



## DEPARTMENT OF HUMAN RESOURCES

### **Study Guide** Plant Operations Series Written Examination

- The Plant Operations Series exam is required for the Wastewater Mechanic classification.
- This booklet contains **SAMPLE QUESTIONS ONLY**. Studying this booklet will not necessarily improve your exam score.

JUNE 2018

## **PURPOSE AND CONTENT OF THIS EXAM PREPARATION GUIDE**

This guide was developed to help you prepare to take the written exam for Plant Operations. It contains general exam-taking advice and also provides specific information related to the exam content. This information includes the subject areas covered by the exam, the kinds of questions to expect, strategies for approaching the questions, and sample questions. Though this information cannot guarantee a higher exam score, it can give you direction for your exam preparation that will assist you in doing your best.

## **PREPARING TO TAKE THE EXAM**

### **Before the Day of the Exam**

- Review this guide to get familiar with the content of the exam. Knowing about the topics and kinds of questions that will be in the exam will ensure that you will not be surprised by the content of the exam or the manner in which it is presented. This can improve your ability to demonstrate your job potential.
- Make sure that you know where the exam will be administered and all of the relevant details, such as where to park, where to report for the exam, and what identification is required.

### **On the Day of the Exam**

- Make sure that you are well rested and have eaten. These things will help your concentration during the exam.
- Plan your day to allow plenty of time to get yourself prepared and get to the exam site. Allow enough time to cope with weather, traffic, parking, etc. Hurrying creates anxiety, so do not put yourself in the position of having to hurry.
- Listen carefully to all instructions from the exam administrator. Make sure that you understand the instructions and carry them out correctly. Ask questions at the proper time before the exam begins if you are unsure of any aspect of what you should do during the exam.

## GENERAL EXAM TAKING TIPS

- Use your time carefully. The time limit should provide you with more than enough time if you move through the exam steadily and do not spend too much time on any one question.
- Read the questions and answer choices carefully. Read all of the answer choices before you select an answer.
- If you come to a question that is especially difficult, skip that question and come back to it later if you have time.
- Answer every question. Scores are based on the number of correct answers. You will receive no credit if you leave an answer space blank. It is to your advantage to use your best judgment to make a choice among the answer choices provided.

## PLANT OPERATIONS SERIES EXAM

This written exam is based upon a job study that identified the most important knowledge, skills, and abilities required to perform the job successfully. These areas include:

- your knowledge of workplace safety practices.
- your knowledge and understanding of mechanical concepts.
- your ability to read and interpret gauges, scales and charts.
- your knowledge and understanding of electrical concepts.
- your knowledge of concepts related to the operation and maintenance of pumps.

All of the exam questions are presented in a multiple-choice format. Each question is identified by a question number that is followed by a question statement. After the question statement, there are between two and four answer choices. You should read all of the answer choices and then choose the best answer. **Each question has only one correct answer.**

## EXAM SECTION 1: WORKPLACE SAFETY

This exam section contains twenty (20) questions related to performing physical tasks and responding appropriately to indoor and outdoor safety concerns. An effective strategy for answering questions in this section is to create a picture in your mind of the situation described in each question and its response options. This should help you to clarify what types of hazards might be associated with the situation and how they are affected by the different choices.

Examples of these types of questions are shown below. The sample questions are followed by brief explanations of the correct answers.

1. Safety precautions for work activities may be overlooked:
  - A. at no time.
  - B. when speed is of utmost importance.
  - C. when it is agreed that the usual safety precautions are not necessary.
  - D. when it is very unlikely that an accident will result from ignoring the precaution.

**Answer:** The correct answer to sample question #1 is response choice "A". Workplace accidents and injuries are largely preventable when the right precautions are taken. Accidents and injuries are often the result of unsafe work practices by workers who did not follow the safety precautions that would have prevented them. Under no circumstances should safety be sacrificed for speed.

2. Which of the following best describes proper lifting technique?
  - A. Keep the knees straight and bend at the waist.
  - B. Bend the knees, bend at the waist, and do most of the work with the large muscles in the back.
  - C. Bend the knees, bend at the waist, and do most of the work with the large muscles in the arms.
  - D. Bend the knees, keep the back straight, and do most of the work with the large muscles in the legs.

