

DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION



Mine Safety and Health Inspector

Math Test Preparation Guide

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Table of Contents

Introduction.....	3
What can I expect from this Math Test Preparation Guide?.....	4
What can I NOT expect from this Math Test Preparation Guide?	4
What happens if I pass the Math Test?	4
What information will I be provided to take the Math Test?.....	5
General Test-Taking Tips	5
Math Formulas and Other Information	6
Sample Math Problems	7
Answer Key and Explanations for Sample Math Problems.....	9
Sample Math Test	11
Sample Math Test Answer Key	14

Introduction

Welcome to the preparation guide for the Mine Safety and Health Inspector math examination. This guide is designed to help prepare you for the examination process. The Mine Safety and Health Inspector math examination is the second step, following the application, for employment consideration as a Mine Safety and Health Inspector.

Mine Safety and Health Administration (MSHA) Inspectors are responsible for enforcing compliance under the provisions of the Federal Mine Safety and Health Act of 1977 (Mine Act), as amended by the Mine Improvement and New Emergency Response Act of 2006 (MINER Act). MSHA carries out the mandates of the Mine Act at all mining and mineral processing operations in the United States.

MSHA has extensively evaluated the skills and training for its inspectors to competently perform mine safety and health inspection, enforcement, and related compliance assistance activities. Basic math skills are required to successfully carry out various inspection activities, including those related to hoisting, ventilation, ground control, load haul and dump, health sampling, electrical, and materials storage and handling.

Applicants are given 60 minutes to complete a math test consisting of 30 multiple-choice questions covering basic arithmetic and math reasoning. Basic arithmetic questions include converting fractions to decimals, and adding, subtracting, multiplying, and dividing decimals. Math reasoning questions include calculating the perimeter, circumference, area, and volume of various shapes. The questions are geared towards solving mathematical problems which are similar to those encountered during regular mine inspections and investigations.

What can I expect from this Math Test Preparation Guide?

In this guide, we familiarize you with the testing process so that you know what to expect on the test and have a better chance of success. We want you to be able to take the Mine Safety and Health Inspector math test feeling more confident and at ease.

This guide is organized into two sections:

- Section I: Sample Math Problems
- Section II: Sample Math Test

In Section I, beginning on page 7, we provide you with sample math problems. These problems are similar to questions found in the actual math test. This section contains 5 math reasoning problems. Read each problem carefully and then record your answer. Then turn to page 9 and compare your responses to the answer key and detailed explanations we have provided for you. You will receive the most benefit from the sample math problems if you first record your responses before reviewing the answer key and explanations.

In Section II, we provide you with a 11-question sample math test. The sample math test is comprised of both basic arithmetic and math reasoning questions. These questions are representative of the questions that could appear on the actual math test. Detailed explanations are not provided for these questions. However, this guide does provide you with the correct answer to these questions. The answer key for the sample math test is on page 14.

Both the sample math problems and questions in the sample math test are similar in format and difficulty level to those items on the actual math test.

Some of the math questions in this guide are presented in the context of mine safety and health work. You do not need any experience or training in this area to correctly answer these questions.

What can I NOT expect from this Math Test Preparation Guide?

Completing the sample math exercises provided in this guide does not guarantee a passing score on the actual math test or in your aptitude to perform Mine Safety and Health Inspector work. However, the sample exercises do resemble the actual test in style and format.

What happens if I pass the Math Test?

A passing score on the Mine Safety and Health Inspector math test qualifies you to continue in the assessment process but does not guarantee you a position with MSHA. If you achieve a passing score on this test, you will be invited to complete the next step in the assessment process – a writing evaluation. The writing evaluation is administered on the same day and in the same location as the math test.

What information will I be provided to take the Math Test?

On the day of the math test, you will be provided with math formulas and other information to assist you in answering some of the math questions. The formulas you are provided in this guide are very similar to the formulas that you are provided for the actual math test. Use the math formulas and other information, provided on page 6 of this guide, as needed to solve the math problems in this guide.

