This is a try for the solution of Laplace Equation.
The uncompleted solution is

$$\phi = \sum_{m=0}^{\infty} A_m \sinh(\frac{P_m}{a} z) BesselJ(0, \frac{P_m}{a} r)$$

Where $BesselJ(0, P_m) = 0$, that is $P_m,\ (m = 1,2,3...)$ is the solution of $BesselJ(0, x) = 0$, and

z is the z axis of cylinder coordinate and r is the r axis. In the case, the distribution of potential ϕ has no relationship with θ of cylinder coordinate.

Using the given boundary condition $\phi(r, h) = U_0$, we can get

$$U_0 = \sum_{m=0}^{\infty} A_m \sinh(\frac{P_m}{a} h) BesselJ(0, \frac{P_m}{a} r) \qquad (1)$$

Now need to solute the formula of A_m.

The method on the book is that:

Multiply $r \times BesselJ(0, \frac{P_m}{a} r)$ on both sides of the equal mark, then integral and because of the orthogonality of Bessel function, we have

$$A_m = \frac{\int_0^a U_0 \times r \times BesselJ(0, \frac{P_m}{a} r) dr}{\int_0^a r \times \sinh(\frac{P_m}{a} h) \times [BesselJ(0, \frac{P_m}{a} r)]^2 dr} \qquad (2)$$

I really do not know what the basis of above equation is. Why can we get (2) from (1)? Does anyone give me any advice?
Thanks in advance.
Regards
Hector