

Trajectory of projectile with Gravity

```
(Local) In[11]:=
Clear["Global`*"];
```

■ Equations of motion for a projectile launched from origin with {vx0,vy0}

```
(Local) In[12]:=
S = DSolve[
  {x''[t] == 0, y''[t] == -g, x[0] == 0, y[0] == 0, x'[0] == vx0, y'[0] == vy0}, {x[t], y[t]}, t]
(Local) Out[12]=
{{x[t] == t vx0, y[t] ==  $\frac{1}{2}(-g t^2 + 2 t vy0)$ }}
```

■ Find the takeoff and landing (y=0) times and locations

```
(Local) In[13]:=
T = Solve[y[t] == 0 /. S, t]
```

```
(Local) Out[13]=
{{t == 0}, {t ==  $\frac{2 vy0}{g}$ }}
```

```
(Local) In[14]:=
x[t] /. S /. T
```

```
(Local) Out[14]=
{{0}, { $\frac{2 vx0 vy0}{g}$ }}
```

■ Find the time the trajectory peaks and its maximum height

```
(Local) In[15]:=
U = Solve[D[y[t] /. S, t] == 0, t]
```

```
(Local) Out[15]=
{{t ==  $\frac{vy0}{g}$ }}
```

```
(Local) In[16]:=
y[t] /. S /. U
```

```
(Local) Out[16]=
{{ $\frac{vy0^2}{2 g}$ }}
```

■ Plot the trajectory for certain parameters

```
(Local) In[17]:=  
v = {vx0 Æ 5, vy0 Æ 5, g Æ 10};  
  
(Local) In[18]:=  
ParametricPlot[Evaluate[{x[t], y[t]} /. S /. V], {t, 0, 1},  
Frame Æ True, FrameLabel Æ {"x[t]", "y[t]"}, RotateLabel Æ False];
```

