FUNCTIONS

1. The range of the function $y = \sqrt{9 - x^2}$ is
   (a) $(-\infty, -3] \cup [3, \infty)$
   (b) $[0, 3]$
   (c) $[-3, 3]$
   (d) $[3, \infty)$
   (e) $[0, \infty)$

2. The domain of the function $f(x) = \sqrt{x^2 - 3x - 4}$ is
   (a) $[-1, 4]$
   (b) $(-\infty, -1] \cup [4, \infty)$
   (c) $(-\infty, -4] \cup [1, \infty)$
   (d) $[4, \infty)$
   (e) $(-\infty, -1) \cup (-1, 4) \cup (4, \infty)$

3. The domain of the function $f(x) = -\sqrt{\frac{7}{5-|x|}}$ is
   (a) $[-5, 5]$
   (b) $(-\infty, -5) \cup (-5, 5) \cup (5, \infty)$
   (c) $(-\infty, -5) \cup (5, \infty)$
   (d) $[-5, 0) \cup (0, 5]$
   (e) $(-5, 5)$

4. The range of the function $y + 1 = -\sqrt{x + 2} + 4$ is
   (a) $[3, \infty)$
   (b) $[2, 3]$
   (c) $(-\infty, 3]$
   (d) $(-\infty, 0]$
   (e) $[0, \infty)$

5. The domain D and range R of the function $f(x) = -\frac{3}{4x^2+4x+1}$ are
   (a) $D = (-\infty, 0] \cup [1, \infty), R = (-\infty, \infty)$
   (b) $D = (-\infty, \infty), R = (-\infty, 0)$
   (c) $D = \left(-\infty, -\frac{1}{2}\right) \cup \left(-\frac{1}{2}, \infty\right), R = (-3, \infty)$
   (d) $D = \left(-\infty, -\frac{1}{2}\right) \cup \left(-\frac{1}{2}, \infty\right), R = (-\infty, 0)$
   (e) $D = \left(-\infty, \frac{1}{2}\right) \cup \left(\frac{1}{2}, \infty\right), R = (-\infty, 0)$

6. The domain of the function $f(x) = \sqrt{-x^2 - 25}$ is
   (a) $x \geq 5$
   (b) $(-\infty, \infty)$
   (c) $\emptyset$
   (d) $-5 \leq x \leq 5$
   (e) $-25 \leq x \leq 25$

7. The domain of the function $f(x) = \sqrt{\frac{-3+4x-x^2}{x}}$ is
   (a) $[1, 3]$
   (b) $(-\infty, 0) \cup [1, 3]$
   (c) $(-\infty, 1] \cup [3, \infty)$
   (d) $(0, 3]$
   (e) $(0, 1] \cup [3, \infty)$

8. The domain D and range R of the function $f(x) = \sqrt{-3x - 12}$ are
   (a) $D = \emptyset, R = [0, \infty)$
   (b) $D = R = \emptyset$
   (c) $D = (-\infty, -4], R = (-\infty, 0]$
   (d) $D = R = (-\infty, 0]$
   (e) $D = (-\infty, -4], R = [0, \infty)$

9. The domain of the function $f(x) = \frac{\sqrt{x+1}}{x}$ is
   (a) $(-1, 0) \cup (0, \infty)$
   (b) $[-1, \infty)$
   (c) $[-1, 0) \cup (0, \infty)$
   (d) $[1, \infty)$

(e) $[0,\infty)$

10. The domain D and range R of the function $f(x)=\sqrt{|x-5|}$ are
    (a) $D=(-\infty,-5], R=[0,\infty)$
    (b) $D=(-\infty,\infty), R=[0,\infty)$
    (c) $D=[5,\infty), R=(-\infty,0)$
    (d) $D=[-5,5], R=[0,\infty)$
    (e) $D=(-5,\infty), R=[5,\infty)$

11. The domain D and range R of $|xy|=1$ are
    (a) $D=(-\infty,\infty), R=(-\infty,\infty)$
    (b) $D=(0,\infty), R=(0,\infty)$
    (c) $D=(-\infty,0)\cup(0,\infty), R=(-\infty,0)\cup(0,\infty)$
    (d) $D=(-\infty,0), R=(-\infty,0)$
    (e) $D=(-\infty,\infty), R=[0,\infty)$

12. The domain D and range R of $|x+y|=1$ are
    (a) $D=[-1,1), R=[-1,1)$
    (b) $D=[1,\infty), R=[1,\infty)$
    (c) $D=[-1,\infty), R=[-1,\infty)$
    (d) $D=(-\infty,\infty), R=(-\infty,\infty)$
    (e) $D=[-1,1], R=[-1,1]$

