2002 National Mu Alpha Theta Convention
Alpha Level---LOGARITHMS AND EXPONENTS TOPIC TEST

1. When $(x^{-1} - y^{-1})^{-1}$ is simplified to remove negative exponents, the result is:

    a. xy   b. $\dfrac{1}{x-y}$ c. $\dfrac{y-x}{xy}$ d. $\dfrac{xy}{y-x}$ e. NOTA

2. If $\log_2 x + \log_2(x+2) = 3$, then $x = $ ____ .
    a. 3   b. 2   c. –3   d. 0.5   e. NOTA

3. If for a certain base b, $\log_b 2 = .4307$ and $\log_b 10 = 1.4307$, then $\log_b 250 = $ ____ .
    a. 3.4307   b. 2.7430   c. 25.0745   d. 23.1377   e. NOTA

4. Solve for x. $x^{\frac{1}{6}} + 8^{\frac{1}{6}} = \dfrac{7}{3-\sqrt{2}}$.

    a. 7390   b. 3   c. 729   d. .005   e. NOTA

5. If $n = x - y^{(x-y)}$, find n when $x=2$ and $y = -2$.
    a. 256   b. –14   c. 18   d. 1   e. NOTA

6. Solve for x. $\log_4 8 + \log_8 4 + \log_2 8 = \log_2 x$.

    a. $32\sqrt[6]{2}$ b. $\dfrac{31}{6}$ c. $\dfrac{11}{2}$ d. $64\sqrt[8]{2}$ e. NOTA

7. Solve for x: $\log(x+1) = 2 + \log(3x+1)$

    a. no solution   b. 1/3   c. 101/299   d. –99/299   e. NOTA

8. Solve for x: $e^{3x} - 3e^{2x} + 4e^x - 4 = 0$

    a. ln 2   b. 2   c. ln 3   d. no real solution   d. NOTA

9. For the following system of equations, find $x + y + z$.

$$\begin{cases} 27^{2x} = 3^{2x-4} \\ \left(\dfrac{1}{3}\right)^y = \left(\dfrac{1}{27}\right)^{-1} \\ \log z + \log 2 = 1 \end{cases}$$

    a. 3   b. 7   c. 4   d. 1   e. NOTA

10. Simplify: $\left[\left(8a^6\right)^{\frac{-1}{3}} \cdot \dfrac{1}{\left(a^{-2}\right)^{\frac{1}{2}}} \right]^{-1}$

    a. a/2   b. 2a   c. 2/a   d. a/8   e. NOTA

11. If $\log_b(3^b) = \dfrac{b}{2}$, then $b = $ ____.

    a. 9   b. 6   c. 1.5   d. 4.5   e. NOTA

12. If $9^x + 9^{-x} = 34$, then the positive value for $3^x - 3^{-x} = $ ___ .

    a. 16   b. $4\sqrt{2}$ c. $\sqrt{34}$ d. 6   e. NOTA

13. Solve for all x such that $\log\left(x^{\log x^2}\right) = 18$

    a. $\pm \dfrac{10^9}{\sqrt{2}}$ b. 1,000,000   c. ± 1000 d. $10^{\pm 3}$ e. NOTA

14. Find the sum of all x satisfying the following equation: $\left(4^x\right)^{-x} = 2^{1-3x}$

    a. ½   b. 1   c. −1/2   d. 0   e. NOTA

15. The cube of the maximum value of the function $f(x) = 3^{(-x^2 - \frac{1}{2})}$

     a. $\dfrac{\sqrt{3}}{9}$ b. $\dfrac{1}{\sqrt{3}}$ c. 0   d. $\dfrac{1}{729}$ e. NOTA

16. Find the y-coordinate in the solution of the system:

$$\begin{Bmatrix} y = 5^{2x} - 3 \\ y = 5^x + 9 \end{Bmatrix}$$

     a. 21   b. 4   c. 12   d. 13   e. NOTA

17. Solve for x: $5 \bullet \ln\left[\dfrac{e}{\sqrt[5]{5}}\right] = 3 - \ln x$

     a. $\dfrac{5}{e^2}$ b. $\sqrt[5]{e^5} + 15$ c. $\dfrac{\sqrt[5]{3}}{15}$ d. $e^{\frac{1}{5}}$ e. NOTA

18. If $\dfrac{4^{x-1} - 4^x}{24} = -1$, find $(2x)^{2x}$.

     a. 747.8   b. 8.806   c. 2.5   d. 3125   e. NOTA

19. Simplify: $\dfrac{\left(1 + x^{-1}\right)\left(x - x^{-1}\right)^{-1}}{\left(1 - x^{-1}\right)^{-2}}$.

     a. $\dfrac{x-1}{x}$ b. $\dfrac{x^2 - 1}{x}$ c. $\dfrac{x-1}{x^2}$ d. $\dfrac{x+1}{x}$ e. NOTA

20. Which of the following does not equal the other three?

     a. $2 \ln (r)$ b. $\ln (r^2)$ c. $8 \ln (\sqrt{r})$ d. $16 \ln \sqrt[8]{r}$ e. NOTA

21. Solve for x: $3 \log 3 - \dfrac{1}{2} \log 3 = \log \sqrt{x}$

     a. 6561   b. 243   c. $5 \log (3)$ d. 15   e. NOTA

22. Find all x such that $\log(x) + \log(x-15) = 2$

    a. $-5, 20$ b. $\dfrac{15 \pm \sqrt{233}}{2}$ c. 20 d. 8.5 e. NOTA

23. Which of the following does not equal $(\ln 15)$?

    a. $(\ln 5)(\ln 3)$ b. $\ln 5 + \ln 3$ c. $2 \ln \sqrt{15}$ d. $\ln 45 - \ln 3$ e. NOTA

24. How long does it take $700 to triple if it is invested at 7% interest compounded quarterly? Round answer to the nearest tenth of a year.

    a. 13.5 years   b. 15.8 years   c. 14.9 years   d. 109.0 years   e. NOTA

25. In 1971, the population of a country was estimated at 5 million. For any subsequent year, the population , P(t) in millions, can be modeled using the equation:
$$P(t) = \frac{250}{5 + 44.99e^{-0.0208t}},$$ where t is the number of years since 1971. Determine the year below which is closest to when the population will be 37 million.

    a. 1989   b. 2312   c. 2002   d. 2287   e. 2127

  TIEBREAKER:
WORK in WHITE PORTION ON BACK OF SCANTRON SHEET

A thermometer is taken from a room at 68 degrees F to the outdoors where the temperature is 15 degrees F. Determine (to the nearest degree) what the reading on the thermometer will be after five minutes if the reading drops to 52 degrees F after 1 minute.

Alpha Division---LOGARITHMS AND EXPONENTS TOPIC TEST
ANSWER KEY

1. d
2. b
3. a
4. c
5. b
6. a
7. d
8. a
9. d
10. b
11. a
12. b
13. d
14. e
15. a
16. d
17. a
18. d
19. c
20. c
21. b
22. c
23. a
24. b
25. e

TIEBREAKER: 24 degrees F