**Answer:** The correct answer to sample question #2 is response choice "D". Back injuries are the primary risk of improper lifting techniques. Bending at the waist endangers the back because this necessarily engages the back in performing much of the work. Keeping the back straight and using the legs is safer and generally

more efficient.

3. In discussing worker safety concerns, the defining characteristic of an area that is designated as a "confined space" is that it:
  - A. does not have forced air ventilation.
  - B. has limited openings for entry and exit.
  - C. has insufficient vertical clearance to allow the worker to stand upright.
  - D. has an open top, requiring the use of a ladder or hoist to enter or exit.

**Answer:** The correct answer to sample question #1 is response choice "B". OSHA's definition of "confined spaces" is centered around the concept of limited or restricted means for entry and exit. Confined spaces include, but are not limited to, tanks, manholes, vaults, tunnels, and equipment housings. While some of the other answer choice characteristics may apply to particular types of confined spaces, limited physical access is an attribute of all confined space areas.

## **EXAM SECTION 2: MECHANICAL CONCEPTS**

This exam section contains twenty (20) questions designed to assess your knowledge and understanding of tools and mechanical principles, including the classic simple machines that are components of larger mechanical devices. A good approach to answering these questions is to carefully read each question and make sure you know what is being asked. Then, you should be better able to draw upon your knowledge of these topics and thoughtfully consider the response choices. Depending on your current knowledge and experience, an additional strategy to assist in doing your best would be to review some references on these topics prior to taking the exam.

Examples of these types of questions are shown below. The sample questions are followed by brief explanations of the correct answers.

4. Which of the following is the primary advantage of a hammer with a raised checkered pattern on the striking surface of the head?
  - A. It permits driving larger gauge nails.
  - B. It makes the striking surface more durable.
  - C. It compensates for slightly off-center blows.
  - D. It has the maximum shock-absorbing qualities.

**Answer:** The correct answer to sample question #4 is response choice "C". Hammers with a raised checkered pattern are called "waffle-faced" or "milled head" hammers and are used for framing or similar tasks where marring of the wood by the pattern is not an issue. The checkered pattern helps to prevent the hammer from sliding off the nail head when striking the nail.

5. The tool pictured here is most likely to be used to perform which of the following tasks?

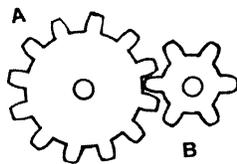
- A. To cut heavy metal pipe.
- B. To clamp wood or metal.
- C. To measure the density of a fluid.
- D. To cut steel rods, bolts, and locks.



**Answer:** The correct answer to sample question #5 is response choice "A". This hand tool is called a pipe cutter or pipe cutter tool and is used to cut metal pipe. Besides producing a clean cut, the tool is often a faster, cleaner, and more convenient way of cutting pipe than with a hacksaw. Different wheels are used for cutting pipe comprised of different materials, for example, steel, stainless steel, and cast iron.

6. In Figure A below, Gear A has 12 teeth and Gear B has 6 teeth. If Gear A makes 8 complete revolutions, how many revolutions will Gear B make?

- A. 4.
- B. 8.
- C. 12.
- D. 16.



**Answer:** The correct answer to sample question #6 is response choice "D". Using imagery and logic, you can visualize the movement of the gears. As they turn, their teeth match, tooth for tooth. Therefore, it will only take 6 of Gear A's teeth to have moved Gear B a full rotation. So every full rotation of Gear A will move Gear B two rotations. It follows that 8 rotations of Gear A will have rotated Gear B 16 times. Therefore, the correct answer is choice "D".

### EXAM SECTION 3: INTERPRETING GAUGES/CHARTS

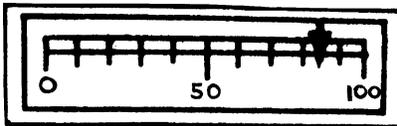
This exam section contains twenty (20) questions designed to assess your ability to read and understand gauges, scales, and numerical information in a chart. The questions will involve looking at drawings of gauges, scales, and dials. A good strategy to use for these types of questions is to first look carefully at the drawing and determine what kind of information it is providing.

Note the range of numbers presented and the direction in which the values ascend: from left to right or right to left; clockwise or counterclockwise. Note the units between the scale values shown, for example: tenths or eighths of a unit; 5 or 10 units. Then carefully read each question and identify the information for which the question is specifically asking. Now, looking back at the drawing, determine the value to which the question is referring, and find it among the response choices provided.

