Solutions to problems on chapter 14

1) Use $c = u_0 - \frac{\beta}{\lambda^2 + \mu^2}$, with $u_0 = 12ms^{-1}$,

$$\beta = \frac{2\Omega\cos 60}{a} = \frac{2\times 7.292\times 10^{-5}s^{-1}\times 0.5}{6.3712\times 10^6 m} \text{ and } \lambda^2 + \mu^2 = \left(\frac{2\pi}{10^7 m}\right)^2 + \left(\frac{2\pi}{2.5\times 10^6 m}\right)^2.$$

This gives $c = 10.29ms^{-1}$.

This value is, of course, fairly close to the basic wind. This is because the y-wavelengths in this case is rather small, and this dominates the term involving the wavenumbers

2) $L_x = 2\pi\sqrt{\frac{u_0}{\beta}}$ with $\beta = \frac{2\Omega\cos 35}{a} = \frac{2\times 7.292\times 10^{-5}s^{-1}\cos 35}{6.3712\times 10^6 m} = 1.875\times 10^{-11}m^{-1}s^{-1}$

Note that the length of the latitude circle is $2\pi a\cos 35 = 3.279\times 10^7 m$.

$u/(ms^{-1})$	10	15	20
L_x/km	4590	5620	6490
No. round lat circle	7.1	5.8	5.05

3) The choice seems to be between making the number round a latitude circle 5 or 6. To make it 6 would mean decreasing the x-wavelength. The waves would then be smaller and would drift to the east (since small waves travel more slowly against the basic flow than do long waves). Adding in a variation in the y direction would reduce the total wavelength and just exacerbate this problem. Hence we need to aim at having 5 waves round a latitude circle, so that the x-wavelength would be 6558 km.

We will need $\lambda^2 + \mu^2 = \frac{\beta}{u_0} = 2.186\times 10^{-12}m^{-2}$.

So $\mu^2 = 2.186\times 10^{-12}m^{-2} - \frac{4\pi^2}{6.558^2 10^{12} m^2}$, which gives $L_y = 5580km$