

Functions and Relations Lesson #8:

Practice Test

Section A

No calculator may be used for this section of the test.

1. If $f(x) = 3x^2 - 2$, then $f(3x)$ is

A. $9x^2 - 2$ B. $9x^2 - 6$
 C. $27x^2 - 2$ D. $27x^2 - 6$

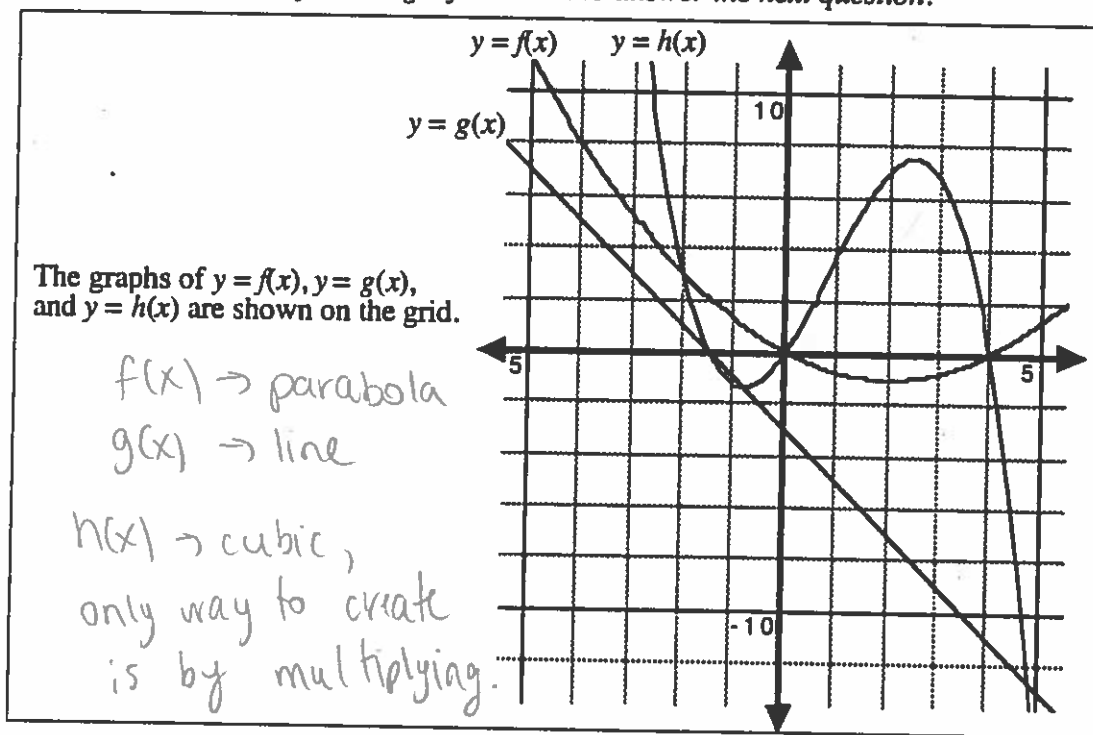
$$\begin{aligned} &3(3x)^2 - 2 \\ &3(9x^2) - 2 \\ &27x^2 - 2 \end{aligned}$$

2. If a polynomial function is defined by $P(a) = a^3 + 1$, then $2a^3 + 1$ represents

A. $2P(a)$ \times
 B. $P(2a)$ \times
 C. $2P(a) + 1$ \times
 D. none of A, B, or C

$$\begin{aligned} &2(a^3 + 1) = 2a^3 + 2 \\ &(2a)^3 + 1 = 8a^3 + 1 \end{aligned}$$

Use the following information to answer the next question.

