

The Steady Temperature Interior to a Finite or Semi-infinite Cylinder With a Discontinuous Radiation Condition^{1,2}

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1. Introduction. Explicit solutions are developed for Laplace's equation in the interior of a cylinder with boundary conditions that preclude the separability of the Laplacian operator. For example we determine (Problem 1) the steady-state temperature distribution in a semi-infinite cylinder whose face is kept at a fixed axisymmetric temperature, part of whose lateral wall is perfectly insulated whereas the remaining part of the lateral wall radiates heat by the first power law (Newtonian cooling). See Figure 1a.

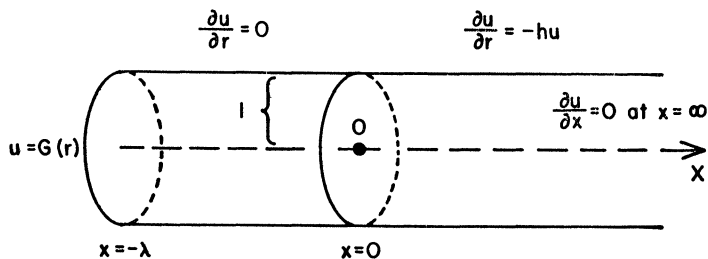


FIGURE 1a

(Problem 1). $G(r)$ is a given axisymmetric temperature distribution on the face of a semi-infinite cylinder of radius 1. The lateral wall of the cylinder is perfectly insulated between $-\lambda < x < 0$. For the region $x > 0$, the lateral wall loses heat by Newtonian cooling. h is a positive constant. u is the steady state temperature distribution and $\Delta u = 0$ inside the cylinder

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² This is the second in a group of papers [11] dealing with aspects of axisymmetric potential theory suggested by problems of steady-state diffusion in biological systems. The present paper is self-contained but the introduction to [11] and the report [12] include background material of interest to the entire series.