

Study Guide
for
Health Physics Instrument (HPI)
Technician
Test No. 2738

Human Resources Performance Assessment Services
Southern California Edison Company

Introduction

The HEALTH PHYSICS INSTRUMENT (HPI) Test is a job knowledge test designed to cover the major knowledge areas necessary to perform the job. This *Guide* contains strategies to use for taking tests and a study outline, which includes knowledge categories and study references. Some sample questions are also provided.

Test Scheduling

Employees who apply for positions, bids, and transfers requiring testing before March 9, 2009, will be scheduled for testing by their Supervisor through Human Resources. For those who apply after March 9, 2009, both the employee and their Supervisor will be notified of a scheduled test date by Human Resources. Test times and dates for positions requiring testing will be specified in the bid/transfer/requisition/job posting. Employees should be prepared to test on the specified dates. Only employees who apply for positions requiring testing, and who meet basic qualifications, will be invited to test. Applicants will be scheduled through the recruiter. If you have any questions, please call 626-302-9830.

Test Session

It is important that you follow the directions of the Test Administrator *exactly*. If you have any questions about the testing session, be sure to ask the Test Administrator before the testing begins. During testing, you may not leave the room, talk, smoke, eat or drink. Since some tests take several hours, you should consider these factors before the test begins.

All questions on this test are multiple-choice with four possible answers. Prior to March 9, 2009, your answers to the questions are indicated by filling in a circle on an answer sheet with a special mark-sense pencil. For your answers to be read accurately by the scanner, you must fill in the circles completely and erase completely any answer you wish to change. After March 9, 2009 you will take the exam on a computer. For more information on this, please see the next section of this study guide, Computer Based Testing.

The test has a three hour (180 minutes) hour time limit. A non-programmable calculator may be used during the test. **Calculators will be provided by the Test Administrator, and will be one of the following three models: Casio fx-250HC, Texas Instruments TI-30XA, TI 36-X.** The calculator should have square root and square functions. Also, you will be provided with a copy of the periodic table of the elements for your reference during the test. You will receive a Test Comment form so that you can make comments about test questions. Write any comments you have and turn it in with your test when you are done.

Study Guide Feedback

At the end of this *Guide* you have been provided with a Study Guide Feedback page. If a procedure or policy has changed, making any part of this *Guide* incorrect, your feedback would be appreciated so that corrections can be made.

Computer Based Testing

Effective **March 9, 2009**, all knowledge tests will be administered on the computer. This information will help prepare you for a knowledge test taken on or after **March 9, 2009**.

Taking an SCE knowledge test on the computer is simple. You do not need any computer experience or typing skills. You will only use the keyboard to enter your candidate ID and password. You'll answer all questions by pressing a single button on the mouse.

Log in Screen

You will be seated at a testing station. When you are seated, the computer will prompt you to enter the candidate ID and password you received in your invitation e-mail. You **MUST** have your candidate ID and password or you will be unable to take the test. Once you have confirmed your identity by entering this information, you will see a list of tests available to you.

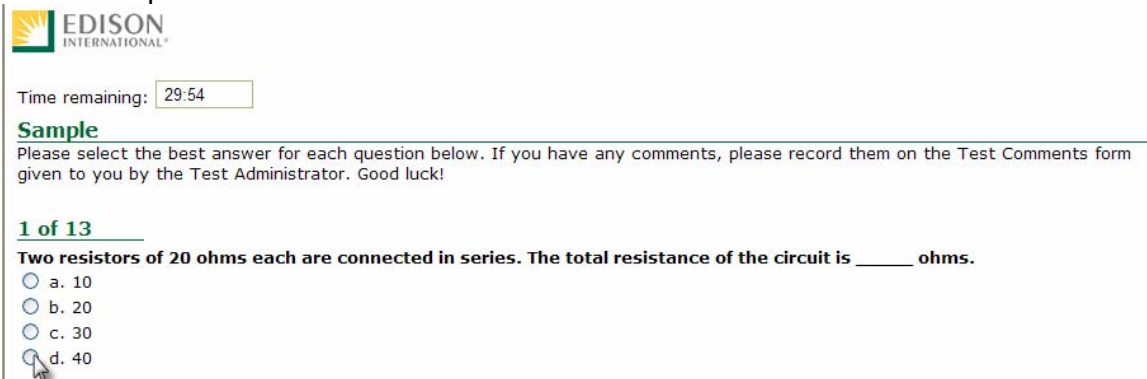
Sample/Tutorial

Before you start your actual test, a Sample/Tutorial Test is provided to help you become familiar with the computer and the mouse. From the list of exams that appear when you complete the log in, you will select Sample/Tutorial. You will have up to 10 minutes to take the Sample/Tutorial Test. The time you spend on this Sample Test DOES NOT count toward your examination time. Sample questions are included so that you may practice answering questions. In the Sample/Tutorial Test, you will get feedback on your answers. You will not receive feedback on your actual test.

