Problems 11.5, Page 41

3. The slope of the line through $(4,0,0)$ and $(0,0,2)$ is $(2-0)/(0-4) = -1/2$, and the slope of the line through $(0,3,0)$ and $(0,0,2)$ is $(2-0)/(0-3) = -2/3$, so the desired equation, using the point $(0,0,2)$ is

$$z = f(x,y) = 2 - \frac{1}{2}(x-0) - \frac{2}{3}(y-0) = 2 - \frac{1}{2}x - \frac{2}{3}y \ .$$

4. The $z = 2$ in the xz-plane is parallel to the x-axis, so the desired plane has slope 0 in the x-direction — so there is no x in its equation. The equation of the line in the yz-plane through $(0,1,0)$ and $(0,0,2)$ is $z = 2 - 2y$, so this is also the equation of the desired plane.

6. The given line meets the x- and y-axes in $(0,4,0)$ and $(-4/3,0,0)$ respectively, so the slopes of the desired plane in the x- and y-directions are $(5-0)/(0-(-\frac{4}{3})) = 15/4$ and $(5-0)/(0-4) = -5/4$ respectively; so the desired equation is

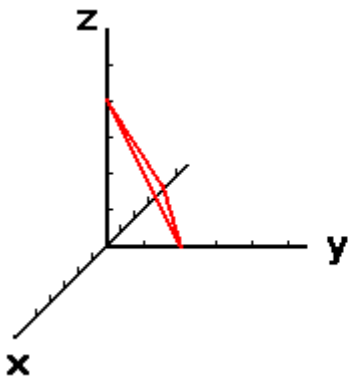$$z = f(x,y) = 5 + \frac{15}{4}(x-0) - \frac{5}{4}(y-0) = 5 + \frac{15}{4}x - \frac{5}{4}y \ .$$

10. The slope in the x-direction is $-1/100$ and the slope in the y-direction is $3/10$; and one point on the plane is $(100,10,3)$, so the desired equation is

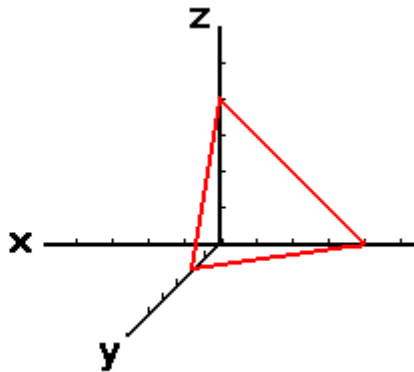$$z = f(x,y) = 3 - \frac{1}{100}(x-100) + \frac{3}{10}(y-10) = 1 - \frac{1}{100}x + \frac{3}{10}y \ .$$

15. The plane hits the axes at $(3,0,0)$, $(0,2,0)$, and $(0,0,6)$:
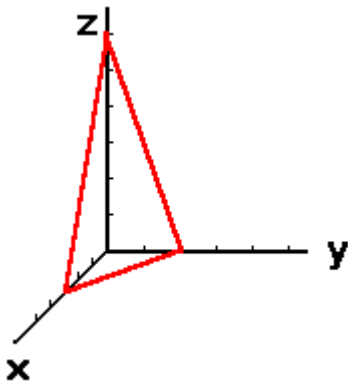
16. The plane hits the axes at $(-4,0,0)$, $(0,2,0)$, and $(0,0,4)$:

18. All three, assuming that (s)he sells all (s)he produces. In (a), if the unit price of the raw materials are c_1 and c_2, then the total amount expended on raw materials is $c_1 m_1 + c_2 m_2$. In (b) and (c), revenue is $p_1 q_1 + p_2 q_2$ (I am assuming here that the p's are prices <u>per unit</u> of product). So (b) is linear in the q's; but (c) is not linear, because the product of variables $p_1 q_1$ is not a linear term.