13. The domain D of $f(x)=\sqrt[3]{25-x^2}$ and the range R of $g(x)=-\sqrt{\frac{1}{x^2+9}}$ are
    (a) $D=[-5,5], R=\left(0,\frac{1}{3}\right]$
    (b) $D=(-\infty,0], R=(0,\infty)$
    (c) $D=(-\infty,\infty), R=\left[-\frac{1}{3},0\right)$
    (d) $D=[0,\infty), R=(-\infty,0)$
    (e) $D=(-\infty,-5]\cup[5,\infty), R=\left[-\frac{1}{3},\frac{1}{3}\right]$

14. If $f(x)=\frac{1}{x+1}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
    (a) $-\frac{2}{h}$
    (b) $-\frac{3}{2(2+h)}$
    (c) $-\frac{1}{2(2+h)}$
    (d) $-\frac{2}{2+h}$
    (e) $-2(2+h)$

15. If $f(x)=x^2$, then $\frac{f(x+h)-f(x)}{2xh+h^2}$ is equal to
    (a) x
    (b) 1
    (c) $x+h$
    (d) $2x+h$
    (e) $\frac{2x+h}{x+h}$

16. If $f(x)=\frac{x}{x+1}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
    (a) $\frac{1}{2+h}$
    (b) $\frac{1}{h(2+h)}$
    (c) $\frac{1}{2(2+h)}$
    (d) $\frac{h+1}{2h(2+h)}$
    (e) $\frac{h}{2(2+h)}$

17. If $f(x)=\sqrt{x}$, then $\frac{f(1+h)-f(1)}{h}$ is equal to
    (a) $-\frac{1}{1+\sqrt{1+h}}$
    (b) $\frac{1}{h}$
    (c) $\frac{1}{\sqrt{1+h}-1}$
    (d) $\frac{1}{1+\sqrt{1+h}}$
    (e) $-\frac{1}{h}$

18. If $f(x)=\frac{2x+1}{x-2}$, then $\frac{f(x)-f(4)}{x-4}$ is equal to
    (a) $\frac{-5x-16}{2(x-2)(x-4)}$
    (b) $-\frac{5}{2x-4}$
    (c) $-\frac{5}{x-2}$
    (d) 1
    (e) $\frac{-5x+16}{2(x-2)(x-4)}$

19. If $f(x)=\frac{1}{\sqrt{x-1}+2}$, then $f(x+1)$ is equal to
    (a) $\frac{\sqrt{x}+2}{x+4}$
    (b) $\frac{\sqrt{x-1}-3}{x-8}$
    (c) $\frac{\sqrt{x-1}+3}{x+8}$
    (d) $\frac{\sqrt{x}-2}{x-4}$
    (e) $\frac{\sqrt{x-1}+3}{\sqrt{x-1}+2}$

20. If $f(x)=3-x^2$, then $[f(x)]^2+f\left(x^2-1\right)$ is equal to
    (a) $13-8x^2$
    (b) $11-4x^2$
    (c) $10-7x^2+x^4$
    (d) $11-7x^2+x^4$
    (e) $7-x^2-x^4$

21. If $f(x)=\sqrt{x^2+2x+1}$ with $-2<x<-1$, then $\frac{f(x-2)}{x-1}$ is equal to
    (a) 1
    (b) ± 1
    (c) $\frac{|x+2|-2}{x-1}$
    (d) $\frac{x}{x-1}$
    (e) -1

22. Which one of the following relations represents a function of x ?
    (a) $x^2+y^2=9$
    (b) $x^2-y^2=1$

(c) $x^3 - y = 1$
(d) $x = |y|$
(e) $x^2 + y^4 = 4$

23. The graph of the function $f(x) = -x^4 + 2x^3 + 3x^2$ intercepts the x-axis at
(a) $(1,0), (-1,0), (0,0), (3,0)$
(b) $(3,0), (0,-3), (0,0)$
(c) $(1,0), (0,0), (0,3), (0,-3)$
(d) $(0,0), (3,0), (-1,0)$
(e) $(-3,0), (0,0), (1,0)$

24. The value of k in interval notation for which the function $y = kx^2 - 8x + 4$ has no x-intercepts is
(a) $(-\infty, 4)$
(b) $(4, \infty)$
(c) $(0, 4)$
(d) $(-4, 4)$
(e) $(-4, 0)$

