



Exact Solutions > Nonlinear Partial Differential Equations >
Second-Order Parabolic Partial Differential Equations > Heat Equation with a Exponential Nonlinearity

$$7. \quad \frac{\partial w}{\partial t} = a \frac{\partial}{\partial x} \left(e^{\lambda w} \frac{\partial w}{\partial x} \right).$$

Heat equation with a exponential nonlinearity.

1°. Solutions:

$$w(x, t) = \frac{2}{\lambda} \ln \left(\frac{\pm x + A}{\sqrt{B - 2at}} \right),$$
$$w(x, t) = \frac{1}{\lambda} \ln \frac{A + Bx - Cx^2}{D + 2aCt},$$

where A, B, C , and D are arbitrary constants.

2°. There are solutions of the following forms:

$$w(x, t) = F(z), \quad z = kx + \beta t \quad \text{traveling-wave solution};$$
$$w(x, t) = G(\xi), \quad \xi = xt^{-1/2} \quad \text{self-similar solution};$$
$$w(x, t) = H(\eta) + 2kt, \quad \eta = xe^{-k\lambda t};$$
$$w(x, t) = U(\zeta) - \lambda^{-1} \ln t, \quad \zeta = x + k \ln t,$$

where k and β are arbitrary constants.

References

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<http://eqworld.ipmnet.ru/en/solutions/npde/npde1207.pdf>