## Dr. K. Karuppasamy

www.drkk.in

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**Problem**: The top and bottom margins of a poster are each 12 cm and the side margins are each 8 cm. If the area of printed material on the poster is fixed at 1536 cm2, find the dimensions of the poster with the smallest area.

## Solution:

Let the dimensions of the poster be x cm by y cm.

Area of the printed portion = (x - 24) (y - 16) = 1536.

Let f(x,y) = xy and g(x,y) = (x - 24)(y - 16) - 1536 = 0

Let us apply Lagrange's multiplier method, to find the dimensions of the smallest area.

The Lagrange's function be

 $L(x,y, \lambda) = f(x,y) + \lambda g(x,y) = xy + \lambda((x - 24) (y - 16) - 1536)$ 

 $\partial L/\partial x = 0 \implies y + \lambda (y - 16) = 0$  ------(1)

 $\partial L/\partial y = 0 \implies x + \lambda (x - 24) = 0$  ------(2)

 $\partial L/\partial \lambda = 0 \Longrightarrow ((x - 24) (y - 16) - 1536 = 0$  -----(3)

From (1) & (2), we get  $y = 16 \lambda/(1+\lambda)$  and  $x = 24 \lambda/(1+\lambda)$  ------(4)

Using (4) in (3), we get  $\lambda = -3/2$  or -1/2

Put x = -1/2 in (4), we get x = -24 and y = -16 (it is not possible)

Put x = -3/2 in (4), we get x = 72 and y = 48.

Hence the dimensions of the poster with smallest area is 72 cm by 48 cm.