25. The graph of $x|y| = 1$ is completely in
(a) the first and second quadrants
(b) the first and third quadrants
(c) the third and fourth quadrants
(d) the first and fourth quadrants
(e) the fourth quadrant

26. The graph of the set of points (x, y) for which $|x+4| \leq 1$ and $0 \leq y+2 \leq 1$ lies completely in
(a) all quadrants
(b) the first quadrants
(c) the third quadrant
(d) the second quadrant
(e) the fourth quadrant

27. In the graph of $f(x) = \begin{cases} |x| - 1 & if \quad x > -1 \\ x - 1 & if \quad x \leq -1 \end{cases}$ we have
(a) one x-intercept and one y-intercept
(b) one x-intercept and two y-intercepts
(c) two x-intercepts and one y-intercept
(d) two x-intercepts and two y-intercepts
(e) two x-intercepts only

28. If the point (a, b) is in the fourth quadrant, then $(b, -a)$ lies in the
(a) first quadrant
(b) third quadrant
(c) fourth quadrant
(d) second quadrant
(e) first and second quadrants

29. The x- and y-intercepts of $y = \begin{cases} 2x - 3 & if \quad x \leq 2 \\ 12 - 3x & if \quad x > 2 \end{cases}$ are
(a) x-intercept $= -4$ and y-intercept $= -3$
(b) x-intercept $= \frac{3}{2}, 4$ and y-intercept $= -3$
(c) x-intercept $= 0$ and y-intercept $= 0$
(d) x-intercept $= \frac{3}{2}$ and y-intercept $= 12$
(e) x-intercept $= \frac{3}{2}$ and y-intercept $= 12, -3$

30. The graph of $y = \begin{cases} 3 - 2x & if \quad x \leq 1 \\ x - 2 & if \quad x > 1 \end{cases}$ has
(a) x-intercept $= 2$ and y-intercept $= 3$
(b) x-intercept $= \frac{3}{2}, 2$ and y-intercept $= -2, 3$
(c) x-intercept $= -2$ and y-intercept $= -3$
(d) x-intercept $= \frac{3}{2}$ and y-intercept $= -2$
(e) no x- or y-intercepts

31. If $f(x) = \begin{cases} 4x^2 & if \quad x \leq 0 \\ 2x + 1 & if \quad 0 < x < 2 \\ |x - 2| & if \quad x \geq 2 \end{cases}$, then $f(-1) + f(1) + f(5)$
(a) 10
(b) 4
(c) 6
(d) 18
(e) 14

32. The slope of the line passing through $(2, 3)$ and $(-4, r)$ is equal to $\frac{1}{2}$, then r is equal to
(a) 3
(b) 0
(c) 1
(d) 2
(e) 4

33. Which one of the following statements is TRUE ?
(a) If a line goes down from left to right, then its slope is negative
(b) A horizontal line has no slope
(c) A vertical line has zero slope
(d) The slope of $x = my + b$ is m
(e) The slope of the line joining (x_1, y_1) and (x_2, y_2) is $\frac{y_2 - y_1}{x_2 - x_1}$ for all values of x_1, x_2, y_1, y_2

34. If $(-2, 20)$ is the midpoint of the line segment joining (a, b) and $\left(-\frac{a}{2}, \frac{2b}{3}\right)$, then a, and b are
(a) $-4, 12$
(b) $-8, 24$
(c) $-\frac{8}{3}, 12$
(d) $-8, 12$
(e) $-\frac{8}{3}, 24$

35. If $(4,6)$ is the midpoint of the line segment joining $\left(\frac{x}{2}, y\right)$ and $\left(\frac{3x}{2}, \frac{y}{2}\right)$, then x and y are

(a) $8, 4$
(b) $4, 8$
(c) $8, -24$
(d) $4, -24$
(e) $8, -4$

36. If $(-2, 8)$ is the midpoint of the line segment joining (a, b) and $\left(-\frac{a}{2}, \frac{b}{3}\right)$, then $a + b$ is

(a) 16
(b) $\frac{10}{3}$
(c) 12
(d) 4
(e) 8

37. If (x, y) is equidistant from $(1, 1)$ and $(3, 3)$, then $x + y$ is

(a) 3
(b) 1
(c) 4
(d) 0
(e) 2

38. If $f(x) = [2x - 1]$, where $[]$ is the greatest integer function, then $f(x) = 0$ when

(a) $0 \le x < \frac{1}{2}$
(b) $0 < x \le \frac{1}{2}$
(c) $0 \le x < 1$
(d) $\frac{1}{2} \le x < 1$
(e) $\frac{1}{2} < x \le 1$

