1. For what value of x is $f(x) = 2$ for $f(x) = 2x - 1$?

A. 3 B. $\frac{3}{2}$ C. 2 D. $\frac{1}{2}$ E. NOTA

2. If $f(g(x)) = g(f(x)) = x$ for all real numbers x, and $f(2) = 5$, and $f(5) = 3$, then give the value of $g(3) + g(f(2))$.

A. 7 B. 5 C. 3 D. 2 E. NOTA

3. If $A(x) = |x - 3|$ then give an expression equal to $A(|x|)$ for all values of x less than -5.

A. $x + 3$ B. $-x + 3$ C. $x - 3$ D. $-x - 3$ E. NOTA

4. If $f(x) = x^2 - 3x - 4$ then for how many integer values of x is $f(x) < 0$?

A. 0 B. 4 C. 6 D. 7 E. NOTA

5. For $f(x) = x^3 - 10x^2 + Ax + B$, A and B are constants. If f has one root at x=2, and $A + B = 9$ then give the value of $f(1)$.

A. 0 B. 1 C. 2 D. 4 E. NOTA

6. For $g(x) = 2x^{\frac{2}{3}}$ if $g(2x) = \sqrt[3]{2^{11}}$ for $x > 0$ then $x =$?

A. 16 B. 8 C. 4 D. 2 E. NOTA

7. For $f(x) = Arc\cot x$ give the value of $f(-\sqrt{3})$.

A. $-\frac{\pi}{3}$ B. $-\frac{\pi}{6}$ C. $\frac{2\pi}{3}$ D. $\frac{5\pi}{3}$ E. NOTA

8. Given the function $f(x) = \sec^2 x - \tan^2 x$, for how many values of x over the domain $[0, \frac{\pi}{2})$ is $f(x) = 0$?

A. none B. one C. two D. infinitely many E. NOTA

9.

f(x)	2	3	8	2	1
g(x)	3	4	6	1	8
x	1	2	3	4	5

Functions *f* and *g* are defined over all real numbers; f is an even function and g is an odd function. Find the value of $f(g(1)) + g(-1) + f(-2)$.

A. 14 B. 8 C. 3 D. 0 E. NOTA

10. Every point of the curve $f(x) = \frac{1}{4}x^2 - \frac{1}{2}x + \frac{9}{4}$ is equidistant from the line $y = 1$ and the point (a, b). Give the value of b.

A. 2 B. 3 C. 4 D. 6 E. NOTA

11. What is the area between the graph of $f(x) = \sqrt{9 - x^2}$ and the x-axis?

A. 9π B. 3π C. $\frac{9}{2}\pi$ D. $\frac{3}{2}\pi$ E. NOTA

12. For the domain [0, 90°), let $A(x)$ be defined as the angle of inclination of the graph of the line $f(x, m) = mx - 1$. What is the value of $A(x)$ for $f(x, \frac{1}{2})$

A. $Arc\tan(0.5)$ B. $Arc\tan(0.5) + 45^\circ$ C. $Arc\tan(2)$ D. $Arc\tan(2) + 45^\circ$ E. NOTA

13. $f(x) = x^3 - 10x^2 + Dx + E$ for D and E integers, and $f(2) = 0$. If two of the roots of f are r_1 and r_2, and neither is equal to 2, then $r_1 + r_2$ =

A. 0 B. 6 C. 8 D. 12 E. NOTA

14. For $f(x) = \tan x$ when $0 < x < \frac{\pi}{2}$, which is a function g that represents $\sin x$ over the same domain, in terms of f ?

A. $g(x) = \frac{1}{1 - (f(x))^2}$ B. $g(x) = \frac{f(x)}{\sqrt{1 + (f(x))^2}}$ C. $g(x) = \frac{-f(x)}{\sqrt{f(x) - 1}}$

D. $g(x) = \sqrt{1 - f(x)}$ E. NOTA

15. How many complex roots does the function $y = 2x^4 - 3x^3 + x^2 + 2x + 1$ have?

A. 0 B. 2 C. 3 D. 4 E. NOTA

16. $f(x) = \cos(x)\sin(\frac{\pi}{2} - x) + \sin(x)\cos(\frac{\pi}{2} - x)$. If $f(K) = A$ for $0 < K < \frac{\pi}{2}$ then give the value of $f(\frac{K}{2})$.

A. $\frac{A}{2}$ B. $\frac{1}{2}A(A-1)$ C. $\frac{\pi}{2} - A$ D. 1 E. NOTA

17. $f(x) = \dfrac{\sin x}{1 - \dfrac{\sin x}{1 - \dfrac{\sin x}{1 - ...}}}$ for $0 < x \le \frac{\pi}{2}$. The least value of x in this interval where $f(x) = \frac{1}{4}$ is $Arc\sin(k)$. What is the value of k ?

