The concept of phase is somewhat difficult to grasp - especially in the field of acoustics. However it is important to have some concept of phase however simplified to appreciate the concept of time delay since the two are related.

An illustration of phase

Consider a bicycle with large visible tyre valves. With the bicycle at rest the tyre valves are set so that both valves are pointing straight down at the ground. The bicycle is wheeled along for one revolution of the front wheel until the front valve is at the same position again. If the back wheel is the same diameter as the front then the back wheel valve will also map out one revolution and return to a position pointing downwards. It will be exactly in step with the front wheel. As an electrical engineering concept the back wheel valve is exactly in phase with the front wheel valve. i.e the phase difference is zero.

Supposing the rear wheel is slightly larger than the front wheel. As the front wheel maps out one complete revolution the rear wheel valve falls short of pointing straight downwards. It could be measured as say 10° short. In other words the position mapped out by the rear wheel valve is now 10° out of phase with the front wheel valve. As the bike is wheeled along so the error in back wheel valve position is cumulative. On the second revolution of the front wheel, the rear wheel is now 20° in error and so on. After 18 revolutions of the front wheel the rear wheel would be 180° out of phase $(18 \times 10)^{\circ}$ and whilst the front valve pointed straight down the rear valve would point straight up. They would be exactly out of phase with each other. A further 18 revolutions of the front wheel would bring the rear wheel apparently in phase with the front wheel again. But the rear wheel is actually $(36 \times 10^{\circ}) = 360^{\circ}$ out of phase. Although the valves are both pointing straight down again after 36 revolutions of the front wheel, the back wheel has only done 35 revolutions i.e. it has now lagged behind the front wheel by one complete revolution of 360 degrees.

To an observer who looks at the bicycle at the beginning of this experiment, goes away, and looks at it again after 36 revolutions of the front wheel, both valves appear to be in phase with one another. To the person pushing the bike and observing the position of the valves the rear wheel is 360° out of phase with the front wheel.

The moral of this story with regard to understanding phase and bicycles is:

1) The phase of anything must be quoted as relative to some fixed reference. The phase of the back wheel was examined with reference to the front wheel. The back wheel could have been taken as the reference in which case after 35 revolutions of the back wheel the front wheel would be 360° ahead (or leading) of the back wheel. Hence the terms phase lag or phase lead, designated as - or + phase change respectively.

2) Multiples of 360° (or 2π Radians) appear to give "in phase" conditions. Multiples of 180° (or π Radians) appear to give "out of phase" conditions.