Exact Solutions for Flows in Periodic Domains PETER BADDOO,
DARREN CROWDY, Imperial College London — In this work it is shown that
recent advances in conformal geometry can be leveraged to obtain analytic solutions
for flows in periodic domains. The solutions are constructed in a parametric cir-
cular domain and then conformally mapped to the periodic physical domain. By
expressing the problem in terms of the transcendental Schottky–Klein prime func-
tion, the ensuing solutions are valid for domains of arbitrary connectivity, i.e. any
number of objects per period window. Moreover, the conformal mapping to the de-
sired physical domain may be constructed using a new periodic Schwarz–Christoffel
formula. The mathematical analysis is valid for conformally invariant equations and
is therefore applicable to a range of scenarios in fluid mechanics including poten-
tial flows, advection-diffusion problems and interfacial dynamics. Accordingly, the
solutions find relevance in areas such as vortex dynamics, transport phenomena,
turbomachinery flows, mesh generation and fractal growth.

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