39. If $f(x) = [1 - 2x]$, where $[]$ is the greatest integer function, then $f(x) = 1$ when

(a) $0 \le x < \frac{1}{2}$
(b) $-\frac{1}{2} < x \le 0$
(c) $-\frac{1}{2} \le x < 0$
(d) $-1 < x \le 1$
(e) $\frac{1}{2} < x \le 1$

40. If $f(x) = [3x - 2]$, where $[]$ is the greatest integer function, then the x- and y-intercepts are

(a) $\frac{3}{2} \le x < 2,\ y = 2$
(b) $\frac{1}{3} \le x \le \frac{2}{3},\ y = 2$
(c) $-\frac{2}{3} < x \le 1,\ y = -2$
(d) $\frac{2}{3} \le x < 1,\ y = -2$
(e) $\frac{1}{3} < x \le \frac{2}{3},\ y = 2$

41. If $f(x) = [x] + 1$, then the part of the graph which lies on the x-axis is

(a) $[-1, 0)$
(b) $(-1, 0)$
(c) $[-1, 1)$
(d) $(-1, 1)$
(e) $[0, 1)$

42. Given $f(x) = \begin{cases} 2x + 1 & if \quad x < 2 \\ [2x + 1] & if \quad x \ge 2 \end{cases}$, where $[]$ is the greatest integer function, then $f(-4) + f\left(\frac{7}{3}\right)$ is equal to

(a) -2
(b) $\frac{29}{3}$
(c) -3
(d) -9
(e) $-\frac{4}{3}$

43. Given $f(x) = \begin{cases} \sqrt{(1 - 5x)^2} & if \quad x < 2 \\ [2x + 1] & if \quad x \ge 2 \end{cases}$, where $[]$ is the greatest integer function, then $f(\pi) + f(1)$ is equal to

(a) 11
(b) $5\pi + 2$
(c) -4
(d) 7
(e) $2\pi + 5$

44. Let $f(x) = [x]$ be the greatest integer function. Then the value of $\frac{f(x+h) - f(x)}{h}$ when $x = 1.5$ and $h = 0.5$ is equal to

(a) 0
(b) 2
(c) 4
(d) -6
(e) 1

45. Let $f(x) = [x]$ be the greatest integer function. Then only one of the following statements is TRUE ?

(a) $y = [x]$ is not a function by the vertical line test
(b) $[\pi - 1] = 3$
(c) $[x] = -3$ if $-4 \le x < -3$
(d) the range of $y = [x - 1]$ is the set of all integers
(e) the domain of $y = [x - 1]$ is the set of all integers

THE ALGEBRA OF FUNCTIONS

1. If $f(x) = \sqrt{2 - x}$ and $g(x) = \sqrt{x + 3}$, then the domain of $\left(\frac{f}{g}\right)(x)$ is

(a) $[-2,3)$
(b) $(-3,\infty)$
(c) $(-3,2]$
(d) $(-\infty,-3]\cup[2,\infty)$
(e) $(-\infty,-2]\cup(3,\infty)$

2. If $f(x)=\sqrt{16+\sqrt{x}}$, then $(f\circ f)(0)$ is equal to
   (a) 9
   (b) $2\sqrt{3}$
   (c) $3\sqrt{2}$
   (d) 8
   (e) 4

3. If $f(x)=\begin{cases} 2x-1 & if \quad x\le -1 \\ 2x+3 & if \quad x>-1 \end{cases}$, and $g(x)=[x]$, where $[]$ is the greatest integer function, then $(f\circ g)(-0.3)+\sqrt{(f\cdot g)(0.5)}$ is equal to
   (a) -2
   (b) -4
   (c) -1
   (d) -3
   (e) 1

4. Let $f(x)=x^2-12x+36$ and $g(x)=\sqrt{-x}$, then $(g\circ f)(x)$ is
   (a) equal to zero
   (b) undefined
   (c) equal to $|x-6|$ for all x in the domain of f
   (d) equal to $(x-6)$ for all x in the domain of f
   (e) equal to $-(x-6)$ for all x in the domain of f

5. If $f(x)=2x-1$ and $(f\circ g)(x)=2x+1$, then $g(x)$ is equal to
   (a) -2
   (b) $2x+2$
   (c) 2
   (d) $x+2$
   (e) $x+1$

6. If $f(x)=3x^2-2$ and $g(x)=x^2-3x+4$, then $\sqrt{\left(\frac{f}{g}\right)(3)}$ is equal to
   (a) 25
   (b) $\frac{25}{4}$
   (c) undefined
   (d) $\frac{5}{2}$
   (e) 4

