

As a reminder, you are welcome to use a non-internet accessing calculator (which includes Desmos Test Mode) and one side of notes. Show your work for the following problems. The correct answer with no supporting work will receive NO credit.

1. Choose *ONE* of the following functions to compute the questions below. That is, do parts (a), (b), and (c) with either the function α or β , not both.

$$z = \alpha(x, y) = y^2 \ln(x)$$

XOR

$$z = \beta(x, y) = \cos(\pi xy)$$

- (a) [3] (3DderivativeActivity #3) Find $\frac{\partial z}{\partial x}$

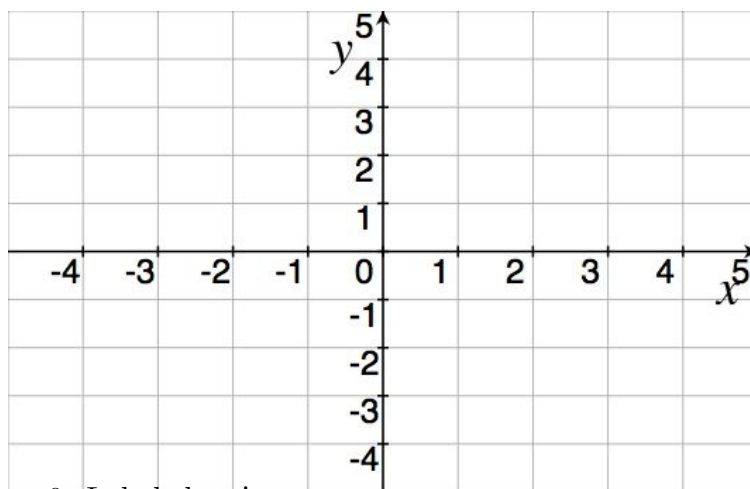
- (b) [1] (WebHW14.4 #2) Find $z_x(1, 4)$.

- (c) [3] (WebHW14.6 #2) Let $\vec{u} = \langle 2, -4 \rangle$, find $D_{\vec{u}}(1, 4)$

2. Let $f(x, y) = \sqrt{x - 2y}$

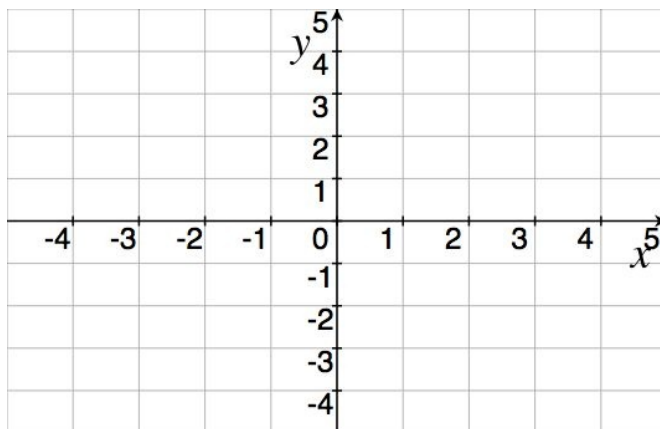
- (a) [2] (WebHW14.1#2)
Find the domain of f .

- (b) [3] (3DFunctionActivity #2)
Sketch the contour lines/level curves for $f(x, y) = 2$ and $f(x, y) = 0$. Label them!



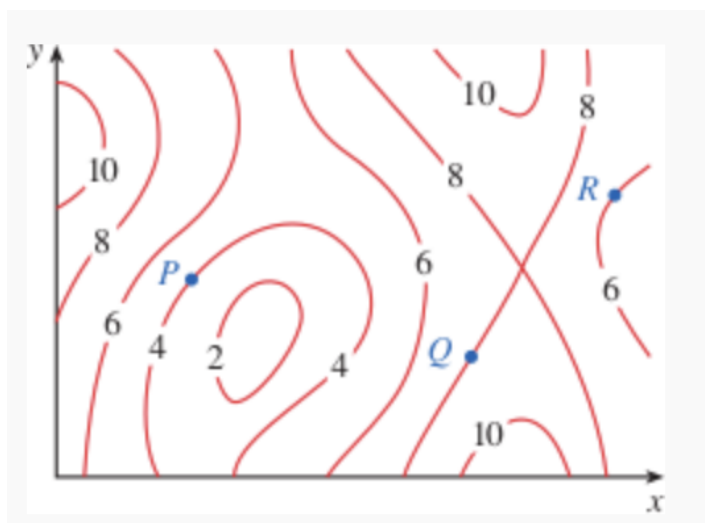
3. [5] (Quiz5 #1) Create a function $g(x, y) = z$, with contour lines/level curves that satisfy *all* of the following