A. 1 B. $\frac{1}{4}$ C. $\frac{3}{4}$ D. $\frac{3}{16}$ E. NOTA

18. In a computer game, I have won 4911 games and lost 1274 games. The computer shows my "percent won" as 79% since it rounds to the nearest whole percent. How many consecutive games do I **<u>now</u>** need to play and win (there are no ties allowed) for me to first show 80%.

A. 138 B. 140 C. 184 D. 185 E. NOTA

19. For $f(x) = |\sin x|$, over the domain $\left[\frac{\pi}{2}, 4\pi\right]$, if the solutions to $f(x) = \frac{\sqrt{3}}{2}$ are from least to greatest, $a_1, a_2, ..., a_n$ then give the value of a_3.

A. $\frac{7\pi}{6}$ B. $\frac{4\pi}{3}$ C. $\frac{5\pi}{3}$ D. $\frac{11\pi}{6}$ E. NOTA

20. The lengths in centimeters of the sides of four triangles are

I. 7, 24, 25 II. $6\frac{1}{2},\ 8\frac{1}{2},\ 10\frac{1}{2}$ III. $4,\ 7\frac{1}{2},\ 8\frac{1}{2}$ IV. 14, 48, 50

Of these four given triangles, the only right triangles are …

A. I and II B. I and III C. I, II, and IV D. I, III, and IV E. NOTA

21. For $f(x) = 2(\log x + \log(x+1) + \log(x+3))$, the value of $f(k)$ is equal to $2 + 2\log 3$. Give the value of k.

A. 1 B. 2 C. 3 D. 9 E. NOTA

22. For the domain $[0, \pi]$, the graphs of $y = \sin x$ and $(x-a)^2 + (y-b)^2 = c$ share a maximum y-value, while the latter graph has its minimum value 0. What is the value of $a \bullet b \bullet c$?

A. $\frac{\pi}{2}$ B. $\frac{\pi}{8}$ C. $\frac{\pi}{16}$ D. 0 E. NOTA

23. The radius of a sphere varies directly as the cube root of its volume. What is the constant of proportionality?

A. $\sqrt[3]{\frac{3}{4\pi}}$ B. $\pi\sqrt[3]{\frac{3}{4}}$ C. $\frac{4}{3\pi}$ D. $\frac{4}{3}\pi$ E. NOTA

24. The probability of rain Monday is 0.3 and the odds that it will rain Tuesday are 1:4. What are the odds that it will rain on at least one of these two days?

A. 3:40 B. 11:14 C. 11:25 D. 47:3 E. NOTA

25. The function *P* is defined so that $P(x)$ gives the probability that, given x marbles of which $(x-2)$ are red, and the remaining marbles are blue, a person can randomly choose a marble and get a blue marble. The domain of P is $[5, \infty)$. What is the value of k for which $P(k) = 0.02$?

A. 95 B. 97 C. 98 D. 100 E. NOTA

26. For $f(x) = \frac{1}{x^2 - x}$ and $i = \sqrt{-1}$ then $f\left(\frac{1 - i\sqrt{3}}{2}\right) =$

A. -2 B. -1 C. $1 + i\sqrt{3}$ D. 2 E. NOTA

27. A triangle has two angles which measure 30 and 45 degrees. If the side opposite of the 45 degree angle has length x then the function $A(x)$ gives the area of the triangle, for domain $x > 0$.
Find the value of $A(4)$.

A. $2\sqrt{6}$ B. $2\sqrt{3}+2$ C. 3 D. $\sqrt{3}+1$ E. NOTA

28. The area of a triangle RST is $A(x)$ for $x = \sin(S)$. If the geometric mean (mean proportional) of side lengths RS and ST is $\frac{1}{4}A(k)$, and $A(k) = 48$ then $k =$

A. $\frac{1}{16}$ B. $\frac{1}{4}$ C. $\frac{2}{3}$ D. $\frac{8}{9}$ E. NOTA

29. There is a function f, such that $f(1) = 6$ and $f(4) = 18$. All values of f are positive and $f(1)$, $f(2)$, and $f(3)$ form a geometric sequence, while $f(2)$, $f(3)$, and $f(4)$ form an arithmetic sequence. Give the product of $f(2)$ and $f(3)$.

A. 12 B. 24 C. 108 D. 121.5 E. NOTA

30. The function $B(x)$ is the base ten representation of the number $221_{(base\ x)}$ for $x \geq 3$. Give the value of $5k-5$ for $B(k) = 265$.

A. 10 B. 12 C. 15 D. 50 E. NOTA