

8.
$$(ax^2 + bx + c)^4 y_{xxxx}^{""} = ky$$
.

The transformation

$$\xi = \int \frac{dx}{ax^2 + bx + c}, \quad w = \frac{y}{(ax^2 + bx + c)^{3/2}}$$

leads to a constant coefficient linear equation:

$$w''''_{\xi\xi\xi\xi} - \frac{5}{2}Dw''_{\xi\xi} + (\frac{9}{16}D^2 - k)w = 0,$$

where $D = b^2 - 4ac$.

Reference

Polyanin, A. D. and Zaitsev, V. F., *Handbook of Exact Solutions for Ordinary Differential Equations, 2nd Edition,* Chapman & Hall/CRC, Boca Raton, 2003.

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http://eqworld.ipmnet.ru/en/solutions/ode/ode0408.pdf