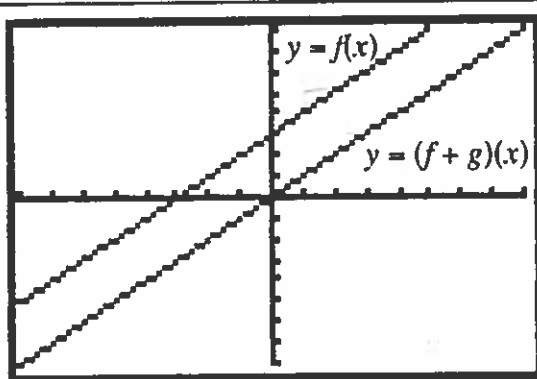


3. $h(x)$ is equivalent to

A. $(f+g)(x)$ B. $(f-g)(x)$ C. $(g-f)(x)$ D. $(fg)(x)$

Use the following information to answer the next question.

The screen shot from a graphing calculator shows the graphs of $y = f(x)$ and $y = (f + g)(x)$.



$$f(x) = x + 3$$

$$f + g(x) = x$$

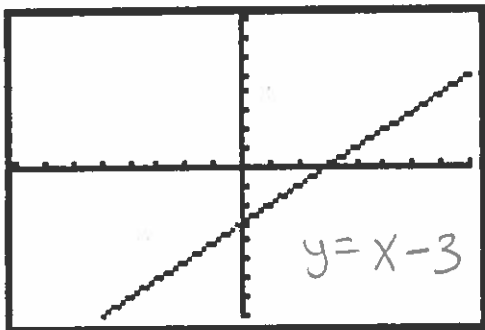
$$f(x) + g(x) = (f + g)(x)$$

$$x + 3 + \underline{\hspace{1cm}} = x$$

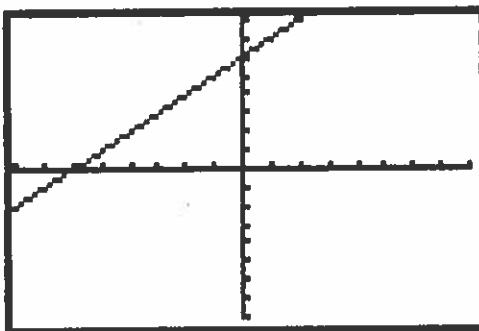
$$g(x) = -3$$

4. Which of the following screen shots shows the graph of $y = g(x)$?

A.

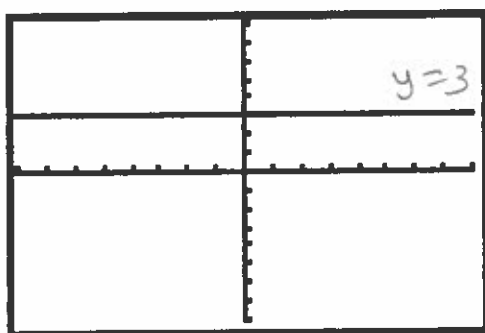


B.

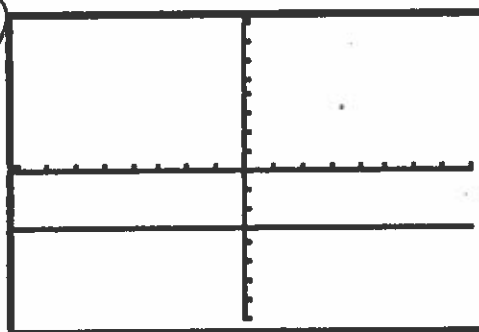


$$y = x + 3$$

C.



D.



