1. Simplify as much as possible or state 'cannot be simplified'.

\[a) \sqrt{x^2 + 2x + 1} \quad b) \frac{4}{\sqrt[4]{x^4 + 16}} \quad c) \frac{4}{\sqrt{x - 10}} \quad d) \sqrt[4]{4ab + (a - b)^2} \]

\[e) \sqrt[4]{4 + \left(\frac{3x - 1}{3x}\right)^2} \quad f) \sqrt[3]{x^6 + 8} \quad g) \sqrt{\cos(t - \sin t)^2 + (\sin t + \cos t)^2} \]

2. Write in power form, \(a^b\) or \(\lfloor a \rfloor^b\).

\[a) \sqrt{x^3} \quad b) \frac{1}{\sqrt[3]{x}} \quad c) \frac{1}{\sqrt[3]{x^2}} \quad d) \frac{x^{-1}}{x^2} \]

3. Rationalize the numerator.

\[a) \sqrt{x + h} - \sqrt{x} \quad b) \frac{3\sqrt{x + h} - 3\sqrt{x}}{h} \quad \text{Hint: } a^3 - b^3 = (a - b)(a^2 + ab + b^2) \]

4. Multiply out:

\[a) 3\sqrt{x}(\sqrt{x} + 1) \quad b) (\sqrt{x} - 1)(\sqrt{x} + 1) \quad c) (e^x - 1)(e^x + 1) \]

\[d) (e^x - 1)^2 \quad e) (2x - 1)^2 - (2x - 1)(2x + 1) \]

5. Which quadratics are irreducible over the real numbers?

\[a) x^2 + 5x + 7 \quad b) x^2 + 5x + 6 \quad c) x^2 + 2x + 1 \]

\[d) x^2 + 3x + 4 \quad e) x^2 + 3x + 5 \]

6. Find a formula for the polynomial, \(p(x)\), described. Sketch \(p(x)\) and \(|p(x)|\).

a) The leading coefficient is 1, the degree is 4, \(x=1\) and \(x=2\) are double roots.

b) The leading coefficient is -5, the degree is 6, \(x=1\) is a single root, \(x=3\) is a double root, and \(x=0\) is a root of multiplicity 3.
7. Solve each equation for $x$.

$a) \quad x^2 = 8x + 9 \quad b) \quad e^{2x} + 6 = 7e^x \quad c) \quad 2^{2x+1} + 1 = 3\left(2^x\right)$

d) \quad \frac{x^2 - 4}{x^2 - 3x + 2} = 0

8. Write in interval notation:

$a) \quad |x - 2| < 3 \quad b) \quad |3x + 1| < 4 \quad c) \quad |2x - 5| > 1 \quad d) \quad |3x + 6| \leq 9$

9. Determine all intervals where \( \frac{x^2 - 5x}{x^2 - 3x + 2} > 0 \).

10. Find the center and radius of each circle.

$a) \quad 2x^2 + 2y^2 - 4x + 10 = 14 \quad b) \quad x^2 + y^2 + 3x + 4y = 0$

c) A diameter is of the circle is AB for A(3,7) and B(6,11).

11. The parabola \( y = x^2 - 4x + 9 \):

a) is symmetric about the line ______________.

b) has vertex ____________.

c) has max/min of \( y = \) ________ at \( x = \) ______________.

12. Test each function for symmetry about the y-axis and about the origin.

\( a) \quad y = x^5 + x^3 + x \quad b) \quad y = x^4 + x^2 + 1 \)

13. Simplify \( \frac{f(x+h) - f(x)}{h} \) for \( f(x) = x^3 \).

14. Find an equation of the line connecting \( (0, f(0)) \) and \( (3, f(3)) \) for \( f(x) = 2^x + x^2 \).
15. \( f(x) = \begin{cases} 
\frac{2(x^2 - 1)}{x^2 + 3x - 4} & x < 2 \\
2 & 2 \leq x
\end{cases} \)

Find the domain of \( f \), the value of \( f(2) \), and all asymptotes of \( f \).

