

## Pre-Professional Skills Test: Mathematics (0730)

<i>Test at a Glance</i>			
Test Name	Pre-Professional Skills Test: Mathematics		
Test Code	0730		
Time	60 minutes		
Number of Questions	40		
Format	Multiple-choice questions (calculators prohibited)		
	Content Categories	Approximate Number of Questions	Approximate Percentage of Examination
	I. Conceptual Knowledge and Procedural Knowledge	18	45%
	II. Representations of Quantitative Information	12	30%
	III. Measurement and Informal Geometry, Formal Mathematical Reasoning	10	25%

### About This Test

The Pre-Professional Skills Test in Mathematics measures those mathematical skills and concepts that an educated adult might need. It focuses on the key concepts of mathematics and on the ability to solve problems and to reason in a quantitative context. Many of the problems require the integration of multiple skills to achieve a solution.

The test questions are from three content categories: conceptual and procedural knowledge, representations of quantitative information, and measurement and informal geometry and formal mathematical reasoning.

Computation is held to a minimum, and few technical words are used. Terms such as area, perimeter, ratio, integer, factor, and prime number are used, because it is assumed that these are commonly encountered in the mathematics all examinees have studied. Figures are drawn as accurately as possible and lie in a plane unless otherwise noted.

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## Topics Covered

Representative descriptions of topics covered in each category are provided below.

### I. Conceptual Knowledge and Procedural Knowledge

#### Conceptual Knowledge

Demonstrate number sense and operation sense, that is, an understanding of the foundational ideas of numbers, number properties, and operations defined on numbers (whole numbers, fractions, and decimals).

- Order: demonstrate an understanding of order among whole numbers, fractions, and decimals
- Equivalence: demonstrate an understanding that a number can be represented in more than one way
- Numeration and place value: demonstrate an understanding of how numbers are named, place value, and order of magnitude of numbers
- Number properties: demonstrate an understanding of the properties of whole numbers without necessarily knowing the names of the properties
- Operation properties: demonstrate an understanding of the properties (commutative, associative, and distributive) of the basic operations (addition, subtraction, multiplication, and division); recognize equivalent computational procedures

#### Procedural Knowledge

Demonstrate an understanding of the procedures required to represent quantitative relationships and the ability to plan, execute, interpret, or complete operations to solve problems.

- Computation: perform computations; adjust the result of a computation to fit the context of a problem; identify numbers or information or operations needed to solve a problem
- Estimation: estimate the result of a calculation; determine the reasonableness of an estimate
- Ratio, proportion, and percent: solve problems involving ratio, proportion, and percent
- Probability: interpret numbers used to express simple probability; assign a probability to a possible outcome
- Equations: solve simple equations and inequalities; predict the outcome of changing some number or condition in a problem
- Algorithmic thinking: demonstrate an understanding of the algorithmic point of view—that is, follow a given procedure; recognize various ways to solve a problem; identify, complete, or analyze a procedure; discover patterns in a procedure

### II. Representations of Quantitative Information

Demonstrate an ability to interpret visual displays of quantitative information, to retrieve information from data, to determine if statements based on data are true or false, to recognize relationships in and make inferences from data, and to represent a given set of data graphically.

- Interpretation: read and interpret visual displays of quantitative information, such as bar graphs, line graphs, pie charts, pictographs, tables, stemplots, scatterplots, schedules, simple flowcharts, and diagrams; recognize relationships in data; determine an average, a range, a mode, or a median
- Trends: given a data display, observe groupings, make comparisons, and make predictions or extrapolations
- Inferences: given a data display, draw conclusions or make inferences from the data
- Patterns: identify and recognize patterns in data, such as variation
- Connections: demonstrate an understanding of the relationship between numerical values in a table, the symbolic rule relating table values, and the corresponding graphical representation of the table and the rule; choose a graph appropriate to represent a given set of data; recognize quantitative relationships in symbols or in words

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### III. Measurement and Informal Geometry and Formal Mathematical Reasoning

#### Measurement and Informal Geometry

Demonstrate a basic understanding of measurement, of the U.S. customary and metric systems of measurement, and of geometric properties and relationships. At least half the questions will focus on informal geometry.

- Systems of measurement: demonstrate basic literacy in the U.S. customary and metric systems of measurement; convert from one unit to another within the same system and between different systems; recognize and use appropriate units for making measurements; read a calibrated scale

- Measurement: determine the measurements needed to solve a problem; recognize and use geometric concepts in making linear, area, and volume measurements; solve measurement problems by using a formula, estimating, employing indirect measurement, using rates as measures, making visual comparisons, using scaling/proportional reasoning, or using a nonstandard unit
- Geometric properties: recognize and use geometric properties and relationships in both pure and real-world situations, such as recognizing a symmetrical design or determining a distance using the Pythagorean relationship

#### Formal Mathematical Reasoning

Demonstrate an ability to use the basics of logic in a quantitative context.

