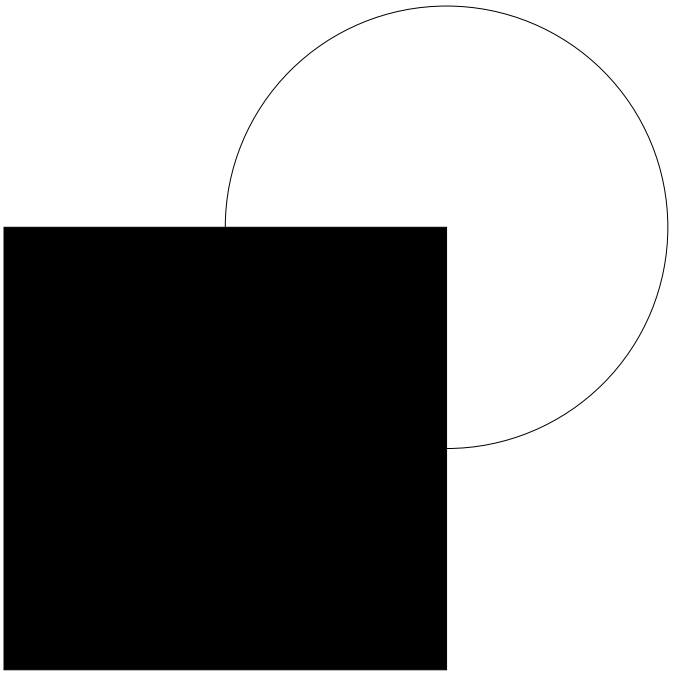
Графика

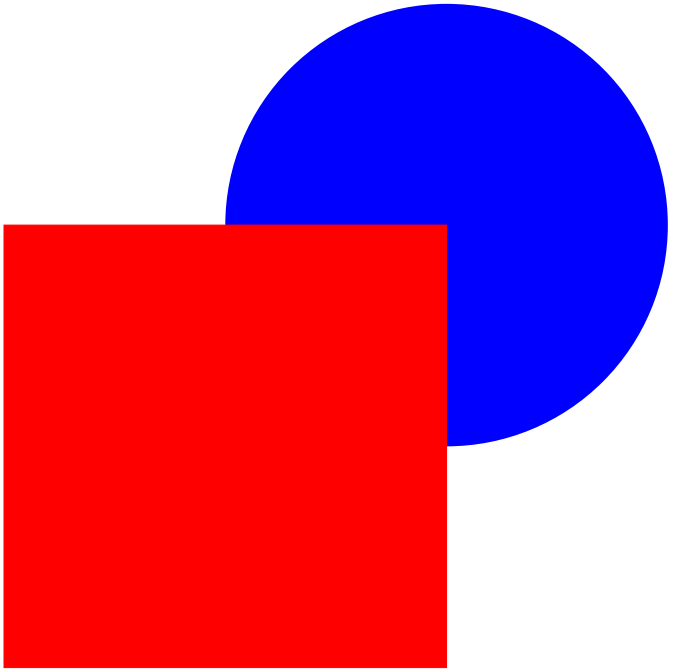
In[1]:=
```
Graphics[{
  Circle[{1, 1}, 1],
  Rectangle[{-1, -1}, {1, 1}],
 }]
```

Out[1]=

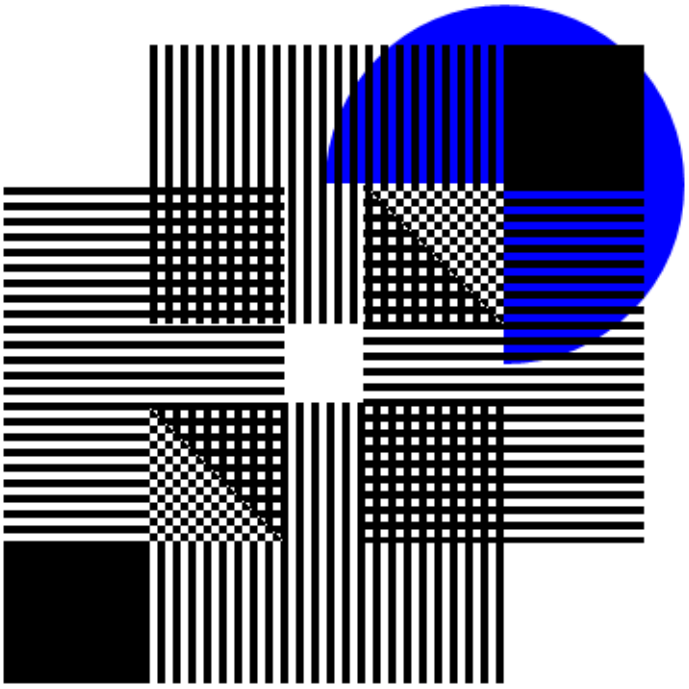


In[2]:=
```
Graphics[{
  Blue, Disk[{1, 1}, 1],
  Red,
  Rectangle[{-1, -1}, {1, 1}],
 }]
```

Out[2]=

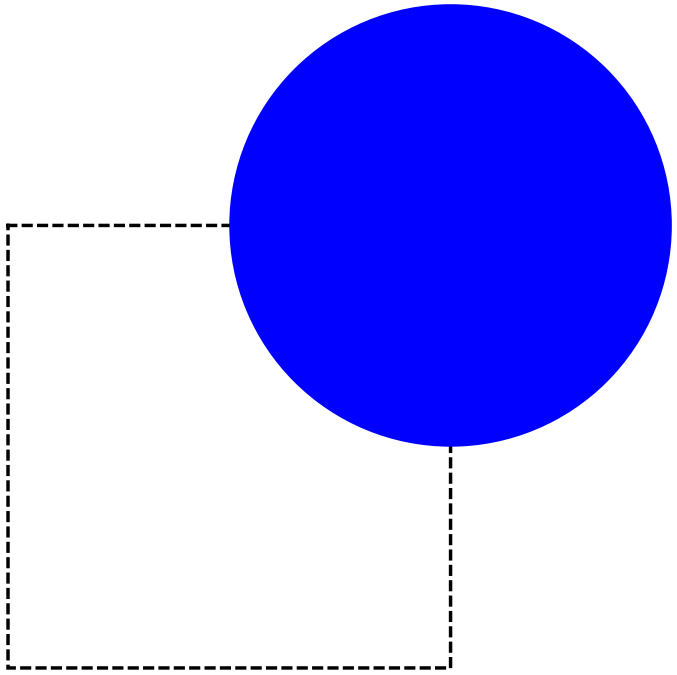


In[3]:=
```
Graphics[{
  Blue, Disk[{1, 1}, 1],
  White, EdgeForm[Directive[Thickness[.5], Dashed]],
  Rectangle[{-1, -1}, {1, 1}],
 }]
```



