PART I:
SOLUTIONS TO PROBLEMS

1 INTRODUCTION

1.1 Develop your personal definition for the practice of surveying.

Answers will vary by response. See Section 1.1 for book definitions.

1.2 Explain the difference between geodetic and plane surveys.

From Section 1.4,

> In geodetic surveys the curved surface of the earth is considered by performing the computations on an ellipsoid (curve surface approximating the size and shape of the earth). In plane surveys, except for leveling, the reference base for fieldwork and computations is assumed to be a flat horizontal surface. The direction of a plumb line (and thus gravity) is considered parallel throughout the survey region, and all measured angles are presumed to be plane angles.

1.3 Describe some surveying applications in:

(a) Construction

In construction, surveying is used to locate the precise location of structures such as roads, buildings, bridges, and so forth. From the FIG definition of surveying, item 11: "The planning, measurement and management of construction works, including the estimation of costs. In application of the foregoing activities surveyors take into account the relevant legal, economic, environmental, and social aspects affecting each project."

(b) Mining

In mining, surveying is used to direct the locations of mining activities according to a systematic plan, to make sure mining occurs within the boundaries of the claim, to connect tunnels and shafts, and to provide legal records of mining activities.

(c) Agriculture

In agriculture, surveying is used to determine the acreage of fields, to locate lines of constant elevation for strip farming, to track harvesting machinery to enable the size of the harvest, and to track the position of the planting equipment to allow for precise applications of seeds and fertilizers. The field is known as high-precision agriculture.

1.4 List 10 uses for surveying other than property and construction surveying.

Some items students may lists include:

1. Establishing control for use in other surveys.
2. Mapping the surface of the earth and other celestial objects with photogrammetry, laser scanning, or remote sensing.
3. Mapping archeological artifacts.
4. Mapping the bottom of oceans and waterways.
5. Creating Geographic and Land Information Systems for public use.
6. Performing ordinance surveys for the military.
7. Creating topographic maps.
8. Optical tooling.
9. Mapping of statues and other forms of artwork using terrestrial photogrammetry or laser scanning.
10. Mapping of accident sites in forensic surveying.

1.5 Why is it important to make accurate surveys of underground utilities?

To provide an accurate record of the locations of these utilities so they can be found if repairs or servicing is needed, and to prevent their accidental destruction during excavation for other projects.

1.6 Discuss the uses for topographic surveys.

Topographic surveys are used whenever elevation data is required in the end product. Some examples include (1) creating maps for highway design; (2) creating maps for construction surveys; (3) creating maps for flood plain delineation; (4) creating maps for site location of buildings; and so on.

1.7 What are hydrographic surveys, and why are they important?

From Section 1.6, hydrographic surveys define shorelines and depths of lakes, streams, oceans, reservoirs, and other bodies of water. *Sea surveying* is associated with port and offshore industries and the marine environment, including measurements and marine investigations made by ship borne personnel.

1.8 Print a view of your location using Google Earth.®

An image of your region should be produced.

1.9 Briefly explain the procedure used by Eratosthenes in determining the Earth's circumference.

From Section 1-3, paragraph 8 of text: His procedure, which occurred about 200 B.C., is illustrated in Figure 1-2. Eratosthenes had concluded that the Egyptian cities of Alexandria and Syene were located approximately on the same meridian, and he had also observed that at noon on the summer solstice, the sun was directly overhead at Syene. (This was apparent because at that time of that day, the image of the sun could be seen reflecting from the bottom of a deep vertical well there.) He reasoned that at that moment, the sun, Syene, and Alexandria were in a common meridian plane, and if he could measure the arc length between the two cities, and the angle it subtended at the earth's

center, he could compute the earth's circumference. He determined the angle by measuring the length of the shadow cast at Alexandria from a tall vertical staff of known length. The arc length was found from multiplying the number of caravan days between Syene and Alexandria by the average daily distance traveled. From these measurements Eratosthenes calculated the earth's circumference to be about 25,000 mi. Subsequent precise geodetic measurements using better instruments, but techniques similar geometrically to Eratosthenes', have shown his value, though slightly too large, to be amazingly close to the currently accepted one.

