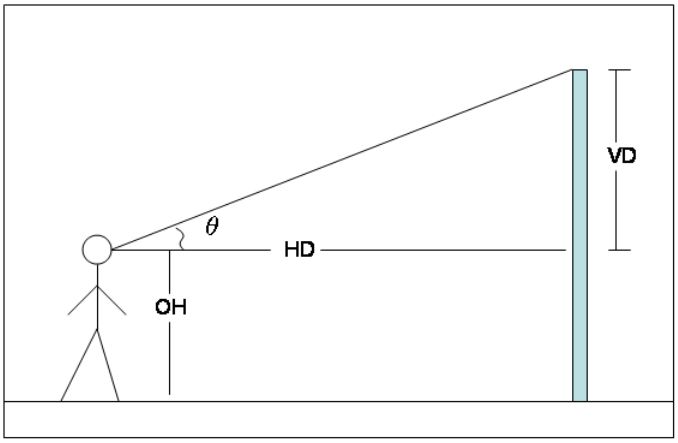
ES302 Quantitative Methods **NAME_____**
Applied Geologic Problem Solving Using Trigonometric Solutions

Task 1 – Measuring Heights of Objects

Heights of objects in the field can be measured using a tape, clinometer and tangent function.
The trigonometric relations are shown below.



OH = ocular height of persons eyes from ground surface, VD = vertical distance from eyes to top of object, HD = horizontal distance from eyes to object, θ = angle of inclination between eyes and top of pole using a clinometer:

$\text{Tan } \theta = VD / HD$ Total Height of Object = OH + VD

1. Your job is to measure the height of a cliff face in the field. Your ocular height is 1.8 meters, and you are standing 50 meters due west of the cliff face. Using a clinometer, you sight an angle of 18 degrees through the view finder. Draw and label a sketch of the relationships in the space below, label your diagram with West to the left and East to the right.

Using the Tangent function relationships shown in the diagram / equations above, determine the total height of the cliff face, from base to top, in feet and meters. Show all of your math work, and fill in the answer slots below.

OH = _____ feet HD = _____ feet $\theta =$ _____ degrees VD = _____ feet

Total Cliff Height = OH + VD = _____ feet = _____ meters

Task 2. Geologist Word Problems

2. Your job as a geologist is to drill vertical test boring to a tilted 100 ft thick Eocene sandstone bed on the perfectly flat desert plains of Saudi Arabia. Before you begin drilling, it is essential to know the depth at which the top of the sandstone bed will be first encountered. The sandstone bed outcrops along a road cut at point A, located 5 miles due west of the drilling site. The attitude of the bed is such that the strike is 0 degrees, and dip is 20 degrees tilted towards the east from point A. The surface elevation at point A is 600 ft above sea level. Draw and label a cross-sectional sketch below, showing the geospatial-distance relationships of the scenario.

    a. Using a trigonometric solution, determine the depth at which the top of the sandstone bed will be encountered with the drill bit. Answer in feet and meters. Show all of your math work.

    b. What will be the elevation of the top of the sandstone bed, relative to sea level, answer in feet? Show all of your math work.

    c. Calculate the anticipated depth to the top of the sandstone bed, assuming constant strike / dip and surface topography, if a second vertical drilling site at Point C is set up 1 mile due south of Point B. Draw and label a sketch showing the geospatial-relationships between the three points A, B, and C. Show all of your math work in determining the depth of drilling at pt. C.

    d. The unit cost of drilling a test boring to the top of sandstone at Point B is $250 per ft, including equipment and labor. What is the total estimated cost of drilling the bore hole from surface to top of sandstone? Show all of your math work.

3. Points X and Y are located on a map with the following UTM Easting and Northing Coordinates, in projected cartesian coordinate system:

X =	350,500 meters E.	Y =	352,800 m E.
	4,400,500 meters N.		4,402,800 m N.

Draw a map sketch showing the geospatial-distance relationships, include a north arrow. Using a trigonometric solution, determine the azimuth compass bearing direction from point Y to point X. Show all of your math work.