- Logical connectives and quantifiers: interpret statements that use logical connectives (and, or, if – then) as well as quantifiers (some, all, none)
- Validity of arguments: use deductive reasoning to determine whether an argument (a series of statements leading to a conclusion) is valid or invalid
- Generalization: identify an appropriate generalization, an example that disproves an inappropriate generalization, or a hidden assumption

## Sample Test Questions

The sample questions that follow illustrate the types of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding lettered space on the answer sheet with a heavy, dark mark so that you cannot see the letter.

Remember, try to answer every question.

**Special Note:** Figures that accompany problems in the test are intended to provide information useful in solving the problem. The figures are drawn as accurately as possible except when it is stated in a specific problem that its figure is not drawn to scale. Figures can be assumed to lie in a plane unless otherwise indicated. Position of points can be assumed to be in the order shown, and lines shown as straight can be assumed to be straight. The symbol  $\square$  denotes a right angle.

- Which of the following is equal to a quarter of a million?
  - 40,000
  - 250,000
  - 2,500,000
  - $\frac{1}{4,000,000}$
  - $\frac{4}{1,000,000}$
- Which of the following fractions is least?
  - $\frac{11}{10}$
  - $\frac{99}{100}$
  - $\frac{25}{24}$
  - $\frac{3}{2}$
  - $\frac{501}{500}$
- Which of the sales commissions shown below is greatest?
  - 1% of \$1,000
  - 10% of \$200
  - 12.5% of \$100
  - 15% of \$100
  - 25% of \$40
- |       |    |
|-------|----|
| Men   | 12 |
| Women | 18 |
| Boys  | 10 |
| Girls | 8  |

The table above shows the distribution of men, women, boys and girls, in a group of 48 individuals. If one individual is to be randomly selected from the group, what is the probability that the individual will be a woman?

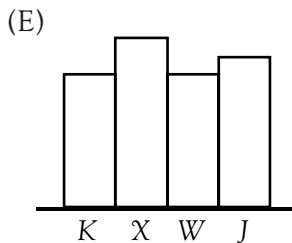
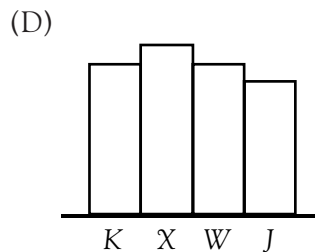
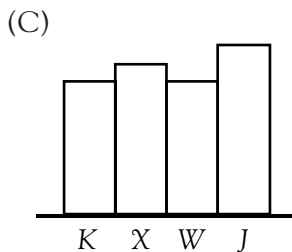
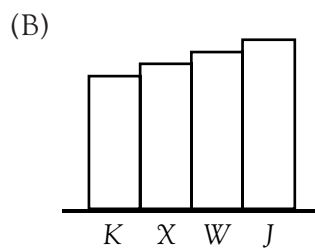
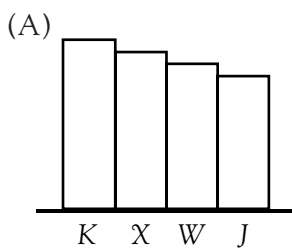
  - $\frac{1}{18}$
  - $\frac{1}{4}$
  - $\frac{2}{15}$
  - $\frac{3}{8}$
  - $\frac{1}{2}$
- If  $P \div 5 = Q$ , then  $P \div 10 =$ 
  - 10Q
  - 2Q
  - $Q \div 2$
  - $Q \div 10$
  - $Q \div 20$

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Car Model	Frequency
K	7
X	9
W	7
J	8

x	y
0	5
2	11
6	23
7	26
10	35

6. The chart above gives data about the distribution of four compact-car models in a company parking lot. Which of the following figures best represents the given data?



7. Which of the following equations expresses the relationship between  $x$  and  $y$  in the table above?

- (A)  $y = x + 5$
- (B)  $y = x + 6$
- (C)  $y = 3x + 5$
- (D)  $y = 4x - 1$
- (E)  $y = 4x - 5$

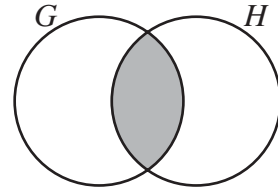
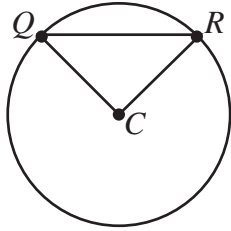
WIND-CHILL CHART

Temp. (F)	Wind Speed (m.p.h.)				
	10	15	20	25	30
40°	28	22	18	16	13
30°	16	9	4	0	-2
20°	4	-5	-10	-15	-18
10°	-9	-18	-25	-29	-33
0°	-21	-36	-39	-44	-48
-10°	-33	-45	-53	-59	-63
-20°	-46	-58	-67	-74	-79
-30°	-58	-72	-82	-88	-94

8. The temperature today is  $10^{\circ}\text{F}$ , but it feels as cold as it did last week when the temperature was  $-10^{\circ}\text{F}$  and the wind speed was 10 miles per hour. According to the chart above, what is the wind speed today?

