

■ Two-Body One-Dimensional Elastic Collision

```
(Local) In[77]:=
Clear["Global`*"];
```

■ Conservation of momentum and kinetic energy:

```
(Local) In[78]:=
eq = {m1 vi1 + m2 vi2 == m1 vf1 + m2 vf2,
      
$$\frac{m1 vi1^2}{2} + \frac{m2 vi2^2}{2} == \frac{m1 vf1^2}{2} + \frac{m2 vf2^2}{2}};$$

```

■ In the first solution (quadratic equation) the objects miss each other:

```
(Local) In[79]:=
sol1 = Solve[eq, {vf1, vf2}][[1]]
```

```
(Local) Out[79]=
{vf1 &E vi1, vf2 &E vi2}
```

■ But in the second solution they collide:

```
(Local) In[80]:=
sol2 = Solve[eq, {vf1, vf2}][[2]]
```

```
(Local) Out[80]=
{vf1 &E  $\frac{m1 vi1 - m2 vi1 + 2 m2 vi2}{m1 + m2}$ , vf2 &E  $\frac{2 m1 vi1 - m1 vi2 + m2 vi2}{m1 + m2}$ }
```

■ Define the masses and initial velocities (try some other values!):

```
(Local) In[81]:=
val = {m1 -> 1, m2 -> 1, vi1 -> 10, vi2 -> 0};
```

■ Get {x,t} coordinates for both objects before and after the collision: (assume the collision is at {x,t} = {0,0})

```
(Local) In[82]:=
coord1[t_ /; t &lt; 0] := {vi1 t, t} /. val
coord1[t_ /; t > 0] := {vf1 t, t} /. sol2 /. val
```

```
(Local) In[84]:=
coord2[t_ /; t &lt; 0] := {vi2 t, t} /. val
coord2[t_ /; t > 0] := {vf2 t, t} /. sol2 /. val
```

■ Plot the $\{x,t\}$ trajectories of the two objects:

```
(Local) In[86]:=
Clear[coordplot1];
coordplot1[t_] := ListPlot[{coord1[t]},
  PlotStyle  $\{$ PointSize[0.03], RGBColor[1, 0, 0] $\}$ , GridLines  $\{$ Automatic, Frame  $\{$ True,
  FrameLabel  $\{$ "x", "t" $\}$ , RotateLabel  $\{$ False, PlotRange  $\{$ {-100, 100}, {-10, 10} $\}$ ]
```

```
(Local) In[88]:=
plotarray1 = Table[coordplot1[tp], {tp, -10, 10, 2}];
```

```
(Local) In[89]:=
Clear[coordplot2];
coordplot2[t_] := ListPlot[{coord2[t]},
  PlotStyle  $\{$ PointSize[0.03], RGBColor[0, 0, 1] $\}$ , GridLines  $\{$ Automatic, Frame  $\{$ True,
  FrameLabel  $\{$ "x", "t" $\}$ , RotateLabel  $\{$ False, PlotRange  $\{$ {-100, 100}, {-10, 10} $\}$ ]
```

```
(Local) In[91]:=
plotarray2 = Table[coordplot2[tp], {tp, -10, 10, 2}];
```

```
(Local) In[92]:=
Show[plotarray1, plotarray2];
```