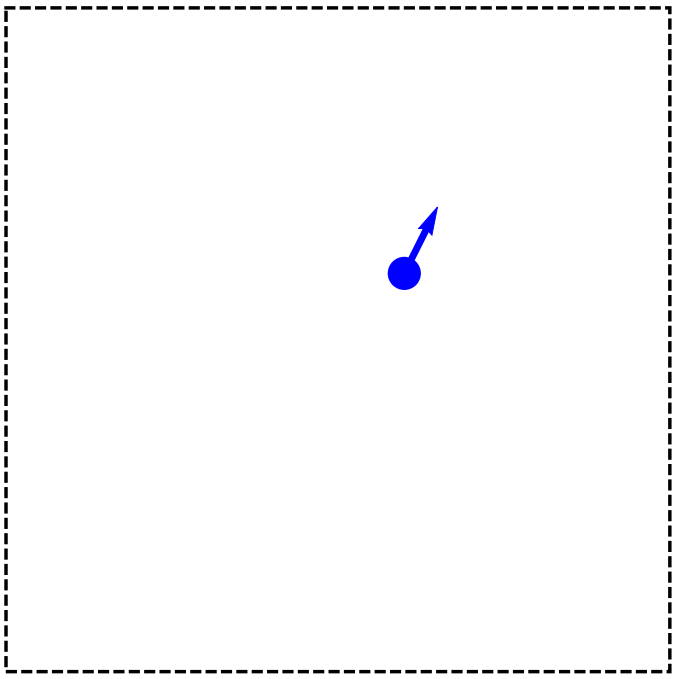
In[4]:=
```
Graphics[{
  White, EdgeForm[Directive[Thickness[.005], Dashed]],
  Rectangle[{-1, -1}, {1, 1}],
  EdgeForm[None],
  Blue, Disk[{1, 1}, 1]
 }]
```

Out[4]=



In[5]:=
```
Graphics[{
  White, EdgeForm[Directive[Thickness[.005], Dashed]],
  Rectangle[{-1, -1}, {1, 1}],
  EdgeForm[None],
  Blue, {{{Disk[.2 {1, 1}, .05]}}},
  Thickness[.01],
  Arrow[{.2 {1, 1}, {.3, .4}}]
 }]
```

Out[5]=



Цвета

In[6]:=
```
Blue
```

Out[6]=

In[7]:=
```
// FullForm
```

Out[7]//FullForm=
```
RGBColor[0, 0, 1]
```

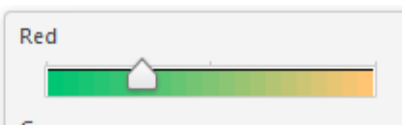
In[8]:=
```
RGBColor[.9, .2, .3]
```

Out[8]=

In[9]:=

Out[9]=

In[ ]:=



In[10]:=
```
RGBColor[.9, .2, .3, .4]
```

Out[10]=

In[11]:=
```
ColorData[3]
```

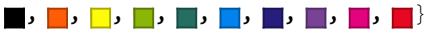
Out[11]=
```
ColorDataFunction[ ]
```
Index: 3 Colors: 10
Palette:

In[12]:=
```
ColorData[3][4]
```

Out[12]=

In[13]:=
```
ColorData[3] /@ Range[10]
```

Out[13]=



In[14]:=
```
ColorData /@ Range[8]
```

Out[14]=
```
{ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ],
 ColorDataFunction[ ]}
```
Index: 1 Colors: ∞
Palette:

Index: 2 Colors: 9
Palette:

Index: 3 Colors: 10
Palette:

Index: 4 Colors: 10
Palette:

Index: 5 Colors: 10
Palette:

Index: 6 Colors: 11
Palette:

Index: 7 Colors: 11
Palette:

Index: 8 Colors: 9
Palette:

Задача

In[15]:=
```
(Flatten[{RandomReal[{-1, 1}, 4], ColorData[3][#]}] & /@ Range[8])
```

Out[15]=
```
{{-0.755888, 0.969415, 0.232613, -0.810135, ■},
 {0.0697005, -0.915704, -0.0197519, -0.648394, ■},
 {0.630061, -0.219442, 0.152534, -0.502579, ■},
 {-0.687268, -0.876847, 0.696427, 0.114215, ■},
 {-0.169385, -0.566104, 0.707201, 0.644766, ■},
 {-0.136515, -0.727695, -0.587773, -0.785913, ■},
 {-0.83959, -0.448895, 0.81154, 0.853577, ■},
 {-0.84303, 0.646506, 0.00100485, -0.358778, ■}}
```

In[16]:=
```
G[x_, y_, vx_, vy_, col_] :=
 Module[{x1, y1},
  {x1, y1} = {x, y} + .2 {vx, vy};
  {col, EdgeForm[None], Disk[{x, y}, .035],
   Thickness[0.01], Arrow[{{x, y}, {x1, y1}}]}
 ];
```

