



MAT097 Foundations II

Course Description: (6 Credits) Development of fundamental mathematical skills and concepts such as operations/properties of exponents and complex numbers; factoring; graphing functions; solution/application of linear, quadratic, and rational equations; operations on rational and radical expressions.

Prerequisite: MAT086 or higher or placement test. Recommended: RDG091.

Learning Outcome Statement: Upon completion of this course the student will be able to

1. (Application Level) Apply the appropriate rules of addition, subtraction, multiplication, and division with polynomials, rational expressions, and radical expressions and express the answer in the simplest form. (CSLO 4)

1a. Divide using long division $\frac{x^4 + 6x^2 - 7}{x + 1}$

1b. $\frac{m^2 + mn - 12n^2}{m^3 - 27n^3} \div \frac{m + 5n}{m^2 + 3mn + 9n^2}$

2. (Application Level) Apply the laws of exponents, such as squared, cubed, to the power of x based on nested or compound operations, to simplify problems involving the product and/or quotient of expressions with exponents and to express answers without any negative exponents. (CSLO 4)

2a. $\frac{2x^9y^3}{14xy^{-7}}$

2b. $\left(\frac{15x^{-2}y^3}{3xy^{-2}}\right)^{-2}$

3. (Evaluation Level) Evaluate problems involving scientific notation, including converting numbers expressed as scientific notation to standard notation and vice versa. (CSLO 4)

Perform the indicated operations. Write the answers in scientific notation and then without exponents.

3a. $(2 \times 10^{-3})(4 \times 10^5)$

3b. $\frac{12 \times 10^9 \times 5 \times 10^{-2}}{4 \times 10^{-7} \times 6 \times 10}$

3c. Human hair grows at a rate of 1×10^{-8} mile per hour. Express this number in decimal notation. What is the growth rate in miles per year?

4. (Application Level) Apply variation formulas to set up and solve direct and inverse variation problems. (CSLO 4)

4a. The electrical resistance of a wire varies directly with the length of the wire and inversely with the square of the diameter of the wire. If a wire 50 feet long and 3mm in diameter has a resistance of 0.255 ohm, find the length of a wire of the same material whose resistance is 0.147 ohm and whose diameter is 2.5 mm.

4b. Suppose that the demand D for candy at a theater is inversely related to the price p .

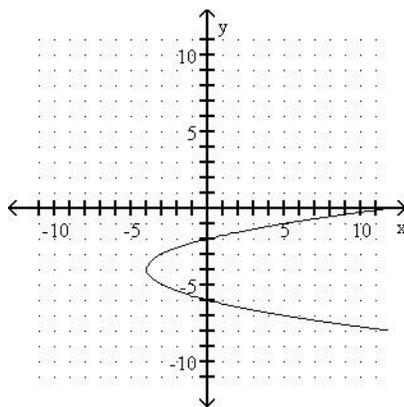
(a) When the price of candy is \$3.25 per bag, the theater sells 112 bags of candy. Express the demand for candy in terms of its price. **(b)** Determine the number of bags of candy that will be sold if the price is raised to \$4.00 a bag.

5. (Application Level) Determining the domain and range of a relation. (CSLO 4)

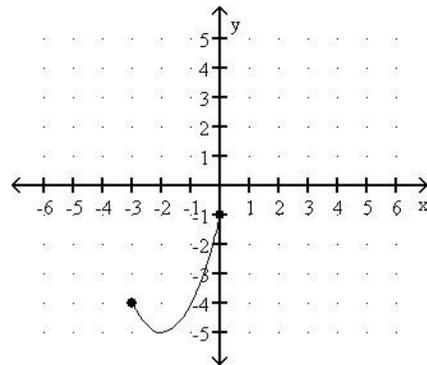
Identify the domain and range of the relation. Also, determine whether the relation represents a function.

5a. $\{(4, 20), (5, 25), (6, 30), (7, 35)\}$

5b.



5c.



6. (Application Level) Construct linear models and graphs given multiple representations of the function and describe trends and predictions for a given data set. (CSLO 2, 4)

6a. Anita is interested in the relationship between age and salary for the employees of her company. She obtains the following information which shows the average annual income for employees of various ages.

| Age (years), x | Average annual income (Thousands of Dollars), y |
|------------------|---|
| 28 | 31.4 |
| 36 | 40.3 |
| 44 | 46.1 |
| 52 | 61.9 |
| 59 | 65.2 |

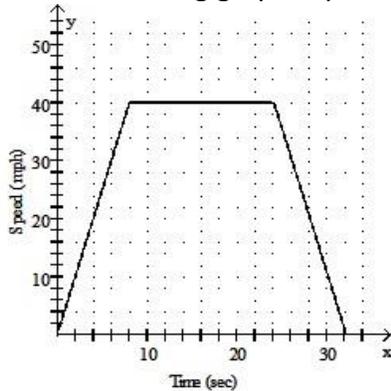
- Draw a scatter diagram of the data treating age as the independent variable.
- What type of relation appears to exist between age and average income?
- Find an equation of the line containing the points (36, 40.3) and (59, 65.2).
- Graph the line on the scatter diagram.
- Predict the income of an employee aged 45.
- Interpret the slope of the line.

6b. Suppose economists use as a model of a country's economy the function $N(x) = 0.7478x + 6.0802$, where N represents the consumption of products in billions of dollars and x represents disposable income in billions of dollars.

