50 points total
(1 point per minute is a good pace, but it is good to have time to recheck your answers!)

1. a) Where in a water flow is there usually a zone of laminar flow even if the bulk of the water is turbulent? (1 point)

b) Why is it laminar? (1 point)

2. List one thing that each of the following characteristics could tell you if they were present in a sandstone. (4 points total; 1 point each)

   a) grains are well sorted

   b) grains are poorly sorted

   c) grains are coarse sand

   d) grains are silt sized

3. What property of clay minerals makes consolidated mud more difficult to erode than sand? (1 point)

4. What mineral do you predict makes up the most sand in almost every environment? Why? (2 points)

5. Two rivers in Costa Rica have different concentrations of suspended sediment; one has a concentration that is high enough that the water is brown, whereas the other river has a very low concentration, and the water is clear. The two rivers merge in a mountainous area that is heavily forested (see projected photo). What are two reasons that the concentration of suspended sediment might be different in the two rivers? Be sure to include whether each process would promote high or low suspended sediment concentrations. (4 points)
6. What are two conditions that results in laminar flows that transport large volumes of sediment, and what characteristics of each flow make it laminar? (4 points)

7. In the following sketch of a subaqueous dune, sketch and label the features listed below.
   a) The separation and attachment points of the laminar/viscous sublayer (2 points)
   b) The areas where deposition occurs (1 point)
   c) The areas where erosion occurs (1 point)
   d) The internal cross stratification within the dune. Include both the cross beds and the erosion surfaces separating sets of cross stratification. Make sure the geometry of the internal cross stratification corresponds to the other areas labeled. (2 points)
8. On the following picture of cross stratification, some of the laminae and erosional surfaces have been outlined.

a) Label at least 2 erosional surfaces in the part labeled B. (1 point)

b) What direction(s) did the water flow for part B? (1 point)

c) Was part B deposited by ripple or dune migration? Why? (2 points)

d) Assume that the lamination in part A is upper planar lamination. How did flow speed change through time? Why? (2 points)

e) The cross lamination sets in part B are not even in thickness nor do the laminae have constant dips. What do these features imply about the shape of the bedforms and the direction of flow relative to the orientation of the rock surface? (3 points)
9. Answer the following questions about this stratigraphic column.

a) How did the velocity of the flow change through time from 0 to 80 cm? What are at least 2 features that allow you to make this interpretation? (3 points)

b) Which part of the deposit was deposited quickly and which part was deposited slowly, in relative terms? (2 points)

c) Describe the flow characteristics that generate this type of deposit, including the early stages of flow before deposition. (3 points)
10. The following stratigraphic column represents a sequence of rocks deposited during a change in depositional environments. First there was erosion of igneous rocks; then rocks were deposited in environment #1, which gradually changed to environment #2.

a) Next to the stratigraphic column, interpret the processes that deposited the sediment for environments #1 and #2. Please include the way sediment was transported (i.e. bedload, suspension, in a laminar/turbulent flow, by wind/water/ice) and how it was deposited (i.e. by migration of a bedform, settling out, etc.). (4 points)

b) Draw a simple sketch that illustrates the processes that deposited the sediment in both environments and shows the spatial relationship among the two environments and the erosional area, i.e. where they were located relative to each other. (Remember that Walther’s Law says that environments that grade into each other vertically in a stratigraphic section occur next to each other.) Label the environments on your sketch (erosion, #1 and #2). Make sure that the processes that you described in part a are included in your sketch! (6 points)