Example

During the test, to answer each question, you should move the mouse pointer over the circle (radio button) next to the answer of your choice, and click the left mouse button. The amount of time you have remaining to take the test will always be shown in the top left corner of the screen. A sample is show below:

1. When you begin the test, you can see the total time allowed for completion displayed at the top of the screen. You can scroll up to see that information at any time during the test.
2. In order to answer each question, first read the question and determine the response that best answers the question. Put the mouse pointer directly over the circle corresponding to that response.



The screenshot shows the Edison International test interface. At the top left is the Edison International logo. Below it, a timer displays "Time remaining: 29:54". A section titled "Sample" contains the instruction: "Please select the best answer for each question below. If you have any comments, please record them on the Test Comments form given to you by the Test Administrator. Good luck!". Below this is a progress indicator "1 of 13". The sample question is: "Two resistors of 20 ohms each are connected in series. The total resistance of the circuit is _____ ohms." with four radio button options: a. 10, b. 20, c. 30, and d. 40. A mouse cursor is pointing at option d.

3. While the pointer is over the circle corresponding to the best answer, click the left mouse button.



Click the left button when the pointer icon is over your answer choice.

- The answer you selected should now have a green dot in the circle. If you need to select an alternate answer, simply move the pointer over that circle, and click again.



Time remaining:

Sample

Please select the best answer for each question below. If you have any comments, please record them on the Test Comments form given to you by the Test Administrator. Good luck!

1 of 13

Two resistors of 20 ohms each are connected in series. The total resistance of the circuit is _____ ohms.

- a. 10
- b. 20
- c. 30
- d. 40

- You can change your answers at any time during the test until the time runs out, or you click the "Submit" button.



Test Taking Strategies

Introduction

The Health Physics Instrument (HPI) contains multiple-choice questions. The purpose of this section is to help you to identify some special features of a multiple-choice test and to suggest techniques for you to use when taking one.

Your emotional and physical state during the test may determine whether you are prepared to do your best. The following list provides common sense techniques you can use before the test begins.

Technique

Remarks

Be confident

- o If you feel confident about passing the test, you may lose some of your anxiety.
- o Think of the test as a way of demonstrating how much you know, the skills you can apply, the problems you can solve and your good judgment capabilities.

Be punctual

- o Arrive early enough to feel relaxed and comfortable before the test begins.

Concentrate

- o Try to block out all distractions and concentrate only on the test. You will not only finish faster but you will reduce your chances of making careless mistakes.
- o If possible, select a seat away from others who might be distracting.
- o If lighting in the room is poor, sit under a light fixture.
- o If the test room becomes noisy or there are other distractions or irregularities, mention them to the Test Administrator *immediately*.

Budget your time

- o Pace yourself carefully to ensure that you will have enough time to complete all items and review your answers.

Read critically

- o Read all directions and questions carefully.
- o Even though the first or second answer choice looks good, be sure to read all the choices before selecting your answer.

Make educated guesses

- o Make an educated guess if you do not know the answer or if you are unsure of it.

Changing answers

- o If you need to change an answer, be sure to erase your previous answer completely. On the computer, be sure that the new answer is selected instead of the old one.

Return to difficult questions

- o If particular questions seem difficult to understand, make a note of them, continue with the test and return to them later.

Double-check mathematical calculation

- o Use scratch paper and/or a calculator to double check your work

Review

- o If time permits, review your answers.
- o Do the questions you skipped previously.
- o Make sure each answer bubble is *completely* filled in. Erase any stray marks on your answer sheet. When testing on the computer, make sure each question has a green dot next to the correct answer.

Remember that the techniques described in this section are only suggestions. You should follow the test taking methods that work best for you.

