Solution to Problem 204B:

Since the hydraulic circuit head loss, H, varies as the square of the flow rate, Q, and the head generated by the pump must equal H, the head coefficient at which the pump operates, ψ, is given by

$$H \quad \propto \quad Q^2 \tag{1}$$

or

$$\frac{R_{T2}^2 \Omega^2 \psi}{g} \quad \propto \quad (R_{T2} \Omega A_2 \phi)^2 \tag{2}$$

where ϕ is the flow coefficient. This leads to the relation

$$\psi \quad \propto \quad g A_2^2 \phi^2 \tag{3}$$

But the basic pump characteristic is that ψ is a function of ϕ, say $F(\phi)$ and therefore

$$F(\phi) \quad \propto \quad g A_2^2 \phi^2 \tag{4}$$

The solution of this equation that determines ϕ is independent of Ω and hence the flow coefficient is independent of the speed, Ω.