Examples of these types of questions are shown below. The sample questions are followed by brief explanations of the correct answers.

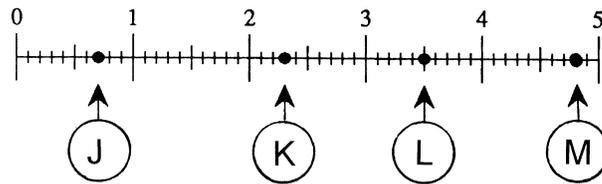
7. Which of the following values is closest to the value indicated by the gauge in Figure B?

- A. 53.5
- B. 80.5
- C. 85.0
- D. 90.0



**Answer:** The correct answer to sample question #7 is response choice "C". The scale values range from zero through 100, ascending from the left to the right. There are 50 units between the minimum and midpoint and between the midpoint and 100. There are five (5) intervals between each of these three scale values. Therefore, there are 10 points between each demarcation: 50 divided by 5. The pointer is indicating the value that is 3 and one half intervals to the right of the midpoint, 50. That value is 50 plus 3.5 times 10, which is 85.0 and is response choice "C" in sample question #7.

Sample questions 8 and 9 are based on the scale in Figure C below.



8. Which of the following values is closest to the value indicated by the arrow labeled "J" in Figure C?
- A.  $\frac{7}{10}$
  - B.  $\frac{7}{12}$
  - C.  $\frac{6}{8}$
  - D.  $\frac{7}{8}$

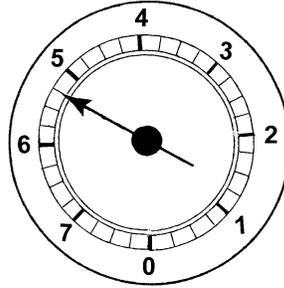
**Answer:** The correct answer to sample question #8 is response choice "A". The scale values range from zero through 5, ascending from the left to the right. There are 10 intervals between each of the scale values shown, so the scale is in tenths of a unit (1 unit divided by 10). Each interval is equal to  $\frac{1}{10}$ . The arrow is indicating the value that is 7 intervals to the right of the zero, or zero plus 7 tenths, which is  $\frac{7}{10}$  and is response choice "A" in sample question #8.

9. Which of the following values is closest to the value indicated by the arrow labeled "M" in Figure C?
- A. 4.53
  - B. 4.75
  - C. 4.80
  - D. 4.85

**Answer:** The correct answer to sample question #9 is response choice "C". The scale values range from zero through 5, ascending from the left to the right. There are 10 intervals between each of the scale values shown, so the scale is in tenths of a unit (1 unit divided by 10). Each interval is equal to  $\frac{1}{10}$ . The arrow is indicating the value that is 8 intervals to the right of the scale value of 4, or 4 plus 8 tenths, which is  $4\frac{8}{10}$ . In this case, the value is expressed as 4.8, the equivalent decimal value, and is response choice "C" in sample question #9.

10. Which of the following values is closest to the value indicated by the gauge in Figure D?

- A. 6.75
- B. 5.40
- C. 5.25
- D. 4.75



**Answer:** The correct answer to sample question #10 is response choice "C". The scale values range from zero through 7, ascending in a counterclockwise direction from the zero at the bottom of the circular gauge. There are 4 intervals between each of the scale values shown, so the scale is in quarters of a unit (1 unit divided by 4), or 0.25 units. The arrow is indicating the value that is 1 interval counterclockwise from the scale value of 5, or 5 plus 0.25, which is 5.25 and is response choice "C" in sample question #10.

#### EXAM SECTION 4: ELECTRICAL CONCEPTS

This exam section contains twenty (20) questions designed to assess your knowledge and understanding of electrical concepts. Question content includes terminology, electrical system components and tools, and electrical equipment, especially electric motors. An effective strategy for answering questions in this section is to prepare before the exam by reviewing the areas described above. Then, when taking the exam, carefully read each question and make sure you know exactly what is being asked. With a clear understanding of the question, you then should be better able to draw upon your knowledge of these topics and thoughtfully consider the response choices.

Examples of these types of questions are shown below. The sample questions are followed by brief explanations of the correct answers.