1.10 Describe the steps a land surveyor would need to do when performing a boundary survey.

Briefly, the steps should include (1) preliminary walking of property with owner; (2) courthouse research to locate deed of property and adjoiners to determine ownership, possible easements, right-of-ways, conflicts of interest, and so on; (3) location survey of property noting any encroachments; conflicting elements; and so on; (4) resolution of conflicting elements between deed and survey; (5) delivery of surveying report to owner.

1.11 Do laws in your state specify the accuracy required for surveys made to lay out a subdivision? If so, what limits are set?

Responses will vary

1.12 What organizations in your state furnish maps and reference data to surveyors and engineers?

Responses will vary but some common organizations are the (1) county surveyor, (2) register of deeds, (3) county engineer or county highway department (4) Department of Transportation, (5) Department of Natural Resources of its equivalent, and so on.

1.13 List the legal requirements for registration as a land surveyor in your state.

Responses will vary. Contact with you licensing board can be found on the NCEES website at http://www.ncees.org/licensure/licensing_boards/.

1.14 Briefly describe the European Galileo system and discuss its similarities and differences with GPS.

See Section 13.10.2. Students can look this information and much more with a web search.

1.15 List at least five nonsurveying uses for GPS.

Responses may include (1) logistics in transportation; (2) hunting; (3) location of cell phone calls; (4) timing of telecommunications networks; (5) navigation in the boating industry; and so on.

1.16 Explain how aerial photographs and satellite images can be valuable in surveying.

Photogrammetry presently has many applications in surveying. It is used, for example, in land surveying to compute coordinates of section corners, boundary corners, or point of evidence that help locate these corners. Large–scale maps are made by photogrammetric procedures for many uses, one being subdivision design. Photogrammetry is used to map shorelines, in hydrographic surveying, to determine precise ground coordinates of points in control surveying, and to develop maps and cross sections for route and engineering surveys. Photogrammetry is playing an important role in developing the necessary data for modern Land and Geographic Information Systems.

1.17 Search the Internet and define a VLBI station. Discuss why these stations are important to the surveying community.

VLBI stands for *Very Long Baseline Interferometry*. Responses will vary. These stations provide extremely accurate locations on the surface of the Earth. The stations are used to develop world-wide reference frameworks such as ITRF08. They also may provide tracking information for satellites.

1.18 Describe how a GIS can be used in flood emergency planning.

Responses will vary but may mention the capabilities of a GIS to overlay soil type and their permeability with slopes, soil saturation, and watershed regions. A GIS can also be used to provide a list of business and residences that will be affected by possible flooding for evacuation purposes. It can provide "best" routes out of a flooded region.

1.19 Visit one of the surveying web sites listed in Table 1.1, and write a brief summary of its contents. Briefly explain the value of the available information to surveyors.

Responses will vary with time, but below are brief responses to the question

- NGS – control data sheets, CORS data, surveying software
- USGS – maps, software
- BLM – cadastral maps, software, ephemerides
- U.S. Coast Guard Navigation Center - GPS information
- U.S. Naval Observatory –Notice Advisory for NAVSTAR Users (NANU) and other GPS related links
- American Congress on Surveying and Mapping (ACSM) – professional organization for surveying and mapping profession
- American Society for Photogrammetry and Remote Sensing – professional organization for photogrammetry and remote sensing
- The Pearson Prentice Hall publishers access to software and support materials that accompany this book.
- SaGES – An organization of surveying/geomatics educators

1.20 Read one of the articles cited in the bibliography for this chapter, or another of your choosing, that describes an application where satellite surveying methods were used. Write a brief summary of the article.

Answers will vary. Students should be told to look in trade journals for articles.

1.21 Same as Problem 1.20, except the article should be on safety as related to surveying.

Answers will vary. Students should be told to look in trade journals for articles.