$$y = -3$$

5. If $a(x) = 12x^2 - 25x + 12$ and $b(x) = 12x^2 + 7x - 12$, then the domain

of the function $\left(\frac{a}{b}\right)(x)$ is

A. $x = \frac{3}{4}, -\frac{4}{3}, x \in \mathbb{R}$

B. $x = -\frac{4}{3}, x \in \mathbb{R}$

C. $x = \frac{3}{4}, \frac{4}{3}, x \in \mathbb{R}$

D. $x \in \mathbb{R}$

$$12x^2 - 25x + 12$$

$$12x^2 + 7x - 12$$

$$= \frac{12x^2 + 16x - 9x - 12}{12x^2 + 7x - 12}$$

$$= \frac{4x(3x + 4) - 3(3x + 4)}{12x^2 + 7x - 12}$$

$$\frac{12x^2 - 25x + 12}{(4x - 3)(3x + 4)}$$

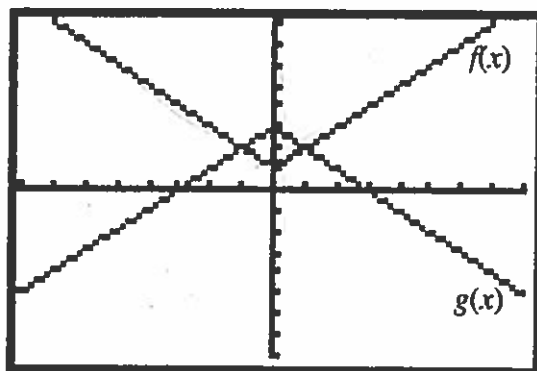
$$\downarrow \quad \quad \downarrow$$

$$\frac{3}{4} \quad \quad -\frac{4}{3}$$

$$= (4x - 3)(3x + 4)$$

Use the following information to answer the next question.

Calculator representations of the graphs of two functions, $f(x)$ and $g(x)$, are shown.



$$f(x) = |x| + 1$$

$$g(x) = -|x| + 3$$

The calculator representations below show the graphs of operations on these functions.

Diagram 1

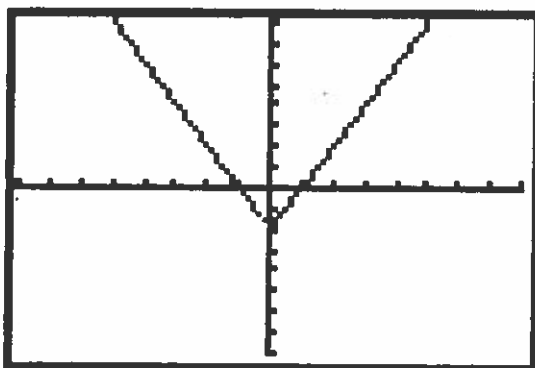


Diagram 2

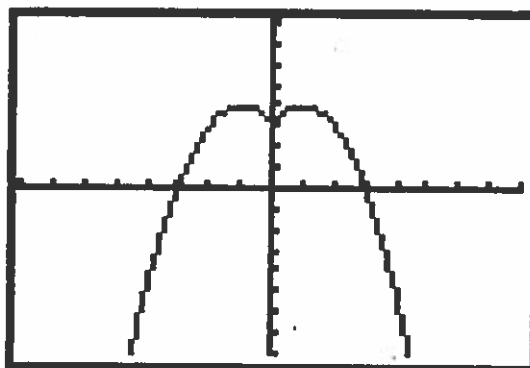


Diagram 3

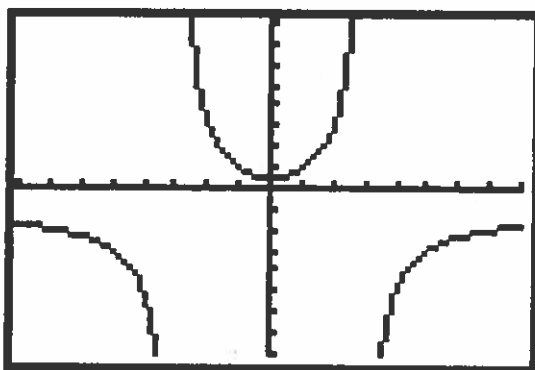
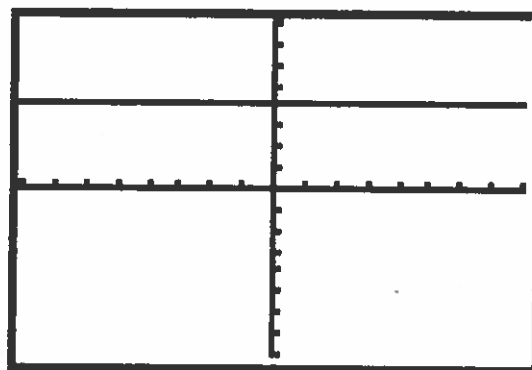


