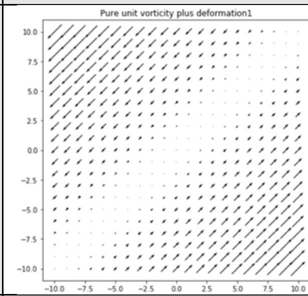
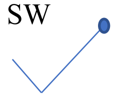
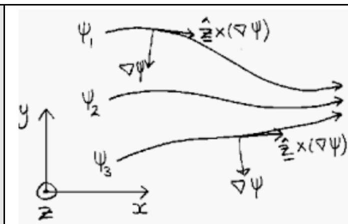
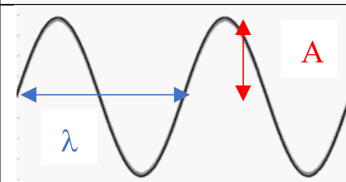
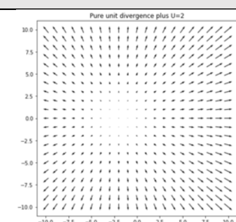
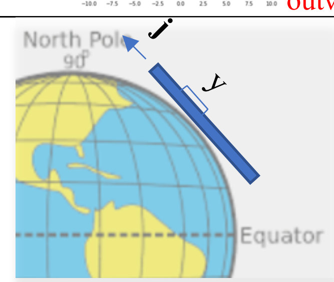
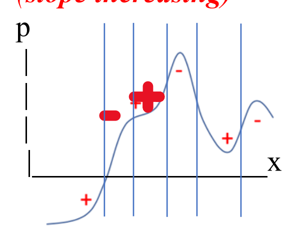
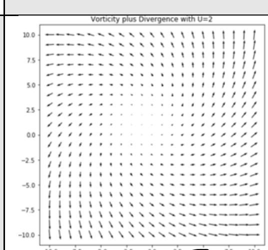
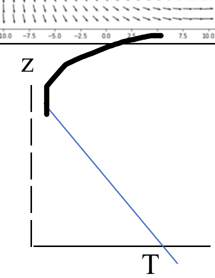
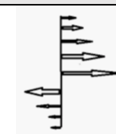
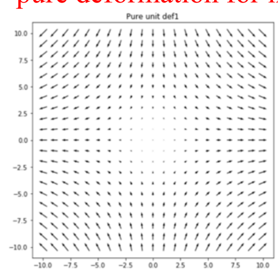
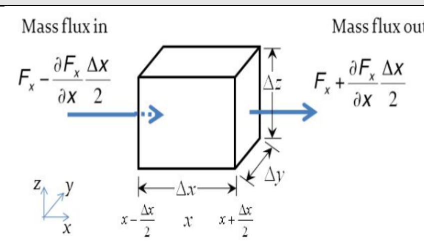
ATM 651 Exam 1: vocabulary. Name___________________

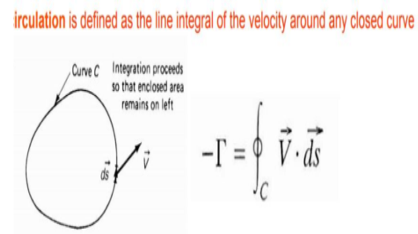
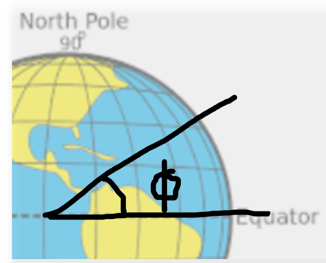
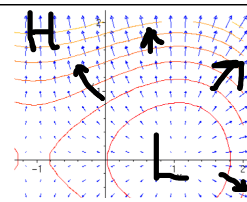
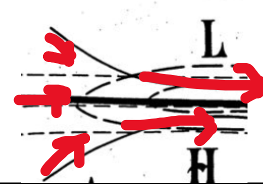
50 rows, 2 points for each row. Fill in the white boxes, 2 per row. *gray box: no response asked*

