GLY 4734/6932 - Coastal Morphology and Processes
Alongshore Sediment Transport

March 14, 2019

Names: Solution key Group: ____________________

1. Describe how each of the following changes as wave angle changes:

   (a) Alongshore component of wave energy density (E_y)
   1 pt for identifying positive relationship

   (b) The ratio of distance between wave rays at breaking to distance between wave rays when they reach the shore (W_{break}/W_{shore})
   1 pt for identifying negative relationship

   (c) Sediment flux
   1 pt for identifying positive relationship up to 45° and negative to 90°

2. Describe how each of the following changes as wave height changes:

   (a) Alongshore component of wave energy density (E_y)
   1 pt for identifying positive relationship

   (b) The ratio of distance between wave rays at breaking to distance between wave rays when they reach the shore (W_{break}/W_{shore})
   1 pt for identifying no change

   (c) Sediment flux
   1 pt for identifying positive relationship

3. How much alongshore sediment transport potential exists when wave angle is 0? Why is this?
   1 pt for identifying no potential; 1pt for rational - there is no alongshore component of wave energy to drive alongshore transport

4. How much alongshore sediment transport potential exists when wave angle is 90? Why is this?
   1 pt for identifying no potential; 1pt for rational - the alongshore component of wave energy is spread across an infinite stretch of shoreline (1/2 pt for "no interaction with the shore")

5. What wave angle would you expect to yield the highest alongshore sediment transport? Why?
   1 pt for identifying 45 °; 1pt for rational - maximizes the competition between the alongshore component of wave energy and the spread of wave energy

6. Recall that alongshore sediment transport is primarily driven by wave-generated alongshore currents. Komar (1971) used this relationship to define the volumetric alongshore sediment transport potential (Q_s) as follows:

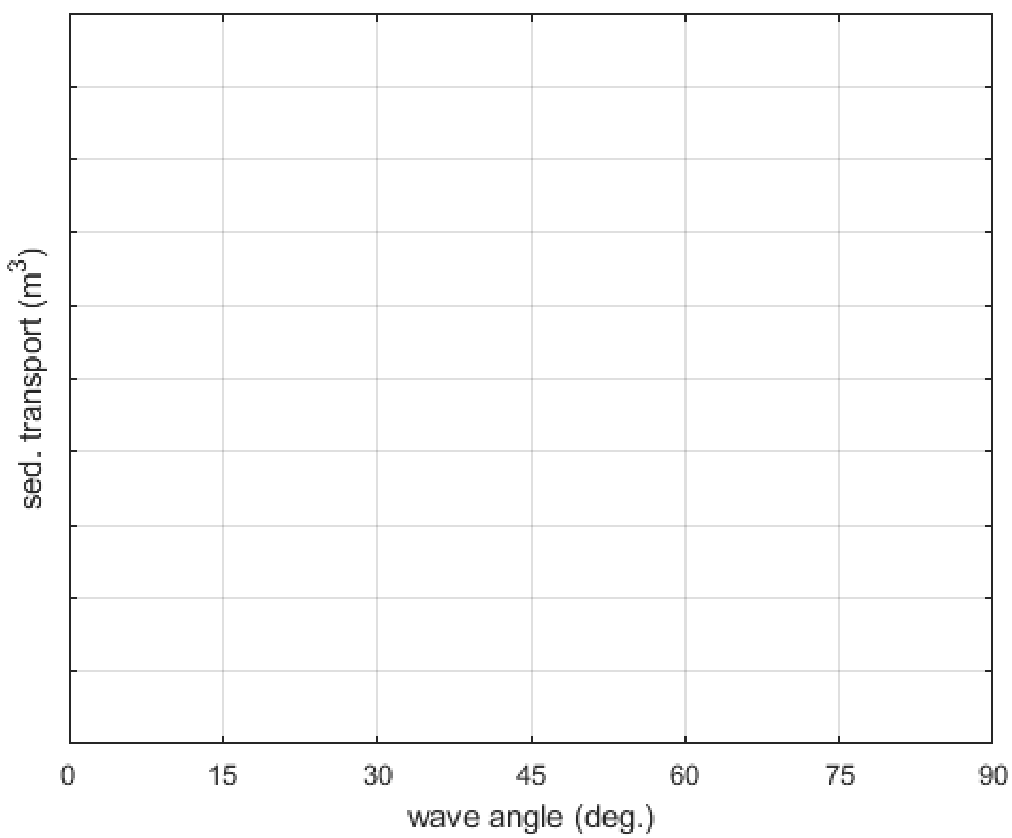
$$Q_s = K_1 H_b^{5/2} \cos(\alpha) \sin(\alpha)$$

where K_1 is an empirical constant, H_b is the breaking wave height, and α is the angle of the wave crest relative to the shoreline.