Diagram 4



graph them

Numerical Response

- Write the diagram number for the graph of $(f + g)(x)$ in the first box. $(|x| + 1) + (-|x| + 3)$
 Write the diagram number for the graph of $(f - g)(x)$ in the second box. $(|x| + 1) - (-|x| + 3)$
 Write the diagram number for the graph of $(fg)(x)$ in the third box. $(|x| + 1)(-|x| + 3)$
 Write the diagram number for the graph of $\left(\frac{f}{g}\right)(x)$ in the fourth box. $\frac{|x| + 1}{-|x| + 3}$

(Record your answer in the numerical response box from left to right.)

4 1 2 3

Section B

A graphing calculator may be used for the remainder of the test.

6. If
- $f(x) = x^2 - 3x - 1$
- and
- $g(x) = 2x - 5$
- , then the value of
- $(fg)(-1)$
- is

- A. -7
 B. -21
 C. 7
 D. 21

$$(x^2 - 3x - 1)(2x - 5)$$

$$((-1)^2 - 3(-1) - 1)(2(-1) - 5)$$

$$3(-7)$$

Numerical Response

- 2.
- $P(x) = 8x^2 - 4x - 14$
- and
- $Q(x) = 9 - 2x$
- . The function
- $(P + Q)(x)$
- can be written in the form
- $(ax - b)(cx + d)$
- where
- a, b, c
- , and
- d
- are all positive integers.

Write the value of a in the first box.
 Write the value of c in the third box.

Write the value of b in the second box.
 Write the value of d in the fourth box.

(Record your answer in the numerical response box from left to right.)

4 5 2 1

to fit format

$$\begin{array}{r} 8x^2 - 4x - 14 \\ + \quad -2x \quad 9 \\ \hline 8x^2 - 6x - 5 \end{array}$$

$$8x^2 - 10x + 4x - 5$$

$$2x(4x - 5) + 1(4x - 5)$$

$$(2x + 1)(4x - 5) \rightarrow (4x - 5)(2x + 1)$$

A B C D

Use the following information to answer the next two questions.

Consider the two linear functions $f(x) = 4x - 5$ and $g(x) = x - 3$, defined for all real numbers.

7. Which of the following is an expression for
- $3(f + g)(x) - 2(f - g)(x)$
- ?

- A. $9x - 8$
 B. $9x - 20$
 C. $9x - 28$
 D. $10x - 9$

$$3(4x - 5 + x - 3) - 2(4x - 5 - (x - 3))$$

$$3(5x - 8) - 2(3x - 2)$$

$$15x - 24 - (6x - 4)$$

$$9x - 20$$

8. Which of the following is an expression for
- $(ff)(x)$
- ?

- A. $8x - 10$
 B. $16x - 25$
 C. $16x^2 + 25$
 D. $16x^2 - 40x + 25$

$$(4x - 5)(4x - 5)$$

$$16x^2 - 20x - 20x + 25$$

Numerical
Response

3. If $f(x) = 3x^2 - 4x + 17$ and $g(x) = 5x^2 + 9x - 2$, then the value of $(f - g)(-2) - (g - f)(2)$ is _____.

(Record your answer in the numerical response box from left to right.)

2	2		
---	---	--	--

$$\begin{array}{r}
 3x^2 - 4x + 17 \\
 - 5x^2 + 9x - 2 \\
 \hline
 -2x^2 - 13x + 19 \\
 -2(-2)^2 - 13(-2) + 19 \\
 -8 + 26 + 19 \\
 37
 \end{array}
 \qquad
 \begin{array}{r}
 5x^2 + 9x - 2 \\
 - 3x^2 - 4x + 17 \\
 \hline
 2x^2 + 13x - 19 \\
 2(2)^2 + 13(2) - 19 \\
 15
 \end{array}$$

$$37 - 15 = 22$$

Use the following information to answer the next two questions.

