

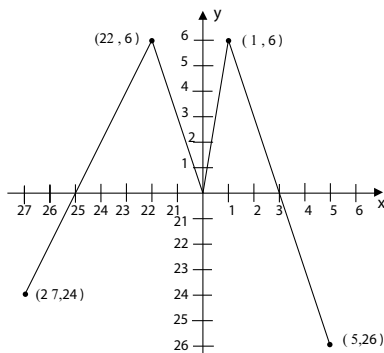
# Functions

1. For the nonzero numbers  $a$ ,  $b$ , and  $c$ , define

$$D(a, b, c) = \frac{abc}{a + b + c}.$$

Find  $D(2, 4, 6)$ .

- (A) 1    (B) 2    (C) 4    (D) 6    (E) 24
2. Define  $x \heartsuit y$  to be  $|x - y|$  for all real numbers  $x$  and  $y$ . Which of the following statements is **not** true?
- (A)  $x \heartsuit y = y \heartsuit x$  for all  $x$  and  $y$     (B)  $2(x \heartsuit y) = (2x) \heartsuit (2y)$  for all  $x$  and  $y$   
 (C)  $x \heartsuit 0 = x$  for all  $x$     (D)  $x \heartsuit x = 0$  for all  $x$   
 (E)  $x \heartsuit y > 0$  if  $x \neq y$
3. The graph of the function  $f$  is shown below. How many solutions does the equation  $f(f(x)) = 6$  have?



- (A) 2    (B) 4    (C) 5    (D) 6    (E) 7
4. A parabola with equation  $y = ax^2 + bx + c$  is reflected about the  $x$ -axis. The parabola and its reflection are translated horizontally five units in opposite directions to become the graphs of  $y = f(x)$  and  $y = g(x)$ , respectively. Which of the following describes the graph of  $y = (f + g)(x)$ ?
- (A) a parabola tangent to the  $x$ -axis    (B) a parabola not tangent to the  $x$ -axis  
 (C) a horizontal line    (D) a non-horizontal line  
 (E) the graph of a cubic function
5. The graph of the polynomial

$$P(x) = x^5 + ax^4 + bx^3 + cx^2 + dx + e$$

has five distinct  $x$ -intercepts, one of which is at  $(0, 0)$ . Which of the following coefficients cannot be zero?

- (A)  $a$     (B)  $b$     (C)  $c$     (D)  $d$     (E)  $e$