12. $f(x,y) = x^2 + y^2 + \frac{1}{x^2y^2}$

$f_x(x,y) = 2x - 2x^{-3}y^{-2}$

$f_y(x,y) = 2y - 2y^{-3}x^{-2}$

Critical points at $(1,1)$, $(1,-1)$, $(-1,1)$, and $(-1,-1)$

1pt

	evaluated at $(1,1)$	$(1,-1)$	$(-1,1)$	$(-1,-1)$
$f_{xx} = 2 + 6x^{-4}y^{-2}$	8	8	8	8
$f_{yy} = 2 + 6x^{-2}y^{-4}$	8	8	8	8
$f_{xy} = f_{yx} = 4x^{-3}y^{-3}$	4	-4	-4	4

$$D = \begin{vmatrix} 8 & 4 \\ 4 & 8 \end{vmatrix} = 48 \qquad \begin{vmatrix} 8 & -4 \\ -4 & 8 \end{vmatrix} = 48 \qquad \begin{vmatrix} 8 & -4 \\ -4 & 8 \end{vmatrix} = 48 \qquad \begin{vmatrix} 8 & 4 \\ 4 & 8 \end{vmatrix} = 48$$

$(1,1)$, $(1,-1)$, $(-1,1)$ and $(-1,-1)$ are all local mins because $f_{xx} > 0$.

13. $f(x,y) = x \sin y$

$f_x = \sin y$

$f_y = x \cos y$

1pt

Critical points are at $(0, k\pi)$ where k is an integer

	evaluated at $(0, k\pi)$
$f_{xx} = 0$	0
$f_{yy} = -x \sin y$	0
$f_{xy} = f_{yx} = \cos y$	$\cos(k\pi) \leftarrow$ 1 if k is even, -1 if k is odd

So

$$D = \begin{vmatrix} 0 & \pm 1 \\ \pm 1 & 0 \end{vmatrix} = 0 - (\pm 1)^2 = -1$$

so these points are saddlepoints