Rational functions f and g are defined as $f(x) = \frac{x-1}{x+1}$ and $g(x) = \frac{2x-1}{2x+1}$.

9. $\left(\frac{f}{g}\right)(x)$ can be written in the form

A. $\frac{2x^2 - 3x + 1}{2x^2 + 3x + 1}$

B. $\frac{2x^2 - x - 1}{2x^2 + x - 1}$

C. $\frac{2x^2 + x - 1}{2x^2 - x - 1}$

D. $\frac{2x^2 + 3x + 1}{2x^2 - 3x + 1}$

$$\frac{x-1}{x+1} \div \frac{2x-1}{2x+1}$$

$$\frac{(x-1)(2x+1)}{(x+1)(2x-1)} = \frac{2x^2 - x - 1}{2x^2 + x - 1}$$

$$x \neq -1, \pm \frac{1}{2}$$

10. The domain of the function $\left(\frac{f}{g}\right)(x)$ is

A. $x \neq -1, \frac{1}{2}, x \in \mathbb{R}$

B. $x \neq -1, -\frac{1}{2}, \frac{1}{2}, x \in \mathbb{R}$

C. $x \neq -1, -\frac{1}{2}, 1, x \in \mathbb{R}$

D. $x \neq -1, -\frac{1}{2}, \frac{1}{2}, 1, x \in \mathbb{R}$

11. If $f(x) = x^2 + 14x + 24$ and $g(x) = x + 2$, then the value of $\left(\frac{f}{g}\right)(-2)$ is

A. 0
B. -24
C. 10
D. not defined

$$\frac{x^2 + 14x + 24}{x + 2} = \frac{(x + 12)(x + 2)}{x + 2}$$
$$= x + 12$$
$$= -2 + 12 = 10$$

12. Given that $m(x) = 3x + 1$ and $n(x) = x^2 - 3$, then $m(n(x))$ equals

A. $3x^2 - 2$
B. $3x^2 - 8$
C. $9x^2 + 6x - 2$
D. $3x^3 + x^2 - 9x - 3$

$$3(x^2 - 3) + 1$$
$$3x^2 - 9 + 1$$
$$3x^2 - 8$$

Use the following information to answer the next two questions.

Consider the functions $f(x) = x^2 + 4$ and $g(x) = \sqrt{4x}$.

13. The composite function $(g \circ f)(x)$ is

A. $\sqrt{4x^2 + 16}$
B. $\sqrt{4x^2 + 4}$
C. $16x + 4$
D. $4x + 4$

14. The domain and range of $y = (f \circ g)(x)$ are, respectively, real numbers such that

A. $x \geq 0$ and $y \geq 4$
B. $x \geq 0$ and $y \geq 0$
C. $x \in \mathbb{R}$ and $y \geq 0$
D. $x \in \mathbb{R}$ and $y \in \mathbb{R}$

Numerical Response

4. The functions f , g , and h are given by $f(x) = |x + 15|$, $g(x) = 4x + 2$, and $h(x) = x^2 - 10$. The value of $(f \circ g \circ h)(-3)$, to the nearest whole number, is _____.

(Record your answer in the numerical response box from left to right.)

1	3		
---	---	--	--

$$h(-3) = (-3)^2 - 10 = -1$$

$$g(-1) = 4(-1) + 2 = -2$$

$$f(-2) = |-2 + 15| = 13$$

15. Given $f(x) = \frac{1}{2x+1}$ and $g(x) = 5x - 1$, then $(g \circ f)(x)$ can be written in the form

A. $\frac{4-2x}{2x+1}$

B. $\frac{6-2x}{2x+1}$

C. $\frac{5}{2x}$

D. $\frac{1}{10x-1}$

$$= 5 \left(\frac{1}{2x+1} \right) - 1 = \frac{5}{2x+1} - \frac{1(2x+1)}{1}$$

$$= \frac{5 - 2x - 1}{2x+1} = \frac{4-2x}{2x+1}$$

Numerical Response

5. $f(x) = 2^x$ and $g(x) = x - 2$. To the nearest tenth, the smallest positive solution of the equation $(f \circ g)(x) = (g \circ f)(x)$ is _____.

