KEY
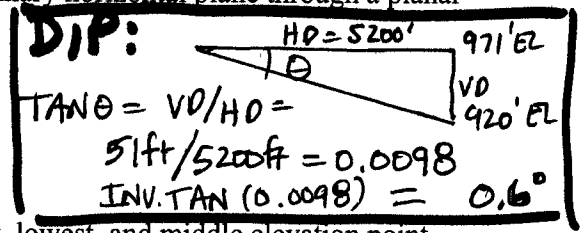
G302 In-Class Exercise
Determining Strike and Dip of Coal Bed from a Topographic Map (3-Point Problem)

The attached topographic map is from the California, PA 7.5-minute quadrangle. The map displays topography plus landuse information, including the location of mine entries. Three mine entries are circled on the map, located near Crescent Heights (east-central), Oak Grove (west-central), and Maple Glen (southwest). The mine entry points represent horizontal tunnels that enter the Pittsburgh Coal seam, a 6-ft thick coal bed that has been extensively mined in the southwestern PA area for use in the steel and energy industries. Your task is to use the elevations of the three mine entries to determine the strike and dip of the Pittsburgh Coal bed in the map area. Remember the definition of strike and dip:

> Strike: the azimuth bearing of a line formed by passing an imaginary horizontal plane through a planar bed of rock (i.e. a line of constant elevation)

> Dip: the inclination of the bed, measured perpendicular to strike

DIP:
$$HO = 5200' \quad 971' EL$$
$$\theta \qquad VD \quad 920' EL$$
$$TAN\,\theta = VD/HO =$$
$$51ft / 5200ft = 0.0098$$
$$INV.TAN\,(0.0098) = 0.6°$$

Steps to complete problem:

(1) determine the elevations of each mine entry; identify the highest, lowest, and middle elevation point.
(2) draw three lines between each entry point (will make a triangle)
(3) calculate the total distance between the highest and lowest elevation points
(4) calculate the total relief between the highest and lowest elevation points
(5) calculate a gradient conversion ratio by dividing total dist (item 3) by total relief (item 4)
(6) determine the relief between the middle elevation point and the lowest elevation point
(7) assuming a constant dip (bed gradient) calculate the distance to the intermediate elevation along the line between the highest and lowest elevation points
   a. multiply item 6 x item 5
   b. measure the resulting map distance from the lowest elevation point, along the line between low and high. This will mark the interpolated middle elevation between the low and high points.
   c. Draw a line connecting the middle elevation point and the interpolated point on 7b above; this is a line connecting points of equal elevation on the coal bed, thus is your strike line
(8) Determine the azimuth bearing of your strike line
(9) Now draw a strike line parallel to the original line in 7 above, and have it intersect the highest elevation mine entry point. (you now have two strike lines drawn parallel to themselves, one through the middle elevation point, and one through the high elevation point).
(10)   Now calculate the angle of dip between the two strike lines by using Tan(dip) = rise / run = V/H = change in elevation / horizontal distance (as measure perpendicular to the strike lines)
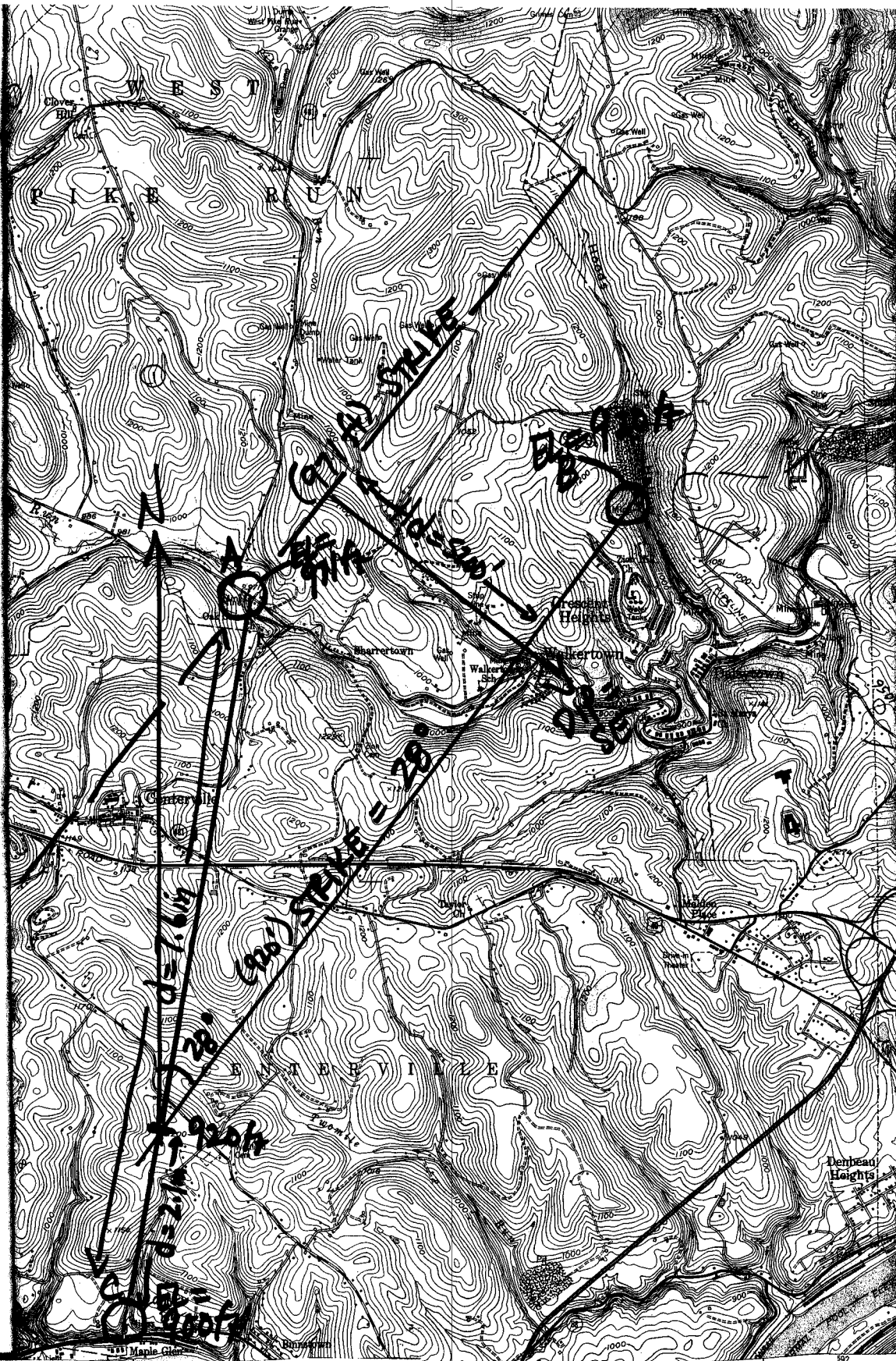
STRIKE:

