

**NOTICE:** Course topics change slightly from one semester to the next, so students should always consult with their instructor.

***Part I. Problems in this section are mostly short answer and multiple choice. Little partial credit will be given. 4 points each.***

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1. Simplify  $(3 + 2i)^2$  to  $a + bi$  form.

2. Indicate the domain of each function. **Use interval notation.**

a)  $f(x) = \frac{x}{2x-5}$

b)  $g(x) = \sqrt[3]{x}$

3. State the equation of the circle with center  $(6, -3)$  tangent to the  $x$ -axis.

4. Find a linear function such that  $f(2) = 5$  and  $f(0) = -1$ .

$f(x) = \underline{\hspace{2cm}}$

5. Let  $f(x) = 4x - 3$  and  $g(x) = x^2 + 1$

a) Find  $(f \circ g)(x)$ .

b) Find and simplify  $g(x+h) - g(x)$ .

6. Given the function  $f(x) = x^2 - 4$ , **state the intervals** on which

a)  $f(x)$  is increasing

b)  $f(x) \geq 0$

7. Graph the function:  $f(x) = -\sqrt{x-3}$ . Label all intercepts.

8. Solve  $x^3 + 3x^2 - 5x - 15 = 0$ .

9. Solve  $A = 2(lw + wh + lh)$  for  $h$ .

10. Solve:  $|2x - 3| > 5$ .

Answers

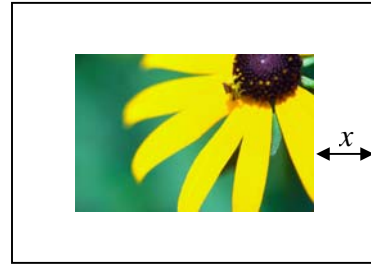
11. Graph the functions. Label all intercepts and asymptotes.

a)  $f(x) = e^{-x} + 2$

b)  $g(x) = -\log x$

Answers

12. A rectangular picture frame measures 28 cm by 32 cm. The thickness of the frame is the same on all 4 sides. Call this thickness  $x$ . Find a function for the area of the picture in terms of  $x$ .



**Part II. There are 10 problems in this section. Partial credit will be awarded. Show all work. 12 pts. each.**

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13. Solve:  $x - 7\sqrt{x} + 10 = 0$

Solution(s):  $x =$  \_\_\_\_\_.

14. For the function below, find the vertex, the axis of symmetry, and the maximum or minimum value.  $f(x) = -x^2 + 5x + 14$

- a) The vertex is (\_\_\_\_\_, \_\_\_\_\_).  
 b) The axis of symmetry is  $x =$  \_\_\_\_\_.  
 c) Does  $f(x)$  have a maximum or a minimum value?  
 Maximum  Minimum  
 d) Minimum/maximum value is = \_\_\_\_\_.

15. Solve for  $x$ :  $3^{x^2} = 9^{4-x}$

16. Given the function  $f(x) = (5 - 2x)(x + 1)^2$ . Sketch the graph of  $f(x)$ , indicating:

- Zeros and their multiplicities
- y-intercept
- End behavior

Answers

17. Given  $f(x) = \frac{x+5}{2x-3}$ , find the formula for the inverse.  $f^{-1}(x) =$

18. Find all asymptotes,  $x$ -intercepts, and  $y$ -intercepts for the graph  $f(x) = \frac{2x+3}{x^2-4}$ .

- The equation of the vertical asymptote(s) is/are  $x =$  \_\_\_\_\_.
- The equation of the horizontal asymptote(s) is/are  $y =$  \_\_\_\_\_.
- The  $x$ -intercept is at the point \_\_\_\_\_.
- The  $y$ -intercept is at the point \_\_\_\_\_.
- Sketch the graph of  $f(x)$ . Label all intercepts and asymptotes.

Answers

19. Solve for  $x$ :  $x^2 + 2x + 4 = 0$

20. Find the quadratic function given one of its zeros is  $2 - 3i$ . Assume leading coefficient to be 1.

21. Solve for  $y$ :  $\frac{6}{y+3} + \frac{2}{y} = \frac{5y-3}{y^2-9}$

22. Solve for  $x$ :  $\log_6 x + \log_6(x-9) = 2$

***Part III. There are 6 problems in this section. Choose any 4. Indicate in the boxes the problems you want graded. 8 points each.***

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Grade 23. Given the polynomial  $g(x) = x^3 - 27$ , find all zeros (real and complex).

Zeros: \_\_\_\_\_

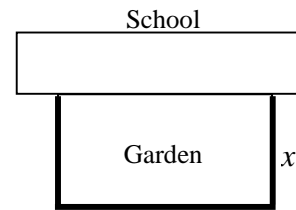
Grade 24. The diagonal of a TV set is 17 inches long. Its length measures 7 inches more than its width. Find the dimensions of the set.

- Set up the appropriate equation.
- What are the dimensions of the TV set?

