GEOL 106 Writing: Mass Wasting - KEY

Name _____

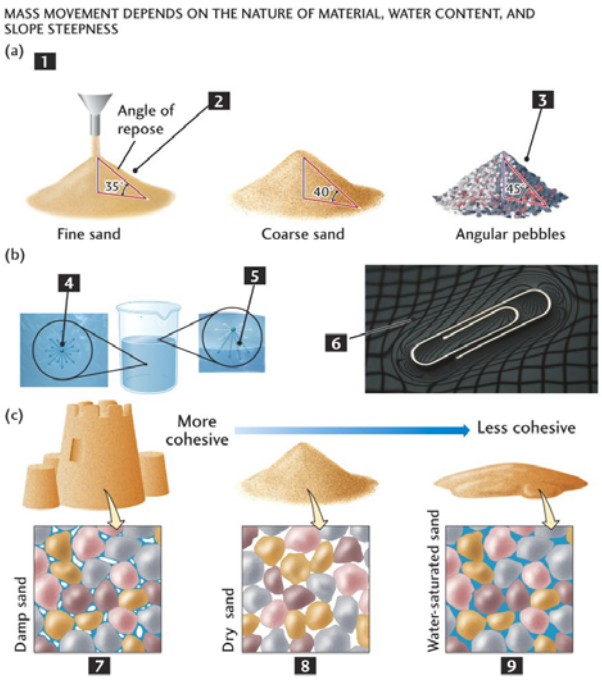
Due Monday Feb 25.

1) All other things being equal, steepness of slope increases mass wasting. Explain based on Fig 8.2 (use the relative effect of shear stress and friction). Why must some slopes be very steep before much mass movement occurs (think of the nature of the Earth material)?

As slope gets steeper, the shear stress component get larger relative to the friction component, leading to failure. Consolidiated slopes can be very steep before they fail, whereas unconsolidated slopes usually fail at less steep angles.

2) What is angle of repose?

Angle of repose is the steepest angle that unconsolidated material naturally rests.



3) How does angle of repose vary with grain size? Grain shape? Grain sorting?

Angle increases with increasing grain size.

Angle increases as grains become more angular.

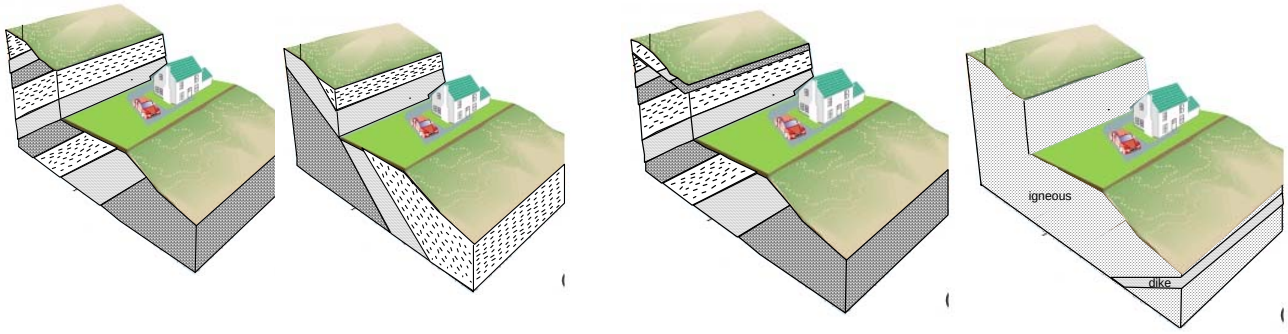
Angle increases with as size sorting decreases.

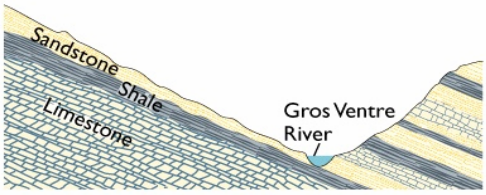
4) The role of water in mass wasting is somewhat complex. How can water reduce the likelihood of downslope movement? How can water increase the likelihood of downslope movement? How does angle of repose vary with water content? Use the terms friction and shear stress.

