

Note: In all questions, NOTA stands for "None of the Above."

1. What is the equation of the directrix

of the parabola  $y^2 + 4y + 8x + 28 = 0$  ?

- A.  $x = -1$       B.  $y = 0$       C.  $x = 1$   
D.  $x = 3$       E. NOTA

2. The geometric mean of two positive integers is 10. Which of the following could not be their sum?

- A. 25      B. 29      C. 50  
D. 101      E. NOTA

3. Let  $f(x) = x^2 + 3$ ,  $g(x) = 4 - x^3$ ,  $h(x) = 2x$   
Evaluate  $h(f(g(0)))$ .

- A. 0    B. 38    C. 39    D. 40    E. NOTA

4. Let  $f(x) = x^2 - 12x + 7$ . What is the slope of the line containing the points  $(-3, f(-3))$  and  $(4, f(4))$ ?

- A.  $-5/7$       B.  $-7/5$       C. 5  
D. 11      E. NOTA

5. Let  $Ax + By = C$  and  $Dx + Ey = F$  be the equations of 2 distinct lines. If the 2 lines are parallel, which of the following must be true?

- I.  $A = D$       II.  $B = E$       III.  $C \neq F$

- A. I only      B. I, II only      C. III only  
D. I, II, III      E. NOTA

6. The graphs of  $f(x) = \log_3(x)$  and  $g(x) = \log_7(x)$  intersect at a single point,  $(a, b)$ . What is  $b/a$ ?

- A. 0      B. 1      C. 3  
D. 7      E. NOTA

7. Let  $r$  be the line which passes through the points  $(-2, -4)$  and  $(4, 14)$ . Let  $s$  be the line which passes through the point  $(1, -1)$  and has slope  $m = -5$ . The lines  $r$  and  $s$  intersect at the point

- A.  $(5/16, 1/16)$       B.  $(35/16, -1/16)$   
C.  $(1/16, 35/16)$       D.  $(-1/16, 35/16)$   
E. NOTA

8. What is the area bounded by the graphs of  $y = |x|$  and  $y = -|3x| + 8$ ?

- A. 4    B. 8    C. 14    D. 16    E. NOTA

9. Evaluate:  $\begin{vmatrix} 3 & 4 & 0 \\ 2 & 8 & -5 \\ 1 & 0 & 9 \end{vmatrix} - \begin{vmatrix} 2 & 4 \\ 1 & 2 \end{vmatrix}$ .

A. 104      B. 124      C. 144  
D. 164      E. NOTA

10. Let  $x=4+\sqrt{3}$  be a zero of the polynomial function

$$f(x) = x^2 + ax + b.$$

Then  $a+b =$

- A. 2    B. 3    C. 4    D. 5    E. NOTA

11. Solve for  $x$  to the nearest

$$\text{thousandth: } 5^x = 13$$

- A. 0.627      B. 0.628      C. 1.593  
D. 1.594      E. NOTA

12. Let  $f(x) = \sqrt{x^2 + 1}$ . The domain of  $f(x)$  is the set of all real numbers, what is its range?

- A.  $(-\infty, \infty)$       B.  $(-\infty, 0]$   
C.  $[0, \infty)$       D.  $[1, \infty)$   
E. NOTA

13. Let  $z$  be a complex number such that  $z$  is a solution of the equation

$$x^3 - 1 = 0. \text{ Assume that } z \neq 1. \text{ Then which of the following must be true?}$$

I.  $z$  is a solution of the equation

$$x^2 + x + 1 = 0$$

II.  $\bar{z}$ , the complex conjugate of  $z$ , is a

solution to the equation  $x^2 + x + 1 = 0$

III.  $z^2$  is a real number

- A. I only      B. I, II only  
C. I, III only      D. I, I, III  
E. NOTA

14. The two roots of

$$f(x) = 3x^2 - 2x + 1$$

are  $a+bi$  and  $c+di$ . What is the distance between the points  $(a,b)$  and  $(c,d)$ ?

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

15. The function  $g(x) = 3x^2 + x^3 - x^7$  has

no negative real roots. How many non-real roots does it have?

