Medical Math

Exam Information	Description
Exam number **740** **Items** **49** **National Career Cluster** **Healthcare & Human Services** **Certification available** **No, in Pilot status**	An instructional program that prepares candidates with critical thinking skills to compute mathematical equations related to healthcare. The course connects math concepts to medical-physiological applications. Candidates will engage in math simulations including but not limited to problem solving, reasoning and proof, communication, connections, and representations.

Exam Blueprint and Performance Skills

Standard	Percentage of exam score
1. Mathematics in Healthcare	0%
2. Math Skills for Problems Solving	24%
3. Proportions and Ratios	12%
4. Medical Instruments	18%
5. Statistical Data	28%
6. Medical Dosages	8%
7. Accounting and Business	6%
8. Exponents and Logarithms	4%

Standard 1 - Mathematics in Healthcare (0% of exam score)

Candidates will investigate how mathematics is applied in healthcare.

Objective 1 Analyze the use of medical mathematics in the healthcare system.

1. Explore various healthcare careers and the mathematical skills used in each one.
2. Compare and contrast at least two different careers.

Standard 2 - Mathematics Skills for Problem Solving (24%)

Candidates will use math skills to solve problems related to healthcare.

Objective 1 Demonstrate fluency in computations and make reasonable estimates.

1. Evaluate and simplify numerical expressions containing rational numbers using the order of operations.
2. Compute solutions to problems and determine the reasonableness of an answer by relating them to applied scenarios.
3. Whole numbers
    a. Cholesterol
    b. Intake and output
    c. Laboratory Values
    d. Lever systems
    e. Nutrition
    f. Quantities
    g. Supplies and inventories
    h. Vital signs labs

Objective 2 Use rational numbers in their most effective forms to solve problems.

1. Choose appropriate and convenient forms of rational numbers for solving problems and representing answers.
2. Compute solutions to problems and determine the reasonableness of an answer by relating them to applied scenarios.
3. Decimals:
    a. Decimals
    b. EKG's
    c. Laboratory values
    d. Medications
    e. Nutrition
    f. Rounding
    g. Temperature
    h. Tools, instruments
    i. Weights

Objective 3 Identify and analyze the relationships among rational numbers and the effects of mathematical operations on them.

1. Compute solutions to problems and determine the reasonableness of an answer by relating them to applied scenarios.
2. Fractions
    a. Conversions (Fahrenheit/Celsius)
    b. EKG's
    c. Estimation
    d. Laboratory values
    e. Medications
    f. Nutrition
    g. Tools, instruments
    h. Weights

Objective 4 Calculate and compare percentages.

1. Compute solutions to problems and determine the reasonableness of an answer by relating them to applied scenarios.
    a. Blood loss
    b. Body composition
    c. Body surface area, burns
    d. Cardiac output
    e. Chemical solutions
    f. Growth charts
    g. Intake/output
    h. Laboratory values
    i. Medications
    j. Nutrition
    k. Oxygen saturation
    l. Stroke volume
    m. Target heart rate

Standard 3 - Proportions and Ratios (12%)

Candidates will calculate and analyze proportions and ratios.

Objective 1 Use algebraic properties to evaluate, solve and analyze mathematical problems.

1. Solve proportions that include algebraic first-degree expressions (solve for X or use dimensional analysis).
    a. Nutrition
    b. Chemical solutions
    c. Dosage conversions
    d. Convert units of measure

Objective 2 Apply ratios to analyze data and identify patterns or relationships.

1. Diseases (statistics)analysis
2. Laboratory values
3. Medications

Standard 4 - Medical Instruments (18%)

Candidates will gather and analyze data using medical instruments.

Objective 1 Analyze patterns, relationships, and functions to represent mathematical situations using collected data.

1. Compute solutions to problems and determine the reasonableness of an answer by relating them to applied scenarios.
    a. Body composition
    b. Body temperature
    c. Pharmacology
    d. Pre/Post workout weight analysis
    e. Vital signs

Objective 2 Represent quantitative relationships using mathematical models and symbols.

1. Find and interpret rates of change by analyzing graphical and numerical data.
2. Understand measurable attributes of objects and the units, systems, and processes of measurement.
3. Solve problems using visualization and spatial reasoning.
4. Instruments
    a. Centrifuges
    b. Goniometry – Range of Motion (ROM)
    c. Intravenous (IV) flow rates
    d. Macro/micro drops (tubing)
    e. Oxygen flowmeter: oxygen flow rates
    f. Pulse oximeters
    g. Rulers, tape measures
    h. Scales
    i. Sphygmomanometer gauges (blood pressure)
    j. Syringes
    k. Thermometers

Standard 5 - Statistical Data (28%)

Candidates will formulate and answer questions by collecting, organizing, and analyzing statistical data.

Objective 1 Graph, analyze, and interpret one-variable quantitative data.

1. Find the mean, median, mode, range, and five number summary for a statistical data set.
2. Graphs and charts.
    a. Body composition
    b. Body mass index (BMI)
    c. Cardiac output
    d. Census

e. Clinical trials
f. Disease, mortality rates
g. Effectiveness (facilities, providers)
h. Healthcare costs
i. Height, weight, measurement graphs
j. Intake and output charts
k. Medication errors
l. Pulse oximeters
m. Sphygmomanometer (blood pressure)
n. Temperature, pulse, respiration graphs
o. Thermometers
p. Treatment prognosis

Objective 2 Graph, analyze, and interpret two-variables quantitative data.

