

HW # 9

due Wednesday November 9

11.7 # 7, 9, 11 Find the critical points and classify them with the second derivative test

11.7 # 25, 27, 35, 37

11.8 # 3, 5, 18, 19, 27, 29

**Extra Problem**

1. (Quadratic approximation) Let  $f(x,y)$  be a given function. Let  $Q(x,y)$  be a function of the form  $Q(x,y) = ax^2 + bxy + cy^2 + dx + ey + f$ , where  $a,b,c,d,e$  and  $f$  are real numbers. Suppose that we impose the conditions that

a)  $Q(0,0) = f(0,0)$

b)  $Q_x(0,0) = f_x(0,0)$  and  $Q_y(0,0) = f_y(0,0)$

c)  $Q_{xx}(0,0) = f_{xx}(0,0)$ ,  $Q_{yy}(0,0) = f_{yy}(0,0)$  and  $Q_{xy}(0,0) = f_{xy}(0,0)$

Show that  $a = \frac{1}{2} f_{xx}(0,0)$ ,  $b = f_{xy}(0,0)$ ,  $c = \frac{1}{2} f_{yy}(0,0)$ ,  $d = f_x(0,0)$ ,  $e = f_y(0,0)$  and  $f = f(0,0)$ .

**Remark** The function  $Q(x,y)$  is called the quadratic (or second order) approximation to  $f(x,y)$  at the point  $(0,0)$ .