1(2). Combine into a single logarithm:
\[
\ln(xy) - x \ln(2) - \frac{1}{2} \ln(x - y)
\]
\[
= \ln(xy) - \ln(2^x) - \ln \sqrt{x-y}
\]
\[
= \ln \frac{xy}{2^x \sqrt{x-y}}
\]

2(2). Write as a sum and/or difference of multiples of \(\log_5 x\), \(\log_5(y-1)\), \(\log_5(x+1)\):
\[
\log_5 \left( \frac{(y-1)^3}{\sqrt[3]{x(x+1)^4}} \right)
\]
\[
= \log_5 (y-1)^3 - \log_5 x^{1/2} - \log_5 (x+1)^4
\]
\[
= 3 \log_5 (y-1) - \frac{1}{2} \log_5 x - 4 \log_5 (x+1)
\]

3(6). Solve for \(x\). Show your work. The solution(s) must be valid.
Write "none" if neither solution is valid.
\[
\ln(x-4) - \ln 6 = -\ln(1+x)
\]
\[
\ln(x-4) + \ln(1+x) = \ln 6
\]
\[
\ln[(x-4)(1+x)] = \ln 6
\]
\[
(x-4)(1+x) = 6
\]
\[
x + x^2 - 4 - 4x = 6
\]
\[
x^2 - 3x - 10 = 0
\]
\[
(x-5)(x+2) = 0
\]
\[
x = 5, -2
\]
At \(x = 5\) the equation holds with all terms defined
\[
\therefore \ 5 \ is \ valid
\]
At \(x = -2\) the equation has undefined terms
\[
\therefore -2 \ is \ invalid
\]
Ans. \(x = 5\)

4(3). Express in terms logarithms to the base 2: \(\ln 13\)
\[
\frac{\log_2 13}{\log_2 e}
\]