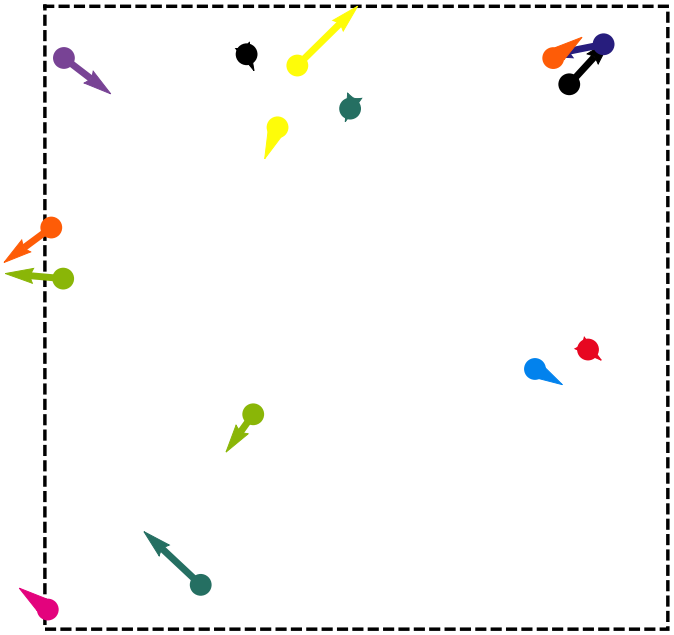
In[17]:=
```
G @@ Flatten[{RandomReal[{-1, 1}, 4], ColorData[3][4]}]
```

Out[17]=
```
{■, EdgeForm[None], Disk[{0.435571, -0.779554}, 0.035],
 Thickness[0.01], Arrow[{{0.435571, -0.779554}, {0.440272, -0.974175}}]}
```

```
@@@ ≈ /@ + @@ (Map[] + Apply[])
```

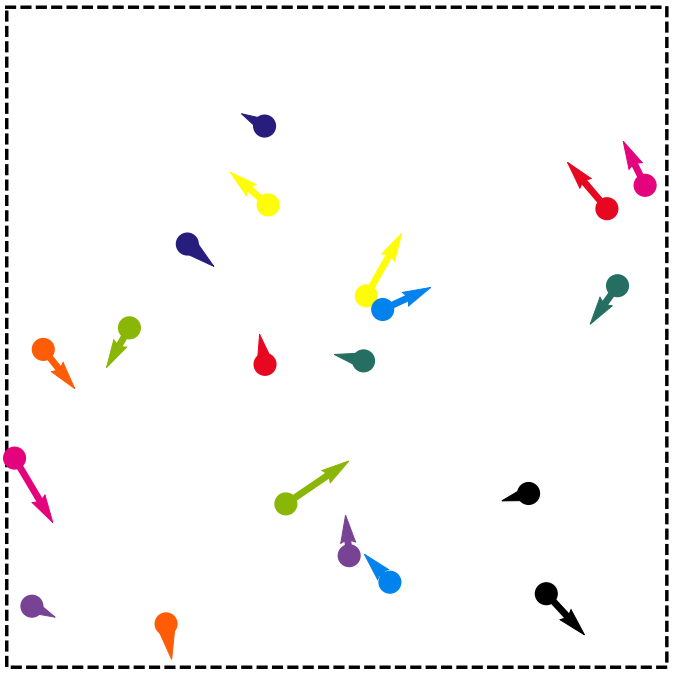
In[18]:=
```
Graphics[{
  White, EdgeForm[Directive[Thickness[0.005], Dashed]],
  Rectangle[{-1, -1}, {1, 1}],
  EdgeForm[None], Thickness[.01],

  G @@@ (Flatten[{RandomReal[{-1, 1}, 4], ColorData[3][#]}] & /@ Range[15])

 }]
```

Out[18]=

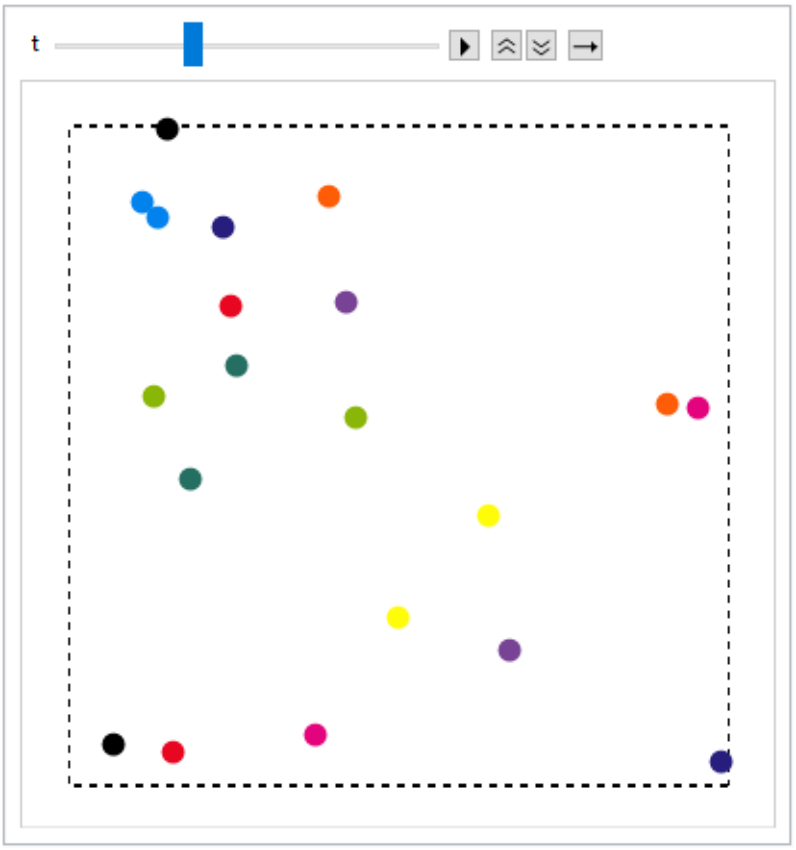


In[19]:=
```
SeedRandom[1];
Graphics[{
  White, EdgeForm[Directive[Thickness[.005], Dashed]],
  Rectangle[{-1, -1}, {1, 1}],
  EdgeForm[None],
  Thickness[.01],
  {#5, Disk[{#1, #2}, .035], Arrow[{{#1, #2}, {#1, #2} + .2 {#3, #4}}]} & @@
     Flatten[{RandomReal[{-1, 1}, 4], ColorData[3][#]} & /@ Range[20]
 }]
```

