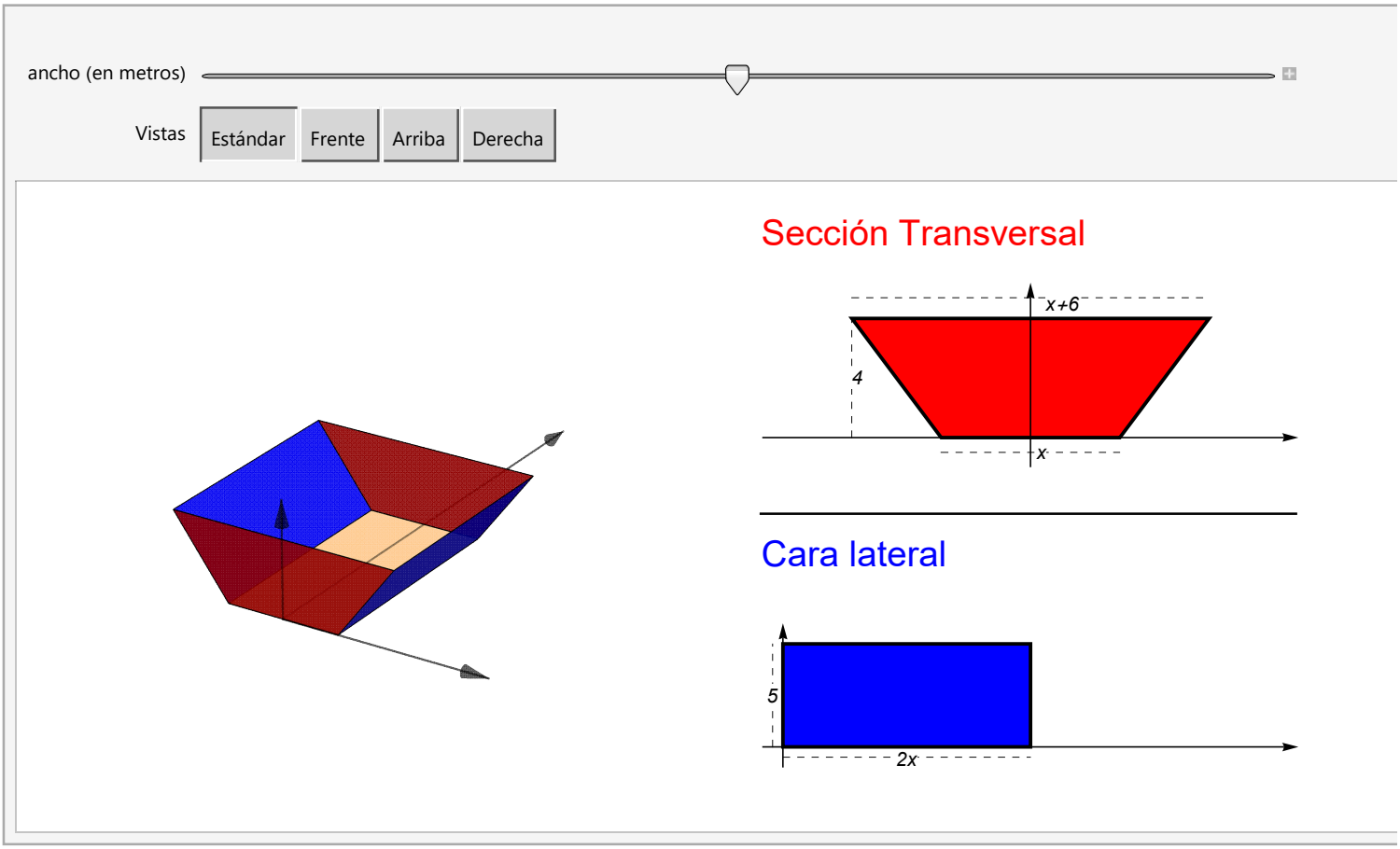
1. Ecuaciones

Situación: Almacenamiento de agua, parte 1

```
DynamicModule[{axis, drawAxes, xo = 11, yo = 25, zo = 6, y},
 drawAxes[x_, y_, z_] :=
  {axis[(*Style["x",Italic],*), {x, 0, 0}],
   axis[(*Style["y",Italic],*), {0, y, 0}],
   axis[(*Style["z",Italic],*), {0, 0, z}]};
 y[x_] := 4 x;
 axis := {Arrowheads[Medium],
    Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
 manípulate[
  Pane[Row[{Show[
      Graphics3D[{Black, Opacity[0.4], drawAxes[xo, yo, zo]}],
      Graphics3D[{Opacity[0.9],
        Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {-x1, y[x1], 0}, {-x1, 0, 0}}]
       }],
      Graphics3D[{Blue, Opacity[0.9],
        Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {x1 + 3, y[x1], 4}, {x1 + 3, 0, 4}}],
        Polygon[{{-x1, 0, 0}, {-x1, y[x1], 0}, {-(x1 + 3), y[x1], 4},
          {-(x1 + 3), 0, 4}}]}],
      Graphics3D[{Red, Opacity[0.9], Polygon[{{x1, 0, 0},
          {x1 + 3, 0, 4}, {-(x1 + 3), 0, 4}, {-x1, 0, 0}}],
        Polygon[{{x1, y[x1], 0}, {x1 + 3, y[x1], 4},
          {-(x1 + 3), y[x1], 4}, {-x1, y[x1], 0}}]
       }],
      Which[z1 === Front,
       Graphics3D[
        {Style[Text[3, {-(2 x1 + 3) / 2, 0, -.5}], 15, Background → White],
         Style[Text[3, {(2 x1 + 3) / 2, 0, -.5}], 15, Background → White],
         Style[Text["x", {0, 0, -.5}], 15, Background → White],
         Style[Text["x+6", {0, 0, -1.3}], 15, Background → White],
         Style[Text[4, {x1 + 3, 0, 2}], 15, Background → White],
         Style[Text[4, {-(x1 + 3), 0, 2}], 15, Background → White],
         Style[Text[5, {(x1 + 1.5), 0, 2}], 15, Background → White],
         Style[Text[5, {-(x1 + 1.5), 0, 2}], 15, Background → White],
         Line[{{-x1, 0, 0}, {-x1, 0, -.8}}],
```

```
2 |
      Line[{{x1, 0, 0}, {x1, 0, -.8}}],
      Dashed,
      Line[{{-x1, 0, -.5}, {x1, 0, -.5}}],
      Line[{{-(x1 + 3), 0, -1.3}, {x1 + 3, 0, -1.3}}],
      Line[{{x1, 0, -.5}, {x1 + 3, 0, -.5}}],
      Line[{{-x1, 0, -.5}, {-(x1 + 3), 0, -.5}}],