You are not permitted to use a calculator or other similar tools on any part of the math test. Therefore, it is to your advantage to solve the math problems in this guide without using a calculator or other assistance (e.g., mechanical, computer, electrical).

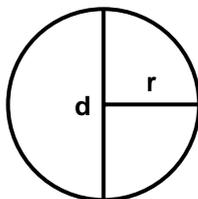
The test administrators will provide you with blank scratch paper and writing tools to complete the math test.

General Test-Taking Tips

- Pay careful attention to all instructions before beginning.
- For each question, read the entire question and all response options carefully before selecting an answer.
- If you do not know the answer to a question, eliminate the response options that you know to be incorrect or probably incorrect and then select an answer from the remaining response options.
- Your score is based on the number of questions you answer correctly. You are not penalized for answering questions incorrectly. Therefore, you should answer every question, even questions that you must guess.
- If you finish before time is up, go back and check your answers.
- Ignore any patterns of A's, B's, C's, D's, and E's. These correct answer positions are chosen randomly and there is no way to improve your chances by guessing based on response patterns.
- Get a good night's sleep. To be rested and prepared, it is important to get adequate sleep the night before you take the test.
- Eat a light, nutritious meal. Although you may be a bit nervous before you take the test, it is important to eat a light and nutritious meal. By doing so, you will increase your energy level.
- You will do your best on the test if you stay calm and relaxed.
- Obtain directions to the testing facility in advance to ensure an on time and stress free arrival.

Math Formulas and Other Information

r = radius ($r = \frac{1}{2} d$)
 d = diameter ($d = 2r$)
 $\pi = 3.14$ in this guide

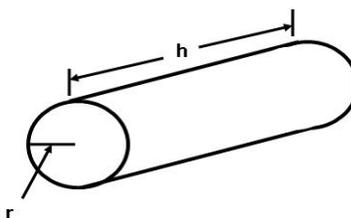


Circle Circumference = $2\pi r$

Circle Area = πr^2

Circular Volume = $\pi r^2 h$

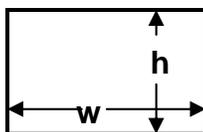
h = height or length of object



Rectangle Perimeter = $2(h + w)$

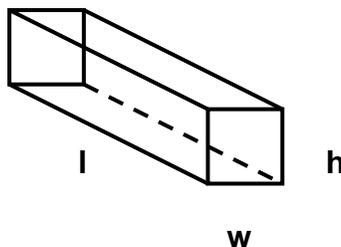
Rectangle Area = $h \times w$

h = height
 w = width



Rectangular Volume = $l \times h \times w$

l = length
 h = height
 w = width



Note: Shapes and formulas other than those presented above may appear on the actual math test.

Rounding

If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up. If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number down. For example, if your response is 4.736, you can round this to 4.74; on the other hand, if your response is 4.734, you can round this to 4.73. As a general rule, do not round until you arrive at a final answer. Rounding in the initial steps of a problem may lead you to an incorrect answer.

Section I: Sample Math Problems

Instructions: Carefully read and solve each of the following math problems and record your answer. Formulas and other information you may need to answer these questions are displayed on page 6. Refer to these formulas and other information as you need it to solve the problems in this section. The answer key and detailed explanations for the math problems in this section are on page 9. It is to your advantage to arrive at answers to these problems before reading the explanations for these problems. Use of calculators and other similar tools are not permitted on the actual math test; therefore, it is to your advantage to solve these problems without using a calculator or other assistance (e.g., mechanical, computer, electrical).

Sample Problem 1. A circular mine passage has a radius of 7.0 feet. What is the circumference of the mine passage?

- a. 42.96 feet
- b. 43.96 feet
- c. 87.92 feet
- d. 153.86 feet
- e. none of these

Sample Problem 2. A rectangular mine passage is 6.7 feet high and 13.0 feet wide. What is the perimeter of the mine passage?

