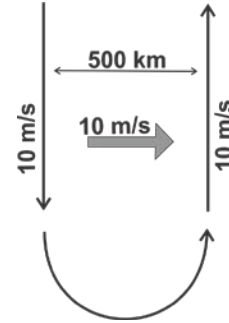


1. Consider a stationary, sharp trough 500 km wide at 45° latitude where $f = 1 \times 10^{-4} \text{ s}^{-1}$. On the west side of the trough the QG meridional wind is from the north at 10 m s^{-1} ; on the east side it is from the south, also at 10 m s^{-1} . The mean QG zonal wind is from the west 10 m s^{-1} . What is the (assumed constant) ageostrophic wind required to reverse the zonal wind as it blows around the bottom of the trough? Note: you will need to take into account the change in time to cross the trough due to the combined QG and ageostrophic wind. Does the ageostrophic wind blow from with or against the QG wind?



2. A constant, 20 m s^{-1} , westerly zonal wind carries an air parcel through a patch of shearing vorticity. On the entrance side of the patch the relative vorticity is zero and $f = 1 \times 10^{-4} \text{ s}^{-1}$. After traveling 1000 km at 20 m s^{-1} , the parcel reaches the center of the patch where $\zeta + f = 0.9 \times 10^{-4} \text{ s}^{-1}$. Is the new relative vorticity cyclonic or anticyclonic? Assuming that the parcel initially extends from the tropopause at 100 mb, where $\omega = 0$, to the 300 mb level, what is the pressure at the bottom of the parcel required to adjust the parcel's absolute vorticity to match that in the vorticity patch? What is the average ω at the bottom of the parcel as it is moving into the patch? Is the required ω directed upward or downward?

