

1. For what value(s) of  $x$  is  $f(x)$  undefined?  $f(x) = \frac{x - 3}{x^2 - 4}$
- a) 2 only      b) -2 only      c) 2, -2, and 3      d) 3      e) 2 and -2
2. If  $g(x) = \frac{12}{x^2 + 1}$  and  $h(x) = \frac{x^2 - 1}{12}$ , find  $g \circ h(5)$ .
- a) 5      b)  $\frac{12}{5}$       c)  $\frac{5}{12}$       d)  $\frac{4}{3}$       e) undefined
3. What is the vertex for  $f(x) = x^2 - 6x - 4$  ?
- a) (3, -13)      b) (3, 5)      c) (-3, -5)      d) (-3, 23)      e) (3, -4)
4. Identify all asymptotes for  $f(x) = \frac{x + 2}{x^2 - 3x - 10}$ .
- a)  $x = 5$ ,  $x = -2$  only      b)  $x = -2$  only      c)  $x = -2$ ,  $y = 0$  only  
d)  $x = 5$ ,  $x = -2$ ,  $y = 0$       e)  $x = 5$ ,  $y = 0$  only
5. The graph of  $y = \sqrt{8 - 2x^2}$  is
- a) semicircular      b) semielliptical      c) parabolic  
d) half of a hyperbola      e) a line
6. The graph of  $y(x + 3) = 6$  is
- a) shifted 3 units to the right of  $xy = 6$   
b) shifted 3 units to the left of  $xy = 6$   
c) shifted 3 units up from  $xy = 6$   
d) shifted 3 units down from  $xy = 6$   
e) none of the above
7. If  $f(3) = 9$  and  $f(7) = 15$ , and  $f$  is linear find  $f(-3)$ .
- a) -9      b) -5      c) -3      d) 0      e) cannot be determined
8. If  $f(x) = \frac{2x - 3}{3x + 4}$  find  $f^{-1}(x)$ .
- a)  $\frac{3x + 4}{2x - 3}$       b)  $\frac{3 - 2x}{4 + 3x}$       c)  $\frac{4x + 3}{3x - 2}$       d)  $\frac{3x + 4}{2 - 3x}$       e)  $\frac{4x + 3}{2 - 3x}$

9. The graphs of the following functions intersect at (A, B) and (C, D). Find  $A + B + C + D$ .  
 $y = 3x - \frac{4}{x}$  and  $y = x^2$
- a) 0            b) 2            c) 6            d) -6            e) The two graphs do not really intersect
10. Which of the following is the slant asymptote for  $f(x) = \frac{2x^2 + 5x - 3}{x + 1}$  ?
- a)  $y = 2x + 3$       b)  $y = 2x + 7$       c)  $y = 2x - 3$       d)  $y = -1$   
 e) This function has no slant asymptote
11. What is the relationship between the slopes of the graphs of a linear function and that of its inverse?
- a) They are equal  
 b) They are additive inverses  
 c) They are multiplicative inverses  
 d) They are opposite reciprocals  
 e) There is no special relationship
12. If  $2ax + 5y = 6$  and  $5x - 7y = 8$  are perpendicular then  $a = \underline{\quad ? \quad}$ .
- a)  $3\frac{1}{2}$             b)  $-3\frac{1}{2}$             c)  $-\frac{25}{14}$             d)  $\frac{25}{14}$             e) cannot be determined
13. Find the equation of the axis of symmetry of  $x = y^2 + 4y - 5$ .
- a)  $x = 2$             b)  $y = -2$             c)  $x = -2$             d)  $y = 2$             e)  $y = -5$
14. Find  $g(1 - i)$  if  $g(x) = 2x^3 - 7x^2 - 10x - 6$
- a) 0            b)  $20 - 20i$             c)  $-20 + 20i$             d)  $-1 + i$             e)  $1 - i$

