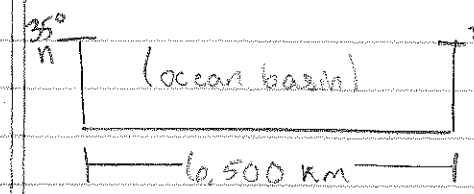
4). $Sv = 10^6 m^3/s$; Ocean basin is 6,500 km wide
35° N latitude; wind stress curl = -10^{-7} Pa/m



$6{,}500\,km \times \frac{1000\,m}{1\,km} = 6{,}500{,}000\,m$

$M^y = \frac{1}{\beta} curl_H \vec{\tau}$

$\beta = \frac{df}{dy} = \frac{8.33 \times 10^{-5}\,s^{-1}}{6{,}500{,}000\,m}$

$f = 2\Omega \sin\phi$

$= 2(7.27 \times 10^{-5}) \sin(35°)$

$= 8.33 \times 10^{-5}\,s^{-1}$

$\beta = 1.28 \times 10^{-11}\,m^{-1}s^{-1}$

$M^y = \frac{-10^{-7}}{1.28 \times 10^{-11}} = -7{,}812.5\,kg\,m^{-1}s^{-1}$

(across basin width of 6,500,000 m)

$M^y = -7{,}812.5 \times 6{,}500{,}000 = -5.08 \times 10^{10}\,kg\,s^{-1}$

$\frac{-5.08 \times 10^{10}\,kg\,s^{-1}}{1{,}030\,kg\,m^{-3}}$

$1\,Sv = 10^6\,m^3/s$

$= \frac{-4.93 \times 10^{7}\,m^{-3}s^{-1}}{10^6} = -49.3\,Sv$

2Ω

$\Omega = \frac{2\pi \sin\theta}{24 hr \times \frac{3600\,s}{1\,hr}}$

$\Omega = \frac{2}{24 \times 3600}$