Problems 13.3, Page 115

2. $z_x = ye^{x/y}(1/y) = e^{x/y}$, so $z_x(1,1) = e$; $z_y = ye^{x/y}(-xy^{-2}) + e^{x/y} = e^{x/y}(1 - x/y)$, so $z_y(1,1) = 0$; so the tangent plane is $z = e + e(x-1) - 0(y-1) = ex$.

4. (a) The $3x^2$ (really $3x^3$) term alone is not linear, so this is not an equation of the plane.
(b) The student neglected to substitute $(2,3)$ for (x,y) in the partial derivatives.
(c) $z = 3(2^2)(x-2) - 2(3)(y-3) - 1 = 12x - 6y - 7$.

8. $f_T(480,20) \approx (28.46 - 27.85)/(500-480) = .0305$ and $f_p(480,20) \approx (25.31 - 27.85)/(22-20) = -1.27$, so the desired tangent line is $V \approx 27.85 + .0305(T - 480) - 1.27(p - 20)$.

11. $df = y\cos(xy)\,dx + x\cos(xy)\,dy$

14. $dh = (e^{-3t}\cos(x+5t))dx + (-3e^{-3t}\sin(x+5t) + 5e^{-3t}\cos(x+5t))dt$

15. $df = e^{-y}dx - xe^{-y}dy$, so $df(1,0) = dx - dy$.

16. $dg = 2x\sin(2t)dx + 2x^2\cos(2t)dt$, so $dg(2,\pi/4) = 4\sin(\pi/2)dx + 8\cos(\pi/2)dt = 4dx$.

22. (a) Letting m denote the (fixed) mass of the liquid in kg, $\rho = m/V$, so $d\rho = -mV^{-2}dV = -mV^{-2}\beta V\,dT = -(m/V)\beta dT = -\rho\beta dT$.
(b) At $T = 20$ I estimate ρ as 998 and the slope $d\rho/dT$ as $(990 - 998)/(58 - 20) \approx -.21$, so $\beta = -(1/\rho)(d\rho/dT) \approx= -(1/998)(-.21) = .00021$. And at $T = 80$, $\rho \approx 972$ and $d\rho/dT \approx (960 - 972)/(100 - 80) = -.6$, so $\beta \approx -(1/972)(-.6) \approx .00062$. (My approximations differ substantially from the solution book, which gives answers of 0.00015 and 0.0005 respectively.)