(Record your answer in the numerical response box from left to right.)

1	.	4	
---	---	---	--

$$2^{x-2} = 2^x - 2$$

y_1

y_2

intersection

1.415

16. If $g(x) = \frac{x^3 - 1}{2}$, $x \in R$, then $g^{-1}(x)$ is

A. $\frac{2}{x^3 - 1}$

B. $\sqrt[3]{2x+1}$

C. $2\sqrt[3]{x} + 1$

D. 2

$$x \leftrightarrow y$$

$$x = \frac{y^3 - 1}{2}$$

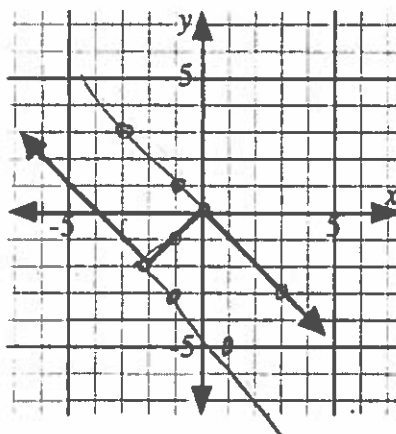
$$2x = y^3 - 1$$

$$2x + 1 = y^3$$

$$\sqrt[3]{2x+1} = y$$

Use the following information to answer the next question.

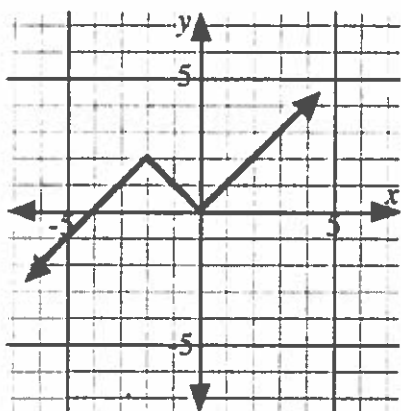
The partial graph of the function $y = f(x)$ is shown.



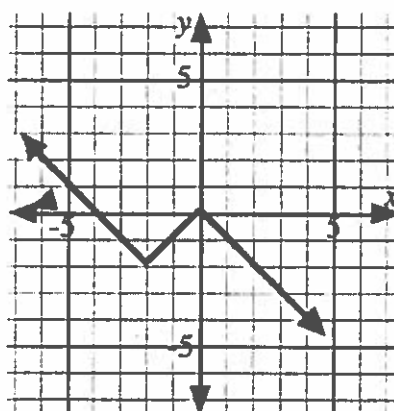
$-5, 1 \rightarrow 1, -5$
 $-3, -1 \rightarrow -1, -3$
 $-2, -2 \rightarrow -2, -2$
 $-1, -1 \rightarrow -1, -1$
 $1, -1 \rightarrow -1, 1$
 $3, -3 \rightarrow -3, 3$

16. Which of the following is the partial graph of $x = f(y)$?

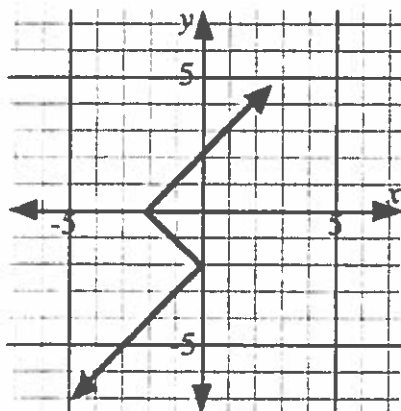
A.