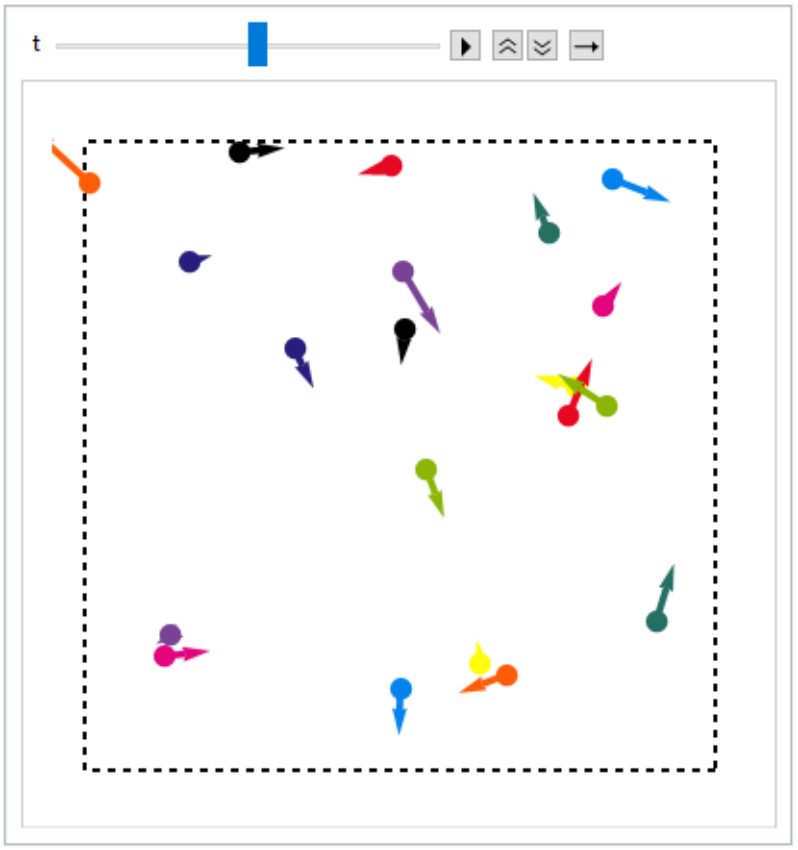
Out[20]=



In[21]:=
```
SeedRandom[1];
ic = Flatten[{(RandomReal[{-1, 1}, 4]), ColorData[3][#]} & /@ Range[20];

pic0[t_] := Graphics[{
    White, EdgeForm[Directive[Thickness[.005], Dashed]],
    Rectangle[{-1, -1}, {1, 1}],
    EdgeForm[None],
    Thickness[.01],
    {#5, Disk[{TriangleWave[(#1 + #3 t) / 4], TriangleWave[(#2 + #4 t) / 4]}, .035]} & @@@
     ic
  }, PlotRange → 1.05 {{-1, 1}, {-1, 1}}]

Animate[pic0[t], {t, 0, 10}]
```



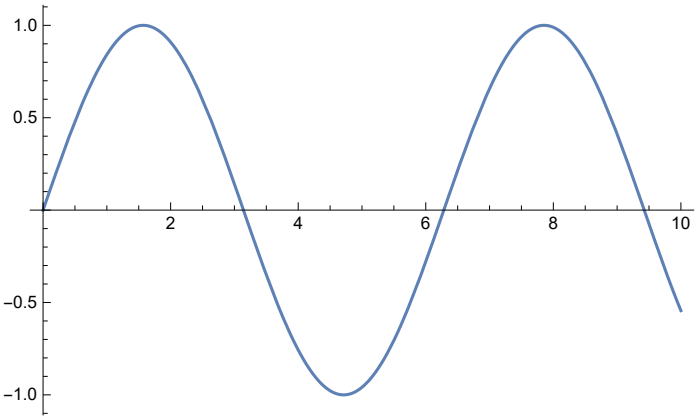
In[25]:=
```
Clear[t];
pic1[t_] = Graphics[{
    White, EdgeForm[Directive[Thickness[.005], Dashed]],
    Rectangle[{-1, -1}, {1, 1}],
    EdgeForm[None],
    Thickness[.01],
    Function[{x, y, vx, vy, col},
      {col, Disk[{x, y}, .035], Arrow[{{x, y}, {x, y} + .2 {vx, vy}}]}] @@@
     ({TriangleWave[(#1 + t #3) / 4], TriangleWave[(#2 + t #4) / 4],
        D[TriangleWave[(#1 + t1 #3) / 4], t1] /. t1 → t,
        D[TriangleWave[(#2 + t1 #4) / 4], t1] /. t1 → t, #5} & @@@
       (Flatten[{RandomReal[{-1, 1}, 4], ColorData[3][#]} & /@ Range[20]))
   }, PlotRange → 1.1 {{-1, 1}, {-1, 1}}];

Animate[pic1[t], {t, 0, 10}]
```