- (A) 10 m.p.h.
- (B) 15 m.p.h.
- (C) 20 m.p.h.
- (D) 25 m.p.h.
- (E) 30 m.p.h.

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9. In the figure above,  $C$  is the center of the circle.  
Which of the following must be true?

- (A)  $QC$  and  $RC$  have the same length
- (B)  $QR$  and  $RC$  have the same length
- (C)  $QC$  is perpendicular to  $QR$
- (D)  $QR$  is perpendicular to  $RC$
- (E)  $\triangle QRC$  is equilateral

10. In the Venn diagram above, circle  $G$  represents the integers 2 to 10, inclusive, and circle  $H$  represents the integers 6 to 12, inclusive. How many integers are represented by the shaded region?

- (A) Two
- (B) Three
- (C) Four
- (D) Five
- (E) Six

## Answers

1. Since one million is 1,000,000, a quarter of a million is  $\frac{1}{4} \times 1,000,000$ , or 250,000. The answer is B.

2. Of the five fractions given, four are greater than 1; that is, the numerators are greater than the denominators. Only one of the fractions,  $\frac{99}{100}$ , is less than 1, so it must be the least. The answer is B.

3. Since 15% of \$100 is greater than 12.5% of \$100 (choices C and D), C is incorrect; and 10% of \$200 (choice B) is \$20, which is greater than 15% of \$100, or \$15. That leaves 1% of \$1,000 (choice A) and 25% of \$40 (choice E) to consider, both of which equal \$10. The answer is B.

4. Since there are 48 individuals in the group and 18 are women, the probability of a woman being selected is 18 out of 48 or  $\frac{18}{48} = \frac{3}{8}$ . The answer is D.

5. There are several ways to solve this problem.

One way is to express  $P \div 5 = Q$  as  $\frac{P}{5} = Q$ .

Then  $P = 5Q$ ,  $\frac{P}{10} = \frac{5Q}{10} = \frac{Q}{2}$  or  $Q \div 2$ .

Alternatively,

$$\frac{P}{5} = Q, \quad \frac{1}{2} \left( \frac{P}{5} \right) = \frac{1}{2} Q, \quad \text{and} \quad \frac{P}{10} = \frac{Q}{2}.$$

Another way is to divide a few numbers, such as 30 or 100, by both 5 and 10 and compare results. All of these examples illustrate the fact that if  $P \div 5 = Q$ , then  $P \div 10$  must be  $\frac{1}{2}$  of  $Q$  or  $Q \div 2$ . The answer is C.

6. The chart shows that one frequency is greater than the others and two frequencies are equal. A quick look at the choices shows that only C, D, and E have both one bar that is taller than the others and two bars of equal height. According to the chart, the frequency of model X is greatest, which eliminates choice C. Only choice E shows that the relative heights of all the bars agree with the information in the chart; that is, J is less than X and greater than K and W. The best answer is E.

7. The correct equations must hold when each of the pairs of values from the table is substituted for  $x$  and  $y$ . Choice A holds for  $x = 0, y = 5$ , but not for  $x = 2, y = 11$ . Choices B, D, and E do not hold for  $x = 0$ . Choice C holds for all of the values given:

$$\text{if } x = 0, \text{ then } y = 3(0) + 5 = 5,$$

$$\text{if } x = 2, \text{ then } y = 3(2) + 5 = 11,$$

$$\text{if } x = 6, \text{ then } y = 3(6) + 5 = 23, \text{ and so forth.}$$

The answer is C.

8. According to the chart, if the temperature is  $-10^\circ\text{F}$  and the wind speed is 10 miles per hour, the wind-chill factor is  $-33$ . The problem states that it feels this cold today although the temperature is  $10^\circ\text{F}$ . To solve this problem, look at the row of the chart for  $10^\circ\text{F}$  and find the wind-chill factor  $-33$ . This factor corresponds to a wind speed of 30 miles per hour. The answer is E.

9. Since C is the center of the circle, QC and RC are both radii of the circle and therefore have the same length. The answer is A.

10. In the Venn diagram, the shaded region represents the integers that are in both G and H; that is, the integers 6, 7, 8, 9, and 10, which amount to five integers. The answer is D.