Continue with problem 3 by finding the new canonical equation.

$$u_{\xi\eta} = \Phi(\xi, \eta, u, u_\xi, u_\eta)$$

$$\begin{aligned}
\xi &= y + 2x \\
\eta &= y + \frac{1}{3}x \\
A &= 3, \qquad B = 7, \qquad C = 2 \\
D &= E = F = G = 0 \\
\xi_x &= 2, \qquad \xi_y = 1 \\
\xi_{xx} &= \xi_{xy} = \xi_{yy} = 0 \\
\eta_x &= \frac{1}{3} \qquad \eta_y = 1 \\
\eta_{xx} &= \eta_{xy} = \eta_{yy} = 0 \\
\overline{A} &= \overline{C} = 0
\end{aligned}$$

We solved for $\overline{A} = \overline{C} = 0$ to get ξ, η. Also, because all the second derivatives are zero along with D, E, F we quickly see that $\overline{D} = \overline{E} = 0$. And of course $\overline{F} = F = \overline{G} = G = 0$.

$$\begin{aligned}
\overline{B} &= 2A\xi_x\eta_x + B(\xi_x\eta_y + \xi_y\eta_x) + 2C\xi_y\eta_y \\
&= 2 \cdot 3 \cdot 2 \cdot \frac{1}{3} + 7\left(2 \cdot 1 + 1 \cdot \frac{1}{3}\right) + 4 \\
&= \frac{12}{3} + 14 + \frac{7}{3} + 4 = \frac{19 + 18 \cdot 3}{3} \\
\overline{B}u_{\xi\eta} &= 0 \\
\overline{B} \neq 0 &\to u_{\xi\eta} = 0
\end{aligned}$$