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Page 561, Problem #29

Volume of closet: maximize $V(x, y, z) = xyz$

constraint: $4x + 2y + z = 12$; $g(x, y, z) = 4x + 2y + z - 12$

$F(x, y, z, L) = xyz + L(4x + 2y + z - 12)$

$$F_x = yz + 4L = 0$$

$$F_y = xz + 2L = 0$$

$$F_z = xy + L = 0$$

$$F_L = 4x + 2y + z - 12 = 0$$

Take the first three and solve for L:

$$L = - (1/4) yz$$

$$L = - (1/2) xz$$

$$L = - xy$$

Pair them off

$$- (1/4) yz = - (1/2)xz \rightarrow y = 2x$$

$$- (1/4) yz = - xy \rightarrow z = 4x$$

Substitute these into the fourth equation

$$4x + 2y + z = 12$$

$$4x + 2(2x) + 4x = 12$$

$$12x = 12$$

$$x = 1, y = 2, z = 4$$