7. If $g(x)=1-x^3$ and $(g\circ f)(x)=1-2x-x^2$, then $f(2)$ is equal to
   (a) 3
   (b) -2
   (c) 2
   (d) 1
   (e) -5

8. Let $f(x)=|x|$, and $g(x)=[x]$, where $[]$ is the greatest integer function, then which one of the following is FALSE ?
   (a) $(f\circ g)\left(-\frac{1}{2}\right)=0$
   (b) $(g\circ f)(-3.2)=3$
   (c) $(g\circ f)(x)\ge 0$
   (d) $g(x)=-2$ if $-2\le x<-1$
   (e) $(f\circ g)\left(n^2\right)=n^2$ for any positive integer n

9. If $f(x)=\frac{x-1}{3-x}$ and $g(x)=\sqrt{x+2}$, then the domain of $(f\circ g)(x)$ is
   (a) $[-2,7)\cup(7,\infty)$
   (b) $(3,\infty)$
   (c) $[-2,\infty)$
   (d) $[-2,3)$
   (e) $[-2,3)\cup(3,\infty)$

10. Let $f(x)=x^2-2x$ and $g(x)=\frac{1}{x+3}$. If $(f\circ g)(k)=0$, then k is equal to
    (a) $-\frac{2}{5}$
    (b) 2
    (c) $-\frac{1}{2}$
    (d) -2
    (e) $-\frac{5}{2}$

11. If $f(x)=x^3$ and $g(x)=|x-1|$, then $\left(\frac{f}{g}\right)\left(\sqrt{2}\right)$ is equal to
    (a) $2+2\sqrt{2}$
    (b) $4+2\sqrt{2}$
    (c) $2+\sqrt{2}$
    (d) $4-2\sqrt{2}$
    (e) $2\sqrt{2}-2$

12. If $(f\circ g)(x)=10-x$, and $f(x)=2x+4$ and $g(x)=ax+b$, where a,b are real numbers, then a,b are equal to
    (a) $-\frac{1}{2},3$
    (b) $-\frac{1}{2},7$
    (c) $-2,3$
    (d) $\frac{1}{2},-3$
    (e) $-1,10$

13. If $f(x)=\sqrt{x+3}$ and $g(x)=\frac{\sqrt{25-x^2}}{x+1}$, then the domain of $\left(\frac{f}{g}\right)(x)$ is
    (a) $(-5,5)$

(b) $(-3,5)$
(c) $[-3,-1)\cup(-1,5)$
(d) $(-1,5)$
(e) $(-5,-3]\cup(-1,5)$

14. The domain of $(g\circ f)(x)$, where $f(x)=\frac{2}{x}$ and $g(x)=\sqrt{x-3}$ is
(a) $\left(0,\frac{2}{3}\right]$
(b) $(-\infty,0)\cup\left[\frac{2}{3},\infty\right)$
(c) $(-\infty,\infty)$
(d) $(-\infty,0)\cup(0,\infty)$
(e) $\left[0,\frac{2}{3}\right]$

15. If $f(x)=\sqrt{x}$ and $g(x)=x^2-1$, then the domain of $(f\circ g)(x)$ is
(a) $[0,\infty)$
(b) $[-1,0)\cup(0,1]$
(c) $(-\infty,-1]\cup[1,\infty)$
(d) $(-\infty,\infty)$
(e) $[-1,\infty)$

16. Given that $(g\circ f)(k)=1$, where $f(x)=x+1$ and $g(x)=2-x^2$, then the set of all possible values of k is equal to
(a) $\{-2,0\}$
(b) $\{-2,-1,0,1,2\}$
(c) $\{0\}$
(d) $\{-2,0,2\}$
(e) $\{0,2\}$

17. If $f(x)=2x-1$ and $g(x)=x^3-3x$, then $(g\circ f)(x)$ is
(a) $8x^3-12x^2+2$
(b) $2x^3-6x-1$
(c) $8x^3-16x^2-6x+3$
(d) $2x^3-12x^2+2$
(e) $8x^3-12x^2+6x+1$

18. Let $[x]$ denote the greatest integer function and let $f(x)=\begin{cases}\frac{1}{5}([x]-1) & if \quad x\le -1\\ 1-[x] & if \quad x>-1\end{cases}$, then the value of $(f\circ f)\left(-\frac{3}{2}\right)$ is equal to
(a) 0.2
(b) 0.36
(c) 2
(d) -0.2
(e) 0