Answers

- Grade 25. A fourth grade class decides to enclose a rectangular garden, using the side of the school as one side of the rectangle. Suppose they have 80 feet of fence to enclose the garden.

a) Express the area of the garden as a function of  $x$ .



b) What should the dimensions of the garden be in order to maximize the area?

- Grade 26. Solve  $x^3 \geq 4x$ . Express solution in **interval form**.

- Grade 27. Graph the following piecewise function.

$$f(x) = \begin{cases} -3x, & \text{for } x < 0 \\ -1, & \text{for } x \geq 0 \end{cases}$$

Answers

- Grade 28. Use any method to solve the system.

$$\begin{cases} x - 2y + 3z = 4 \\ 2x + y - 4z = 3 \\ -3x + 4y - z = -2 \end{cases}$$

1.  $(3 + 2i)^2 = 5 + 12i$

2. a)  $(-\infty, \frac{5}{2}) \cup (\frac{5}{2}, \infty)$

b)  $(-\infty, \infty)$

3.  $(x - 6)^2 + (y + 3)^2 = 9$

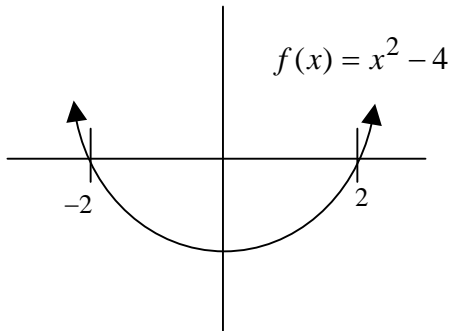
4.  $m = 3, f(x) = 3x - 1$

5. a)  $(f \circ g)(x) = 4x^2 + 1$

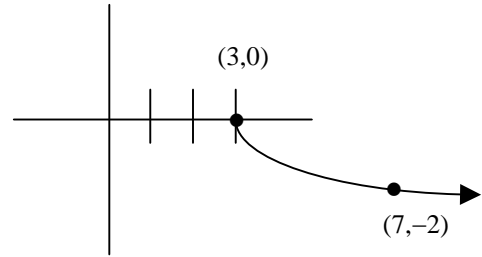
b)  $g(x + h) - g(x) = 2xh + h^2$

6. a)  $(0, \infty)$

b)  $(-\infty, -2] \cup [2, \infty)$



7.



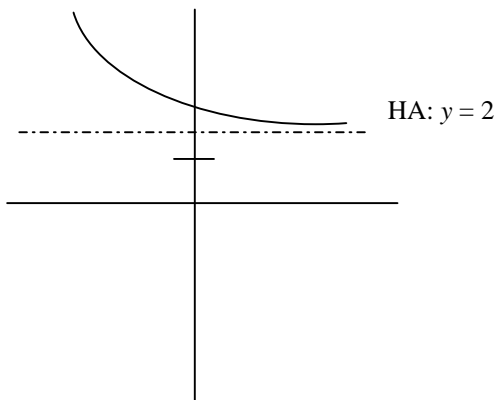
8.  $(x^2 - 5)(x + 3) = 0$   
 $x = \pm\sqrt{5}, -3$

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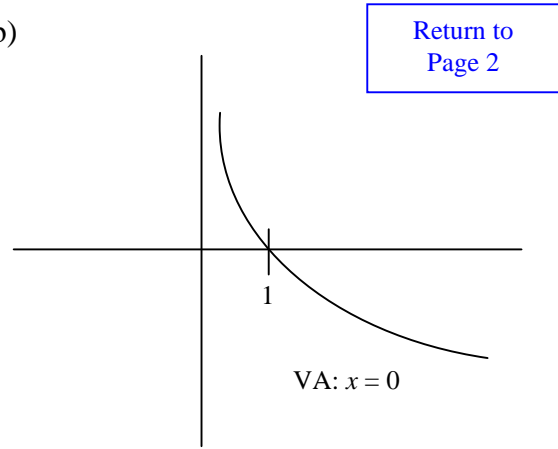
9.  $h = \frac{A - 2lw}{2w + 2l}$

10.  $x < -1 \cup x > 4$   
 or  $(-\infty, -1) \cup (4, \infty)$

11. a)

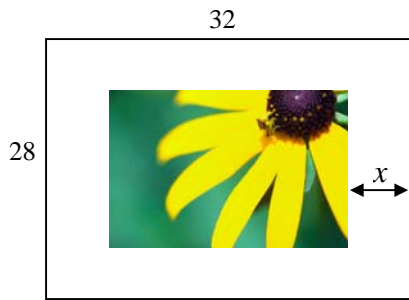


b)



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12.  $A(x) = (32 - 2x)(28 - 2x)$



