Part I – Multiple Choice - NO CALCULATOR - 90 pts total (5 pts each)

1. Write an algebraic formula for the distance \( d \) in meters that a rocket travels in \( t \) seconds at a speed of \( r \) meters per second.

   a) \( d = (r)(t) \)  
   b) \( d = r \cdot t \)  
   c) \( d = 100(r)(t) \)  
   d) \( d = r + t \)  
   e) \( d = 100t \)

2. Write an algebraic formula for the volume of a cone whose height \( h \) is three times its radius \( r \). \( V = \) 

   a) \( \frac{3\pi r^2}{2} \)  
   b) \( 3\pi r^3 \)  
   c) \( \pi r^3 \)  
   d) \( \frac{(\pi r^3)}{3} \)  
   e) \( \frac{(\pi r^3)}{h} \)

3. Simplify the expression: \( \sqrt{50} + \sqrt{98} \)

   a) \( 12\sqrt{2} \)  
   b) \( 12\sqrt{3} \)  
   c) \( 8\sqrt{2} \)  
   d) \( 8\sqrt{3} \)  
   e) \( 12\sqrt{5} \)

4. Simplify the expression \( \left( \frac{z^3}{4y} \right)^{2} \) and eliminate any negative exponents.

   a) \( 4y / z^6 \)  
   b) \( 16y^2 / z^6 \)  
   c) \( 4z^6 / y^3 \)  
   d) \( z^6 / y^3 \)  
   e) \( z / 4y \)

5. Perform the indicated operations and simplify: \( (1 - x - x^2)(1 - x + x^2) \)

   a) \( 1 + 2x - x^2 + x^4 \)  
   b) \( -2x + x^2 + x^4 \)  
   c) \( 1 + 2x - x^2 - x^4 \)  
   d) \( 1 - 2x + x^2 - x^4 \)  
   e) \( 1 - 2x - x^2 + x^4 \)

6. Perform the indicated operations and simplify: \( (2\sqrt{r} - \sqrt{s})^2 \)

   a) \( 4r^2 - 4rs + s^2 \)  
   b) \( 4r^2 - 4\sqrt{rs} + s^2 \)  
   c) \( 4r + 4\sqrt{rs} + s \)  
   d) \( 4r + 4\sqrt{rs} - s \)  
   e) \( 4r - 4\sqrt{rs} + s \)

7. Simplify the expression: \( (x^2 - x - 6) / (x^2 - 4) \)

   a) \( (x + 1)(x + 2) \)  
   b) \( (x + 2)/(x + 3) \)  
   c) \( (x + 3)(x + 2) \)  
   d) \( (x + 2)/(x + 2) \)  
   e) \( (x - 2)/(x - 2) \)

8. Find an equation of the line parallel to \( 3x + 11y + 14 = 0 \) and passes through the point \( ( -1/2, \ 6 ) \)

   a) \( y = 3x/11 + 33 \)  
   b) \( y = -22 - 3x/11 \)  
   c) \( y = 64/11 - x \)  
   d) \( y = 3x/11 + 129/22 \)  
   e) \( y = 129/22 - 3x/11 \)
9. Solve the equation: \( \frac{x - 1}{2x + 7} = \frac{1}{3} \)

a) \( x = -2 \)  

b) \( x = -7 \)  

c) \( x = 19/3 \)  

d) \( x = 27 \)  

e) \( x = 10 \)  

10. A change purse has an equal number of quarters, nickels and dimes. The total value of the coins is $1.60. How many coins of each type does the purse contain?

a) 3  

b) 4  

c) 5  

d) 6  

e) 7  

11. Find all real solutions of the equation \( 3x^2 + 4x - 4 = 0 \)

a) \( x = -1 \) or \( 1/5 \)  

b) \( x = -2 \) or \( 2/3 \)  

c) \( x = -3/2 \) or \( 5/2 \)  

d) \( x = -1/3 \) or \( 3/2 \)  

e) no real solution

12. Find all asymptotes of the function: \( y = \frac{2x - 5}{x^2 + x + 1} \)

a) no asymptote  

b) \( y = 0; x = 5/2 \)  

c) \( y = 2; x = 5/2 \)  

d) only \( y = 0 \)  

e) only \( x = 1, -1 \)  

13. Evaluate the expression: \( \log_2 144 - \log_2 9 \)

a) 3  

b) 4  

c) 5  

d) 6  

e) no solution

14. Express the equation \( \log_2 9 = \frac{2}{3} \) in exponential form.

a) \( 3^2 = 27 \)  

b) \( 9^{2/3} = 27 \)  

c) \( 9 = 3^2 \)  

d) \( 27^{2/3} = 9 \)  

e) \( 9^{3/2} = 27 \)