LINEAR FUNCTIONS

1. The equation of the line passing through the points (k,k) and $(k+1,k)$ is
(a) $y=x+k$
(b) $x=k+1$
(c) $y=k+1$
(d) $y=k$
(e) $x=k$

2. The equation of the line whose x-intercept is -1 and which is perpendicular to the line $2x-3y=5$ is
(a) $2x+3y+2=0$
(b) $3x+2y+2=0$
(c) $3x+2y+3=0$
(d) $2x-3y+2=0$
(e) $3x+2y-3=0$

3. Let f be a linear function such that $f(9)=0$ and the graph of f is parallel to the line $x-3y-4=0$, then $f(3)$ is equal to
(a) -18
(b) 18
(c) -2
(d) 10
(e) $-\frac{1}{3}$

4. The equation of the perpendicular bisector to the line segment containing $(3,-1)$ and $(-1,5)$ is
(a) $3x-2y+4=0$
(b) $3x+2y-7=0$
(c) $2x-3y+4=0$
(d) $2x+3y-4=0$
(e) $3x+2y+9=0$

5. If the lines $ky+2=-5x$ and $2x+4y=5$ are perpendicular, then k is equal to
(a) $-\frac{2}{5}$
(b) $-\frac{5}{2}$
(c) -2
(d) $\frac{2}{5}$
(e) $-\frac{1}{5}$

6. The line with x-intercept equal to -2 and y-intercept equal to 3 is parallel to the line
(a) $6x-4y=3$
(b) $3y-2x=1$
(c) $y=\frac{2}{3}x+1$
(d) $6x+4y=1$
(e) $3x+2y=4$

7. The value of k so that the line through the points $(4,-1)$ and $(k,2)$ is perpendicular to the line $2y-5x=1$ is equal to
   (a) -7
   (b) $-\frac{7}{2}$
   (c) $\frac{14}{5}$
   (d) $\frac{26}{5}$
   (e) $\frac{7}{2}$

8. The equation of the line passing through $(1,6)$ and perpendicular to the line $3x+5y=1$ is
   (a) $2x-3y=-16$
   (b) $x+6y=37$
   (c) $x-\frac{3}{5}y=\frac{1}{5}$
   (d) $5x-3y=-13$
   (e) $\frac{3}{5}x+\frac{3}{5}y=\frac{1}{5}$

9. The x-intercept and the y-intercept of the line passing through $(-2,-1)$ and $(1,3)$ are
   (a) $-\frac{7}{2},-\frac{7}{3}$
   (b) $-\frac{5}{4},\frac{5}{3}$
   (c) $0,0$
   (d) $-3,\frac{9}{4}$
   (e) $-2,\frac{4}{3}$

10. If the line $\frac{1}{2}kx+3y-7=0$ is perpendicular to the line passing through $\left(1,-\frac{1}{2}\right)$ and $(-2,-5)$, then k is equal to
   (a) 4
   (b) -1
   (c) $-\frac{3}{2}$
   (d) $\frac{3}{4}$
   (e) $\frac{1}{2}$

11. If $a,b,c,$ and d are nonzero real numbers such that the line $ax+y=b$ is perpendicular to the line $cx+y=d$, then
   (a) $ac=1$
   (b) $0<ac<1$
   (c) $ac>1$
   (d) $ac>-1$
   (e) $ac=-1$

12. The y-intercept of the line passing through $(2,-5)$ and perpendicular to the line $3x+2y=5$ is
   (a) $\frac{11}{3}$
   (b) -2
   (c) $\frac{19}{3}$
   (d) $-\frac{19}{3}$
   (e) $-\frac{11}{3}$

13. If the line $3x-y=5$ is perpendicular to the line $ax-by=2b$, then
   (a) $ab=-\frac{1}{3}$
   (b) $3a=-b$
   (c) $3a=b$
   (d) $a=3b$
   (e) $a=-3b$

14. If $f(5)=-2$, $f(1)=0$, and f is a linear function, then $f(-4)$ is equal to
   (a) 3
   (b) $\frac{3}{2}$
   (c) $-\frac{5}{2}$
   (d) $\frac{5}{2}$
   (e) $-\frac{3}{2}$

15. The x-intercept of the line passing through $(-1,1)$ and perpendicular to $8x+3y=4$ is equal to
   (a) $-\frac{11}{3}$
   (b) $-\frac{5}{8}$
   (c) $-\frac{11}{8}$
   (d) $\frac{11}{8}$
   (e) $\frac{11}{3}$