- (a) $f(-2, 2) = f(0, 0) = 2$
- (b) $f_x(3, -2) > 0$
- (c) $f_y(3, -2) \approx -1$
- (d) $(-1, 3)$ is a local minimum



4. The contour map of a function $h(x, y)$ is given below.

- (a) [2] (OptimizeAct #1)
Identify a critical point.
Classify the point as a local min, local max, or saddle point.
- (b) [1] (WebHW14.3 #1) Is the partial of h relative to x at P positive or negative?
- (c) [1] (§14.6 #26) Sketch the direction of ∇h at the point Q .
- (d) [2] (Quiz6 #2) Let $\vec{u} = \langle \frac{-1}{\sqrt{2}}, \frac{-1}{\sqrt{2}} \rangle$. Draw a point (c, d) where $D_{\vec{u}}(c, d) > 0$. Provide some brief justification.



5. The wind-chill index W is the perceived temperature when the actual temperature is T and the wind speed is v , so we can write $W = f(T, v)$. The table below provides some values for W as a function of T and v .

(a) [3] (§14.3 #2)

Approximate $f_v(-15, 60)$
and interpret it for a
10 year old.

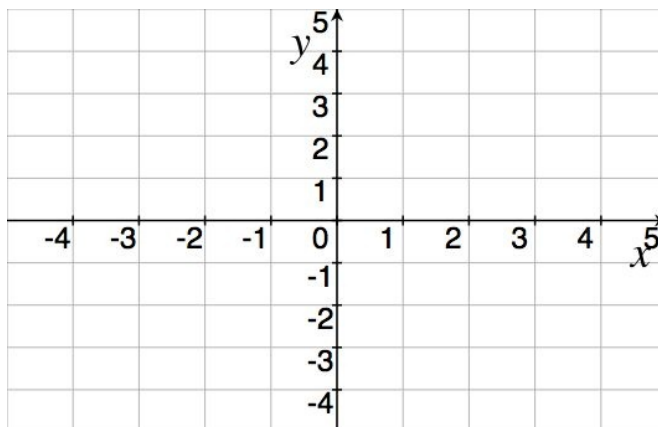
		Wind speed (km/h)					
Actual temperature (°C)	$T \backslash v$	20	30	40	50	60	70
	-10	-18	-20	-21	-22	-23	-23
	-15	-24	-26	-27	-29	-30	-30
	-20	-30	-33	-34	-35	-36	-37
	-25	-37	-39	-41	-42	-43	-44

- (b) [4] (Quiz6 #1) Find one local linearization for f that could be used to approximate both $W(-16, 58)$ or $W(-16, 61)$. Provide the *function*, not the actual approximations.

6. Let the triangular region with vertices $(1, 4)$, $(4, 2)$ and $(1, -1)$ be denoted as D .

(a) [1] (§15.2 #4) Sketch the region D .

- (b) [3] Set up the definite integral that is equivalent to the signed volume trapped by the function $z = 3x^2$ and above the region D . You do *NOT* need to compute this.



7. [6] For the following problem you will outline (not actually find!) a solution. Make sure your outline includes:

- (a) definitions of variables used,
- (b) identifying the function that needs to be optimized,
- (c) boxing systems of equations that need to be solved (but do not solve them!), &
- (d) explaining how you would verify your work is correct (ie a maximum)

(§14.7 #) A package in the shape of a rectangular box can be mailed by the postal service if the sum of its length and girth (the perimeter of a cross-section perpendicular to the length) is at most 108 inches. We would like to find the dimensions of the package with the largest volume that can be mailed.