

50.
$$y_{xx}^{\prime\prime} - f_x^{\prime} y_x^{\prime} - a^2 e^{2f} y = 0$$
, $f = f(x)$.

Solution:

$$y = C_1 \exp\left(a \int e^f dx\right) + C_2 \exp\left(-a \int e^f dx\right),$$

where C_1 and C_2 are arbitrary constants.

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/ode0250.pdf