*The abbreviation NOTA denotes None Of The Above answers are correct. Good luck and have fun!*

1. If , which of the following is always equal to ?

**(A)**  **(B)**  **(C)**  **(D)**  **(E)** NOTA

2. If , then  ?

**(A)**  **(B)**  **(C)** 2011 **(D)** 2012 **(E)** NOTA

3. Points *M* and *I* are on a circle so that  is the perpendicular bisector of chord . The point of intersection of  and  is *H*. If  and , then what is the radius of the circle?

**(A) **  **(B)** 13 **(C)** 25 **(D)** 26 **(E)** NOTA

4. What is the maximum value of the function ?

**(A) **  **(B)** 1 **(C)** 0 **(D)** –1 **(E)** NOTA

5. If *x* is real and , then  ?

**(A)** 21 **(B)** 42 **(C)** 84 **(D)** No solution **(E)** NOTA

6. Equilateral triangle *PHU* has centroid *S*. If a point is randomly chosen inside of *PHU*, what is the probability it lies in triangle *PSU*?

**(A)**  **(B)**  **(C)**  **(D)**  **(E)** NOTA

7. If  and , then what is the domain of ?

**(A)**  **(B)**  **(C)**  **(D)**  **(E)** NOTA

8. Let , where  and  are integers. If  has six distinct integer roots, compute.

**(A)** 0 **(B)** 3 **(C)** 18 **(D)** 81 **(E)** NOTA

9. How many of the following functions are even?

I.  II.  III.  IV. 

**(A)** none **(B)** one **(C)** two **(D)** three **(E)** NOTA

10. Determine the number of distinct ordered pairs of real numbers (*a, b*) such that , where .

**(A)** 6 **(B)** 7 **(C)** 8 **(D)** 9 **(E)** NOTA

11. If , then what is ?

**(A)** 3 **(B)** –1 **(C)** 5 **(D)** 7 **(E)** NOTA

12. What is the point of intersection of the asymptotes of the graph of the parametric equations  and?

**(A)** (2, –2) **(B)** (–2, 2) **(C)** (1, –1) **(D)** (–1, 1) **(E)** NOTA

13. How many solutions are there to the equationon the interval?

**(A)** 1007 **(B)** 2014 **(C)** 4028 **(D)** 8036 **(E)** NOTA

14. Order from least to greatest: .

**(A)**  **(B) ** **(C)**  **(D) **  **(E)** NOTA

15. We say that  and  are *different* if there exists at least one *a* in their domains such that . Let  be a *special* function if . How many *special* surjective (onto) functions are *different*?

**(A)** 24 **(B)** 30 **(C)** 36 **(D)** 39 **(E)** NOTA

16. What is the area of the triangle with vertices (1, 2, 2), (2, 2, 1), and (2, 1, 2)?

**(A)**  **(B)** 1 **(C)**  **(D)**  **(E)** NOTA

17. Let  where . If , then *a* =?

**(A)** 2 **(B)** 3 **(C)** 30 **(D)** 36 **(E)** NOTA

18. Compute the area of the smallest circle that touches both branches of the hyperbola .

**(A)**  **(B)** **(C)**  **(D)**  **(E)** NOTA

19. Use the following system to find :



**(A)** 15 **(B)** 11 **(C)** 0 **(D)** –6 **(E)** NOTA

20. Compute .

**(A)** 2 **(B)** 3 **(C)** 6 **(D)** 7 **(E)** NOTA

21. Find an *n* such that the constant in the expansion of  is 15.

**(A)** 6 **(B)** 9 **(C)** 15 **(D)** 25 **(E)** NOTA

22. Let *a* and *b* be randomly chosen relatively prime positive integers. What is the probability that *b* divides ?

**(A)** 1 **(B)**  **(C) ** **(D)** 0 **(E)** NOTA

23. A sequence of positive integers,, is defined recursively as and for  and some constant positive integer *k.* If is a perfect square, then compute the value of .

**(A)** 4 **(B)** 13 **(C)** 40 **(D)** 121 **(E)** NOTA

24. If , , and , then find .

**(A)**  **(B)**  **(C) ** **(D)** **(E)** NOTA

25. Compute 

**(A)** 0 **(B)** 1 **(C)** **(D)**  **(E)** NOTA

26. In the polar plane, what is the maximum number of times two graphs of the form and can intersect?

**(A)** 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** NOTA

27. Which of the following is the same resultant vector as ?

(Hint: )

**(A)**  **(B)**  **(C)**  **(D)**  **(E)** NOTA

28. What is the value of  where  ranges over all primes?

**(A)**  **(B)**  **(C)**  **(D) **  **(E)** NOTA

29. Benji saw the following question on a math test at school:

*If  are all positive integers, is  an even integer?*

He thought at least one of the following two pieces of information was necessary to answer the question:

(1)  *is an even integer*

(2)  *is an odd integer*

Which of the following is true regarding these additional pieces of information?

**(A)** Statement (1) BY ITSELF is sufficient to answer the question, but statement (2) by itself is not.

**(B)** Statement (2) BY ITSELF is sufficient to answer the question, but statement (1) by itself is not.

**(C)** Statements (1) and (2) TAKEN TOGETHER are sufficient to answer the question, even though NEITHER statement BY ITSELF is sufficient.

**(D)** EITHER statement BY ITSELF is sufficient to answer the question.

**(E)** NOTA (Taken together, the statements are not enough to answer the question.)

30. What must be the value of *k* so that the rank of the matrix is not 4?



**(A)** 2 **(B)** 0 **(C)** 1 **(D)** 4 **(E)** NOTA