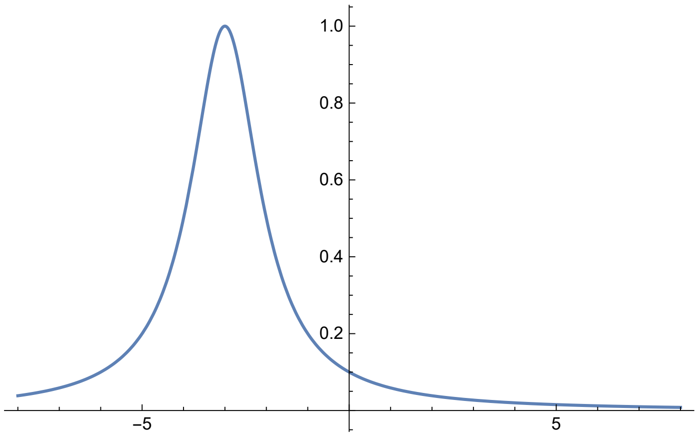
Wave Motion

Motion of a Generic Pulse

In[155]:=
```
f1[x_] := 1/((x + 3)^2 + 1)
```

In[156]:=
```
Plot[f1[x], {x, -8, 8}]
```

Out[156]=



The generic form for a traveling wave moving to the right is f(x - vt).

