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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 cm 2 , find the dimensions of the poster with the smallest area.

## Solution:

Let the dimensions of the poster be xcm by ycm .
Area of the printed portion $=(x-24)(y-16)=1536$.
Let $f(x, y)=x y$ 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
$L(x, y, \lambda)=f(x, y)+\lambda g(x, y)=x y+\lambda((x-24)(y-16)-1536)$
$\partial L / \partial x=0 \Rightarrow y+\lambda(y-16)=0$
$\partial L / \partial y=0 \Rightarrow x+\lambda(x-24)=0$
$\partial L / \partial \lambda=0=>((x-24)(y-16)-1536=0$
From (1) \& (2), we get $y=16 \lambda /(1+\lambda)$ and $x=24 \lambda /(1+\lambda)$
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 .

