On the AP Precalculus Exam, FRQ #4 will require students to solve various logarithmic and exponential function without using a calculator. Below are a part of the directions students will see on this free response problem along with two sample questions that could appear on one of these FRQs.

Directions: **No Calculators Allowed**. Determine the exact value of any expression that can be obtained without a calculator. For example, $\log_2 8$ can be written as 3. Combine terms using algebraic methods and rules for exponents, where applicable. For example, $2x+3x$, $5^2 \cdot 5^3$, $\frac{x^5}{x^2}$, and $\ln 3+\ln 5$ should be rewritten in equivalent forms.

1. $f(x)=\frac{\left(e^x\right)^5}{e^{1/4}}$. Solve $f(x)=e^{1/2}$ for values of x in the domain of f.

$\frac{(e^x)^5}{e^{1/4}} = e^{1/2}$

$(e^x)^5 = e^{1/2} \cdot e^{1/4} = e^{3/4}$

$e^x = \left(e^{3/4}\right)^{1/5} = e^{3/20}$

$x = \ln\left(e^{3/20}\right) = \frac{3}{20}$

2. $g(x)=8e^{(3x)}-e$. Solve $g(x)=3e$ for values of x in the domain of g.

$8e^{(3x)} - e = 3e$

$8e^{(3x)} = 4e$

$e^{(3x)} = \frac{4e}{8} = \frac{e}{2}$

$3x = \ln\left(\frac{e}{2}\right) = \ln(e) - \ln 2$

$x = \frac{1-\ln 2}{3}$