General test instructions: Show all your work on this test paper! If you solve a problem algebraically show all your steps. If you solve a problem by graphing on your calculator, show a sketch of the graph, with the solution labeled. Where appropriate, round answer to 3 decimal places.

Solve the following equations.

1. $3x^2 = 2x + 5$
2. $\frac{x}{3} + \frac{3x}{4} = 2$
3. $x^4 - 7x^2 + 12 = 0$

Solve the following inequality, and sketch the solution on the number line provided.

4. $|2 - 3x| \leq 5$
5. Solve: \(2e^{-3x} = 5\)

6. Solve: \(\ln(\sqrt{x} + 1) = 2\)

7. Find all points of intersection
   \[
   y = x^2 - 1 \\
   y - 2x = 1
   \]

8. Solve
   \[
   \begin{align*}
   3x + 2y &= 10 \\
   2x + 5y &= 3
   \end{align*}
   \]

9. How much do you need to invest now at 7\% compounded continuously, in order to have $5000 in 3 years?

10. Find the exact values of:
    a) \(\log_3 \frac{1}{9}\)
    b) \(\log_2 8\)

11. Simplify: \((5 + 3i)(2 - i)\)
    Write your answer in standard form for a complex number.
12. The height $y$ (in feet) of a ball thrown by a child is

$$y = -\frac{1}{2}x^2 + 2x + 4,$$

where $x$ is the horizontal distance (in feet) from where the ball is thrown.

(a) Use a graphing utility to sketch the path of the ball. Draw the graph below and label your axes.

(b) How high is the ball when it leaves the child’s hand?

(c) How high is the ball when it reaches its maximum height?

(d) How far from the child does the ball strike the ground?

13. The number of bacteria $N$ in a culture is given by the model

$$N = 100e^{kt},$$

where $t$ is the time in hours, with $t = 0$ corresponding to the time when $N = 100$.

If $N = 300$ when $t = 5$, estimate the time required for the initial population to double in size.

14. Find an equation of the line that passes through the points (-2,1) and (6,-5).

15. A small public radio station received $70,000 in listener contributions in 1980 and for 1994 received $215,000. Assume that their contributions follow a linear growth pattern.

(a) Write a linear equation giving listener contributions $C$ (in thousands of dollars) in terms of $t$, the number of years since 1980.

(b) Use the equation for (a) to predict listener contributions in 1997.
16. Given \( f(x) = 5x - 2 \) and \( g(x) = x^2 - x + 1 \), find \( g(f(x)) \) and simplify.

17. Given \( h(x) = 3\sqrt{1-x} \), find the inverse function \( h^{-1}(x) \).

18. Given the function, \( f(x) = \sqrt{4 - x^2} \), what is its
   a) domain?
   b) range?

19. Find all the zeros of this polynomial.
   \( f(x) = x^4 - x^3 - 20x^2 \)

20. Given this sketch of a graph:
   a) Is it a 3rd degree or 4th degree equation? Explain:
   b) Is the leading coefficient positive or negative? Explain.
21. Graph the function
a) 
\[ f(x) = \begin{cases} 
  x^2 + 1, & x < 0 \\
  x - 1, & x \geq 0 
\end{cases} \]

b) find \( f(3) \)

22. Graph \( f(x) = 2^x \) and \( g(x) = \log_2 x \). Plot at least three points for each graph, label any intercepts and asymptotes.

23. \( f(x) \) is sketched on the axes below.
Translate it to sketch a graph of \( f(x+1) + 2 \).
24. The following table gives the yield, y, of a chemical reaction after x minutes

<table>
<thead>
<tr>
<th>Time (x)</th>
<th>Yield (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>7.4</td>
</tr>
<tr>
<td>3</td>
<td>10.2</td>
</tr>
<tr>
<td>4</td>
<td>13.4</td>
</tr>
<tr>
<td>5</td>
<td>15.8</td>
</tr>
<tr>
<td>6</td>
<td>16.3</td>
</tr>
<tr>
<td>7</td>
<td>18.2</td>
</tr>
<tr>
<td>8</td>
<td>18.3</td>
</tr>
</tbody>
</table>

a) Plot these points on the axes below.

b) Use your graphing calculator to find the least squares regression line for the data. Write your equation and correlation coefficient here.

c) Use your graphing calculator to find a logarithmic equation for the data. Write your equation and correlation coefficient here.

d) Which is a better model of the data? ________________________
   Explain why.

e) Using the equation that was the best fit for the data, predict the yield of the chemical reaction after 10 minutes.