16. The equation of the line whose x-intercept is $\frac{4}{5}$ and parallel to $y=-2x+3$ is
   (a) $5y+10x-8=0$
   (b) $y+2x+10=0$
   (c) $5y-10x-4=0$
   (d) $5y-10x-8=0$
   (e) $y-2x+10=0$

17. The equation of the vertical line through $(-2,3)$ is
   (a) $y=-2$
   (b) $x=3$
   (c) $y=3$
   (d) $-2x+3y=0$
   (e) $x+2=0$

18. The equation of the horizontal line through $\left(\sqrt{2},-\sqrt{3}\right)$ is
   (a) $x=-\sqrt{3}$
   (b) $x=\sqrt{2}$
   (c) $y=\sqrt{2}$
   (d) $\sqrt{2}x-\sqrt{3}y=0$
   (e) $y=-\sqrt{3}$

QUADRATIC FUNCTIONS

1. The largest possible value of $\sqrt{-3x^2-2x+1}$ is equal to
   (a) $\frac{4}{\sqrt{3}}$
   (b) $\frac{3}{2}$
   (c) $\frac{4}{3}$
   (d) $\frac{\sqrt{3}}{4}$
   (e) $\frac{2}{\sqrt{3}}$

2. If the line $2x+3y=2$ passes through the vertex of the parabola $y=-2x^2+4x+c$, then c is equal to
   (a) $-\frac{1}{2}$
   (b) -3
   (c) $-\frac{1}{3}$
   (d) -1
   (e) -2

3. The midpoint between the point $(1,2)$ and the vertex of the parabola $y=-4x^2+8x-6$ is
   (a) $(0,1)$
   (b) $(1,2)$
   (c) $(1,0)$
   (d) $(2,1)$
   (e) $(0,0)$

4. If $f(x)=-x^2-16$, then f is decreasing on the interval
   (a) $(-\infty,0]$
   (b) $[-4,\infty)$
   (c) $[-16,0)$
   (d) $[0,\infty)$
   (e) $[-16,\infty)$

5. If one of the x-intercepts of an open downward parabola with vertex at $(-1,8)$ is equal to -3, then the other x-intercept is equal to
   (a) 3
   (b) 2
   (c) 0
   (d) 1
   (e) $-\frac{1}{2}$

6. The maximum value of $(3-2x)(x+2)$ is equal to
   (a) 15
   (b) $\frac{5}{8}$
   (c) $\frac{49}{8}$
   (d) -16
   (e) $\frac{63}{8}$

7. The interval where $f(x)=-2x^2-5x+3$ increases is
   (a) $\left[-\frac{5}{4},\infty\right)$
   (b) $\left[-\frac{49}{16},\infty\right)$
   (c) $\left[-\frac{5}{4},0\right)$
   (d) $\left(-\infty,-\frac{49}{16}\right)$
   (e) $\left(-\infty,-\frac{5}{4}\right]$

8. The parabola $y=-2x^2+2x-1$
   (a) opens to the left and has a vertex at $\left(\frac{1}{2},-\frac{1}{2}\right)$
   (b) opens to the left and has a vertex at $\left(-\frac{1}{2},\frac{1}{2}\right)$
   (c) opens downward and has a vertex at $\left(-\frac{1}{2},\frac{1}{2}\right)$
   (d) opens downward and has a vertex at $\left(\frac{1}{2},-\frac{1}{2}\right)$
   (e) opens downward and has a vertex at $(1,-1)$

9. If the slope of the line passing through $(2,-3)$ and the vertex of the parabola $y=(x+m)^2-5$ is $\frac{3}{m}$, then m is
   (a) -5
   (b) -4
   (c) -3
   (d) undefined
   (e) -6

10. Given the function $f(x)=x^2+4x+2$ with domain $[-3,0]$, then the minimum and maximum values of $f(x)$ are respectively
    (a) -2 and no maximum value
    (b) $-6,12$
    (c) $-1,1$
    (d) no minimum value , 2
    (e) $-2,2$

11. If the equation of a parabola is $y-2=-2(x+3)^2$, then which one of the following is TRUE ?
    (a) The vertex is $(3,-2)$ and the parabola opens downward
    (b) The vertex is $(-3,2)$ and the parabola is symmetric about $x=2$
    (c) The vertex is $(3,-2)$ and the parabola is symmetric about $x=-3$
    (d) The parabola opens upward and is symmetric about $x=-3$
    (e) The vertex is $(-3,2)$ and the parabola opens downward

