1. Critical points and their character:
   (0,0): saddle, \( Q(h,k) = -8hk - 2k^2 = -2((k+2h)^2 - 4h^2) \). Indefinite
   (4,0): saddle, \( Q(h,k) = 8hk - 2k^2 = -2(k-2h)^2 + 8h^2 \). Indefinite
   (2,-2): local max, \( Q(h,k) = -4h^2 - 2k^2 \). Negative definite.

2. Solution: \( \pi^*(1 - \exp(-4))/8 \)

3. a) 0
   b) \( \partial P/\partial y - \partial Q/\partial x = 0 \), Sol. \( e^{-1/e} \)

4. \( g(r) = 1 + c/r \) with \( c = 1 \)
   Solution \( f(x,y) = 1 + 1/\sqrt{x^2+y^2} \)
   5a. The directional derivate is \( 16/(9*\sqrt{3}) \)
   5b. The maximum directional derivative is \( \sqrt{96}/9 \) which is smaller than \( 10/9 \) thus the answer is NO
   5c. No limit exists since we can find at least two different values for the limit (it depends on the angle \( \phi \)).
   5d. The function \( f(x,y) \) reduces to \( \cos(2*\theta) \) which achieves the maximum of 1 if the angle \( \theta = 0 \)
   and minimum of -1 if for instance \( \theta = \pi/2 \) for any \( r \) (even as \( r \) goes to infinity).

6. The radius \( r = \sqrt{2} \). The \( c = 2 \).