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**Question 3.** (10 marks)

*Important: marks will only be awarded for fully worked solutions, showing all steps.*

A scalar function  $V(x, y)$  obeys Laplace's equation

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0$$

in the region  $(0 \leq x \leq 1), (0 \leq y \leq 2)$ , and is subject to the boundary conditions

$$\begin{aligned} V(0, y) = V(1, y) = V(x, 0) &= 0 , \\ V(x, 2) &= \sin(3\pi x) . \end{aligned}$$

Use separation of variables to compute  $V(x, y)$ .

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