

The abbreviation "NOTA" means "None of These Answers."

- For  $x > 2$ ,  $f(x) = \sqrt{x-2}$  and  $f(g(x)) = 2x$ . Give the value of  $g(3)$ .  
A. 146      B. 142      C. 38      D. 34      E. NOTA
- For  $f(x) = x^x$ , give the value of  $f(3) \cdot f(9)$ .  
A.  $3^{54}$       B.  $3^{21}$       C.  $3^{259}$       D.  $27^{27}$       E. NOTA
- If  $r(x) = \sqrt{42 - \sqrt{42 - \sqrt{42 - \dots}}}$  then give the value of  $\sqrt{r(x) - \sqrt{r(x) - \sqrt{r(x) - \dots}}}$ .  
A. 2      B. 3      C.  $\sqrt{6}$       D.  $\sqrt{7}$       E. NOTA
- A function  $g(x)$  has domain all real numbers, and range  $[-1, 4]$ . If  $g(2) = -1$  and  $g(3) = 4$ , give the range of the function  $g(|x-1|)$ .  
A.  $[-2, 3]$       B.  $[0, 3]$       C.  $[0, 5]$       D.  $[-1, 4]$       E. NOTA
- For  $a(x) = |x-1|$  and  $b(x) = |3x+4|$  then for  $0 < x < 1$  which is equivalent to  $a(x) + b(x)$ ?  
A.  $2x+5$       B.  $4x+3$       C.  $4x+5$       D.  $12x$       E. NOTA
- Every point on the graph of  $f(x) = \frac{1}{8}x^2$  is an equal distance from the point  $(0, A)$  and the line  $y = B$ , all in the same plane as  $f$ . Give the value of  $A - B$ .  
A. 0      B. 4      C. 8      D. 16      E. NOTA
- The graph of  $f(x)$  and its inverse function  $g(x)$  both have domains  $\mathbb{R}$ . The graphs of  $f$  and  $g$  meet twice. Both intersection points lie on which line?  
A.  $y=0$       B.  $x=0$       C.  $y=x$       D.  $y=-x$       E. NOTA

8. Which is NOT a function?

- A.  $\{(1,1), (2,2), (3,3)\}$       B.  $\{(1,2), (2,2), (4,-1)\}$       C.  $\{(1,2), (4,-1), (1,3)\}$   
 D.  $\{(0,0), (1, \sqrt{3})\}$       E. NOTA

9. The function  $f(x) = 7 + x$  has a value  $f(k)$  which is inversely proportional to  $k$ , with a constant of proportionality 8. Give the positive value of  $k$ .

- A. 1      B. 4      C. 7      D. 8      E. NOTA

10. Which is not a function?

- A.  $y = -x^2$       B.  $y = |x| - 1$       C.  $y = \frac{2}{x}$       D.  $y^2 = \frac{x}{4}$       E. NOTA

11. For  $f(x) = \frac{x}{2} - \frac{x}{4} + \frac{x}{8} - \dots$        $f(a) = 1$  when  $a =$

- A. 1      B. 2      C. 3      D. 4      E. NOTA

12. Let  $s(x)$  give the slope of the line through the points  $(3, 5)$  and  $(x, 4)$ .  
 For what value of  $x$  is  $s(x)$  undefined?

- A. 0      B. 3      C. 4      D. 5      E. NOTA

13. The graph of  $f(x) = \sqrt{4 - x^2}$  shares a maximum point with the graph of  $g(x) = ax^2 + b$ , and also shares both of its  $x$ -intercepts. Give the value of  $\frac{a}{b}$ .