- a. 16.0 feet
- b. 19.7 feet
- c. 39.4 feet
- d. 87.1 feet
- e. none of these

Sample Problem 3. What is the area of a circular mine passage with a diameter of 8.0 feet?

- a. 12.56 square feet
- b. 50.24 square feet
- c. 157.75 square feet
- d. 200.96 square feet
- e. none of these

Sample Problem 4. What is the area of a rectangle that is 4 feet 6 inches in height and 5 feet 3 inches in width?

- a. 23.63 square feet
- b. 23.85 square feet
- c. 24.15 square feet
- d. 24.38 square feet
- e. none of these

Sample Problem 5. In 2006, labor statistics reported that there were 24,000 coal mine Inspectors in the United States. In 2007, the statistics reported a total of 30,000 coal mine Inspectors in the United States. What is the percentage increase in coal mine Inspectors in the United States from 2006 to 2007?

- a. 11.11%
- b. 20.00%
- c. 25.00%
- d. 80.00%
- e. none of these

Answer Key and Explanations for Sample Math Problems

Sample Problem 1 Explanation. The formula for calculating the circumference of a circle is $2\pi r$, where $\pi = 3.14$ and $r = \text{radius}$.

The correct answer is **option B** because it correctly follows the formula for calculating the circumference of a circle.

Formula: Circle Circumference (C) = $2\pi r$

Step 1: $C = 2 \times 3.14 \times 7.0$

Step 2: $C = 43.96$ feet

Sample Problem 2 Explanation. The formula for calculating rectangular perimeter is $2(h + w)$, where $h = \text{height}$ and $w = \text{width}$.

The correct answer is **option C** because it correctly follows the formula for calculating the perimeter of the rectangle.

Formula: Rectangle Perimeter (P) = $2(h + w)$

Step 1: $P = 2(6.7 + 13.0)$

Step 2: $P = 2(19.7)$

Step 3: $P = 39.4$ feet

Sample Problem 3 Explanation. The formula for calculating circular area is πr^2 where π is equivalent to 3.14 and r^2 is equivalent to radius squared (i.e., radius multiplied by radius). The radius of a circle is equivalent to one-half the diameter (d) of a circle. The diameter is 8 feet; therefore, the radius of the circular passage in this question is 4 feet. When calculating circular area, you must square (i.e., multiply a certain number or product by itself) the radius before multiplying that product by π (i.e., 3.14).

The correct answer is **option B** because it correctly uses the formula for calculating the area of a circle.

Formula: Circle Area (A) = πr^2 .

Step 1: $A = 3.14 \times 4.0^2$

Step 2: $A = 3.14 \times 16.0$

Step 3: $A = 50.24$ square feet

Sample Problem 4 Explanation. The formula for calculating rectangular area is $h \times w$, where h = height and w = width. To correctly calculate the area of a rectangle in which the height and width dimensions are presented in both feet and inches, the dimensions must be converted to either feet or inches. For this particular question, all the response options are presented in feet. Therefore, the dimensions should be converted to feet. One foot is equivalent to 12 inches.

The correct answer is **option A** because it correctly uses the area formula and converts inches to feet.

Formula: Rectangle Area (A) = $l \times w$

Step 1: $l = 4 \text{ feet } 6 \text{ inches}$ (6 inches = $\frac{1}{2}$ foot or .5 feet) $\rightarrow l = 4.5 \text{ feet}$

Step 2: $w = 5 \text{ feet } 3 \text{ inches}$ (3 inches = $\frac{1}{4}$ foot or .25 feet) $\rightarrow w = 5.25 \text{ feet}$

Step 3: $A = 4.5 \times 5.25$

Step 4: $A = 23.625 \rightarrow \text{rounded} = 23.63 \text{ square feet}$

Sample Problem 5 Explanation. To correctly calculate percentage increase, decrease, or difference you must take three steps.