Place your answers in the spaces below:

971' Elevation of highest mine entry point   "PT A"

920' Elevation of middle mine entry point   "PT B"

900' Elevation of lowest mine entry point   "PT C"

28° Strike Azimuth Bearing

SE Dip Direction

0.6° SE Dip Angle (degrees)
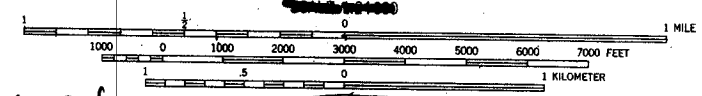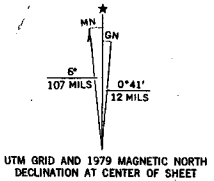
① MAP DISTANCE
$$\overline{AC} = 7.6 \text{ inches}$$

ELEV DISTANCE
② $$\overline{AC} = 971 - 900 = 71 ft$$
$$7.6 \text{ in} = 71 ft$$

③ MAP GRADIENT

DISTANCE FROM PT C 900 ft TO EL 920 ft =
$$\frac{7.6 \text{ in}}{71 ft} (20 ft) = 2.14 \text{ in}$$

④ 920 ft ELEV. IS 2.14 in NORTH of "PT C"

WEST

PIKE RUN

ENTERVILLE

Denbeau Heights

N

STRIKE

(10 ft) STRIKE = 29

$d = 1.6$ km

28°

920 ft

$d = 2.1$ km

Calc = 1100 ft

CI = 20 ft

MN
GN

6°
107 MILS

0°41'
12 MILS

UTM GRID AND 1979 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

1 MILE

1000   0   1000   2000   3000   4000   5000   6000   7000 FEET

1   .5   0   1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST