

SYNCHRONISED METRONOMES

What to do

1. **Start all of the metronomes**
2. **Watch them synchronise**



Each of the metronomes has the same mass and is set to the same frequency as the other metronomes. Ordinarily, if you start metronomes at different times they will continue to oscillate at the frequency at which they are set and will not interact with each other. However, if the metronomes are set onto a surface which has some freedom of movement, the vibration of the metronomes' oscillations will rock the surface. This allows the metronomes to couple with one another.

As the mass of a metronome swings, the surface on which that metronome is sitting will experience a force and, being free to move, will rock in the same direction. This rocking is transferred to other objects sitting on the surface. The rocking due to the first metronome will accelerate the swing of any metronomes with a slower speed (in the same direction) and decelerate the swing of any metronomes swinging at a faster speed (in the same direction) at each instant in time.



The sum of the contributions from each of the swings of the metronomes dictates the net external force on each metronome. This slows down and speeds up the swings of the metronomes until they all become synchronised. When the metronomes are synchronised their swings exert no force on one another as they are travelling with the same velocity at each point of their cycle.

When the metronomes are phase-locked any perturbation to the swing of a metronome is lost through the same mechanism the metronomes came into phase. Thus, the metronomes continue to swing in phase with one another. If the movement of the surface is restricted the metronomes will (after some time) lose their synchronisation.

What happens if one metronome is initially stationary while the others are in motion?