19. (a) For such a student, the predicted college GPA is $z = 0.003(1050) + 0.8(3.0) - 4 = 1.55 < 2.3$, so the student will not be admitted.
(b) No: If the student's high school average is low enough (for example, 0), then even an SAT of 1600 gives only a predicted college GPA of 0.8, so such a student will not be admitted.
(c) No: If a student's SAT is low enough (for example, 400), then even a high school GPA of 4.3 gives only a predicted college GPA of .64, so such a student will not be admitted.
(d)
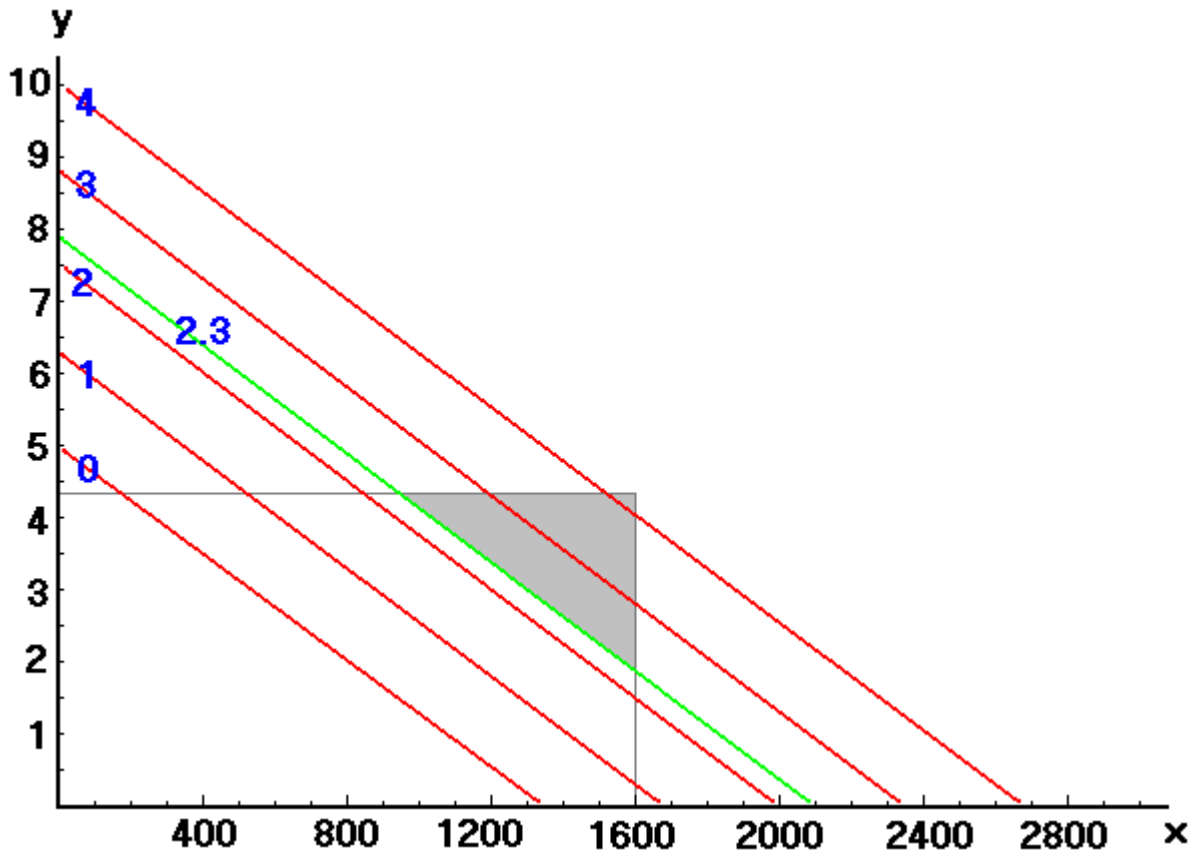
(e) An extra 100 points on the SAT adds $0.003(100) = .3$ to the predicted college GPA; an extra 0.5 in high school GPA adds $0.8(0.5) = .4$ to the predicted college GPA. So the latter is more important.

2