In[157]:=
```
f1[x - vt]
```

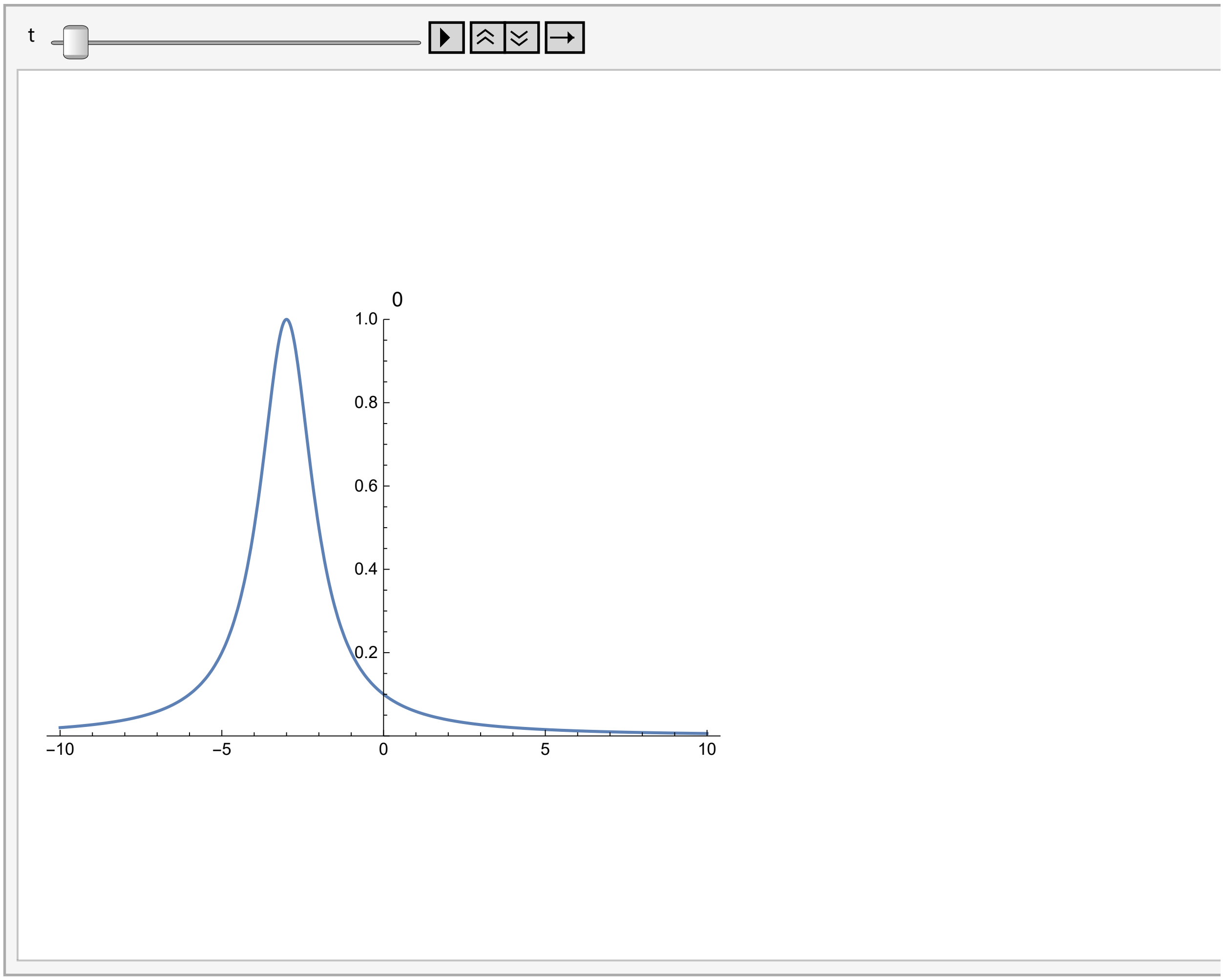
Out[157]=

$$\frac{1}{1 + (3 - vt + x)^2}$$

Make the pulse move with speed v = 2.

In[158]:=
```
Animate[Plot[f1[x - 2 t], {x, -10, 10}, PlotRange → {0, 1},
  PlotLabel → PaddedForm[t, {5, 2}]], {t, 0, 10, 0.1}, AnimationRunning → False]
```

Out[158]=

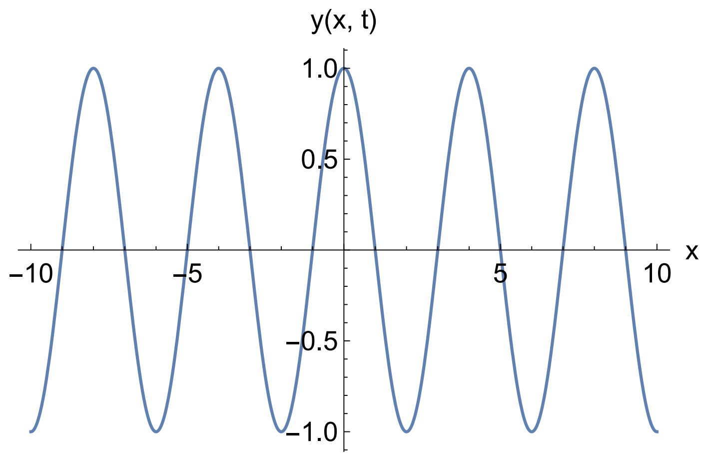


Motion of a Periodic Wave

In[159]:=
```
Clear[λ, f2, v]
λ = 4; v = 2;
```

In[161]:=
```
Plot[Cos[2π/λ x], {x, -10, 10}, LabelStyle → Larger, AxesLabel → {"x", "y(x, t)"}]
```

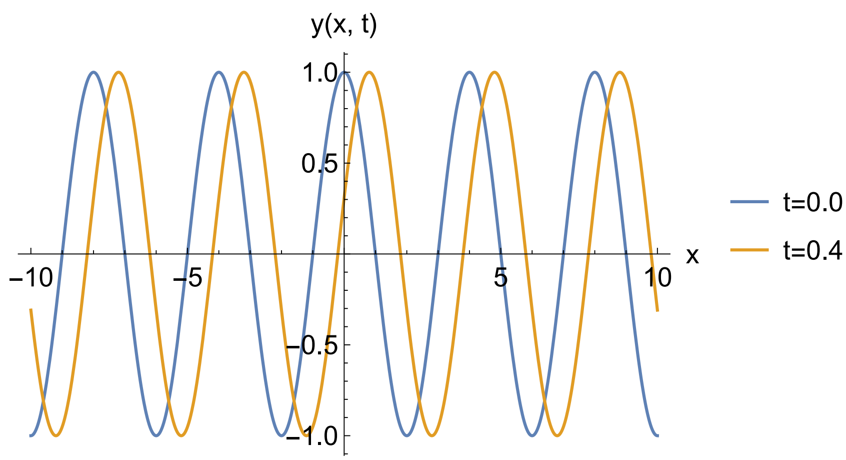
Out[161]=



We can also compare the wave at two different times, say 0.0 and 0.4 seconds:

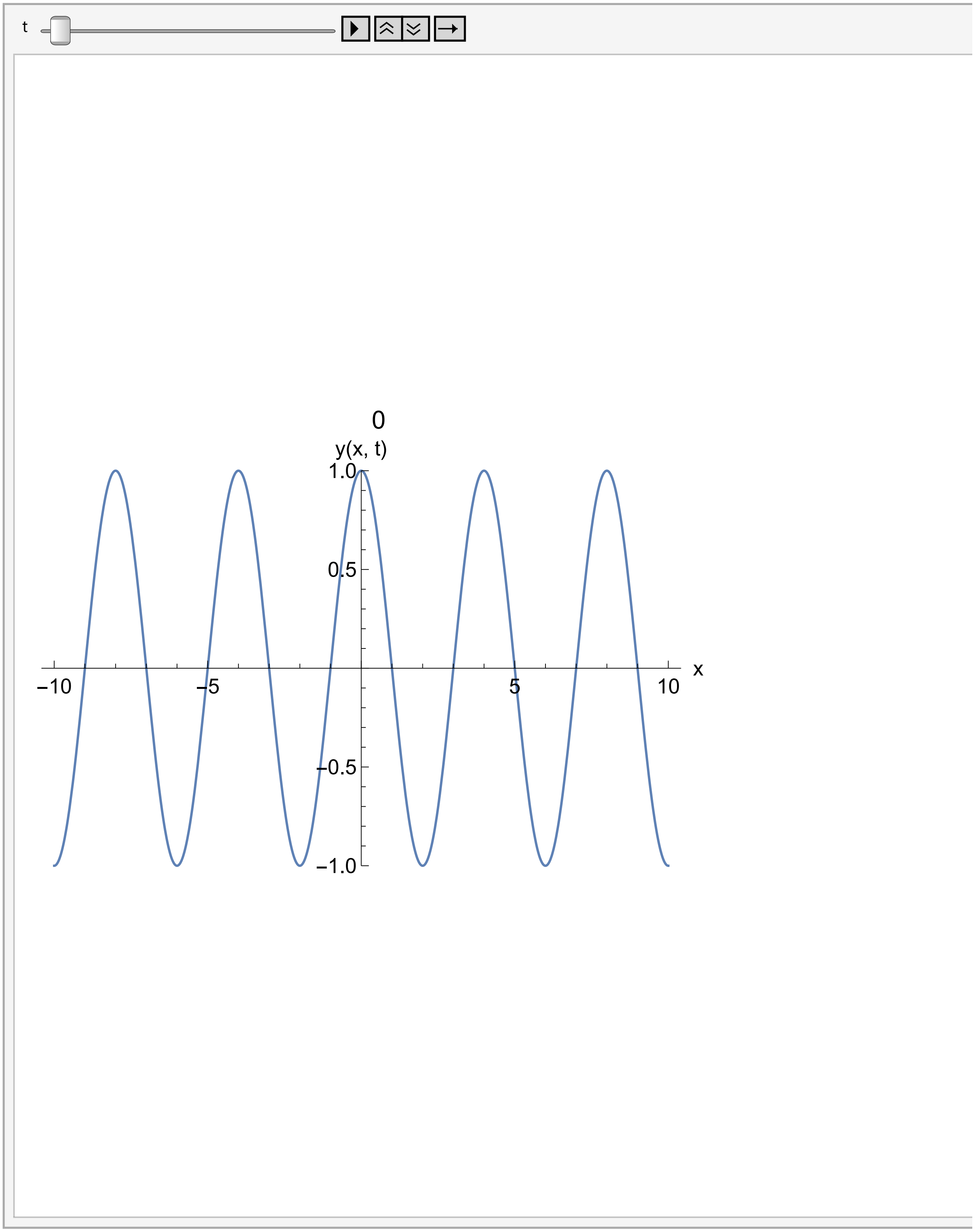
In[162]:=
```
Plot[{Cos[2π/λ (x - v*0)], Cos[2π/λ (x - v*(0.4))]}, {x, -10, 10},
 PlotLegends → {"t=0.0", "t=0.4"}, LabelStyle → Larger, AxesLabel → {"x", "y(x, t)"}]
```