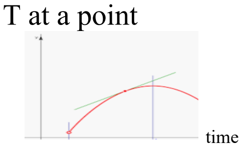
Words	**Symbol**	**Units**	**Definition** **math or words**	**Relevant sketch** **or extra space for more words**
	$-\vec{\nabla}\cdot(q\rho\vec{V})$		"	
Vertical velocity	w, $\dot{z}$		other answers accepted	like a humidity measure from another chapter
(name)			the layer of air in contact w/ the surface	
	One unit of vorticity plus one unit of deformation			
speed of wind whose components are u(x,y), v(x,y)		m s^{-1}	Speed = $\sqrt{u^2+v^2}$	
horizontal advection of specific humidity q	$-\vec{V}\cdot\vec{\nabla}q$	(units of q) s^{-1}	<-- (kg_{water}/kg_{air})	<-- is q "dimensionless"? formally yes, I suppose,...
dot product of a force and velocity (explain letter you choose -->	suggest W for work rate, or power P	(Nm) s^{-1} Joule s^{-1} Watts kg m^2 s^{-3}	$\vec{\boldsymbol{F}}_{PGF}\cdot\vec{\boldsymbol{V}}$	took any rational MKS answer and of course any letter, explained. Few if any saw the energy = force*distance or work rate = force*velocity. That's physics, not math/vocab.
vector velocity of a baseball in x,y,z coordinates	**V**	m s^{-1}	(use $\dot{x},\dot{y},\dot{z}$) $\boldsymbol{V}=\boldsymbol{i}\,\dot{x}+\boldsymbol{j}\,\dot{y}+\boldsymbol{k}\,\dot{z}=\dot{x}\boldsymbol{i}+\dot{y}\boldsymbol{j}+\dot{z}\boldsymbol{k}$	
		m s^{-1} (or knot)	10 knot southwesterly wind	*from* SW 
planetary vorticity	f	s^{-1}		
streamfunction $\psi(x,y)$ of a	$\psi(x,y)$	m^2 s^{-1}	sketch contours and a	

nondivergent 2D horizontal flow ($\vec{\boldsymbol{V}} = \hat{\boldsymbol{k}} \times \boldsymbol{\nabla}\psi$)		$m^2 s^{-1}$	few velocity vectors -->	
wavelength	λ	m	a number measuring something about a *spatial* sinusoid -->	
amplitude	A	freebie	indicate on sketch above	(see above)
temperature *anomaly*	T'(t,x,y)	K or °C or °F	*Deviation* from *time-averaged* T	not "trend" or "tendency", not "change", not "variance", ...
Laplacian of Z(x,y)	divergence of the gradient of Z(x,y)	m^{-1}	$\nabla^2 Z$	
Circulation. *What is it <u>equal to</u> (Stokes' theorem):*	C	$m^2 s^{-1}$	**area-integrated vorticity** = $\iint_{\substack{\text{area}\\\text{bounded}\\\text{by loop}}} \zeta \, dA$	
Coriolis force (per unit mass)	C_o f **k x V**	$m\ s^{-2}$		
del operator	∇	m^{-1}	$\boldsymbol{i}\frac{\partial}{\partial x} + \boldsymbol{j}\frac{\partial}{\partial y} + \boldsymbol{k}\frac{\partial}{\partial z}$	<-- write **i,j,k** to the *left,* since things on the right of the derivative get *operated on.* A *sum*.
vector velocity *field* of pure divergence	$\mathbf{V}_{\mathbf{div}}$(x,y)	$m\ s^{-1}$		 outward
distance north from origin	y (Cartesian coordinate used similar to the above)	meters	distance on a tangent plane, in the direction of the **j** unit vector	