15. Solve the equation for \( x \): \( e^{1-4x} = 2 \)

a) \( x = (\frac{1}{2})(\ln 2 - 1) \)  

b) \( x = 2 \ln 2 - 1 \)  

c) \( x = 0.75(\ln 0.5) \)  

d) \( x = (2/3)(2 - \ln 3) \)  

e) \( x = (\frac{3}{4})(1 - \ln 2) \)

16. State the quadrant in which \( x \) lies if: \( \csc x > 0 \) and \( \cos x < 0 \)

a) Quad I  

b) Quad II  

c) Quad III  

d) Quad IV

Use the Equation: \( y = (\frac{3}{4})\cos(\frac{1}{4}x + \frac{1}{4} \pi) \) to answer #17 and #18

17. The amplitude of the function is:

a) \( \frac{3}{4} \)  

b) \( 1/2 \)  

c) \( 2/3 \)  

d) \( 4\pi \)  

e) \( 2\pi \)

18. The period of the function is:

a) \( \frac{3}{4} \)  

b) \( 1/2 \)  

c) \( \pi \)  

d) \( 4\pi \)  

e) \( 2\pi \)
1. Lucy is hired by FaceBook.com at a salary of $60,000 per year. Three years later her annual salary has increased to $70,500. Assume her salary increases linearly.

A. Find an equation that relates her annual salary (S) and the number of years (t) that she has worked for the firm.
B. What does the slope and intercept represent in the salary equation?
C. Based on the model, what is the expected salary after 12 years?
D. What is the average rate of change of the salary between the first and third year?

2. Your Pre-Calculus text is thrown upward from the top of a building on the Yard. Its height, in feet, above the ground after (t) seconds is given by:
\[ h(t) = -16t^2 + 48t + 32 \]

A. How long does it take to reach its maximum height?
B. What is the maximum height reached by your textbook?

3. A. Solve the equation for x on the interval \([0, 2\pi]\):
\[ 2\sin^2(x) = \sin(x) \]
B. Find the inverse:
\[ f(x) = \sqrt{x + 1} + 2 \]

4. A. Rewrite as a single logarithm:
\[ 5\ln(x + 2) - \frac{3}{5}\ln(x^2) + 3\ln(x - 7) \]
B. Rewrite to eliminate any products, quotients, roots, or powers.
\[ \ln \left( \frac{\sqrt[3]{x^4}}{\sqrt{y^2}} \right) \]

5. A type of radioactive material decays in such a way that the mass in grams remaining after \( t \) days is given by the function:
\[ m(t) = 10e^{-0.08t} \]

A. What is the mass at time zero?
B. How much mass will remain after 24 hours?
C. When will there be 5 grams remaining?
6. Using your calculator, graph the function: \( f(x) = \frac{\sin^2(x)}{x} \)
   A. Is the function Even, Odd or Neither and WHY?
   B. Describe the behavior of the function as \( x \) becomes large.
   C. What happens as \( x \) approaches zero?
   D. What happens to the function when \( x = 0 \)?

7. A ship is cruising the ocean off a straight shoreline. Points A and B are 200 mi apart on the shore. We have determined that angle A is 40° and angle B is 65°.
   A. How far is the ship from point A?
   B. How far is the ship from the shore?

8. Use the graph to answer the following questions.
   A. Estimate the \( f(g(-5)) \)
   B. Estimate \( (f \circ g)(2) \)
9. As dry air moves upward, it expands and in so doing cools at a rate of about $1^\circ$ Celsius for each 100 meters rise, up to about 12 km.

A. If the ground temperature is $20^\circ$ C, write a formula for the temperature at height $h$.

B. What range of temperatures can be expected if a plane takes off and reaches a maximum height of 5 km?

10. Consider the function:

$$F(x) = \begin{cases} 
  x & \text{if } x < 0 \\
  3x - x^2 & \text{if } 0 < x < 2 \\
  2 & \text{if } x > 2 
\end{cases}$$

A. Graph the function.
B. State the domain of $F(x)$.
C. Using interval notation, state where the function is increasing and decreasing.

11. You are leaving on vacation and your parents are driving. The car leaves the Academy traveling at an average speed of 45 mph for 30 minutes. Now on the highway, the car travels at an average speed of 60 mph for 2 hrs. Feeling hungry because you skipped King Hall food, your family stops at a restaurant along the highway for 1 hr and 30 minutes. Back in the car, your parents decide to let you drive ... the car travels at an average speed of 80 mph. After 30 minutes, your parents cannot stand it anymore and you are no longer permitted to drive the minivan. Your mother takes over driving. She averages 60 mph for the final 2 hrs on the highway. Once off the highway, the minivan averages 25 mph until it stops in your driveway 30 minutes later. You are home.

A. Based on information given, how far is your driveway from the Academy?
B. Sketch a graph of your ride home. Let the x-axis represent time and the y-axis represent distance traveled.