STUDENTS – Here is an assortment of problems from old tests. These problems cover most of the topics which might be on your test. At least these problems can give you some idea of the level of sophistication you may expect on the test.

1 // A sky diver jumps from a reasonable height above the ground. The air resistance she experiences is proportional to her velocity, and the constant of proportionality is 0.25. It can be shown that the downward velocity of the skydiver at time \( t \) is given by

\[
v(t) = 90 \left(1 - e^{-0.25t}\right)
\]

where \( t \) is measured in seconds and \( v(t) \) is measured in feet per second.

(a) Find the initial velocity of the sky diver.
(b) Find her velocity after 8 seconds.

#2 // Basic Properties of Logarithms.
(a) Express in logarithmic form:

\[2^3 = 8\]

(b) Express in exponential form:

\[\log_2 4 = \frac{2}{3}\]

(c) Evaluate without using your calculator

\[\log_x \sqrt{2}\]

(d) Solve for \( x \)

\[\log_x 8 = \frac{3}{2}\]

#3 // Solve this exponential equation for \( x \). Write your answer as a solution set.

\[e^{2x} - e^x - 6 = 0\]

#4// EARTHQUAKE – Earthquake X has a magnitude of 8.3 on the Richter Scale, and it is 250 times more intense than Earthquake Y. Using the formula

\[M = \log \left(\frac{I}{S}\right)\]

where \( M \) is the Richter magnitude, \( I \) is the intensity, and \( S \) is the “Standard,” calculate the magnitude of Earthquake Y. Report your answer first to 9 decimal places, then give your final answer in a sentence with the magnitude approximated to 1 decimal place.

#5// Find the equations of (A) the vertical asymptote and (B) the slant asymptote.

\[r(x) = \frac{x^2 + 3x - 1}{x + 1}\]
#6// The population of a certain species of fish in Lake Jones is modeled by the function
\[ n(t) = 14.35e^{0.014t} \]
where \( t \) is measured in years, and \( n(t) \) is the fish population measured in millions of fish at time \( t \).

(a). What is the relative rate of growth of the fish population? Express your answer as a percentage.
(b). What is the initial population of this fish species in Lake Jones?
(c). What will the fish population in Lake Jones be in 10 (ten) years?

[[ Notes:
(1) In parts (a) and (b) give exact answers – there is no need to use a calculator.
(2) In part (c), use your calculator and give the complete calculator answer. There is no work to show in this part either!
(3) In all three parts, give your final answers as sentences.]]

#7// (A) Find the x and y intercepts and any horizontal or vertical asymptotes. Do not graph. Show work.
\[ f(x) = \frac{x + 2}{(x-1)(x+3)} \]
(B) Find the slant asymptote and the vertical asymptote. Do not graph. Show work.
\[ f(x) = \frac{2x^2 + 7x + 2}{x + 2} \]

#8// Do two of these problems (A, B, C). Circle the LETTER of each problem you select.
(A) Express each equation in exponential form.
(1). \( \log_3 81 = 4 \)  
(2). \( \log_4 16 = \frac{2}{3} \)
(B) Express each equation in logarithmic form.
(1). \( 4^{\frac{3}{2}} = \frac{1}{8} \)  
(2). \( 3^5 = 243 \)
In each of the following, use the definition of the logarithmic function to find \( x \).
(1). \( \log_x 6 = \frac{1}{2} \)  
(2). \( \log_x 3 = \frac{1}{3} \)
The number of tribbles in the Starship Enterprise is modeled by the function

\[ n(t) = 12e^{0.255t} \]

where \( t \) is measured in weeks and \( n(t) \) is measured in millions of tribbles.

**Answer each part with a sentence or sentences.**

(A). What is the relative rate of growth of the tribble population? Express your answer as a percentage.

(B). What will the tribble population be after 6 weeks? Give the "complete calculator answer" and also give the answer rounded off to the nearest million.

(C). After how many weeks will the number of tribbles reach 100 million? Give the exact answer (analytical answer), the "complete calculator answer" and also the answer rounded off to the nearest week.

**#10//** Solve the logarithmic equation for \( x \). \( \log_3(5x + 2) = 1 \).

**#11//** Solve the system.

\[ \begin{cases} -x + y = 2 \\ 4x - 3y = -3 \end{cases} \]

**#12//** Solve the system.

\[ \begin{cases} x + 2y + z = 7 \\ -y + 3z = 9 \\ 2z = 6 \end{cases} \]

**#13//** Solve the system.

\[ \begin{cases} x^2 + y^2 = 16 \\ x - y = 2 \end{cases} \]