Job Knowledge Categories and Study References

Below are the major job knowledge categories covered on the test, with study references relating to each category.

I. Repair and Calibration

The HPI technician is required to repair, test, maintain and calibrate health physics radiation monitoring, air sampling, particle counting and multi-channel gamma-ray spectrometer instrumentation and related equipment. To perform these activities, the HPI technician should have knowledge of electronic and electrical theory. To perform these duties, the HPI technician must know how to use hand and power tools and test equipment, such as pulse generators, electrostatic voltmeters, digital multimeters, oscilloscopes, air flow instruments and other pieces of M&TE. In addition, the HPI technician must have knowledge of general health physics in order to correctly handle contaminated materials and radioactive sources used in calibration.

References for this section:

- A.N.S.I N323;A-1997 Section 2
- Basic Radiation Protection Technology, Ch 7-9, (Daniel A. Gollnick, 1994, Pacific Radiation Corp)
- Electricity Five, Hayden Books
- Electricity Three, Hayden Books
- Electronics The Easy Way, Ch 3, 6, 8, 9 (Rex Miller, 1988, Barron's)
- Introduction To Health Physics, Ch 4, 5, 9, (Herman Cember, 1989, Pergamon Press)
- Radiation Detection & Measurement, Ch 2, 5, 6, 7, 9, 20, covering Ionization Chambers, Photo Multiplier Tubes, and GM Counters) (Glenn F. Knoll)
- Radiation Protection, A Guide For Scientists & Physicians (read section on Radiation Measurement)
- S0123-VII-20.14.2.1: Operation of Common Portable Survey Instruments
- S0123-VII-20.14.4.1: Calibration of Common Portable Count Rate Meters
- S0123-VII-20.14.4.2: Calibration of Eberline ASP-1 Count Rate meter with various detectors
- S0123-VII-20.14.5.1: Calibration of Common Portable Dose Rate Instruments
- S0123-VII-20.14.7.1: Calibration of Common Portable Air Samplers

I. Sample Analysis

The HPI technician is required to analyze samples of radioactive material of varying geometries. The HPI technician should know how to read count room equipment and detect various isotopes. To perform these activities, the HPI technician must have knowledge of basic math, statistics (mean, standard deviation, chi-square) and physics.

References for this section:

- BC-4 Beta Counter, Eberline, Op. & Cal.
- Introduction To Health Physics, Ch 4, 5, 9, (Herman Cember, 1989, Pergamon Press)
- Radiation Detection & Measurement, Ch 10, 17, 20 (Glenn F. Knoll)
- Radiation Protection, A Guide for Scientists and Physicians, Jacob Shapiro, 1990, Harvard University Press, pg. 244
- S0123-VII-20.14.3.2: Eberline Model BC-4 Beta Counter
- S0123-VII-20.9: Radiological Surveys
- SO123-vii-20.14.9.1

III. Source Control

The HPI technician acts as the monitor of all radioactive sources used on site. The HPI technician also is required to perform 6 month inventory and leak tests for samples. To perform these duties, the HPI technician uses knowledge of physics, radiation theory, NRC regulations and site procedures to safely and properly handle sources.

References for this section:

- A.N.S.I. N-323; A
- A.N.S.I. N-323; A-1997 sections 2, 5.1, 5.4, 6.1
- Basic Radiation Protection Technology, Daniel A. Gollnick, 1994, Pacific Radiation Corp, Chapter 2
- Code of Federal Regulations:
 - 10 CFR 19.3
 - 10 CFR 20.3
 - 10 CFR 30.18
 - 10 CFR 30.81
 - 10 CFR 30.4
 - 10 CFR 50.2
 - 10 CFR 70.39
- Introduction To Health Physics, Ch 5, (Herman Cember, 1989, Pergamon Press)
- Radiation Detection & Measurement, Ch 1, 17, (Glenn F. Knoll, 1989, John Wiley and Sons)
- Radiation Protection, A Guide for Scientists and Physicians, Jacob Shapiro, 1990, Harvard University Press, pg. 205, 292
- Inventory & Leak Testing of Sealed Radioactive Sources
- The Health Physics & Radiological Health Handbook, Shleien & Terpilak, 1984, Nucleon Lectern Associates, pgs. 146, 165, 193

IV. Administration

The HPI's administrative duties include processing proper paperwork for issuing and returning of sources and instruments. The HPI technician also is responsible for performing 6 month inventories and leak tests for sources. The HPI technician also should have knowledge of NRC and SCE requirements and regulations for such processing. The HPI technician also fills out requisitions for replacement parts for equipment.