- A. 3    B. 4    C. 5    D. 6    E. NOTA

16. Which of the following describes the 4 roots of the function

$$f(x) = x^4 - 2x^3 + 7x - 4$$

- A. 4 irrational  
 B. 2 irrational and 2 rational  
 C. 2 irrational real roots and 2 non-real  
 D. 2 rational and 2 non-real  
 E. NOTA

17. Which of the following functions passes through the origin?

- A.  $y = 2e^{-x} + 1$       B.  $y = 2e^{-2x} - 1$   
 C.  $y = e^{2x} - 2$       D.  $y = e^{2x} - 1$   
 E. NOTA

18. The two circles

$$(x+5)^2 + y^2 = 36$$

$$\text{and } (x+2)^2 + y^2 = 9$$

- A. do not intersect.  
 B. intersect at exactly 1 point.  
 C. intersect at exactly 2 points.  
 D. Not enough information is given.  
 E. NOTA

19. What is the sum of the 2 real solutions of the equation

$$e^{x+4} + e^0 - e^{3x^2} = 1 ?$$

- A.  $-1/3$       B.  $-1/4$       C. 0  
 D.  $1/4$       E. NOTA

20. If you roll 3 dice, what is the probability that the total will be 5? Assume that you are using standard, 6-sided dice, and that all die are fair (that is, each face has an equal probability of coming up).

- A.  $1/108$       B.  $1/36$       C.  $1/52$   
 D.  $5/32$       E. NOTA

21. Let  $a > 1$  be a fixed, positive real number. Then what is the sum of

$$\frac{1}{a} + \frac{1}{a^2} + \frac{1}{a^4} + \frac{1}{a^6} + \dots$$

- A.  $\frac{a}{a^2-1}$       B.  $\frac{1}{a-1}$   
 C.  $\frac{a^2+a-1}{a^3-a}$       D.  $\frac{1}{a^2-1}$       E. NOTA

22. Simplify:  $\frac{4+i}{-6+4i}$

- A.  $\frac{-10-11i}{26}$       B.  $\frac{-10+11i}{26}$   
 C.  $\frac{-14-11i}{26}$       D.  $\frac{-14+11i}{26}$

- E. NOTA

23. A given nondegenerate conic has eccentricity  $e=1.38$ . Which of the following must be true?

- A. The conic is an ellipse  
 B. The conic is a hyperbola  
 C. Eccentricity cannot be greater than 1  
 D. The type of conic cannot be determined solely by the eccentricity  
 E. NOTA

24. Let  $f(x)=9x^7+3x^5-6$ . Which of the following is not a possible root of  $f(x)$ ?

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

25. Consider the following system of equations:  $ax+by+cz=d$ ,  $ex+fy+gz=h$ , and  $ix+jy+kz=m$ , where  $a,b,c,d,e,f,g,h,i,j,k$  and  $m$  are all

constants. Let  $Q = \begin{vmatrix} a & b & c \\ e & f & g \\ i & j & k \end{vmatrix} \neq 0$ .

Then  $y =$

- A.  $Q \begin{vmatrix} a & b & d \\ e & f & h \\ i & j & m \end{vmatrix}$             B.  $Q \begin{vmatrix} a & d & c \\ e & h & g \\ i & m & k \end{vmatrix}$   
C.  $\frac{\begin{vmatrix} a & b & d \\ e & f & h \\ i & j & m \end{vmatrix}}{Q}$             D.  $\frac{\begin{vmatrix} a & d & c \\ e & h & g \\ i & m & k \end{vmatrix}}{Q}$

E. NOTA

26. Thirty people walk by a donation box. Each person drops money in the box, and each person gives \$12 more than the previous person. The last person gives a \$400 donation. How much money is in the box after all 30 people have donated (assume the box was initially empty)?

- A. \$6770            B. \$6780            C. \$6790  
D. \$6800            E. NOTA

27. Which of the following is a solution

of the equation  $\begin{vmatrix} 6-x & -3 \\ 1 & 2-x \end{vmatrix} = 0$  ?

- A. 0    B. 1    C. 2    D. 3    E. NOTA

28. What is the radius of the circle

$x^2 + y^2 + 6x - 4y = 563$  (to the nearest tenth)?

- A. 23.7            B. 24.0  
C. 24.1            D. 25.2            E. NOTA

29. Let  $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ . Then

$$A^{58} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

for some real integers  $a,b,c$  and  $d$ .

What is  $a+b+c+d$ ?

- A. 58            B. 59            C. 6084  
D. 732489            E. NOTA

30. If  $A,B,C$  are all non-zero,  $n$  by  $n$  matrices, which of the following are true?

- I.  $(AB)C=A(BC)$   
II.  $A(B+C)=AB+AC$   
III.  $AB=BA$

- A. I, II only    B. II,III only    C. I only  
D. I,II,III    E. NOTA