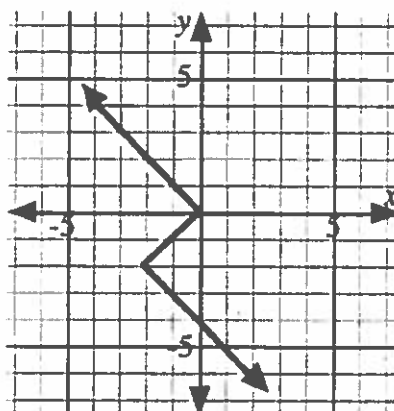
B.



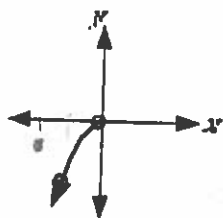
C.



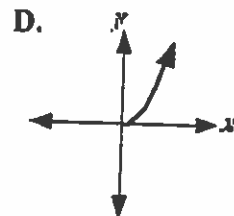
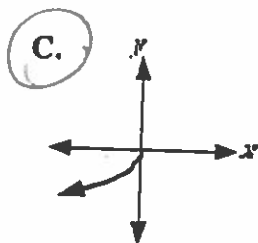
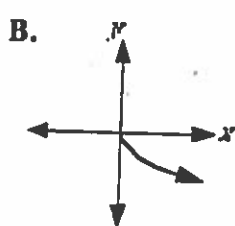
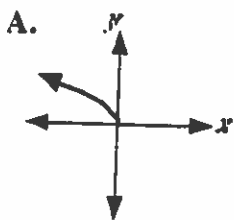
D.



18. The graph of the function $y = f(x)$ is shown in the diagram below.



Which of the following represents $f^{-1}(x)$?



Use the following information to answer the next two questions.

The mapping diagram shows the composition of two functions f and g .

$$x \xrightarrow{f} x^3 \xrightarrow{g} x^3 + 4$$

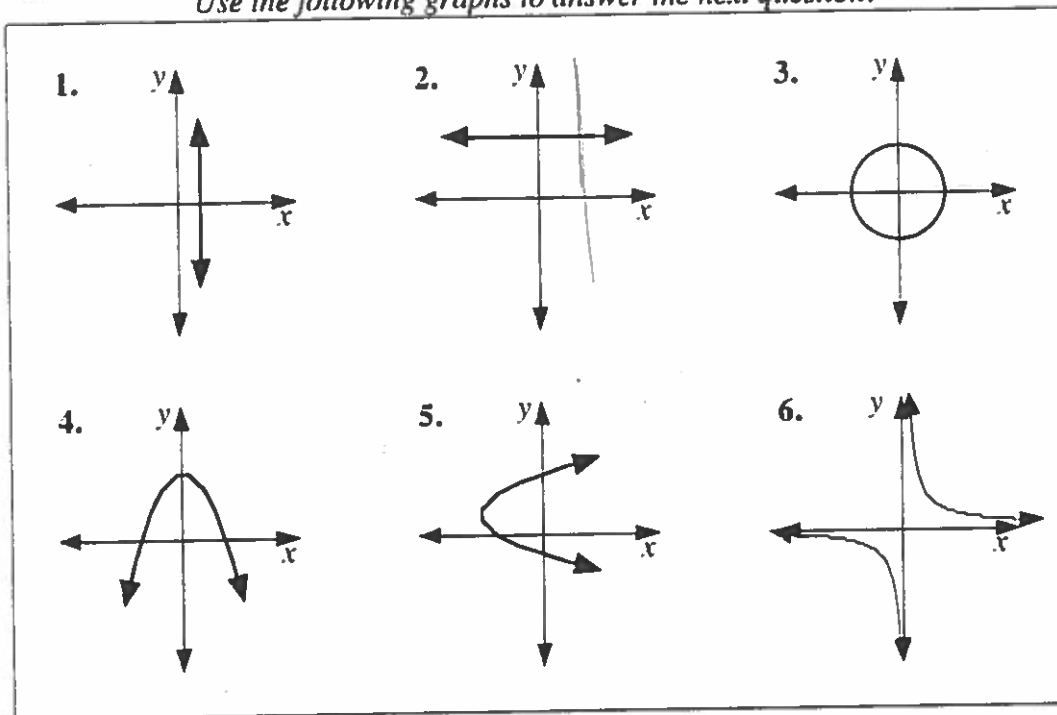
19. The expression which represents $g(x)$ is

