**Harmonic Motion**

The simplest example of harmonic motion is a rotating disc, like a record. We will use this to develop equations to describe position, velocity and acceleration of an object undergoing simple harmonic motion.

|  |  |
| --- | --- |
|  | A marker at the edge of the record and trace its horizontal motion.  Max distance = Amplitude  Will be from R to – R  Horizontal position = |



**ϴ = ωt so x = A cos θ = A cos ω t or A cos (2πf)**



**Velocity**

The velocity of the marker will be along the tangent line, so the x component of velocity will be the x component of that v­tan.

|  |  |
| --- | --- |
|  | Here, that x component is the sin of the vtan sin ϴ and it is in the negative direction.  vx = |

**vx = – vtan sin ϴ = – ω A sin (ω t) = – ω A sin (2π f)**



**Acceleration**

|  |  |
| --- | --- |
|  | Acceleration is along radius  ac = (vtan)2/R |



**ax = – ω2 A cos (ω t) = – ω2 A cos (2π f)**

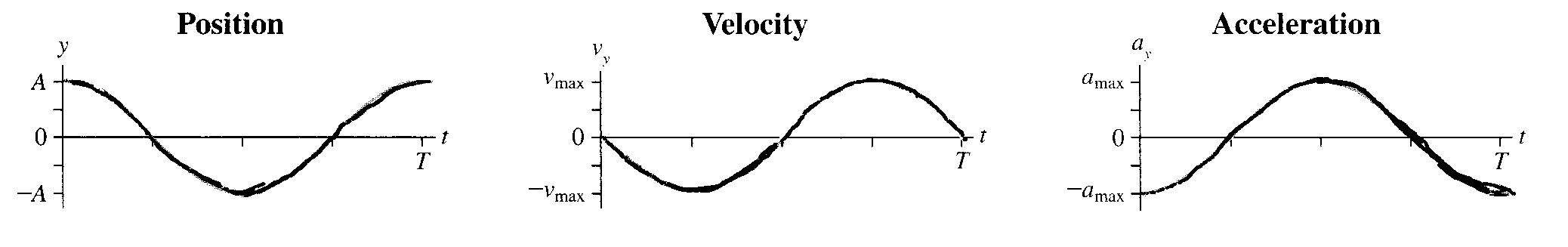
**ax = – ω2 A cos θ = – ω2 x (A cosϴ = x from above)**



**Motion Graphs**

Think about a mass on a spring oscillating up and down or horizontally.







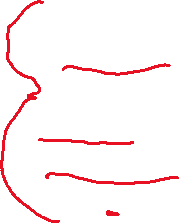
**Θ = ω t = 2πnf (t) ω = 2πn n is revolutions**



**x = A cos ω t vx = – ω A sin ω t a­x = – ω2 A cos ω t**



**x = A cos θ vx = – ω A sin θ ax = – ω2 A cos θ**



xmax = A vmax = – ω A amax = – ω2 A



xmax when θ is vmax when θ is amax when θ is

0, π or n π (n -1/2)π (odd ½’s) 0, π, or n π



The spring has a restorative force and by Hooke’s Law



Newton’s 2nd law



**ma = - kx = m (– ω2x) = – kx ω2 = k/m**