Графики

In[28]:=
```
Plot[Sin[x], {x, 0, 10}]
```

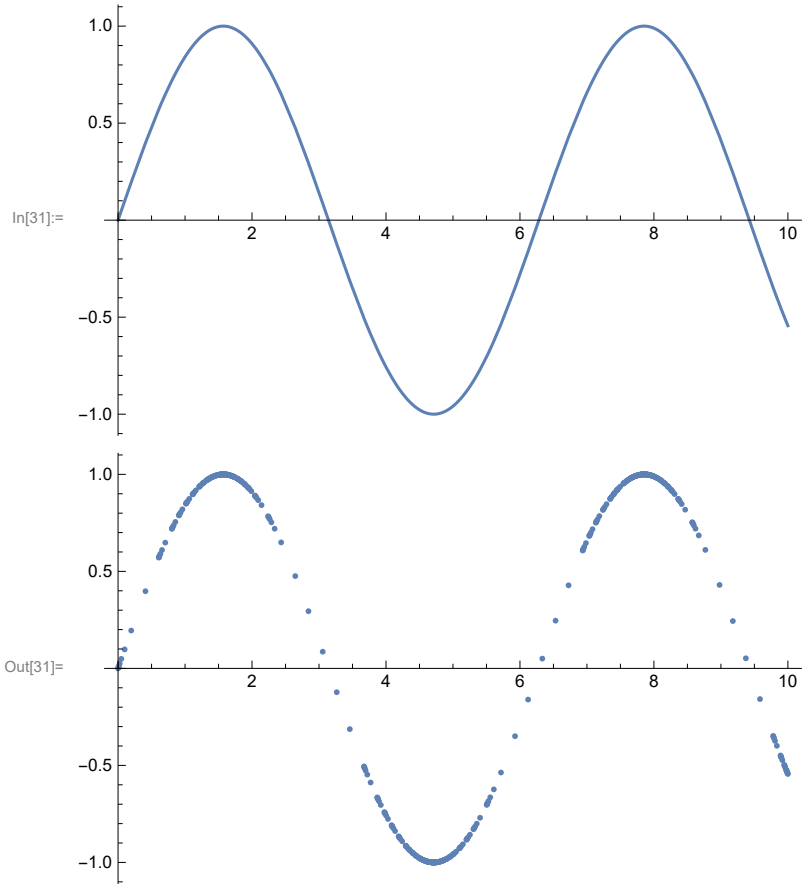
Out[28]=



In[29]:=
```
Plot[Sin[x], {x, 0, 10}] // FullForm
```

In[30]:=

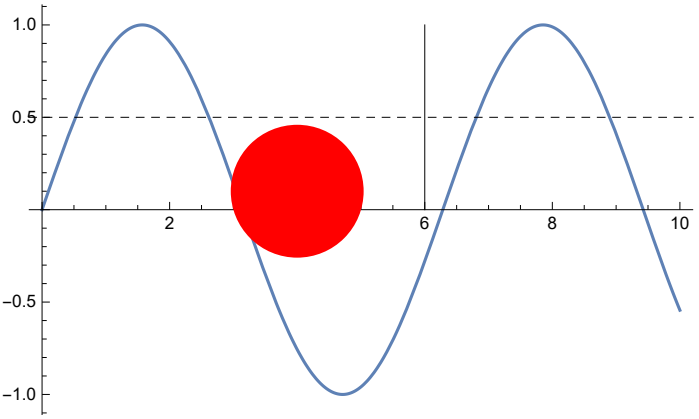
In[31]:=
```
/. Line → Point
```



Out[31]=

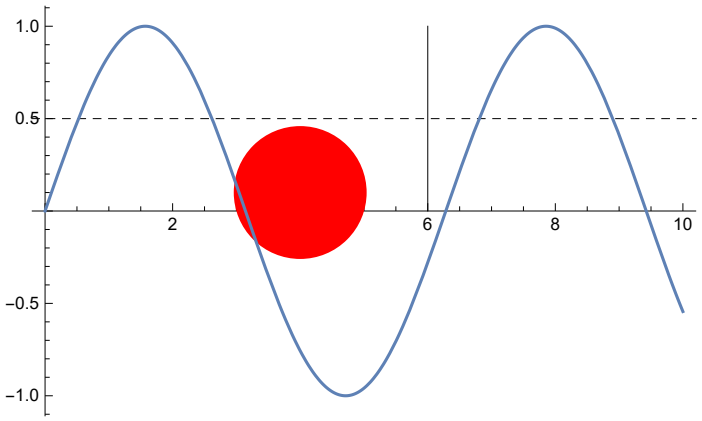
In[32]:=
```
Plot[Sin[x], {x, 0, 10}, Epilog → {Red, PointSize[.2], Point[{4, .1}],
    Black, Line[{{6, 0}, {6, 1}}],
    Dashed, InfiniteLine[{0, .5}, {1, 0}]
  }]
```

Out[32]=



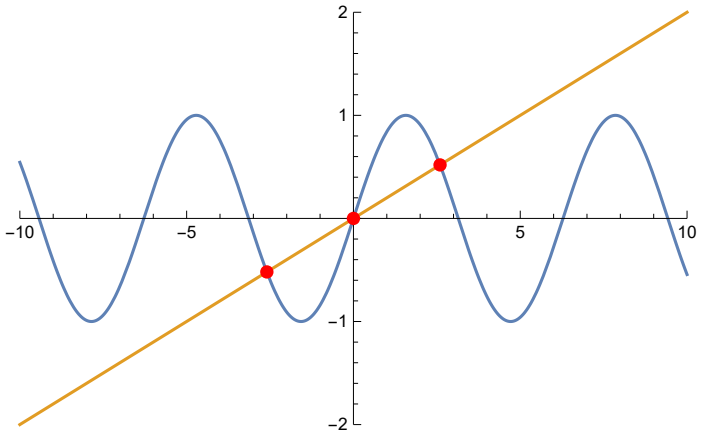
In[33]:=
```
Plot[Sin[x], {x, 0, 10}, Prolog → {Red, PointSize[.2], Point[{4, .1}],
    Black, Line[{{6, 0}, {6, 1}}],
    Dashed, InfiniteLine[{0, .5}, {1, 0}]
  }, Method → {"AxesInFront" → False}]
```

Out[33]=



In[34]:=
```
f1[x_] := Sin[x]; f2[x_] := x / 5;

sol = NSolve[f1[x] == f2[x], x, Reals];
list = {x, f1[x]} /. sol;

Plot[{f1[x], f2[x]}, {x, -10, 10}, PlotRange → {{-10, 10}, {-2, 2}},
 Epilog → {Red, PointSize[.02], Point /@ list}]
```

