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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Change the exponential expression to an equivalent expression involving a logarithm.

- 1) $11^x = 121$ 1) D
 A) $\log_x 121 = 11$ B) $\log_{121} x = 11$ C) $\log_{121} 11 = x$ D) $\log_{11} 121 = x$

Change the logarithmic expression to an equivalent expression involving an exponent.

- 2) $\log_b 49 = \frac{2}{3}$ 2) B
 A) $\left(\frac{2}{3}\right)^b = 49$ B) $b^{2/3} = 49$ C) $49^{2/3} = b$ D) $b^{3/2} = 49$

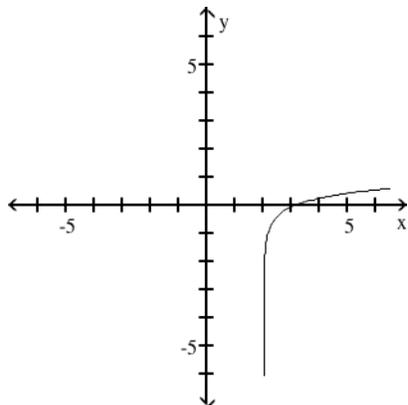
- 3) $\ln \frac{1}{e^5} = -5$ 3) D
 A) $-5e = \frac{1}{e^5}$ B) $e^{-5} = \frac{1}{e^5}$ C) $\left(\frac{1}{e^5}\right)^e = -5$ D) $\left(\frac{1}{e^5}\right)^{-5} = e$

Find the exact value of the logarithmic expression.

- 4) $\log_4 \frac{1}{64}$ 4) A
 A) -3 B) $\frac{1}{3}$ C) 3 D) $-\frac{1}{3}$

The graph of a logarithmic function is shown. Select the function which matches the graph.

- 5) 5) D



- A) $y = \log x - 2$ B) $y = 2 - \log x$ C) $y = \log(2 - x)$ D) $y = \log(x - 2)$

Solve the equation.

- 6) $\log_{30} (x^2 - x) = 1$ 6) B
 A) {1, 30} B) {-5, 6} C) {5, 6} D) {-5, -6}

Write as the sum and/or difference of logarithms. Express powers as factors.

7) $\log_{13} \frac{6\sqrt{r}}{s}$

7) B

A) $\log_{13} 6 \cdot \frac{1}{2} \log_{13} m \div \log_{13} s$

B) $\log_{13} 6 + \frac{1}{2} \log_{13} r - \log_{13} s$

C) $\log_{13} (6\sqrt{r}) - \log_{13} s$

D) $\log_{13} s - \log_{13} 6 - \frac{1}{2} \log_{13} r$

Use the properties of logarithms to find the exact value of the expression. Do not use a calculator.

8) $\ln e^{\sqrt{10}}$

8) C

A) 100

B) 10

C) $\sqrt{10}$

D) e

Write as the sum and/or difference of logarithms. Express powers as factors.

9) $\log_5 \frac{\sqrt[8]{p} \sqrt[7]{q}}{t^2}$

9) C

A) $\frac{1}{8} \log_5 p \cdot \frac{1}{7} \log_5 q \div 2 \log_5 t$

B) $\frac{8}{5} \log_5 p + \frac{7}{5} \log_5 q - \frac{2}{5} \log_5 t$

C) $\frac{1}{8} \log_5 p + \frac{1}{7} \log_5 q - 2 \log_5 t$

D) $8 \log_5 p + 7 \log_5 q - 2 \log_5 t$

10) $\ln \left(\frac{(x+1)(x-8)}{(x-4)^3} \right)^{5/2}, \quad x > 8$

10) B

A) $5 \ln(x+1) - 2 \ln(x-8) - \frac{15}{2} \ln(x-4)$

B) $\frac{5}{2} \ln(x^2 + 9x - 8) - \frac{15}{2} \ln(x-4)$

C) $\frac{5}{2} \ln(x+1) + \frac{5}{2} \ln(x-8) - \frac{15}{2} \ln(x-4)$

D) $\ln(x+1) + \ln(x-8) + \ln 5 - 15 \ln(x-4) - \ln 2$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Express as a single logarithm.

11) $3 \log_6 x + 5 \log_6 (x-6)$

$\text{Log}_6 (x^3(x-6)^5)$
(The 3 & 5 are exponents) 11) _____

Solve the equation.

12) $\log_5 (x+4) = 2$

12) X=21

13) $4(1+2x) = 64$

13) X = $\frac{15}{2}$

Solve the problem.

14) The formula $A = 294e^{0.026t}$ models the population of a particular city, in thousands, t years after 1998. When will the population of the city reach 423 thousand?

14) 2012