Step 1: Find the difference between the two numbers.

Step 2: Divide the difference by the original number.

Step 3: Multiply the resulting number by 100 to obtain the percentage increase.

The correct answer is **option C** because it follows the three steps of calculating percentage increase.

Step 1: $30,000 - 24,000 = 6,000$.

- 30,000 is the number of Inspectors in 2007.
- 24,000 is the number of Inspectors in 2006.

Step 2: $6,000 / 24,000 = 0.25$

- 6,000 is the difference between the number of Inspectors in 2006 and 2007.
- 24,000 is the original number—the number of Inspectors in 2006.

Step 3: $0.25 \times 100 = 25\%$

Section II: Sample Math Test

Instructions: Carefully read and solve each of the following math questions and record your answer. Formulas and other information you may need to answer these questions are displayed on page 6. Refer to these formulas and other information as you need it to work the problems in this section. The answer key for the questions in this section is on page 14. It is to your advantage to arrive at answers to these problems before checking the correct answers for these questions. Use of calculators and other similar tools are not permitted on the actual math test; therefore, it is to your advantage to solve these problems without using a calculator or other assistance (e.g., mechanical, computer, electrical).

1. $33.8 + 6.92 =$
 - a. 30.72
 - b. 39.72
 - c. 40.72
 - d. 49.72
 - e. none of these

2. $5,657.41 - 2,009.78 - 2648.99 =$
 - a. 997.64
 - b. 998.64
 - c. 999.64
 - d. 1,000.64
 - e. none of these

3. $0.005 \times 0.05 =$
 - a. .25
 - b. .025
 - c. .0025
 - d. .00025
 - e. none of these

4. $3 / 8$ most nearly equals
 - a. .266
 - b. .375
 - c. 2.66
 - d. 3.75
 - e. none of these

5. Which of the following is longest?
 - a. .01 inch
 - b. .9 inch
 - c. .003 inch
 - d. .0025 inch
 - e. .87 inch

6. During an 8-hour day, an Inspector spends on the average 3 hours inspecting mine operations, 2 hours interviewing mine personnel, 2 hours writing reports, and 1 hour traveling from mine site to mine site. On the average, what fraction of a 40-hour work week does the Inspector spend writing reports?
- $1/4$
 - $1/20$
 - $1/5$
 - $4/5$
 - none of these
7. An investigator began an inspection trip which covered a total of 200 miles. The investigator traveled 45 miles per hour for the first 90 miles. If the entire trip must be finished in 4 hours, what must the investigator's average speed be for the remaining miles of the trip?
- 27.5 mph
 - 50.0 mph
 - 55.0 mph
 - 77.5 mph
 - none of these
8. What is the volume of a rectangular airway that is 15.0 feet high, 19.0 feet wide, and 169.0 feet long?
- 31,625.0 cubic feet
 - 47,125.0 cubic feet
 - 48,265.0 cubic feet
 - 48,665.0 cubic feet
 - none of these
9. What is the volume of a circular mine passage that is 19.0 feet in diameter and 210.0 feet long?
- 6,264.00 cubic feet
 - 58,510.85 cubic feet
 - 59,510.85 cubic feet
 - 238,043.40 cubic feet
 - none of these
10. While on travel, an inspector rented a car and drove it 480 miles. How many days did the inspector keep the car if the total charge for renting it was \$126 and the rental rate was \$9 per day plus \$.15 per mile driven?
- 4
 - 5
 - 6
 - 7
 - none of these

11. In a state that has a total of 6,000 miners, 1 out of every 4 works in a coal mine. How many of the miners in the state are coal miners?
- a. 1,200
 - b. 1,500
 - c. 2,000
 - d. 4,500
 - e. none of these

Sample Math Test Answer Key

Question Number	Correct Answer
1	C
2	B
3	D
4	B
5	B
6	A
7	C
8	E
9	C
10	C
11	B