The equation $\frac{\partial u}{\partial x} - \frac{2\partial^2 u}{\partial y^2} = 2$ is inhomogeneous due to the additional "source term" 2 on the right-hand side. Therefore, in addition to the conventional separation of variable technique, one needs to use the principle of superposition. The main concept of the principle of superposition is the splitting of a complex problem not solvable by direct application of the method of separation of variables into a number of simpler problems solvable by the method of separation of variables. The solution to the initial complex problems is, then, the sum of the solution of the simpler problems.

To do that for project 1, the solution *u* can be divided into two parts: $u(x, y) = v(x, y) + f(y)$, where the v(x,y) component is the "instant" component that depends on x, and the f(y) is the "steady" component independent on *x*. Then, the original equation can be rewritten as the new form,

$$\frac{\partial v}{\partial x} - 2\frac{\partial^2 v}{\partial y^2} - 2\frac{\partial^2 f}{\partial y^2} = 2$$

By setting $\partial^2 f/\partial y^2 = -1$, we convert the inhomogeneous PDE into a homogeneous type, as follows,

$$\frac{\partial v}{\partial x} - 2\frac{\partial^2 v}{\partial y^2} = 0$$

which can be solved using the conventional separation of variable technique.

Using the boundary conditions $f(y = 0) = 0, f(y = 1) = 0$, we can obtain solution for the steady component as,

$$f(y) = \frac{y}{2}(1 - y)$$

Combine v(x,y) and f(y), and we will get the final solution.

Note that the choice of boundary conditions for f(y) is also somewhat arbitrary; the goal is to choose something that minimizes the effort in solving both components of the problem.