1. Record, organize and display a set statistical data. Examples include:
    a. Scatter plot
    b. Residual plot
2. Determine whether the pattern of the data is linear or nonlinear when given in a list, table, or graph.
3. Interpret the correlation between two variables as positive, negative, or having no correlation.
4. Find a line of best fit by estimation, choosing two points, or using technology for a given set of statistical data. Analyze the meaning of the slope and y-intercept of a line of best fit as it relates to the statistical data set.
5. Make predictions and estimations and determine their reasonableness using a regression equation (line of best fit).
6. Analyze the meaning of the maximum or minimum and intercepts of the regression equation as they relate to a given set of bivariate data.
7. Graphs and charts
    a. Body composition
    b. Body mass index (BMI)
    c. Cardiac output
    d. Census (hospital admissions)
    e. Clinical trials
    f. Disease, mortality rates
    g. Effectiveness (facilities, providers)
    h. Healthcare costs
    i. Height, weight, measurement graphs
    j. Intake and output charts
    k. Job outlook, projections
    l. Temperature, pulse, respiration graphs

Objective 3 Graph, analyze and interpret categorical data.

1. Record, organize and display a set statistical data. Examples include:
    a. Two-way table
    b. Pie chart
    c. Bar graph
2. Calculate and communicate the probability of an event as a fraction, percent, ratio, or decimal.
3. Determine the conditional probability of an event occurring (false positive/false negative).
4. Graphs and charts
    a. Acuities

b. Census
c. Clinical trials
d. Disease, mortality rates
e. Effectiveness (facilities, providers)
f. Epidemiology
g. Healthcare costs
h. Medication errors
i. Reliability and validity
j. Treatment prognosis
k. Wellness indicators

Standard 6 - Medical Dosages (8%)

Candidates will apply mathematical concepts to accurately calculate medication dosages.

Objective 1 Compute fluently and make reasonable estimates.

1. Reading medication labels
2. Interpreting prescriptions

Objective 2 Evaluate, solve, and analyze mathematical situations using algebraic properties and symbols.

1. Simplify and evaluate numerical expressions (including integer exponents and square roots), algebraic expressions, formulas, and equations.
2. Using medical reference materials to determine if calculated dosages are safe to administer.

Objective 3 Represent quantitative relationships using mathematical models and symbols.

1. Dosing
2. Dosage conversions
3. Roman numerals

Standard 7 - Accounting and Business (6%)

Candidates will demonstrate the use of mathematics in medical accounting and healthcare business operations.

Objective 1 Apply systems of order.

1. Numerical filing
2. Appointment scheduling
    a. Time (12/24 hour clock)

Objective 2 Evaluate, solve, and analyze mathematical situations using algebraic properties.

1. Maintaining accounts
2. Checks, deposit slips, and receipts
3. Calculating cash transactions/Payroll

4. Budgeting
5. Depreciation, amortization
6. Insurance

Standard 8 - Exponents and Logarithms (4%)

Candidates will demonstrate the use of exponents and logarithms related to healthcare.

Objective 1 Utilize properties of exponentials to solve equations.

1. Radiation half-life and exposure
    a. Medications half life
        i. Within the body
        ii. Shelf life of medication

Objective 2 Use properties of logarithms to solve equations.

1. pH

Performance Skills Use properties of logarithms to solve equations.

1. Oral presentation on the mathematics used in chosen healthcare career exploration. .
2. Select a healthcare career to create a business model including a graph using data collected.

Durable Skills Use properties of logarithms to solve equations.

1. Professionalism
2. Collaboration
3. Communication (Oral/Written)
4. Leadership
5. Innovation
6. Adaptability

Key Vocabulary Clarifications

Amortization: A process of paying off debt with a regular stream of principal and interest payments.

Acuities: Refers to the sharpness or keenness of thought, vision, or hearing, often used in a medical context to describe the severity of a patient's condition.

Bivariate data: Data that involves two different variables.

Body surface area (BSA): A measurement used in medicine, especially for calculating medication dosages and burn areas, based on height and weight.

Cardiac output: The volume of blood pumped by the heart per minute.

Dimensional analysis: A problem-solving method that uses the fact that any number or expression can be multiplied by one without changing its value, often used for converting units.

Epidemiology: The branch of medicine that deals with the incidence, distribution, and possible control of diseases and other factors relating to health.

Five-number summary: A set of descriptive statistics that provides information about a dataset: minimum, first quartile (Q1), median, third quartile (Q3), and maximum.

Goniometry: The measurement of angles, especially those of the joints in the body, used to assess range of motion (ROM).

Intake and output: Measurements of all fluids a patient ingests and excretes, used to monitor fluid balance.

Line of best fit: A line drawn through a scatter plot that best represents the relationship between two variables.

Macro/micro drops (tubing): Refers to the size of drops delivered by IV tubing, used to calculate IV flow rates.

Mode: The number that appears most frequently in a set of numbers.

Order of operations: A set of rules that dictate the sequence in which mathematical operations should be performed (e.g., PEMDAS/BODMAS).

Oxygen saturation: The percentage of hemoglobin binding sites in the bloodstream occupied by oxygen.

Pulse oximeters: Medical devices that indirectly monitor the oxygen saturation of a patient's blood.

Radiation half-life: The time it takes for half of the radioactive atoms in a sample to decay.

Regression equation: An equation that describes the relationship between a dependent variable and one or more independent variables, often used to make predictions.

Residual plot: A graph that shows the residuals (the differences between observed and predicted values) on the vertical axis and the independent variable on the horizontal axis.

Scatter plot: A graph that displays values for two variables for a set of data.

Sphygmomanometer gauges: Instruments used to measure blood pressure.

Stroke volume: The volume of blood pumped from the left ventricle per beat.

Target heart rate: The minimum number of heartbeats in a given period of time in order to reach the level of exertion necessary for cardiovascular fitness.

Two-way table: A table that displays the frequencies of two categorical variables.

Y-intercept: The point where a line crosses the y-axis on a graph.