15.  $f(x) = \begin{cases} 2x, & x > 2 \\ 1 - x, & -1 < x < 2 \\ 2, & x < -1 \end{cases}$              $g(x) = \begin{cases} \sqrt{x - 4}, & x > 4 \\ x, & 0 < x < 4 \\ 1 - \frac{x}{4}, & x < 0 \end{cases}$

Find  $f \circ g(13)$

- a) 2            b) -12            c)  $\sqrt{22}$             d) 6            e) cannot be determined

16. If  $r$  is positive and the line whose equation is  $x + y = r$  is tangent to the circle whose equation is  $x^2 + y^2 = r$ , then  $r$  equals

- a)  $\frac{1}{2}$       b) 1      c) 2      d)  $\sqrt{2}$       e)  $2\sqrt{2}$

17. If the points  $(1, y_1)$  and  $(-1, y_2)$  lie on the graph of  $y = ax^2 + bx + c$  and  $y_1 - y_2 = -6$ , then  $b =$  ?

- a) -3      b) 0      c) 3      d)  $\sqrt{ac}$       e)  $\frac{a+c}{2}$

18. Let  $F = \frac{6x^2 + 16x + 3m}{6}$  be the square of an expression which is linear in  $x$ . Then  $m$  has a particular value between :

- a) 3 & 4      b) 4 & 5      c) 5 & 6      d) -4 & -3      e) -6 & -5

19. Let a binary operation  $*$  on ordered pairs of integers be defined as  $(a, b) * (c, d) = (a - c, b + d)$ . Then, if  $(3, 2) * (0, 0)$  and  $(x, y) * (3, 2)$  represent identical ordered pairs, then  $x =$  ?

- a) -3      b) 0      c) 2      d) 3      e) 6

20.  $F(x) = \frac{1}{x^2 - x}$ ; find  $F\left(\frac{1 - i\sqrt{3}}{2}\right)$

- a) -2      b) -1      c)  $1 + i\sqrt{3}$       d) 1      e) 2

21. If  $f(x) = \log\left(\frac{1+x}{1-x}\right)$  for  $-1 < x < 1$ , then  $f\left(\frac{3x+x^3}{1+3x^2}\right)$  in terms of  $f(x)$  is

- a)  $-f(x)$       b)  $2f(x)$       c)  $3f(x)$       d)  $[f(x)]^2$       e)  $[f(x)]^3 - f(x)$

22. Let  $f(x) = ax^7 + bx^3 + cx - 5$ , where  $a$ ,  $b$ , and  $c$  are constants. If  $f(-7) = 7$ , find  $f(7)$ .

- a) -17      b) -7      c) 14      d) 21      e) not uniquely determined

23.  $G(x) = \frac{|x - |x||}{x}$ . For what values of  $x$  is  $G$  positive?

- a) for negative  $x$  only      b) for positive  $x$  only      c) only for  $x$  an even integer  
d) for all non-zero real numbers  $x$       e) for no non-zero real numbers  $x$

24.  $P(x) = x^6 - 3x^5 - 6x^3 - x + 8$  has

- a) no real zeros
- b) exactly two distinct negative zeros
- c) exactly one negative zero
- d) no negative zeros, but at least one positive zero
- e) none of the above apply to this function

25. Suppose  $f(x)$  is defined for all real numbers  $x$ ;  $f(x) > 0$  for all  $x$ ; and  $f(a)f(b) = f(a + b)$  for all  $a$  and  $b$ . Which of the following statements are true?

I.  $f(0) = 1$   
II.  $f(-a) = \frac{1}{f(a)}$  for all  $a$

III.  $f(a) = \sqrt[3]{f(3a)}$  for all  $a$   
IV.  $f(b) > f(a)$  if  $b > a$

- a) III and IV only
- b) I, III, and IV only
- c) I, II, and IV only
- d) I, II, and III only
- e) All are true

#### TIEBREAKER

In a certain medical treatment, a tracer dye is injected into the pancreas to measure its function rate. A normally active pancreas will secrete 4% of the dye each minute. A physician injects 0.3 gram of the dye, and 30 minutes later 0.1 gram remains. How much dye would remain if the pancreas were functioning normally?