



# Soil Science Professional Practice Exam

## Sample Questions

### What to know

The Soil Science Professional Practice Exam combines your educational knowledge gained while earning your Bachelor of Science degree in Soil Science (or closely related field) with your actual experiences in applying that knowledge to soils-related situations during the first 3 to 5 years of your career.

The exam is prepared by the Council of Soil Science Examiners (CSSE), a panel of soil scientists from across the United States.

The exam is based entirely on knowledge skills found in the Soil Science Professional Practice Exam Performance Objectives. This document is available free online (<https://www.soils.org/files/certifications/professional-practice-exam-objectives.pdf>). The Performance Objectives are grouped into eight Competency Areas: Soil Chemistry and Mineralogy, Soil Fertility and Nutrient Management, Soil Physics, Soil Genesis, Morphology, and Classification, Soil Biology and Soil Ecology, Soil and Land Use Management, Field and Laboratory Techniques, and Ethics.

Pay attention to how the Performance Objectives are worded. The CSSE uses Bloom's Taxonomy of Cognitive Development as a guide in wording the different levels of Performance Objectives. Understand whether basic knowledge is required or if higher-order learning verbs are used that require analysis, synthesis, or evaluation of data. An example of knowledge levels and associated verbs is included below.

While the Professional Practice Exam uses the Professional Practice Exam Performance Objectives, it is assumed that the examinee also knows all of the Soil Science Fundamentals Exam Performance Objectives (<https://www.soils.org/files/certifications/fundamentals-performance-objectives.pdf>).

### What to expect

The Soil Science Professional Practice Exam is written to ensure a balance of questions among the eight Competency Areas: Soil Chemistry and Mineralogy, Soil Fertility and Nutrient Management, Soil Physics, Soil Genesis, Morphology, and Classification, Soil Biology and Soil Ecology, Soil and Land Use Management, Field and Laboratory Techniques, and Ethics. Not all Performance Objectives are covered on any exam, although the number of questions asked per Competency Area is in proportion to the guidelines developed from a national survey of practicing soil scientists.

The exam is organized in a multiple-choice format with only one correct answer per question. The exam is made up of 120 multiple-choice questions based on a series of scenarios provided throughout the exam. Each scenario may cover one or all of the Competency Areas. If calculations are required, information will be provided for conversions.

It is up to the examinee to decide how to use the information, or parts of the information, to perform those conversions. A knowledge of English, SI, and metric units is expected.

Two sample retired scenarios are provided at the end of this document as an example of the exam's structure. They should not be taken as examples of the content of the current exam.

### Knowledge Levels and Example Verbs Based on Bloom's Taxonomy

<b>Lower</b>	<b>Knowledge</b> arrange define know label list match name order recognize reproduce restate	<b>Comprehension</b> characterize classify describe discuss explain identify illustrate recognize report review sort	<b>Application</b> apply calculate choose compute demonstrate implement interpret perform prescribe sketch solve
<b>Higher</b>	<b>Analysis</b> analyze appraise categorize compare contrast critique diagram differentiate discriminate distinguish examine test	<b>Synthesis</b> combine compose create design formulate hypothesize integrate organize plan propose synthesize theorize	<b>Evaluation</b> appraise argue assess critique defend estimate evaluate examine justify rank rate review

## Sample scenarios

The following two scenarios are retired scenarios used on past exams that will not be used again. Answers to the questions are at the end of this section. **These scenarios and sample questions are included to provide an example of the format to expect on the exam, not the content; some information or wording may be out of date due to the age of the scenarios.** The best way to ensure you are ready for the exam is to be sure you can explain all of the items in the Soil Science Professional Practice Exam Performance Objectives.

### Scenario 1: Waste application site

#### Scenario

A manufacturing company applied 40 metric tons of sludge per hectare in one year. The sludge was incorporated to 15 cm.