      Line[{{-(x1 + 3), 0, 0}, {-(x1 + 3), 0, 4}}],
      Line[{{(x1 + 3), 0, 0}, {(x1 + 3), 0, 4}}]}],
    z1 === Top,
    Graphics3D[{Style[Text["x", {0, -1.5, 0}], 15, Background → White],
      Style[Text["x+6", {0, -3, 0}], 15, Background → White],
      Style[Text["2x", {x1 + 4.5, y[x1] / 2, 0}], 15, Background → White],
      Dashed,
      Line[{{-x1, -1.5, 0}, {x1, -1.5, 0}}],
      Line[{{-(x1 + 3), -2.5, 0}, {x1 + 3, -2.5, 0}}],
      Line[{{x1 + 4.2, 0, 0}, {x1 + 4.2, y[x1], 0}}],
     }],
    z1 === Right,
    Graphics3D[{Style[Text[4, {0, -2, 2}], 15, Background → White],
      Style[Text["2 x", {0, y[x1] / 2, -1}], 15, Background → White],
      Dashed,
      Line[{{0, -2, 0}, {0, -2, 4}}],
      Line[{{0, 0, -1}, {0, y[x1], -1}}],
     }],
    True, Graphics3D[]],
  PlotRange → {{-xo, xo}, {-3, yo}, {-2, zo}},
  Boxed → False,
  ViewPoint → z1,
  ImageSize → {400, 300}],
 Column[{Style[Text["Sección Transversal"], Red, 20],
   Show[
    Graphics[{Dashed, Line[{{-x1, -0.5}, {x1, -0.5}}],
      Line[{{-x1 - 3, 4.7}, {x1 + 3, 4.7}}],
      Line[{{-x1 - 3, 0}, {-x1 - 3, 4}}],
      Style[Text["x", {0.2, -0.5}, {-1, 0}], 11, Background → White],
      Style[Text["x+6", {0.5, 4.1}, {-1, -1}], 11, Background → White],
      Style[Text["4", {-x1 - 3, 2}, {-1, 0}], 11, Background → White]}],
    Graphics[{Red, Opacity[1], EdgeForm[{Thick, Black}],
```

```
        Polygon[{{-x1, 0}, {x1, 0}, {x1 + 3, 4}, {-(x1 + 3), 4}}]}],
      PlotRange → {{-xo + 2, xo - 2}, {-1, zo - 0.8}},
      ImageSize → {300, 120},
      Axes → True,
      Ticks → None,
      AxesOrigin → {0, 0},
      AxesStyle → Directive[Thickness[0.003], Arrowheads[0.03]]
     ], ,
     Style[Text["Cara lateral"], Blue, 20],
     Show[
      Graphics[{Dashed, Line[{{0, -0.5}, {4 x1, -0.5}}],
        Line[{{-0.5, 0}, {-0.5, 5}}],
        Style[Text["2x", {2 x1, -0.6}, {0, 0}], 11, Background → White],
        Style[Text["5", {-0.5, 2.5}, {0, 0}], 11, Background → White]}],
