INSTRUCTIONS: Your Test is 75 min long. There are 12 problems plus one bonus on the test. Each problem counts 8 points, except the four problems which are marked as 9 points. The bonus counts 5 points.

Do all your work and put your answers on the “work sheets” that I am passing out. Box your final answer to each problem. Draw a horizontal line at the end of each problem. Do not do more than four problems per page. Write on one side only.

You must show your work. “Solve” means “Solution Set.” Word problem requires sentence answers.

1) Find the equation of the slant asymptote: \[ r(x) = \frac{x^2 + 8x - 5}{x - 2} \]

2) [9 pts] (Sentence Answers) A skydiver jumps. Her downward velocity is modeled by the equation \[ v(t) = 85 \left(1 - e^{-0.22t}\right) \]
where \( t \) is time measured in seconds and \( v \) is her downward speed measured in ft/sec.

Required: (a) What is her initial speed? (b) What is her speed after 15 sec?

3) [9 pts] Basic Properties of Logarithms.
   (a) Express in logarithmic form. \[ 3^3 = 27 \]
   (b) Express in exponential form. \[ \log_3 8 = \frac{3}{2} \]
   (c) Evaluate without using your calculator \[ \log_2 \frac{1}{16} \]
   (d) Solve for \( x \) \[ \log_x 4 = \frac{2}{3} \]

4) Solve the equation for \( P \). \[ \log P = \log c - k \log w \]

5) You may use your calculator to assist you in finding an approximation for \( \log_3 100 \). Report your answer to 9 decimal places.

6) Solve for \( x \). Give EXACT answer. Report your answer as a solution set. \[ \log_2 (x + 2) = 5 \]

7) Solve for \( x \). Give EXACT answer. Report answer as a solution set. \[ \frac{10}{1 + e^{-x}} = 2 \]
(8)[9 pts] (Sentence Answers) A culture contains 1500 bacteria initially and doubles every 30 min. We assume the exponential growth model \[ n(t) = n_0 e^{rt} \] where \( n(t) \) is the number of bacteria, \( t \) is the time in minutes, \( r \) is the relative rate of growth, and \( n_0 \) is the initial population of bacteria. Additionally, if \( d \) is the “doubling time,” then \[ r = \frac{\ln 2}{d} \].

**Required:** (a) Set up the specific model for this problem (i.e. Subs the given values for \( n_0 \) and \( r \)).

(b) How many bacteria are in the culture after 1 hour 45 min? (Round off to the nearest whole number.)

\[
\begin{align*}
4x + 7y &= -23 \\
3x - 2y &= 19
\end{align*}
\]

**Solution set. Ordered Pair.**

\[
\begin{align*}
2x - 5y - 5z &= 1 \\
4y - z &= -6 \\
3z &= 6
\end{align*}
\]

**Solution set. Ordered Triple.**

(11) Find the equation of the horizontal asymptote.

\[ r(x) = \frac{2x^2 + 10x - 12}{x^2 - x + 6} \]

(12)[9 pts] Solve \[ e^{2x} - 5e^x + 6 = 0 \]

(13) BONUS: Solve the system.

\[
\begin{align*}
x^2 + y^2 &= 16 \\
x - y &= 1
\end{align*}
\]

**Solution set. With several Ordered Pairs.**