- A. -2      B. -1      C.  $-\frac{1}{4}$       D. 2      E. NOTA

14. For  $i = \sqrt{-1}$ ,  $f(x) = |x + xi|$ . Which is equivalent to the value of  $(f(4))^2$ ?

- A. 8      B. 16      C. 32      D. 64      E. NOTA

15. For  $f(x) = \frac{1}{x}$  give the value of  $f(2.5)$ .

- A.  $-\frac{5}{2}$       B. 0.4      C. 5.2      D. 4      E. NOTA

16. Let  $S(x)$  be the area of a sector with degree measure  $x$ , in a circle of radius  $x$ . If  $S(k) = \pi$  then which is the value of  $k$ ?
- A. 360      B. 120      C.  $2\sqrt[3]{45}$       D.  $6\sqrt{10}$       E. NOTA
17. Let  $A(x)$  be the area of a rhombus RSTU with  $RS=12$ , and  $m\angle R = x^\circ$ , for  $0 < x < 180$ . If  $M$  is the maximum value of the function  $A(x)$  and  $A(k) = M$  for some value of  $k$  in the domain of  $A$  then give the value of  $A\left(\frac{k}{2}\right)$ .
- A.  $72\sqrt{2}$       B. 72      C.  $36\sqrt{2}$       D. 36      E. NOTA
18. The function  $p(x)$  gives the greatest prime less than  $x$ . The range of  $p$  is positive prime numbers. Give the least value of  $x$  so that  $p(p(x) - 2)$  is the smallest value in the range of  $p$ .
- A. 7      B. 6      C. 5      D. 4      E. NOTA
19. A 20% saline solution contains 40 liters of solution, which is only salt (20%) and water. Let  $w(x)$  be the amount of pure water that must be added to the solution (original 40 L) so that it is  $x\%$  salt, for  $0 < x \leq 20$  liters. Give the value of  $w(10) - w(5)$ .
- A. 80      B. 40      C. -40      D. -80      E. NOTA
20. The graph of  $f(x) = \sqrt{36 - 4x^2}$  intersects the line  $y = x + c$  once when  $c = 0$ . Find the least value of  $c$  so that the two graphs intersect twice.
- A. 6      B. 4      C. 3      D. 2      E. NOTA
21.  $f(g(x)) = g(f(x)) = x$  for all values of  $x$  in the domain and range of both functions. If  $f(x) = \frac{x-1}{x+3}$  then what is the value of  $g(2)$ ?
- A. -7      B.  $\frac{1}{7}$       C.  $\frac{1}{5}$       D. 5      E. NOTA
22. The zeroes of  $f(x) = (x+3)(x^2 - 4)$  are  $a, b$  and  $c$  for  $a < b < c$ . Give the value of  $b + c$ .
- A. -3      B. -2      C. 0      D. 1      E. NOTA

23.  $f(x) = x + a(x+1) + b(x+2)$  for  $a$  and  $b$  real constants. If  $f(1) = 7$  and  $f(0) = 2$  then find  $f(-1)$ .
- A. -5      B. -2      C. 2      D. -3      E. NOTA
24. If  $a(x)$  gives the  $x^{\text{th}}$  term of an arithmetic sequence with first term 3 and second term  $(x-10)$  then give the value of  $a(4)$ . ( $x > 1$ )
- A. 12      B. 3      C. -15      D. -24      E. NOTA
25. For  $i = \sqrt{-1}$ ,  $f(x) = (1+i)^x$ . If  $f(4) + f(5) = a + bi$ , then  $b - a =$
- A. -12      B. -8      C. 4      D. 12      E. NOTA
26.  $f(x) = \log(x-1)$  and  $g(x) = \log(2x)$ . For  $x > 1$  give the value of  $x$  such that  $f(x) + 1 = g(x)$ , what is the value of  $16x$  ?
- A. 20      B. 12      C. 8      D. 4      E. NOTA
27. For  $b \geq 2$ ,  $f(a,b)$  gives the coefficient of the middle term of  $(1+a)^b$ , if  $b$  is even, and the coefficient of the  $b^{\text{th}}$  term if  $b$  is odd. Find the value of  $f(x, f(x,4))$ .
- A. 4      B. 6      C. 10      D. 20      E. NOTA
28.  $f(1) = 1$  and  $f(2) = 3$ , and for  $x \geq 3$ ,  $f(x) = \sum_{n=1}^{x-1} f(n)$ . Give the value of  $f(6)$ .
- A. 11      B. 18      C. 32      D. 64      E. NOTA
29. For  $f(x) = 7$ , give the value of  $f(f(f(5)))$ .
- A. 7      B. 21      C. 28      D. 35      E. NOTA
30. The graphs of  $f(x) = x - 6$  and  $g(x) = -2x$  and the line  $y = k$  bound a triangular region with area 147. For the positive value of  $k$ , give the value of  $2(14 - k)$ .
- A. -8      B. -3      C. 8      D. 10      E. NOTA