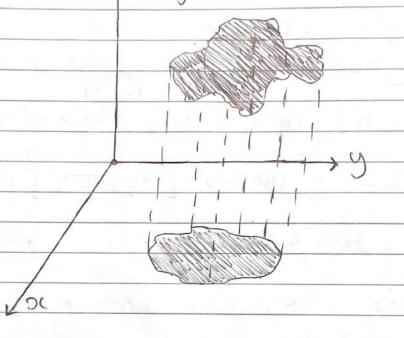
## Functions 10

Partial Differentiation
Consider a function V = V(x,y) of 2 independent
variables (x,y). We can think of a surface over
a (x,y) place v(x,y)



It is often helpful to visualise the surface Using contour lines.

U(or,y) = c (const.)

for various values of c.

Example U=2227y2-5 (circular contours)

<b>36</b>	
≫	
<b>3</b>	Objectable use could represent a geometrical
36	Physically, we could represent a geometrical obsect or temperature or pressure or We now
3	look at (spabal) rates of charge.
30	(OOK at (Spaces) (was or charges
30	which there is some for a sold of the form
30	We stort at P(x,y) and move a small distance in the x direction (dx) to Q(x+5x,y). We define this limit as:
36	The or our school (ax) is alxionid.
-	Che This amit us.
=6	21.1 1 == (11/20 + b 11/20 - 11/20 1)
	80 = lim (U(x+h,y) - U(x,y)) 80c h->0
	Similarly, Marian Marian Land
	0
	$\int_{\Omega} \int_{\Omega} \int_{\Omega$
	$\frac{\partial v}{\partial y} = \lim_{n \to \infty} \left( \frac{v(x_n, y + h) - v(x_n, y)}{h} \right)$
	Example $V = \infty^2 \sin y + y^3$
2	Living 0-25ing +g
	201 - 300 sign 201 20200 - 3.3
	$\frac{\partial v}{\partial x} = 2 \cos i n y$ $\frac{\partial v}{\partial y} = 2 c^2 \cos y + 3 y^2$
9	
3	We can of course, consider higher derivatives:
9	ac all or const (onstoat wither derivative).
9	$\partial^2 \Omega = \partial (\partial \Omega) \partial \Omega = \partial (\partial \Omega)$
9 :	$8^{3}$ $\frac{3}{3}$ $\frac{3}{3$
9 %	8 ( 925 926 (92) 9hs 9h (9h)
9	
9	200 = 2 (20) 200 = 2 (20) 200 = 2 (20) 200 = 2 (20)
9	and or all show and lose
	For the oxonal about 110
9	For the example above we get the following:
	Tallauny.

2300 = 25ing 200 = -2025ing + 69  $\frac{\partial^2 o}{\partial x \partial y} = \frac{2x \cos y}{\partial y \partial x}$ We note that in our case: This is a general result. Example v(x, t) = asin(x-ct) $\frac{\partial v}{\partial x} = \alpha \cos(2x - ct)$   $\frac{\partial v}{\partial t} = -\alpha \cos(x - ct)$  $\frac{\partial^2 v}{\partial x^2} = -a \sin(\alpha - ct)$   $\frac{\partial^2 v}{\partial t^2} = -a c^2 \sin(\alpha - ct)$ => v(x,t) satisfies The 1D -> D20 = 1 D20 = partial differential wave equation  $\partial x^2$   $c^2$   $\partial t^2$  equation. Any reasonable function of the form U = asin(x-ct)Sabfies this equation. It represents a wave form moving (with speed of to the right.

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