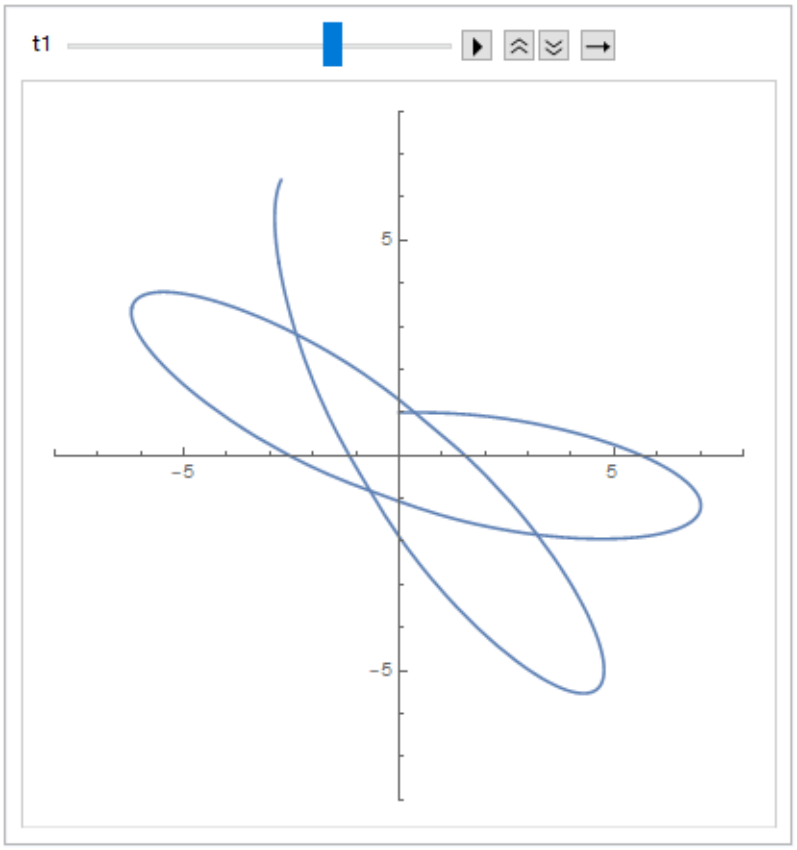
Out[37]=



Задача 3.3

In[38]:=
```
F[r_] := -1 / r + 1 / r^2;
T = 100;

sol = NDSolve[{
       x''[t] == F[r] x[t] / r, y''[t] == F[r] y[t] / r,
       x[0] == 0, x'[0] == 3 / 2,
       y[0] == 1, y'[0] == 0
      } /. r → Sqrt[x[t]^2 + y[t]^2], {x, y}, {t, 0, T}][[1]];
```

In[41]:=
```
Animate[
 ParametricPlot[{x[t], y[t]} /. sol, {t, 0, t1}, PlotRange → 8 {{-1, 1}, {-1, 1}}],
 {t1, 0.001, T}]
```



Анимация

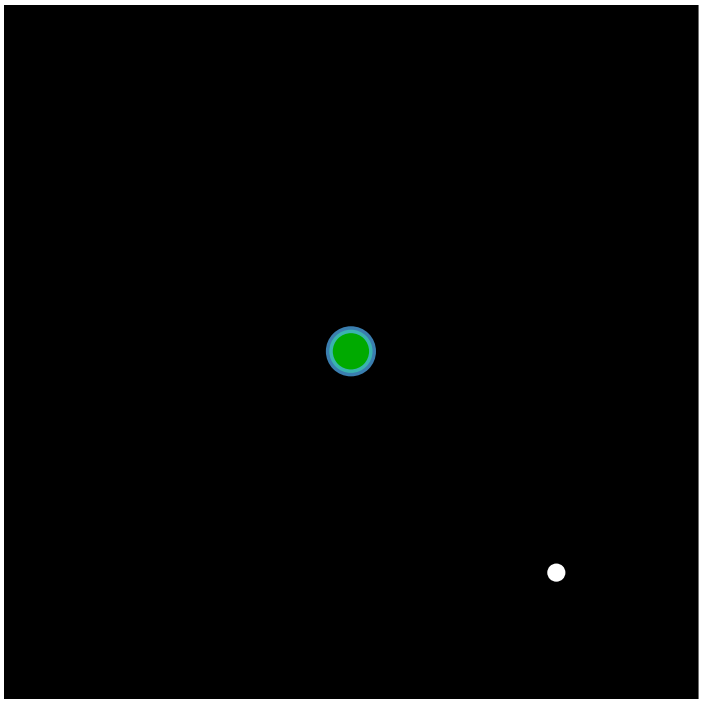
In[42]:=
```
Graphics[{
  Disk[{x[t], y[t]}, .1] /. sol /. t → 2
 }
 , PlotRange → 8 {{-1, 1}, {-1, 1}}]
```

Out[42]=

In[43]:=
```
pic2[t_] :=
  Graphics[{Darker[Green], EdgeForm[Directive[, Thickness[.01]]], Disk[{0, 0}, .5],
    White, EdgeForm[None], Disk[{x[t], y[t]}, .21] /. sol
   }
   , PlotRange → 8 {{-1, 1}, {-1, 1}}, Background → Black];
```