Mass of 1 cc = 1 ml of water in MKS	(<--oops my typo)	1 g	1cc = 10^{-6} m^3 mass 10^{-3} kg	
Energy flux		W m^{-2} (J m^{-2} s^{-1})	How much (energy) passing through per unit area per second	
meridional flux of *zonal momentum*	ρuv or just uv	(*momentum*) m^{-2} s^{-1} or just m^2 s^{-2}	amount of zonal momentum passing northward through a unit area in the x-z plane, per second	Positive for southwesterly wind, negative for northeasterly wind. See below.
Laplacian of p(x)			using p(x) notation: d not ∂ because *p is a function of one variable only* $\frac{d^2p}{dx^2}$	***curvature**. Smile-like is positive **(slope increasing)*** 
vector velocity	**V**	m s^{-1}	**i**u+**j**v+**k**w	
curl operator		m^{-1}	(use nabla) $\nabla\times$	Just the operator. It has units.
Splat with a twist	One unit of divergence plus one unit of vorticity	poor ask but it's a velocity field, m s^{-1}		
troposphere the layer of air that radiation cools, so that surface solar heating must warm it with weather motion			the lowest ~10km of the atmosphere; where most weather occurs. dT/dz < 0	

Gradient of Φ(x,y,t) (Φ = gZ)		m s^{-2}	$\boldsymbol{i}\frac{\partial\Phi}{\partial x}+\boldsymbol{j}\frac{\partial\Phi}{\partial y}+\boldsymbol{k}\frac{\partial\Phi}{\partial z}$	<-- use **i,j,k** (Cartesian unit vectors). This is the *geopotential*.
vertical shear of zonal wind		s^{-1}	$\partial u/\partial z$	
Flux of specific momentum (that is, flux of velocity)		(*m/s*) m^{-2} s^{-1}	How much momentum (per unit mass) carried through a unit area per second	(*quantity in parentheses*) per square meter per second
A flow field with curvature but not vorticity. Sketch it carefully as vectors at the indicated points.	Remember, arrows for vectors apply at their tail point, and length is proportional to speed.		Practice on the back of page, then Just do it -->	pure deformation for instance 
local (Eulerian) tendency of q	$\frac{\partial q}{\partial t}$	(units of q) s^{-1}	"	Hey, don't I sometimes see some subcript on $\vec{V}$ or $\vec{\nabla}$? Yes, like $\vec{V}_h$ for horizontal wind, or $\vec{\nabla}_p$(__) for partial space derivatives taken @constant p
Local or Eulerian tendency of T(x,y,t)	$\left.\frac{\partial T}{\partial t}\right]_{x,y}$	K s^{-1}		
one name:	f	s^{-1}	$f = 2\Omega\sin(\varphi)$	another name:
Mass flux	ρV	(*kg*) m^{-2} s^{-1}	How much (mass) moving through a unit area per second	
Circulation, the **path integral** around a closed curve of the ***curve-tangential***	C		$\oint_{loop} V_s\,ds$	

component of the flow				
vertical component of vector vorticity	ζ	s^{-1}	$\boldsymbol{k} \cdot (\nabla \times \mathbf{V})$	
	$\frac{dq}{dt}$	(units of q) s^{-1}	"	"
latitude	ϕ (a scalar coordinate varying only in one spatial direction)	degrees (or radians)	Latitude is an angle from the center of the Earth. That's why we take its sine and cosine.	
Gradient of p(x,y) where p is pressure	∇p	Pa/m Kg m^{-2} s^{-2}	sketch some contours with H and L, & indicate vectors that illustrate --> concept	
	(use nabla): $\nabla^2 T$	K m^{-2}		
PGF		m s^{-2}	$\frac{-1}{\rho}\nabla p$ or $-\nabla\Phi$	
vertical advection of (meridional momentum per unit mass)	$-w\frac{\partial}{\partial z}(v)$	m s^{-2}	rate of change of v due to advection by vertical wind component	Get used to fluid dynamics presuming *per unit mass*.
Radius of earth in MKS units	a	m	$(10^7 m) / (\pi/2)$ = 6341 km	
confluence without convergence			sketch --> carefully (streamlines and isotachs)	

Temperature	T(x,y,t)	K or °C (accepted Joules)	a measure of the energy of molecular motion ("heat")	
omega	ω	Pa s^{-1}	$\dot{p}$, vertical velocity of air in p coord.	~~draw vector~~ for ω>0: *downward* motion
Local or Eulerian tendency of T(x,y,t)			Rate of change of T with time *for a thermometer at a given location*	T at a point  *Slope* of T(t) curve
cause and effect			"correlation is not causation"	https://xkcd.com/552/