- Identify the dependent and independent variables.
- Evaluate $N(9.52)$ and explain what it represents.

7. (Comprehension Level) Describe the rate of change of a linear function. (CSLO 4)

a. The following graph represents the speed of a truck as a function.



- What is the speed of the truck at 14 seconds?
- Identify and interpret the intercepts.

8. (Application Level) Use various factoring techniques to completely factor polynomials, including GCF, grouping, factoring trinomials, difference of squares, sum and difference of cubes and applying the Zero Product Property. (CSLO 4)

Factor completely if possible.

8a. $10x^3y^4 - 42x^2y^3 - 32x^5y^2$

8b. $x^6 - 4y^2$

8c. $-3y^2 + 12y - 18$

8d. $6x^4 + 8x^2 - 30$

9. (Application Level) Identify if numbers are complex or real and add, subtract, multiply, and divide expressing answers in simplified standard complex form. (CSLO 4)

9a. $(9i - 3) + (-4 + 5i)$

9b. $\sqrt{-64} \cdot \sqrt{-36}$

9c. $\frac{2}{9+i}$

10. (Application Level) Solve linear equations and applications. (CSLO 2, 4)

Solve the equation. Determine if the equation is an identity, a contradiction, or a conditional equation.

10a. $4(x - 2) + 6 = 2x - 6$

10b. $7x + 14(x + 1) = 21(x + 1) - 7$

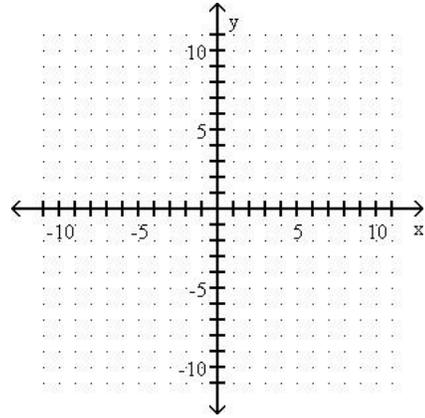
10c. A salesman earns \$400 weekly plus 5% commission on his weekly sales. If he wants to make at least \$1180 in a week, how much must his sales be?

10d. An auto repair shop charged a customer \$570 to repair a car. The bill listed \$70 for parts and the remainder for labor. If the cost of labor is \$50 per hour, how many hours of labor did it take to repair the car?

11. (Application Level) Solve quadratic equations and inequalities with complex solutions by factoring and applying zero Product Property, completing the square, quadratic formula and graphing while expressing the answer in simplified standard complex form. (CSLO 2, 4)

13a. Solve the system of linear equations by graphing:

$$\begin{cases} y = 3x \\ y = -2x + 5 \end{cases}$$



13b. Solve the system of linear equations using either substitution or elimination

$$\begin{cases} y = \frac{1}{2}x + 2 \\ x - 2y = -4 \end{cases}$$

13c.
$$\begin{cases} x + y + z = -3 \\ 2x - 2y - z = -7 \\ -3x + y + 5z = 5 \end{cases}$$

14. (Application Level) Solve and apply appropriate properties to find the solution to compound inequalities involving absolute value, quadratic expressions, and rational expressions. (CSLO 2, 4)

Solve.

14a. $-7x > -14$ and $x + 7 > 8$

14b. Solve: $|8x + 5| - 9 = 0$

Solve the inequality. Graph the solution set and write it in interval notation.

14c. $|4k + 7| - 4 < 4$

14d. $|5k - 9| \geq -7$

15. (Comprehension Level) Demonstrate an understanding of exponential functions and their inverse relationship to logarithmic functions by conversion and graphing. (CSLO 2, 4)

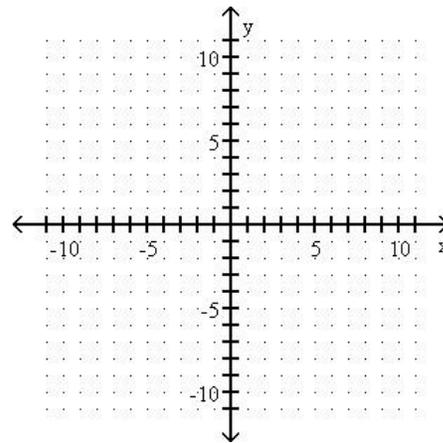
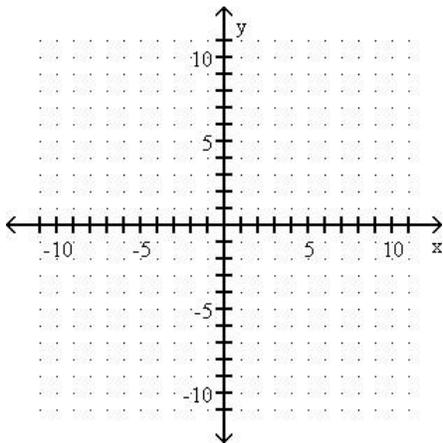
Convert to logarithmic equations or exponential equations

a. $4 = \log_3 81$

b. $5^{(x+2)} = 10$

c. Graph (a) $f(x) = (-4)^x$

d. $f(x) = \log_6 x$



16. (Application Level) Identify and apply various strategies to further success in mathematics such as a) resources, b) time management, c) effective listening and note-taking, d) test preparation, and g) techniques for overcoming test anxiety. (CSLO 3 & 4)