18 MAPPING

Asterisks (*) indicate problems that have partial answers given in Appendix G.

18.1 Give the terms to which the acronyms TIN, DTM, and GIS apply.
TIN – Triangulated Irregular Network
DTM – Digital Terrain Model
GIS – Geographic Information System

18.2* On a map drawn to a scale of 1:6000, a point has a plotting error of 1/30-in. What is the equivalent ground error in units of feet?

200 in. = 6000(1/30)

18.3 What are the two basic questions that should be answered before beginning the design of a map?

From Section 18.6, paragraph 1: "Before beginning the design of a map, the following two basic questions should be answered: **(1)** What is the purpose of the map? and **(2)** Who is the map intended to serve?"

18.4 List five uses for maps in society.

Answers can vary.

18.5 What is the purpose of placing bar scales on maps?

From Section 18.12, paragraph 4: "If a map sheet is enlarged or reduced in a reproduction process, the graphical scale will change accordingly, and thus the original scale of the map will be preserved on the reproduction."

18.6 Why should lines not cross text?

From Section 18.11, paragraph 3: "Text should take precedence over line work. If necessary, lines should be broken where text is placed, as this improves clarity. An example of this is in the labeling of contours, where the lines are preferably broken and the contour elevation inserted in the break. It is best to select straight, or nearly straight, sections of contours for labeling."

18.7 What is the content of a DEM?

From Section 18.3, paragraph 2: "The digital elevation models are arrays of elevation values, produced in grids of varying dimensions, depending on the source of the information."

18.8 What is the content of DLGs?

From Section 18.3, paragraph 2: "The digital line graphs contain only linear features or planimetry in an area. Included are political boundaries, hydrography, transportation networks, and the subdivision lines of the U.S. Public Land Survey System."

18.9 List the advantages of compiling maps using field-to-finish software?

From Section 18.8.2, paragraph 1: 'Fundamentally, CADD systems plot points and lines in a manner similar to manual drafting techniques. However compared to manual map drafting, computer-assisted mapping offers advantages of increased accuracy, speed, flexibility, and reduced cost. Computers are capable of quickly performing many drafting chores that are tedious and time consuming if done by manual methods, e.g., drawing complicated line types and symbols, and performing lettering. With CADD systems, lettering reduces to simply choosing letter sizes and styles and selecting and monitoring placement. Since these systems can often read files of coordinates, such as those from data collectors, the plotting process can become almost totally automated (see Section 17.11). For example, many common features of a map such as bar scale, north arrow, legend, and title block can be created as *blocks* and imported into any map with varied scales. This process simplifies the entire map production process and creates a standardized look for a mapping agency or company. Additionally, the digital environment of a CADD system allows for the easy arrangement of the mapping elements, which simplifies the process of map design and enables colors to be readily selected and changed."

18.10* For a 20-ft contour interval, what is the greatest error in elevation expected of any definite point read from a map if it complies with National Map Accuracy Standards?

±20 ft;

From Section 18.4, paragraph 3: "The NMAS vertical accuracy requirements specify that not more than 10 percent of elevations tested shall be in error by more than one-half the contour interval, and **none can exceed the interval**."

18.11 An area that varies in elevation from 323–434 ft is being mapped. What contour intervals will be drawn if a 20-ft interval is used? Which lines are emphasized?

340, 360, 380, 400, and 420 with 400 being emphasized

18.12 Similar to Problem 18.11, except elevations vary from 67–105 m and a 5-m interval is used.

70, 75, 80, 85, 90, 95, 100, and 105 with 75 and 100 being emphasized

18.13 If a map is to have a 20-ft contour interval, which contours are labeled between the elevations of 1030 and 1210 ft?

1100 and 1200

18.14 How is maximum effectiveness achieved in map design?

From Section 18.6, paragraph 2: "To achieve maximum effectiveness in map design, the following elements or factors should be considered: (1) clarity, (2) order, (3) balance, (4) contrast, (5) unity, and (6) harmony."

18.15* What is the largest acceptable error in position for 90% of the well-defined points on a map with a 1:24,000 scale that meets national map accuracy standards.

From Section 18.4, paragraph 2: "To meet the NMAS horizontal position specification, for maps produced at scales larger than 1:20,000, not more than 10 percent of well-defined points tested shall be in error by more than 1/30 in. (0.8 mm)."

18.16 Discuss how balance is achieved on a map.

From Section 18.6, paragraph 5: "All elements on a map have weight, and they should be distributed uniformly around the "visual center" of the map to create good overall *balance.* The visual center is slightly above the geometrical center of the map sheet. In general, the weight of an element is affected by factors such as size, color, font, position, and line width. Map elements that appear at the center have less weight than those on the edges. Elements in the top or right half of the map will appear to have more weight than those in the bottom or left half of the map. Also map elements identified with thicker line widths will appear to have heavier weights than their slimmer counterparts. Colors such as red appear heavier than blue or yellow. ... The use of thumbnail sketches can often help to achieve a balanced layout for a map. It is important to place highest weights on those elements that enhance the purpose of the map."

18.17 Discuss why insets are sometimes used on maps.

From Section 18.6, paragraph 3: **To enhance clarity**: "If considerable detail must be included on a map, the information could be placed in a table. Other alternatives consist of preparing larger-scale *inset maps* of areas that contain dense detail, or creating an overlay to display some of the detail."

18.18* If a map is to have a 1-in. border, what is the largest nominal scale that may be used for a subject area with dimensions of 604 ft and 980 ft on a paper of dimensions 24 by 36 in?

