

GLACIERS

1. (2pts) Define a glacier:

2. (1pt) From an aircraft, how can you tell the difference between a snowfield and a snow-covered glacier?
3. (2pts) What is the relative size of Antarctica, Greenland, and the USA?
4. (2pts) What is the fundamental reason for the existence of a glacier, irrespective of climate? Like with everything else in geomorphology is a balance between two processes.
5. (3pts) Glaciers exist in the Sierra Nevada and reach down to about 10,000 feet. Glaciers in the North Cascades, Washington reach down to about 5,000 feet. Why the difference?
6. (7 pts) Name 2 end-member descriptions of a glacier using the thermal classification, name 3 topographic descriptors, give 1 dynamic descriptor, and 1 climatic descriptor (can not be the same as the temperature descriptor).

_____	_____
_____	_____
_____	_____
_____	_____

7. (3pts) So, if we found a relatively large glacier in the Wind River Range of Wyoming, what 3 descriptors would we use to describe it?
8. (2pts) What two descriptors would be used for a glacier that meets the ocean and shows looped moraines, which is evidence of periods of anomalously rapid motion?
9. (2 pts) Name the two descriptors used for an ice body that almost completely covers an island near the North Pole?
10. (3 pts) Please describe why the thermal classification is particularly useful or important?
11. (3pts) Name the two zones of a glacier and name the dividing line between them:

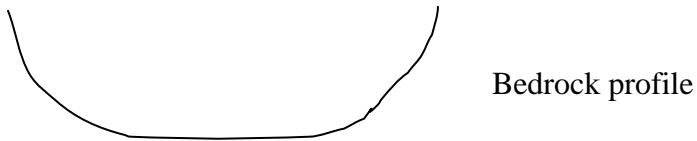
a. _____

b. _____

c. _____

12. (6pts) Draw the topographic profile of the glacier surface, ACROSS the glacier zone (not down the glacier) named in (a) and (b) above:

a. (this is from (a) above):



b. (this is from (b) above):



13. (2pts) Snow metamorphoses into ice. What is the metamorphic transitional stage called between snow and ice, and how is it defined?

14. (4pts) Name two ways glacier accumulate mass and name two ways glaciers ablate:

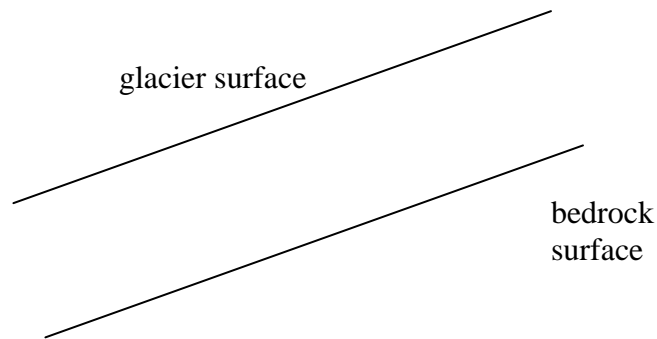
Gain mass: _____ Ablate: _____

Gain mass: _____ Ablate: _____

15. (5pts) For a glacier on Mount Hood, say, graph the mass balance versus time (one year) for a site in the accumulation zone, at the ELA, and one site in the ablation zone. Draw a separate graph for each site, and use the seasons (F, W, S, S) for time on the abscissa. Label all parts of all graphs.



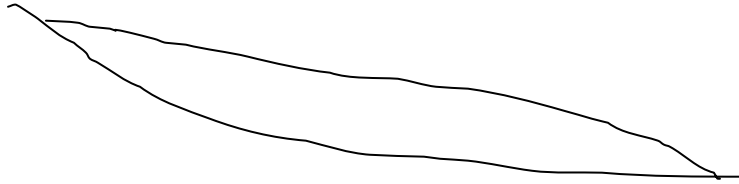
16. (5pts) In the lab on mass balance, we observed that the ELA was constant over a period of time when the glacier was receding. What does this say about the nature of equilibrium in natural systems?
17. (3pts) What does AAR stand for? Please define it, and briefly explain its usefulness.
18. (5 pts) Draw the force diagram for a glacier with an inclined surface at a constant slope and constant thickness lying on a parallel bedrock surface. Label all vectors. Be careful with this drawing such that the geometry of the vectors makes sense.



