Few Points to remember about Doppler's effect

1. If the source is moving towards the listener wavelength of the sound produced in air is less then with stationary source and hence the frequency increases. The frequency heard is

$$f = f_0 \frac{c}{c - v_s}$$

Here f_0 is the frequency of the source, c is speed of wave and v_s is speed of source.

2. If the source is moving away from the listener wavelength of sound is more than usual and hence the frequency increases. The frequency is given by

$$f = f_0 \frac{c}{c + v_s}$$

Thus, the equation is the same if we consider that the source is moving with negative velocity.

3. If the source is stationary and the listener is moving towards the source with velocity v_L, he receives greater number of waves (because sweeps extra pulses in the distance moved in one second) thus the frequency increases and the frequency is given by

$$f = f_0 \frac{c + v_L}{c}$$

4. If the source is stationary and the listener is moving away from the source with velocity v_L, he receives less number of waves (because some pulses still remained to get in one second) thus the frequency decreases and the frequency is given by

$$f = f_0 \frac{c - v_L}{c}$$

Including all equations we can remember only one equation.

$$f = f_0 \left(\frac{c \pm v_L}{c \mp v_s}\right)$$

Only the appropriate sign is to be taken. Upper sign for approaching nearer and lower for moving away.

5. If the wind is blowing with speed w at an angle θ to the line joining the source and the listener, the component of wind velocity in the direction of the line joining is w*cos θ and hence the speed of sound in still air c is to be written as c + w*cos θ and the equation becomes

$$f = f_0 \left(\frac{c + w * \cos\theta \pm v_L}{c + w * \cos\theta \mp v_s}\right)$$

For still air w = 0,