   (a) What does $\cos(\alpha)$ represent in this formula?
   1 pt for "spread of wave energy" or "ratio of W_{break}/W_{shore}"

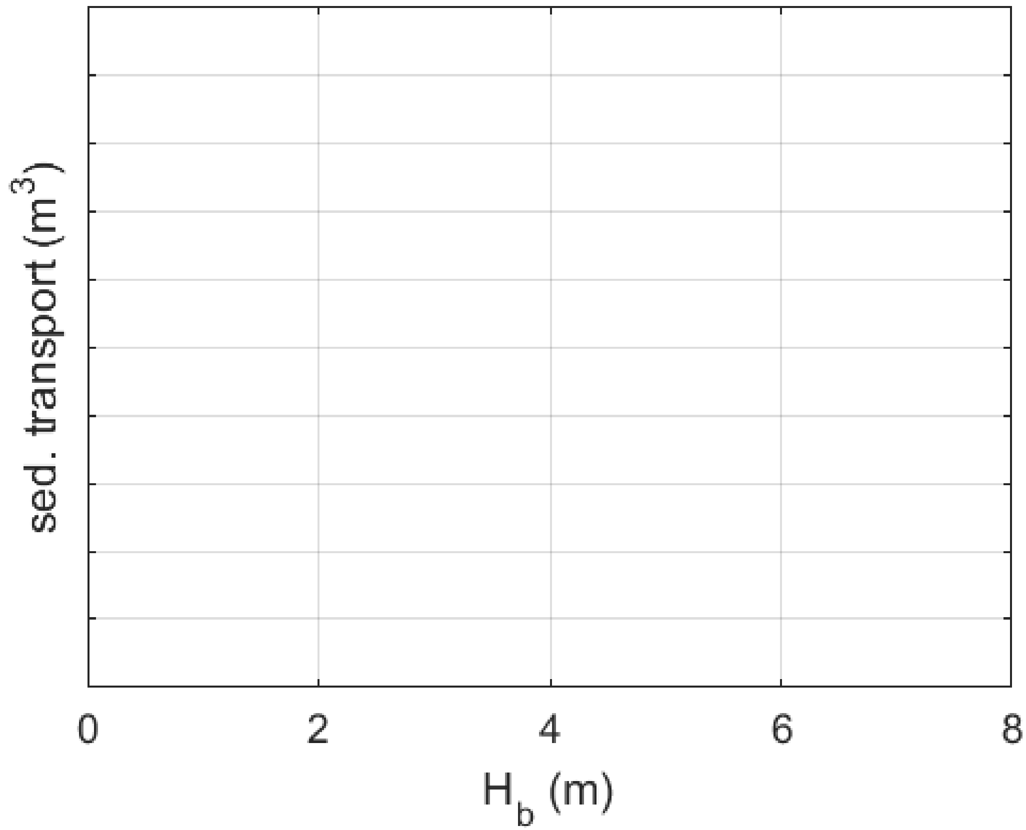
   (b) What does $\sin(\alpha)$ represent in this formula?
   1 pt for alongshore component of wave energy density"

7. Use the diagram below to illustrate the relationship between alongshore sediment transport potential and wave angle when all other variables are held constant.



1 pt for a downward parabolic figure

8. Use the diagram below to illustrate the relationship between alongshore sediment transport potential and breaking wave height when all other variables are held constant.



1 pt for a positive relationship; 1 pt for 5/2 relationship

References

1. Ashton, A., Murray, A. B., & Arnoult,. O. (2001). Formation of coastline features by large-scale instabilities induced by high-angle waves. Nature, 414(6861), 296.

2. Komar, P. D. (1971), The mechanics of sand transport on beaches,J. Geophys. Res.,76, 713721.