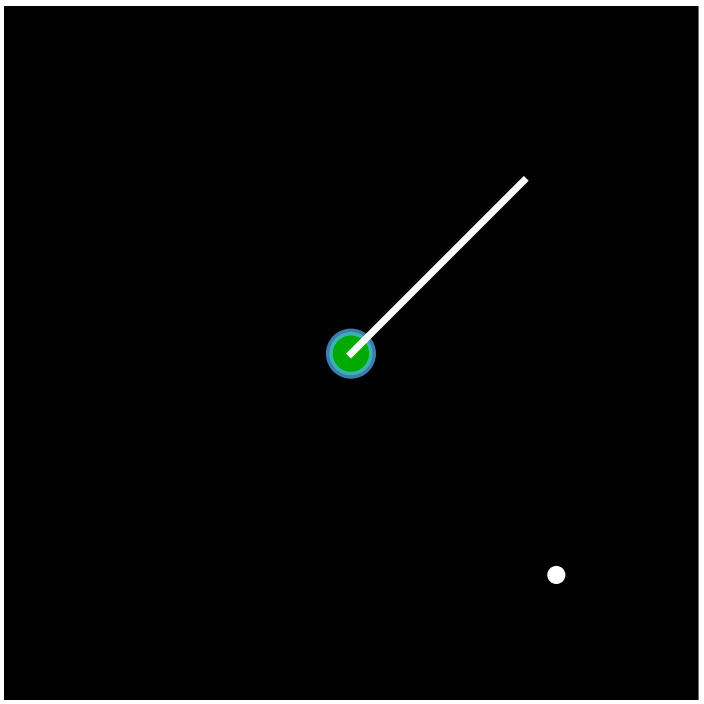
```
pic2[T / 2]
```

Out[44]=

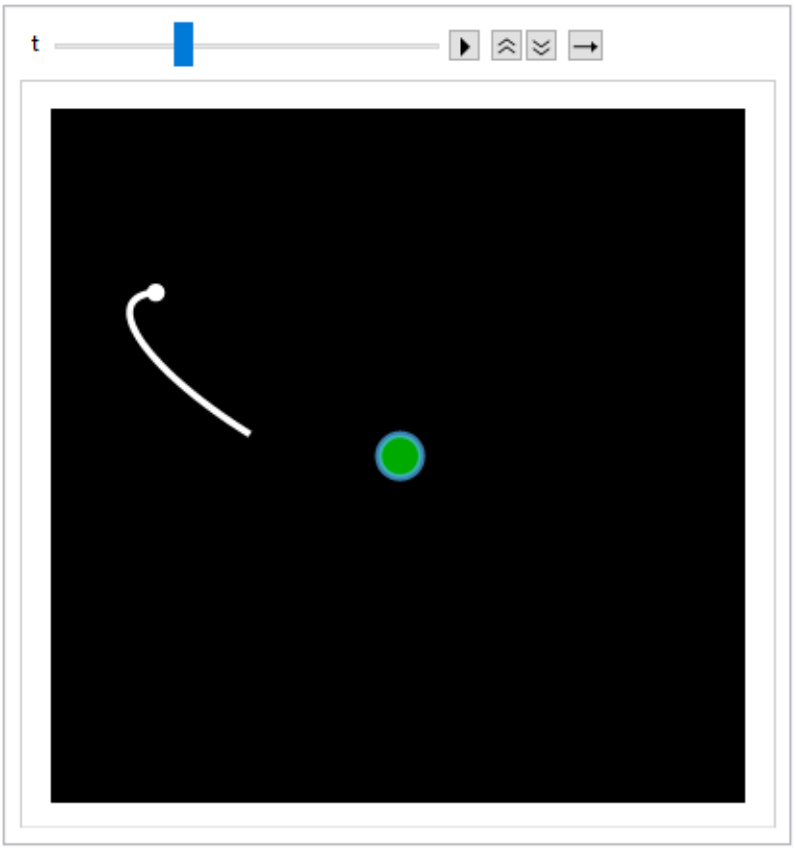


In[45]:=
```
pic2[t_] :=
  Graphics[{Darker[Green], EdgeForm[Directive[, Thickness[.01]]], Disk[{0, 0}, .5],
    White, Thickness[.01], Line[{{0, 0}, {4, 4}}],
    EdgeForm[None], Disk[{x[t], y[t]}, .21] /. sol
   }
   , PlotRange → 8 {{-1, 1}, {-1, 1}}, Background → Black];

pic2[T / 2]
```

Out[46]=

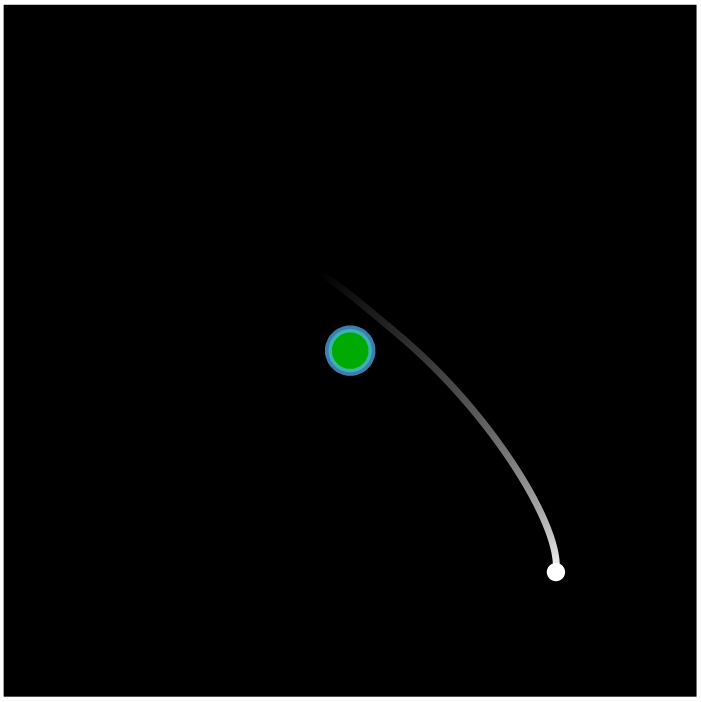


In[47]:=
```
pic2[t_] :=
  Graphics[{Darker[Green], EdgeForm[Directive[, Thickness[.01]]], Disk[{0, 0}, .5],
    White, Thickness[.01],
    Line[{x[#], y[#]} /. sol & /@ Subdivide[Max[t - 10, 0], t, 100]],
    EdgeForm[None], Disk[{x[t], y[t]}, .21] /. sol
   }
   , PlotRange → 8 {{-1, 1}, {-1, 1}}, Background → Black];

Animate[pic2[t], {t, 0, T}]
```