References for this section:

- A.N.S.I. N-323;A-1997 Radiation Protection Instrumentation, Test and Calibration, Portable Survey Instruments
- Basic Radiation Protection Technology, Daniel A Gollnick, 1994, Chapter 2
- S0123-VII-20.14.1: Health Physics Instrumentation Program
- S0123-VII-20.14.9.6: Victoreen Model 530 Electrometer/Dosimeter
- Shepherd Operational Manual for The Model 89 Calibrator

Study References

Below is a combined listing of the study references for the major job activities. The listing includes the major references for material covered on the test.

- A.N.S.I. - American National Standard, Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments (A.N.S.I. N323; A-1997), Institute of Electrical and Electronics Engineers, Inc., Sections 2, 5.1, 5.4, 6.1
- Basic Radiation Protection Technology, (Daniel A. Gollnick, 1994, Pacific Radiation Corp), Chapters 2, 7-9
- BC-4 Beta Counter, Eberline, Op. & Cal.
- Electricity Five, Hayden Books
- Electronics The Easy Way, Ch 3, 6. 8. 9 (Rex Miller, 1988, Barron's)
- Introduction To Health Physics, Ch 4, 5, 9, (Herman Cember, 1989, Pergamon Press)
- Inventory & Leak Testing of Sealed Radioactive Sources
- Radiation Detection & Measurement, (Glenn F. Knoll, 1989, John Wiley and Sons), Chapters 1, 2, 5, 6, 7, 9, 10, 17, 20
- Radiation Protection, A Guide for Scientists and Physicians, Jacob Shapiro, 1990, Harvard University Press, pg. 205, 244, 292
- S0123-VII-20.14.1: Health Physics Instrumentation Program
- S0123-VII-20.14.2.1: Operation of Common Portable Survey Instruments
- S0123-VII-20.14.3.2: Eberline Model BC-4 Beta Counter
- S0123-VII-20.14.4.1: Calibration of Common Portable Count Rate Meters
- S0123-VII-20.14.4.2: Calibration of Eberline ASP-1 Count Rate meter w/various detectors
- S0123-VII-20.14.5.1: Calibration of Common Portable Dose Rate Instruments
- S0123-VII-20.14.7.1: Calibration of Common Portable Air Samplers
- S0123-VII-20.14.9.6: Victoreen Model 530 Electrometer/Dosimeter
- S0123-VII-20.9: Radiological Surveys
- SO123-VII-20.14.9.1
- Shepherd Operational Manual for The Model 89 Calibrator
- The Health Physics & Radiological Health Handbook, Shleien & Terpilak, 1984, Nucleon Lectern Associates, pgs. 146, 165, 193
- Code of Federal Regulations:
 - 10 CFR 19.3
 - 10 CFR 20.3
 - 10 CFR 30.18
 - 10 CFR 30.81
 - 10 CFR 70.39
 - 10 CFR 30.4
 - 10 CFR 50.2

Sample Questions

The following sample questions, while **NOT** representative of the **WHOLE** test, should give you some idea of the form the test will take.

- 1. The installation of a Mu shield to a photomultiplier tube would:**
 - a. increase the electron-gain of the tube by focusing more electrons to the plate.
 - b. reduce dark current in the tube by preventing external light sources from entering the tube prior to installation.
 - c. minimize gain fluctuations in the tube by absorbing electrons that stray from the focused beam before they multiply.
 - d. reduce gain shifts caused by external magnetic fields on the electron beam.

- 2. The primary purpose of using a heat sink when soldering an electronic component is to:**
 - a. allow the use of higher wattage soldering iron.
 - b. allow the use of higher temperature solder.
 - c. prevent cold solder joints.
 - d. prevent thermal damage to components.

- 3. If a linear meter movement has a logarithmic scale and the current through the meter increases to 5 times its initial value, the meter's pointers would deflect:**
 - a. 5 times its initial distance.
 - b. .60 times its initial distance.
 - c. 1.6 times its initial distance.
 - d. 25 times its initial distance.

Sample Answers

1. D
2. D
3. A

