drainage pattern is seen in this basin? How do you know? (5 points)

Dendritic. Looks like a branching pattern of tree roots and the streams join at high angles.

D. Short answer (25 points)

1. Will the sinuosity index of a river be higher or lower in regions of steep topography? Why?

Lower, because rivers on slopes tend to cut straight channels.

2. What is the difference between stream competence and capacity?

Competence is the largest material the stream can move, capacity is the maximum load of sediment it can carry.

3. What's the difference between porosity and permeability?

Porosity is the amount of void space in a sediment or rock, permeability is how easily water flows through it. Porous rocks may be more permeable, but they need not be- if the pores are closed they won't be.

4. How is a solution valley formed?

It occurs when several sinkholes merge to form a larger depression.

5. Why are tropical lakes more likely to become hypoxic than Arctic lakes?

In Arctic lakes, the surface ices over every year. Since freshwater is most dense at 4C, this means the lakes overturn, bringing oxygenated water to the bottom in both the spring and fall. In tropical lakes, this doesn't happen, and so organic matter can sink to the bottom and draw down the oxygen. Additionally (I gave credit for this) tropical lakes are warmer and so hold less oxygen.

Section E: Map interpretation (15 points each)

The topographic map below shows the Mississippi just south of Kellogg, MN. The solid contour interval is 20 feet. The dashed contour interval is five feet.

On this map identify the
A. Edges of the floodplain (The thick lines below, note that the floodplain is far broader to the west)
B. Areas of alluvium (All the land within the floodplain is likely alluvium)
C. Natural levees (if any), if not say so. (The hummocky area in the middle of the plot)
D. Thalweg (the dashed line down the main channel is the thalweg)
E. Back swamp