If water does not saturate pores between grains, it can bind grains together by surface tension. If a fairly wet sediment dries out, it can become less stable (e.g., if a sand castle dries out). If a sediment becomes too wet, slopes can fail due to lubrication as pore pressure gets too high, and the shear stress overcomes resistance by friction. Very wet sediment angle < slightly wet sediment angle < very wet sediment angle.

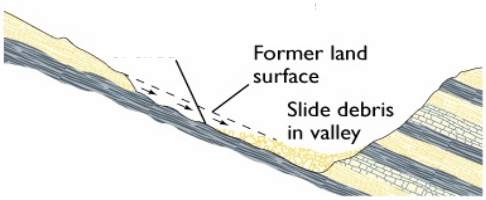
5) Which home(s) would you rather buy? Why? Consider dip of bedding planes, fault plane, slope, nature of Earth material. Rocks in A-C are consolidated sedimentary rocks.

I'd rather buy A or D. The slope behind A should be relatively stable because the bedding planes of the sed rocks dip away from the slope, although rockfall is more likely than in D. The slope behind D should be relatively stable because the slope is composed of igneous rock which doesn't seem to be faulted or jointed. The slope behind B is set to fail because the bedding planes dip toward the slope. The slope behind B is set to fail because although the bedding planes dip away from the slope, a fault plane dips toward the slope. Note that in all case, the very steep artificial cut of the slope could lead to dangerous rockfall.





(a) Before slide



(b) After slide

6) Examine the sketches of the 1925 Gros Vente ("grow vant") landslide.

A. How did the structural geology (how do rock beds dip relative to the slope?) and the rock types influence the likelihood of a slide?

The rocks dip to the right, and left-most slope failed because the dip parallels the slope. The contact between the sandstone and shale provided a surface along which the sandstone could easily slide.

B. How did water affect this slide? Consider both rainfall/snowmelt and the location of the river. What cut off the "toe" of the slope?

Rainfall and snowmelt lubricated the base of the slide (sandstone/shale interface). The sandstone could also slide easily once the "toe" of the slope was eroded by the river.

C. Why did the structural geology dictate that the slide would move left-to-right (in the sketch) as opposed to in and out of the page or right-to-left?

The right-most slope did not fail because these rocks dip away from the slope.

D. How and why did the landslide flood the upstream valley? Why did a catastrophic downstream flood occur later?

Debris from the slide dammed the Gros Ventre river, flooding the upstream valley. Once water spilled over this dam, it quickly began to erode the unconsolidated rubble, causing the dam to catastrophically fail and flooding to occur downstream.

7) How should mass wasting play into human decision making? What about construction of roads, dams, businesses and homes? Cutting of forests on steep slopes? Zoning? Insurance?

We should avoid building in areas prone to slope failure, especially catastrophic failure, because the costs in lives and money can be avoided by doing so. Taking this step requires education of the public and policymakers. Land use regulations and zoning could prevent building in the wrong places. Cutting of forests or creating steep slopes can destabilize slopes, and the extent depends on the geology of a particular site. Insurance companies could adjust rates based on the potential for slope hazards.

8) What conditions are needed for a mudflow (or lahar) to form? Consider slope, material, and likely triggers.

Unconsolidated fine particles and water from rain or snowmelt. Volcanic eruptions in high altitude mountains covered with ash under snow often produce rapid snowmelt and the resulting mudflows are called lahars.

9) What evidence would suggest that a mountainous area had undergone recent landslides?

Poorly vegetated scars where the slide turned loose. Deposits of fine to very coarse or mixed particle size material at the base of the slope where the flow lost energy.

10) What role do earthquakes play in the occurrence of landslides?

Earthquakes are commonly triggers, providing the energy to cause a slope to fail.

11) How does vegetation affect the occurrence of landslides?

Vegetation can stabilize some slopes because roots bind unconsolidated soils. However, roots may not reach deep enough, so slopes can fail below the root zone. Trees may also add to the slope mass, aiding failure.