#### Soils information

The dry bulk density of the upper 15 cm of the soil on the treatment site is  $1.33 \text{ g cm}^{-3}$ . The soil on the site is a Ziegfield sand and is described as follows:

*Typic Udipsamments, mixed, mesic: The Ziegfield series consists of very deep, excessively drained soils formed in sandy drift on outwash plains, stream terraces, valley trains, and glacial moraines. The surface layer is dark brown sand 7 inches thick. The subsoil is brown and strong brown 27 inches thick. The substratum is yellowish brown sand.*

#### Questions

**Table 1. Median nitrogen, phosphorus, and metal concentrations in the sludge.**

Chemical or nutrient	Concentration	Max. cumulative application
Organic N	2.5%	
Ammonium ( $\text{NH}_4^+$ )	1.5%	
Total P	1.5%	
Arsenic	$6 \text{ mg kg}^{-1}$	
Cadmium	$7 \text{ mg kg}^{-1}$	$39 \text{ kg ha}^{-1}$
Copper	$1,766 \text{ mg kg}^{-1}$	$1,500 \text{ kg ha}^{-1}$
Lead	$106 \text{ mg kg}^{-1}$	$300 \text{ kg ha}^{-1}$
Mercury	$4 \text{ mg kg}^{-1}$	
Molybdenum	$11 \text{ mg kg}^{-1}$	
Nickel	$29 \text{ mg kg}^{-1}$	
Selenium	$5 \text{ mg kg}^{-1}$	
Zinc	$725 \text{ mg kg}^{-1}$	$2,800 \text{ kg ha}^{-1}$

**Table 2. Major soil cations in the surface layer (0–18 cm) of the Ziegfield series on the organic waste treatment site.**

<b>Exchangeable cations</b>	<b>Valences +</b>	<b>Atomic wt. (g mole<sup>-1</sup>)</b>	<b>Conc. in soil (mg kg<sup>-1</sup>)</b>
Ca	2	40	400
Mg	2	24	12
Na	1	23	57.5
K	1	39	97.5
Al	3	27	9

1. The Ziegfield series is classified as
  - a. an Alfisol
  - b. an Inceptisol
  - c. an Entisol
  - d. a Vertisol
  
2. The most important soil forming factor for the Ziegfield sand is
  - a. climate
  - b. topography
  - c. organisms
  - d. parent material
  
3. The most mobile form of N in soils from applied and incorporated waste is
  - a. ammonium
  - b. nitrate
  - c. elemental nitrogen
  - d. organic nitrogen
  
4. For adequate decomposition of biosolids applied to soils, environmental conditions must favor activity of
  - a. aerobic bacteria
  - b. anaerobic bacteria
  - c. nematodes
  - d. earthworms
  
5. The dry mass of a hectare of soil to a depth of 15 cm on the application site is approximately
  - a. 100 metric tons
  - b. 500 metric tons
  - c. 1,000 metric tons
  - d. 2,000 metric tons
  
6. One approach to reduce the plant availability of Zn in the treated soil would be to amend the soil with
  - a. lime
  - b. sulfur
  - c. hydrochloric acid
  - d. iron

7. Using the information in Table 1, the element that will limit the number of years the waste can be applied is
  - a. Cu
  - b. Zn
  - c. Pb
  - d. Cd
  
8. Following rainfall, nitrates in the groundwater beneath this site increased in advance of the general wetting front. This increase is most likely a result of
  - a. the sandy soil texture
  - b. preferential flow
  - c. low CEC
  - d. mineralization of older illuviated soil
  
9. Assuming a mineralization rate for organic N of 40% during the initial year of application and using Table 1, the amount of N that would be mineralized by the end of the first year is
  - a. 4 metric tons  $\text{ha}^{-1}$
  - b. 0.4 metric tons  $\text{ha}^{-1}$
  - c. 10 metric tons  $\text{ha}^{-1}$
  - d. 0.16 metric tons  $\text{ha}^{-1}$
  