- A. x^3
- B. $x^3 + 4$
- C. $x + 4$
- D. 4

20. The expression which represents $(g \circ f)^{-1}(x)$ is

- A. $\sqrt[3]{x} - 4$
- B. $\sqrt[3]{x - 4}$
- C. $4 - \sqrt[3]{x}$
- D. $\sqrt[3]{4 - x}$

Use the following graphs to answer the next question.



Numerical
Response

6. Consider the following questions:

- Which graph represents a function whose inverse is also a function? **6**
- Which graph does not represent a function, but **could** be made to represent a function if the range were restricted to $y \geq 0$? **3**
- Which graph represents a function whose inverse is not a function, but **could** be made to represent a function whose inverse is also a function if the domain were restricted to $x \leq 0$? **4**
- Which graph represents a function whose inverse is not a function but **could not** be made to represent a function whose inverse is also a function if the domain were restricted to $x \leq 0$? **2**

Write the graph number corresponding to answer a) in the first box, the graph number corresponding to answer b) in the second box, the graph number corresponding to answer c) in the third box, and the graph number corresponding to answer d) in the fourth box.

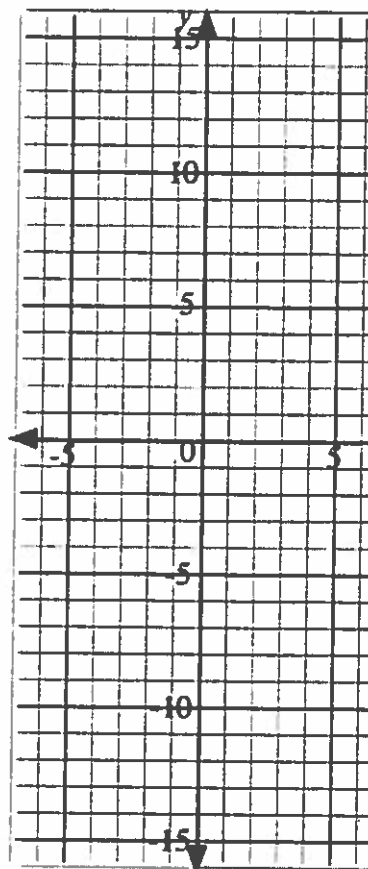
(Record your answer in the numerical response box from left to right.)

6342

Written Response

Consider the functions $f(x) = x + 4$ and $g(x) = 2x - 3$ defined for all real numbers.

- Sketch the graphs of $y = f(x)$ and $y = g(x)$ on the grid.
- Explain how to use the graphs of f and g to sketch the graph of $f - g$.
Sketch the graph of $y = (f - g)(x)$ on the grid.



- Algebraically, determine to the nearest tenth the root(s) of the equation $(f \circ g)(x) = (fg)(x)$.

Answer Key

Multiple Choice

1. C 2. D 3. C 4. D 5. A 6. B 7. B 8. D
9. B 10. B 11. D 12. B 13. A 14. A 15. A 16. B
17. D 18. C 19. C 20. B

Numerical Response

1.

4	1	2	3
---	---	---	---

 2.

4	5	2	1
---	---	---	---

 3.

2	2		
---	---	--	--

4.

1	3		
---	---	--	--

 5.

1		4	
---	--	---	--

 6.

6	3	4	2
---	---	---	---

Written Response

1. • See graph at the side.

- For integer values of x , subtract the corresponding y coordinate of $g(x)$ from the y -coordinate of $f(x)$ and plot the points (x, y) . Join the points to form a straight line.

- -3.4, 1.9