19. (3 pts) What is the equation for the shear stress at the bottom of a glacier? Define each term and include units. Show that the units work out.
20. (5pts) Explain how glacier flow is rheologically different from water flow. Use the stress-strain diagrams to help in your explanation and illustrate your knowledge.



21. (3pts) On the longitudinal (down glacier) cross-section of a glacier show the flow lines in the ice and direction of movement. Include the position of the equilibrium line for reference.



22. (4 pts) How do glaciers flow down slope? That is, what two mechanisms exist? Do all glaciers flow this way? What is the relevance to landscape modification?

Flow processes: a. _____; b. _____

23. (6pts) Do all glaciers utilize both flow mechanisms, why? What is the relevance to landscape modification by glaciers? Explain how landscape modification might differ.
24. (6pts) Describe in pictures and words the regelation process, which controls the movement at the base of the glacier. Include directions of ice flow, water flow, and heat flow. Also explain, in words, the order of the thermodynamic processes. That is, what happens first, then what happens second, and so on?
25. (9 pts) A glacier cross-section can be divided into 3 main zones, supraglacial, englacial, and subglacial. Identify the hydraulic features (components) that govern water flow in each zone as covered in class.
26. (5pts) For the subglacial system describe the hydraulic mechanics of the two main systems that route most of the water flow. That is, how can they stay open under hundred's of meters of ice? Clue: Till is not one of the systems.
27. (5pts) Describe the relevance of subglacial hydrology to glacier motion including surging.
28. (5pts) Using the regelation diagram, what part of the bedrock is subject to abrasion and what part is subject to plucking? Briefly describe why. Redraw the diagram here to make your answer clear.
29. (3 pts) Name 3 processes that affect the rate of glacial abrasion?

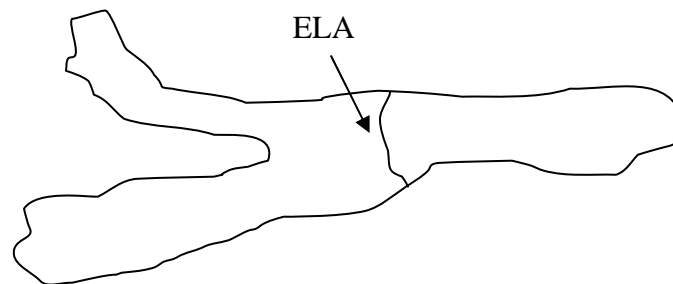
a. _____

- b. _____
- c. _____

30. (3pts) What is the relevance of basal hydrology to glacier erosion and deposition?

31. (4pts) How are U-shaped valleys formed? Be specific.

32. (4 pts) On the plan view of a glacier with two tributaries glaciers feeding into it. Draw the location of a terminal, medial, and lateral moraine. Include the equilibrium line to illustrate the relation between the position of that line and the formation of lateral moraines.



33. (5 pts) How are terminal and lateral moraines formed and what controls their size?

34. (3pts) What are the sedimentological characteristics of terminal and lateral moraines?

35. (4 pts) Lakes typically form in front of glaciers in the Cascades. Glaciers advance, form a moraine. During the time of maximum extension, the glacier erodes a basin and the glacier retreats and the basin fills with water forming a lake. The glacier re-advances to near its maximum extent forming a second moraine on the glacier-side of the first moraine. How would the sedimentological characteristics of the two moraines differ?

36. (4pts) How can terminal moraines be used to infer past ELAs? (with previous positions of ELA, we can infer past climate) Use the concepts of ELA and AAR to structure your answer.

37. (2pts) How can lateral moraines be used to infer past climates?

38. (4 pts) What is the potential problem in using a set of terminal moraines from the same glacier to define the sequence of past climate changes?

39. (6 pts) Within the ground moraine, several tills exist. Please briefly describe the formation process of each kind and include a sedimentological characteristic that helps to distinguish each:

- a. Lodgement Till

 - b. Ablation Till:

 - c. Outwash Till:
40. (4pts) Eskers are connected with which subglacial hydraulic system? Briefly explain how the two may be related and what processes form an esker.
41. (6pts) Define a kame terrace. On what basis could it be confused with a lateral moraine? What sedimentological characteristics distinguish it from a lateral moraine?
42. (1pts) Define erratic (the rock).
43. (2pts) Define drumlin.
44. (2pts) Define flute
45. (2pts) Define kame.
46. (4pts) Describe the processes involved with the formation of a cirque basin.
47. (3pts) What is loess, where is it often found, and what is its connection to glaciation?