Quiz Second Derivative Test

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a) $f(x,y,z) = x + y^2 + z^3 - xy - 3z$

$f_x = 1 - y = 0 \mid +y \Rightarrow 1 = y$
$f_y = 2y - x = 0 \mid y=1 \Rightarrow 2 - x = 0 \Rightarrow x = 2$
$f_z = 3z^2 - 3 = 0 \mid +3 \mid :3 \Rightarrow z^2 = 1$
$\Rightarrow z = \pm 1$

$f_{xx} = 0 \quad f_{xy} = -1 \quad f_{xz} = 0$
$f_{yx} = -1 \quad f_{yy} = 2 \quad f_{yz} = 0$
$f_{zx} = 0 \quad f_{zy} = 0 \quad f_{zz} = 6z$

$H_1 = 0$
$H_2 = 1$
$H_3 = \text{if } z = 1 \Rightarrow 6 \mid \text{if } z = -1 \Rightarrow -6$

The function has two critical points one at $(2|1|1)$ and another one at $(2|1|-1)$ but neither can be classified, because $H_1 = 0$

b) $f(x,y,z) = x^4 + y^4 + z^4 + x^2 + y^2 + z^2$

$f_x = 4x^3 + 2x \quad x = 0$
$f_y = 4y^3 + 2y \quad y = 0$
$f_z = 4z^3 + 2z \quad z = 0$
$f_x = (4x^2 + 2) \cdot x \quad x = 0$

Quiz Second derivative Test

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$f_{xx} = 12x^2 + 12$ $f_{xy} = 0$ $f_{xz} = 0$
$f_{yx} = 0$ $f_{yy} = 12y^2$ $f_{xz} = 0$
$f_{zx} = 0$ $f_{zy} = 0$ $f_{zz} = 0$ $12y + 2$

$x = 0$ & $y = 0$ & $z = 0$ in ↑

$f_{xx} = 0 + 2$ $f_{xy} = 0$ $f_{xz} = 0$
$f_{yx} = 0$ $f_{yy} = 0 + 2$ $f_{yz} = 0$
$f_{zx} = 0$ $f_{zy} = 0$ $f_{yz} = 0 + 2$

$H_1 = 2$
$H_2 = 4$
$H_3 = 8$

The function has a minimum on pt where $x = 0$, $y = 0$ and $z = 0$.