1 in./30 ft, or 1:360

Usable height = 22 in. Usable width = 34 in.

Scale for width = 604/22 = 27.5 ft/in. Scale for length = 980/34 = 28.8 ft/in.

18.19 Similar to Problem 18.18, except the dimensions of the subject area are 1110 ft and 1475 ft.

60 ft/in. or 1:720

Scale for height= 1110/22 = 50.4 ft/in. Scale for length = 1475/34 = 43.4 ft/in.

18.20 If a map is to have 1-1/2 in. borders on the top and left sides and 1/2 in. borders on the bottom and right sides what is the largest nominal scale that may be used for a subject

area with dimensions of 423 and 804 ft on a paper of dimensions 24 by 36 in?

30 ft/in. or 1:360

Scale for height= 423/22 = 19.2 ft/in. Scale for length = 804/34 = 23.6 ft/in.

18.21 If 90 percent of all elevations on a map must be interpolated to the nearest ±1 ft, what contour interval is necessary according to the National Map Accuracy Standards? Explain.

2 ft

From Section 18.4, paragraph 3: "The NMAS vertical accuracy requirements specify that not more than 10 percent of elevations tested shall be in error by more than one-half the contour interval, and **none can exceed the interval**."

18.22 If an area having an average slope of 5.5% is mapped using a scale of 1:1000 and contour interval of 0.5 m, how far apart will contours be on the map?

9.1 mm; run = 0.5m/0.055 = 9.0909 m; x = 9090.9 mm/1000 = 9.1 mm

18.23 Similar to Problem 18.22, except average slope is 8%, map scale is 200 ft/in., and contour interval is 5 ft.

0.31 in.; run = 5 ft/0.08 = 62.50 ft; x = 62.5/200 = 0.3125 in.

18.24* Similar to Problem 18.22, except average slope is 4%, map scale is 1:1000, and contour interval is 0.5 m.

12.5 mm; run = 0.5 m/0.04 = 12.5 m; x = 12,500 mm/1000 = 12.5 mm = 1.25 cm

18.25* The three-dimensional (X, Y, Z) coordinates in meters of vertexes A, B, and C in Figure 18.14 are (5412.456, 4480.621, 248.147), (5463.427, 4459.660, 253.121) and (5456.081, 4514.382, 236.193), respectively. What are the coordinates of the intersection of the 250-m contour with side AB? With side BC?

***AB*: (5431.445, 4472.812); *BC* = (5462.073, 4469.745)**

AB = 55.113 m; Az_{AB} = 112°21'14.8"; BC = 55.213 m; Az_{BC} = 352°21'15.1"

Interpolations:

$$AB: x = 55.113\frac{1.853}{4.974} = 20.532 \text{ m};\ BC: x = 55.213\frac{-3.121}{-16.928} = 10.180 \text{ m}$$

18.26 The three-dimensional (X,Y,Z) coordinates in feet for vertices A, B, and C in Figure 18.14 are (8649.22, 6703.67, 865.89), (8762.04, 6649.77, 872.34) and (8752.64, 6770.20, 874.03), respectively. What are the coordinates of the intersections of the 870-ft contour as it passes through the sides of the triangle?

***AB*: (8762.04, 6649.77, 870); *AC*: (8701.44, 6737.26)**

AB = 125.034 ft; Az_{AB} = 115°32'10.5"; AC = 122.971 ft; Az_{AC} = 57°14'48.7"

Interpolations:

$$AB: x = 125.034\frac{4.11}{6.45} = 79.673 \text{ ft};\ \ AC: x = 122.971\frac{4.11}{8.14} = 62.090 \text{ ft}$$

18.27 Similar to Problem 18.26, except compute the coordinates of the intersection of the 872-ft contour.

***AB*: (8756.09, 6652.61); *BC* = (8726.85, 6753.61)**

AB = 125.034 ft; Az_{AB} = 115°32'10.5"; *BC* = 120.796 ft; Az_{AC} = 57°14'48.7"

Interpolations:

$$AB: x = 125.034\frac{6.11}{6.45} = 118.443 \text{ ft};\ \ AC: x = 122.971\frac{6.11}{8.14} = 92.304 \text{ ft}$$

18.28 Discuss how contrast can be improved on a map.

From Section 18.6, paragraph 6: "*Contrast* relates primarily to the use of different line weights, and fonts of varying sizes. Contrast can be used to enhance balance, order, and clarity. For example, the title of the map should be displayed in a larger font than the other textual elements. This will attract the viewer's attention, thereby enhancing the order and clarity of the map. Various fonts can also be used to provide balance with other elements on the map. Another example where contrast supports the clarity of a map is in contouring. Here *index contours* (every fifth contour) should be drawn with a heavier line than the other contours. This enhances the map's clarity and facilitates the determination of elevations."

84	78	62	55	63	69
78	71	66	61	66	75
76	72	68	62	58	65

The following table gives elevations at the corners of 50-ft coordinate squares, and they apply to Problems 18.29 and 18.31.

18.29 At a horizontal scale of 1 in. = 50 ft draw 2-ft contours for the area.

Plot showing 2-ft contour interval

18.30 Similar to Problem 18.29, except at the bottom of the table add a fourth line of elevations: 79, 69, 72, 62, 61, and 65 (from left to right).

Plot showing 2-ft contour interval

18.31 If a map is drawn with 1-m contour intervals, what contours between 243 and 265 m are drawn with heavier line weight?

245, 250, 255, 265