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12. $f_1(x)g_1(y) + f_2(x)g_2(y) + f_3(x)g_3(y) = 0.$

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Two solutions:

$$\begin{aligned} f_1(x) &= C_1 f_3(x), & f_2(x) &= C_2 f_3(x), & g_3(y) &= -C_1 g_1(y) - C_2 g_2(y); \\ g_1(y) &= C_1 g_3(y), & g_2(y) &= C_2 g_3(y), & f_3(x) &= -C_1 f_1(x) - C_2 f_2(x), \end{aligned}$$

where C_1 and C_2 are arbitrary constants, the functions on the right-hand sides of the solutions are arbitrary.

Reference

Polyanin, A. D. and Zaitsev, V. F., *Handbook of Nonlinear Partial Differential Equations (Supplement S.4.4)*, Chapman & Hall/CRC Press, Boca Raton, 2004.

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