Out[162]=



In[163]:=
```
Animate[Plot[Cos[2π/λ (x - v t)], {x, -10, 10},
  LabelStyle → Larger, AxesLabel → {"x", "y(x, t)"}, PlotRange → {-1, 1},
  PlotLabel → PaddedForm[t, {5, 2}], ImageSize → Scaled[0.75]],
 {t, 0, 5, 0.1}, AnimationRate → .5, AnimationRunning → False]
```

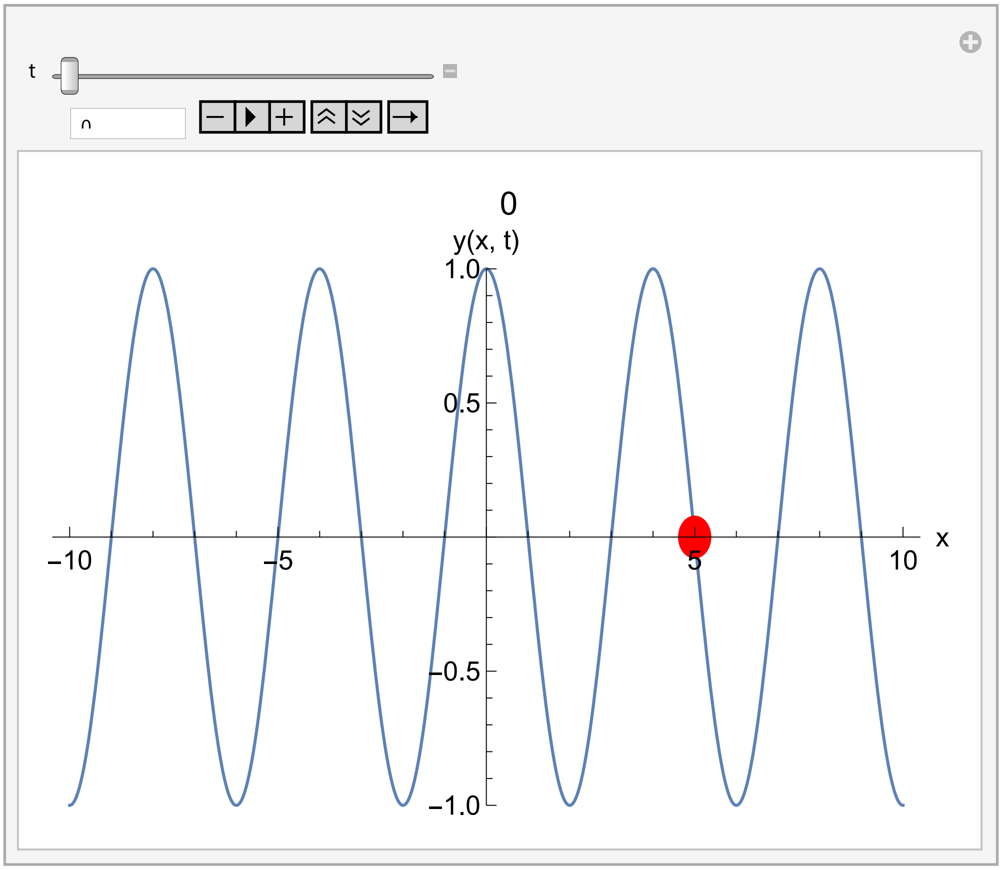
Out[163]=



Now look at a fixed point in space (say x == 5) and ask what the wave does at that point.

In[164]:=
```
v = 2;
Manipulate[Show[{Plot[Cos[2π/λ (x - v t)], {x, -10, 10}, LabelStyle → Larger, AxesLabel →
    {"x", "y(x, t)"}, PlotRange → {-1, 1}, PlotLabel → PaddedForm[t, {5, 2}]],
   Graphics[{Red, Disk[{5, Cos[2π/λ (5 - v t)]}, {0.4, 0.08}]}]}],
  ImageSize → Scaled[0.8]], {t, 0, 25, 0.01, Appearance → "Open",
  AnimationRate → 0.5, AnimationRunning → False}]
```

Out[165]=



In[166]:=

It exhibits periodic motion, with a time T = λ/v.

In[167]:=
```
T = λ / v
```

Out[167]= 2