10. Using the information in Table 2, the exchange of acidity of the Ziegfield soil located at the application site is
  - a. 0.10  $\text{cmol kg}^{-1}$
  - b. 0.33  $\text{cmol kg}^{-1}$
  - c.  $\text{cmol kg}^{-1}$
  - d. 2.70  $\text{cmol kg}^{-1}$
  
11. The phosphorus contained in the organic waste applied and incorporated into the soil at this site is mainly
  - a. removed by the crop
  - b. leached below the root zone
  - c. retained in the root zone
  - d. removed as runoff following rainfall events
  
12. In a waste-amended soil, denitrification can occur when nitrate is present, oxygen is absent, and
  - a. available carbon/energy sources are present
  - b. soil fungi are the predominant organisms
  - c. soil pH is less than 4.3
  - d. waste C/P ratio is less than 10:1

## Scenario 2: Industrial wastewater irrigation

### Scenario

A food processing company operates 300 days per year and generates an average of 100,000 gallons per day of process water. The company plans to apply this water through irrigation on 100 acres. The site information is listed below.

### Site information

Precipitation: 7 in yr<sup>-1</sup>

Potential evapotranspiration: 35 in yr<sup>-1</sup>

Soils: formed in calcareous parent material

### Questions

1. The number of acre-feet of process water produced in one year is (conversion factors: 1 gal = 8.35 lbs, 1 ton = 2,000 lbs, 1 cu.ft. = 7.48 gal, 1 ac = 43,560 sq. ft.):
  - a. 689
  - b. 112
  - c. 92
  - d. 240
2. The water needed to satisfy a crop's consumptive use is 31 inches. Assuming 100 acre-feet of process water needs to be applied, what would be the minimum number of acres needed for irrigation?
  - a. 50
  - b. 39
  - c. 154
  - d. 106
3. When determining the maximum sprinkler irrigation intensity rate, the most useful soil properties are
  - a. permanent wilting point and field capacity.
  - b. bulk density and particle density.
  - c. texture and structure.
  - d. soil infiltration rate and drainage class.
4. A likely problem from applying high levels of manure to this site is
  - a. CEC would increase.
  - b. pathogens would accumulate.
  - c. ammonia concentrations would rise to toxic levels.
  - d. salt accumulations would increase.
5. The food processing company has been irrigating with process water for five years. The EC has increased from 1.8 to 4.9. The best remedial course of action is to
  - a. apply gypsum to the irrigation site.
  - b. leach or flush the soil.
  - c. lime the soil.
  - d. add sulfur.

6. Increasing salinity in a soil will likely lead to
- a rapid decrease in water infiltration rate.
  - a decrease in plant-available water at a given water content.
  - a decrease in soil pH.
  - heavy metals dissolution.
7. When received from the field, each of three homogenous split subsamples weighed 20 g. After overnight drying, the subsample dried at 40°C weighed 19 g, the subsample dried at 105°C weighed 18 g, and the subsample dried at 450°C weighed 17 g. According to SSSA methods of soil analysis, the gravimetric water content is
- 5%
  - 10%
  - 11%
  - 18%
8. Characteristics of the soil surface horizons as the irrigation site are listed in the table below. These characteristics were determined from surface soil samples.

<b>Soil</b>	<b>pH</b>	<b>CEC (meq/100g)</b>	<b>ESP (%)</b>	<b>OM (%)</b>
A	7.2	18.7	6.5	3.1
B	8.7	22.8	14.3	0.7
C	6.5	6.5	4.2	1.6
D	8.1	11.6	14.6	3.8

- The soil to show the effects of excess sodium first would be soil
- A
  - B
  - C
  - D
9. A neighboring field is irrigated with water containing Sr. Strontium, which is similar to Ca, will most easily displace the following cation:
- Al
  - Ca
  - Na
  - Pb

## Answer key to sample scenarios

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<b>Scenario 1</b>	<b>Scenario 2</b>
1. a	1. c
2. d	2. b
3. b	3. d
4. a	4. d
5. d	5. b
6. a	6. b
7. a	7. c
8. b	8. d
9. b	9. c
10. a	
11. c	
12. a	

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