

① Let  $\langle P, Q \rangle = \langle 6x^2 + 10xy^4 - 3, 20x^2y^3 + 1 \rangle$  HW  
47

Find the general solution to  $\vec{\nabla} f = \langle P, Q \rangle$ .

② Find  $f$  as in ① such that  $f(1, 1) = 7$ .

③ Find  $f(x, y)$  such that  $f(1, 0) = 1$  and

$$\vec{\nabla} f(x, y) = \left\langle \frac{-y^2}{x^2 \sqrt{x^2 + y^2}}, \frac{y}{x \sqrt{x^2 + y^2}} \right\rangle$$

for all  $(x, y) \in D = \{(x, y) \in \mathbb{R}^2 \mid x > 0\}$ .

④ Repeat ③ with  $f(-1, 0) = 5$  and

$D = \{(x, y) \in \mathbb{R}^2 \mid x < 0\}$  (but same  $\vec{\nabla} f$  formula).

⑤ Does  $\frac{\langle x, y \rangle}{(x^2 + y^2)^{3/2}}$  equal some  $\vec{\nabla} f$  on all

of  $D = \mathbb{R}^2 - \{(0, 0)\}$  (which is not simply connected)?