12. If $x=3$ is the axis of symmetry of the parabola $f(x)=-x^2+2cx+c^2+4$ for some constant c, then the maximum value of $f(x)$ is equal to
    (a) 13
    (b) 22

(c) 3
(d) 6
(e) 18

13. If the sum of two numbers is 106 and their product is maximum, then the difference of these numbers is
    (a) 2
    (b) 0
    (c) 10
    (d) 14
    (e) 53

CIRCLE

1. The center C and the radius R of the circle $2x^2 + 2y^2 - 12x + 8y + 18 = 0$ are given by
    (a) $C = (-6,4)\,, R = 4$
    (b) $C = (-3,2)\,, R = 2$
    (c) $C = (2,-3)\,, R = 2$
    (d) $C = (-3,-2)\,, R = 2$
    (e) $C = (3,-2)\,, R = 2$

2. The center C and the radius R of the circle $2x^2 - 12x + 2y^2 + 16y - 22 = 0$ are given by
    (a) $C = (-3,4)\,, R = 6$
    (b) $C = (-3,4)\,, R = \sqrt{14}$
    (c) $C = (6,-8)\,, R = \sqrt{21}$
    (d) $C = \left(-\frac{3}{2}, 2\right), R = 6$
    (e) $C = (3,-4)\,, R = 6$

3. The center C and the radius R of the circle $\frac{1}{2}x^2 + 3x + \frac{1}{2}y^2 + 4y + \frac{9}{2} = 0$ are given by
    (a) $C = (3,4)\,, R = 4$
    (b) $C = (-3,-4)\,, R = 16$
    (c) $C = (-3,-4)\,, R = 4$
    (d) $C = \left(-\frac{3}{2},-2\right), R = 4$
    (e) $C = \left(-\frac{3}{2},-2\right), R = 16$

4. If the points $(0,-5)$ and (a,b) are the endpoints of a diameter of the circle $(x-1)^2 + (y+2)^2 = 10$, then the expression $4a - 5b$ is equal to
    (a) 4
    (b) 5
    (c) 0
    (d) 3
    (e) -5

5. The equation of the circle that has the points $(2,4)$ and $(-4,6)$ as the endpoints of a diameter is
    (a) $(x-1)^2 + (y+5)^2 = 10$
    (b) $(x+1)^2 + (y-5)^2 = 10$
    (c) $(x-3)^2 + (y-1)^2 = 10$
    (d) $(x+1)^2 + (y-5)^2 = 90$
    (e) $(x+3)^2 + (y+1)^2 = 10$

6. The equation of the circle that has the points $(-2,0)$ and $(-4,-2)$ as the endpoints of a diameter is
    (a) $(x-3)^2 + (y+1)^2 = \sqrt{10}$
    (b) $(x+3)^2 + (y+1)^2 = 4$
    (c) $(x+3)^2 + (y-1)^2 = 2\sqrt{10}$
    (d) $(x+3)^2 + (y+1)^2 = 2$
    (e) $(x-3)^2 + (y-1)^2 = 2$

7. The equation of the circle which is tangent to the x-axis at the point $(-4,0)$ and of radius 3 and whose center lies in the second quadrant, is given by
    (a) $(x-4)^2 + (y-3)^2 = 9$
    (b) $(x+1)^2 + (y+3)^2 = 9$
    (c) $(x-4)^2 + (y+3)^2 = 9$
    (d) $(x+4)^2 + (y-3)^2 = 9$
    (e) $(x+1)^2 + (y-3)^2 = 9$

8. The equation of the circle whose center is $(-1,1)$ and which passes through the point $\left(\sqrt{3},\sqrt{3}\right)$ is
    (a) $x^2 - x + y^2 + y = 6$
    (b) $x^2 - 2x + y^2 + 2y = 6$
    (c) $x^2 + 2x + y^2 - 2y = 6$
    (d) $x^2 + x + y^2 - y = 6$
    (e) $x^2 + 2x + y^2 - 2y = 8$

9. Let $a \neq 0$. Which of the following statements is TRUE about the circle $x^2+y^2+2a\,(x+y)+a^2 = 0$
    (a) The circle touches both the x- and the y-axes
    (b) The circle touches the y-axis only
    (c) The circle touches the x-axis only
    (d) The circle passes through the point $(a,-a)$
    (e) The circle passes through the origin

10. The equation $2x^2 - 8x + 2y^2 + 26 = 0$ represents
    (a) a circle
    (b) a point
    (c) no graph
    (d) a straight line
    (e) a parabola

11. The equation $x^2 - 8x + y^2 + 10y = -41$ represents