t

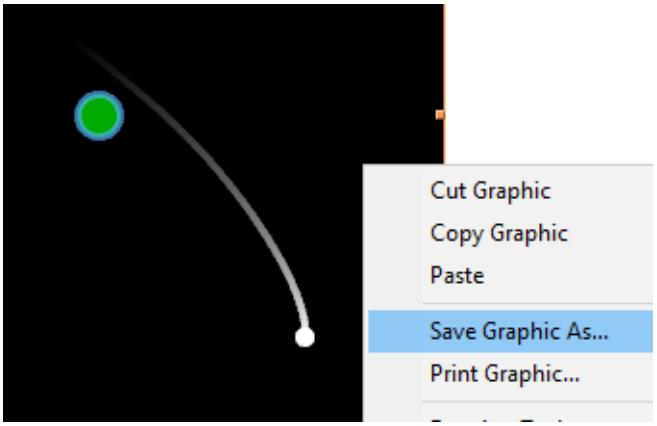
In[49]:=
```
np = 100;
pic3[t_] :=
  Graphics[{Darker[Green], EdgeForm[Directive[, Thickness[.01]]], Disk[{0, 0}, .5],
    White, Thickness[.01], Line[{x[#], y[#]} /. sol & /@ Subdivide[Max[t - 10, 0], t, np],
     VertexColors → (Opacity[#, White] & /@ Subdivide[0, 1, np])],
    EdgeForm[None], Disk[{x[t], y[t]}, .21] /. sol
   }
   , PlotRange → 8 {{-1, 1}, {-1, 1}}, Background → Black];

img = pic3[T / 2]
```

Out[51]=



Экспорт

In[ ]:=



In[52]:=
```
Directory[]
```

In[53]:=
```
NotebookDirectory[]
```

In[54]:=
```
SetDirectory[NotebookDirectory[]]
```

In[55]:=
```
Directory[]
```

In[56]:=
```
FileNames[]
```

In[57]:=
```
Export["pic.pdf", img, "pdf"]
```

Out[57]= pic.pdf

In[58]:=
```
Export["pic.png", img, "png"]
```

Out[58]= pic.png

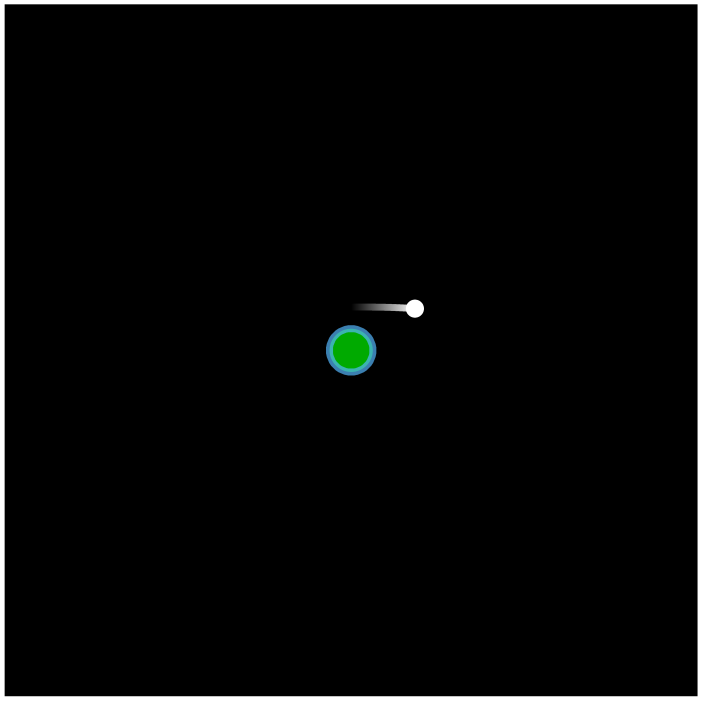
In[59]:=
```
Export["pic.png", img, "png", ImageSize → 1000]
```

Out[59]= pic.png

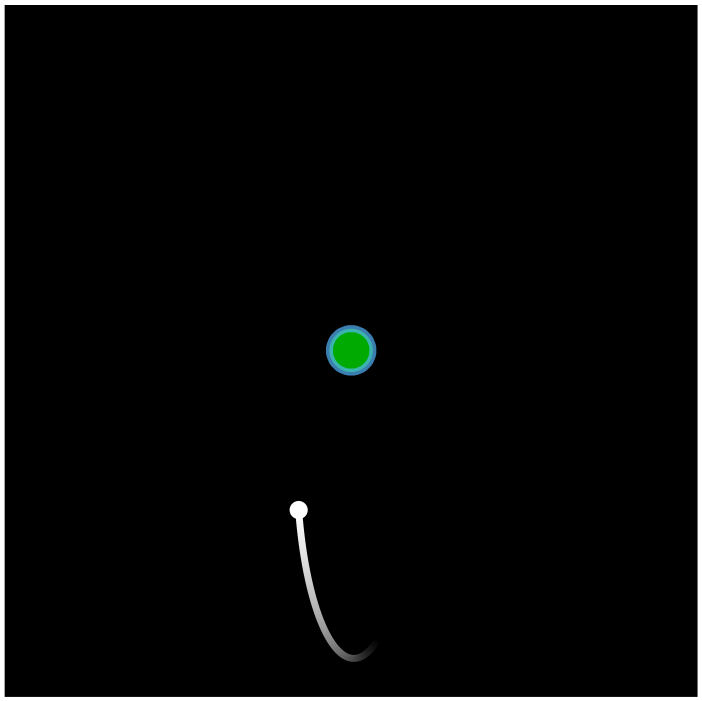
!

In[60]:=
```
Pic[t_] := pic3[t T];
pic3[1]
Pic[1]
```

Out[61]=



Out[62]=



In[63]:=

Параметры анимации:

```
dirname = "animation_frames"; (*имя анимации*)
size = 250; (*разрешение кадра в пикселях*)
time = 5; (*время анимации в секундах*)
fps = 25; (*частота кадров*)
loop = False;(*зациклевание анимации*)
```

Покадровый экспорт в .png:

```
Nframes = Ceiling[fps time]; (*количество кадров*)
SetDirectory@NotebookDirectory[];
Quiet@CreateDirectory[dirname]; (*создание папки для сохранения кадров*)
Export[
    dirname <> "//frame" <> StringPadLeft[ToString[# - 1], 4, "0"] <> ".png", Rasterize[
     Pic[(# - 1)/(Nframes - Boole[! loop])], ImageSize → size], "png"] & /@ Range[Nframes];
```