16. For \( f(x) = \sqrt{x} \) and \( g(x) = x^2 + 16 \), find \((f\circ g)(3)\), \((f\circ g)(x)\). \((g\circ f)(x)\).

17. Find the inverse function and its domain and range for each function.

a) \( f(x) = x^2 + 4x - 6 \quad x \leq -2 \)  
   b) \( f(x) = 5e^{x+3} \)  
   c) \( f(x) = \frac{2x + 7}{x + 1} \)

18. Find the asymptotes of each function.

a) \( f(x) = \left(1 - \frac{2}{x}\right)^x \quad 1 \leq x \)  
   b) \( f(x) = \frac{4x^2 - 20x + 24}{3x^2 - 27} \)

  c) \( f(x) = 6e^{-x} + 3 \)  
   d) \( f(x) = \frac{x^2 + 1}{x^3 - 8} \)

19. A rectangular area is to be enclosed by a fence. The total amount of fence material is 200 feet, all 6 feet high. Find the maximum area that can be enclosed in each case.

a) Part of the fence material will divide the area by a partition parallel to two of the sides.

b) There is no partition but one side will not need a fence since the wall of a building closes one side.

20. \( f(x) = 8\left(\frac{4}{5}\right)^x + 2 \quad \text{Find} \quad f^{-1}(12) \).

21. The weight of a substance changes exponentially with time. Every 20 years, the weight is multiplied by 0.75. Find the half-life.

22. A population grows at the continuous growth rate of 2% per year. In Jan of 2000 there were 7.5 million. In what year will the population reach 10 million?

23. \( \log_b M^2 = 14 \quad \log_b (MN^{-3}) = -5 \quad \text{Find} \quad \log_b N \).
24. Find the solution set to each linear system.
   a) $4x - 3y = 12$ and $3x + 2y = 43$   
   b) $7x + 2y = 10$ and $3x - 4y = 14$

25. Find $k$ so the system has no solution.
   a) $8x + ky = 30$, $12x - 6y = 12$   
   b) $7x - 3y = 10$, $kx + 2y = 12$

26. Find the solution set to the system of equations.
   
   $a) \quad x^2 + y^2 - 2x + 4y = 0, \quad x^2 + y^2 = 4$
   $b) \quad x^2y - xy^2 = 0, \quad x^2 + 2y^2 - 4x + 2y = 12$

27. Use the addition/subtraction of angles formulas for $\sin(t)$ and $\cos(t)$ to evaluate:
   
   $a) \quad \sin \left( \frac{7\pi}{12} \right) \quad b) \quad \cos \left( \frac{\pi}{12} \right) \quad c) \quad \tan \left( \frac{\pi}{12} \right)$

28. Evaluate each:
   
   $a) \quad \cos(\arcsin \left( \frac{4}{5} \right)) \quad b) \quad \tan(\arccos \left( \frac{2}{3} \right)) \quad c) \quad \sin(\arctan \left( \frac{3}{4} \right))$
   
   $d) \quad \arctan \left( -1 \right) \quad e) \quad \arccos \left( -\frac{1}{2} \right) \quad f) \quad \arcsin \left( -\frac{1}{2} \right)$

29. Solve the equation for all $x$ in $[0, 2\pi]$.
   
   $a) \quad \sin 2x = \cos x \quad b) \quad 3\sec^3 x = 4 \sec x \quad c) \quad \sin x \sec^3 x - 4 \tan x = 0$

30. Find the angles of the triangle with the given sides.
   
   a) 2, 4 and 5   
   b) 3, 4, and 6

31. Find the third side of the triangle:
   
   a) Two sides measure 2 and 3, the angle between these two sides is $\frac{\pi}{6}$.
   
   b) Two sides measure 5 and 7, the angle between them is $\frac{\pi}{3}$. 