

1) (2.5 pts., 0.25 pts. ea.) Use the table below to indicate how the tidal current in an estuary such as Hood Canal moves at different tidal stages.

Tidal Phase	Flood	Ebb	Slack
a/ the surface layer between high & low tide			
b/ The surface layer at high tide			
c/ the surface layer between low & high tide			
d/ the subsurface layer between high & low tide			
e/ The subsurface layer at high tide			
f/ the subsurface layer between low & high tide			
g/ The surface layer at low tide			
h/ the surface layer over a period of several days			
i/ The subsurface layer at low tide			
j/ the subsurface layer over a period of several days			

- 2) (2.5 pt.) Answer the questions below about net estuarine circulation
 - a) (0.5 pts.) What drives the net estuarine circulation in the surface layer of an estuary (1h above)?
 - b) (0.5 pts. ea.) Name and describe the two processes that drive water from the subsurface layer of an estuary into the surface layer.
 - i)
 - ii)

- c) (1 pt.) What does the term "flushing" refer to when applied to estuaries? What drives the flushing process?
- 3) (4 pts., 0.5 pts.ea.) The diagram below shows vertical profiles of temperature, salinity, and density from Hood Canal during summer 2005.



- a) Label the thermocline, halocline, and pycnocline on the diagrams.
- b) What causes the change in temperature with depth?
- c) How does the change in temperature with depth affect the change in water density with depth?
- d) What causes the change in salinity with depth?
- e) How does the change in salinity with depth affect the change in water density with depth?

- f) Is the water column at this time and place stratified? Why or why not?
- g) About how deep is the "mixed layer?" What created the mixed layer?
- h) Is the water column at this time and place vertically stable? Why or why not?
- 4) (5.5 pts.) Answer the following questions about the differences between fjords and other types of estuaries.
 - a) (1.5 pts.) What are three characteristics of the shape and mode of creation of fjords that distinguish them from other types of estuaries?
 - i)
 - ii)
 - iii)
 - b) (1 pt.) How does the deep-water circulation in a fjord differ from that of other estuaries? Why?
 - c) (1 pt.) Are fjords strongly stratified? Why or why not?

- d) (1 pt.) How does the deep-water circulation in a fjord affect the amount of dissolved oxygen in its deep waters?
- e) (1 pt.) How does phytoplankton production at the surface of the fjord affect the amount of dissolved oxygen in its deep waters?
- 5) (4 pts.) List three examples of possible human or natural causes for the decreasing oxygen in the subsurface waters near the head of Hood Canal in recent years. For one of those possible causes, describe changes in human activities that could reduce or eliminate that cause.

a)

b)

c)

6) (1.5 pts.) List three approaches that regulators could use to get citizens to reduce their impact on oxygen in Hood Canal, and cite one advantage and one disadvantage of each approach.

a)

b)

c)