13. Solution(s):  $x = 4, 25$

14. a) The vertex is  $(\frac{5}{2}, \frac{81}{4})$

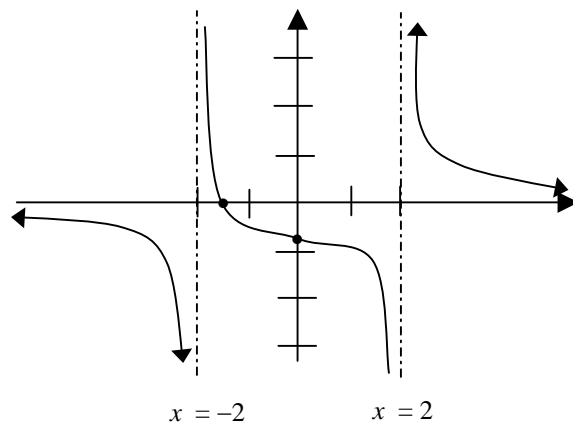
b) The axis of symmetry is  $x = \frac{5}{2}$

c)  $f(x)$  have a maximum value

17.  $f^{-1}(x) = \frac{3x+5}{2x-1}$

18. a) 2, -2      b) 0      c)  $(-\frac{3}{2}, 0)$       d)  $(0, -\frac{3}{4})$

e)



15.  $3^{x^2} = (3^2)^{(4-x)}$

$x^2 = 8 - 2x$

$x^2 + 2x - 8 = 0$

$x = -4, 2$

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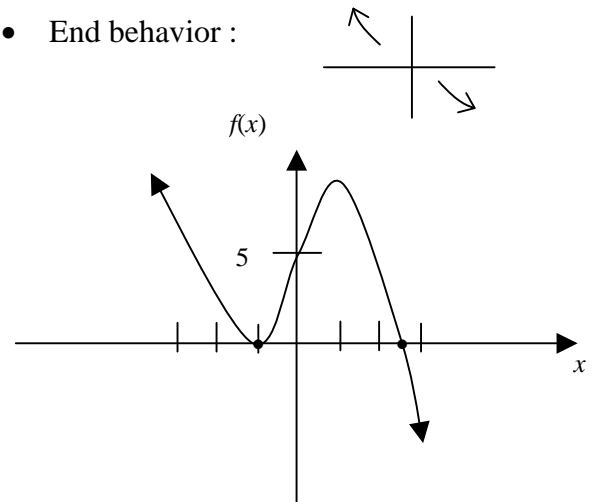
16.

- Zeros and their multiplicities:

$\frac{5}{2}$  mult 1,  $-1$  mult 2

- y-intercept:  $f(0) = 5$

- End behavior :



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19.  $x^2 + 2x + 4 = 0$   
 $= -1 + i\sqrt{3}, -1 - i\sqrt{3}$

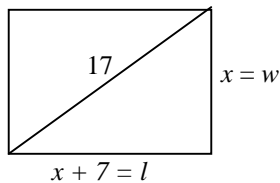
20. zeros:  $2 - 3i, 2 + 3i$   
 $f(x) = x^2 - 4x + 13$

21.  $3y^2 - 15y - 18 = 0$   
 $y = 6, -1$

22.  $\log_6 x(x-9) = 2$   
 $x(x-9) = 6^2$   
 $x = 12, x = -3$   
 $-3$  is not in domain of  $\log_6 x$   
 Only solution:  $x = 12$

23. Cube factor or use synthetic division  
 $g(x) = (x-3)(x^2 + 3x + 9)$   
 zeros:  $3, \frac{-3 + 3i\sqrt{3}}{2}, \frac{-3 - 3i\sqrt{3}}{2}$

24. a)  $x^2 + (x+7)^2 = 17^2$



b)  $x^2 + 7x - 120 = 0$   
 $(x+15)(x-8) = 0$   
 $x \neq -15, x = 8$

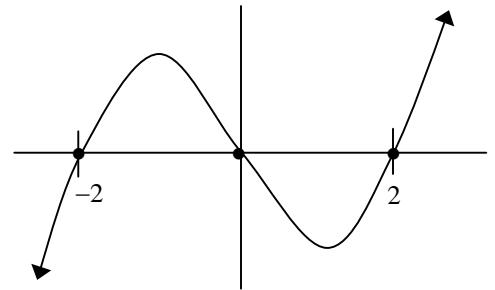
width = 8, length = 15

25. a)  $w = x$   
 $l = 80 - 2x$   
 $A(x) = x(80 - 2x)$

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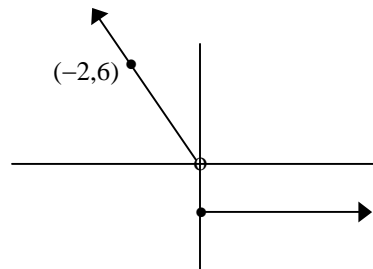
b)  $A(x) = 80x - 2x^2$   
 at max,  $x = -\frac{b}{2a} = \frac{80}{4} = 20$   
 width = 20, length = 40

26.  $x^3 - 4x \geq 0$   
 $\underbrace{x(x-2)(x+2)}_{f(x)} \geq 0$



Solution:  $[-2, 0] \cup [2, \infty)$

27.



28. Solution:  $(4, 3, 2)$

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