11. The letters SPST, which are frequently found on wiring plans, refer to a type of:
- A. fuse.
  - B. cable.
  - C. motor.
  - D. switch.

**Answer:** The correct answer to sample question #11 is response choice "D". The abbreviation stands for "single pole, single throw" which is a simple on-off switch.

12. A megger or megohmmeter is a tool used in the inspection and maintenance of wiring, motors, and other electrical equipment to detect which of the following?
- A. Short circuits.
  - B. Overloaded circuits.
  - C. Deterioration of insulation components.
  - D. Deterioration of fuses or circuit breakers.

**Answer:** The correct answer to sample question #12 is response choice "C". This tool is a special type of ohmmeter that measures the electrical resistance of insulators. As part of the maintenance of high voltage equipment and installations, the megohmmeter is used to measure the insulation strength of insulation components, for example, electrical wires, cable jackets, and motor windings.

13. Which of the following types of electric motors is most appropriate for applications that require variable speed operation?
- A. Split-phase motor.
  - B. Synchronous motor.
  - C. Wound-rotor induction motor.
  - D. Squirrel cage induction motor.

**Answer:** The correct answer to sample question #13 is response choice "C". This type of induction motor has a rotor winding that is not short-circuited on the rotor, like a squirrel cage motor. Instead, it is brought to slip rings so that the rotor circuit can be modified by inserting external resistance. Adjusting the resistance allows control of the speed and torque characteristics of the motor. The split-phase, synchronous, and squirrel cage induction types of motors are all defined as constant speed motors.

## EXAM SECTION 5: PUMP OPERATION AND MAINTENANCE

This exam section contains twenty (20) questions designed to assess your knowledge and understanding of concepts related to the operation and maintenance of pumps. Exam content includes pump characteristics, uses, trouble shooting, terminology, and related components. An effective approach to assist you in doing your best on this section is to prepare before the exam by reviewing the areas described above. Then, when taking the exam, carefully read each question and make sure you know exactly what is being asked. With a clear understanding of the question, you then should be better able to draw upon your knowledge of these topics and thoughtfully consider the response choices.

Examples of these types of questions are shown below. The sample questions are followed by brief explanations of the correct answers.

14. The primary reason that a centrifugal pump should never be started unless it is filled with liquid is that:
- A. the presence of the liquid is required to provide lubrication and cooling.
  - B. in the absence of a liquid, the impeller might start rotating in the wrong direction.
  - C. the presence of the liquid is required to ensure that no air is pumped into the discharge piping.
  - D. in the absence of a liquid, pump startup would create enormous pressure within the pump.

**Answer:** The correct answer to sample question #14 is response choice "A". Necessary leakage of liquid from the high pressure discharge area back into the suction area of the pump only occurs during operation. This leakage is necessary to act as a lubricant and coolant, keeping the surfaces separated and preventing rubbing and seizing of the surfaces. Because of this, centrifugal pumps must not be started unless they are filled with liquid.

15. In a pumping system, the term "head" refers to the:
- A. suction side of the pump.
  - B. discharge side of the pump.
  - C. pipe between the pump and the check valve.
  - D. system pressure in terms of water column height.

**Answer:** The correct answer to sample question #15 is response choice "D". Head is a hydraulics term and is the measurement of the energy possessed by the liquid at any point in a pumping system. It is an indication of the pressure or force exerted by the liquid. Head is expressed in feet or meters to represent the height of liquid above some reference point, or it can be expressed as pressure in pounds per square inch (psi).

16. Foot valves are sometimes installed on the end of the suction pipe to a centrifugal pump in order to:
- A. allow manual bleeding of any accumulated air.
  - B. prevent loss of prime and to ensure that seals remain wet.
  - C. eliminate line pressure surges caused by the starting and stopping of the pump.
  - D. prevent backflow through the pump by closing when there is a power failure or loss of prime.

**Answer:** The correct answer to sample question #16 is response choice "B". A foot valve is installed at the bottom, or foot, of the suction line and closes when the pump stops. When the ports of the foot valve close, the liquid cannot drain back to the suction well, so prime is maintained and seals remain wet.

### **ADDITIONAL ASSISTANCE**

If you feel that you would benefit from more practice, your local library or relevant internet web sites may have reference materials that can be helpful. This is true for all of the subject areas covered by the Plant Operations Series written exam.