      Graphics[{Blue, Opacity[1], EdgeForm[{Thick, Black}],
        Polygon[{{0, 0}, {4 x1, 0}, {4 x1, 5}, {0, 5}}]}],
      PlotRange → {{-1, yo}, {-1, zo}},
      ImageSize → {300, 120},
      Axes → True,
      Ticks → None,
      AxesOrigin → {0, 0},
      AxesStyle → Directive[Thickness[0.003], Arrowheads[0.03]]
     ]}]}], ImageSize → {750, Automatic}],
{{x1, 3, "ancho (en metros)"}, 0, 6, 0.2,
 ControlType → "Slider", Appearance → {"DownArrow"}, ImageSize → 600},
{{z1, {3.5, -5.5, 3}, "Vistas"}, {{3.5, -5.5, 3} → "Estándar",
  Front → "Frente", Top → "Arriba", Right → "Derecha"}},
SaveDefinitions → True, Deployed → True, ImageMargins → 0]]
```

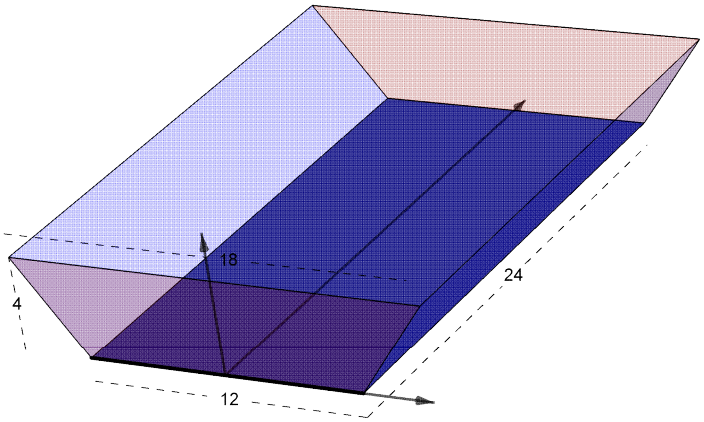


Situación: Almacenamiento de agua, parte 2

Problema 1

```
DynamicModule[{axis, drawAxes, xo = 9, yo = 25, zo = 6, x1 = 6, y, line, h = 0},
 drawAxes[x_, y_, z_] :=
  {axis[(*Style["x",Italic],*), {x, 0, 0}],
   axis[(*Style["y",Italic],*), {0, y, 0}],
   axis[(*Style["z",Italic],*), {0, 0, z}]};
 y[x_] := 4 x;
 line[h_] := 3 h/4 + 6;
 axis := {Arrowheads[Small],
    Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
 Show[
  Graphics3D[{Black, Opacity[0.4], drawAxes[xo, yo, zo]}],
  Graphics3D[{Opacity[0.9],
    Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {-x1, y[x1], 0}, {-x1, 0, 0}}]
   }],
  Graphics3D[{Blue, Opacity[0.2],
```

```
    Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {x1 + 3, y[x1], 4}, {x1 + 3, 0, 4}}],
    Polygon[{{-x1, 0, 0}, {-x1, y[x1], 0},
      {-(x1 + 3), y[x1], 4}, {-(x1 + 3), 0, 4}}]}],
  Graphics3D[{Red, Opacity[0.2], Polygon[{{x1, 0, 0},
      {x1 + 3, 0, 4}, {-(x1 + 3), 0, 4}, {-x1, 0, 0}}],
    Polygon[{{x1, y[x1], 0}, {x1 + 3, y[x1], 4},
      {-(x1 + 3), y[x1], 4}, {-x1, y[x1], 0}}]
   }],
  Graphics3D[{Opacity[0.8], Blue,
    Polygon[{{line@h, 0, h},
      {line@h, y[x1], h}, {-line@h, y[x1], h}, {-line@h, 0, h}}]}],
  Graphics3D[{Blue, Opacity[.8], EdgeForm[{Thick, Black}],
    Polygon[{{-x1, 0, 0}, {x1, 0, 0}, {line@h, 0, h}, {-line@h, 0, h}}]}],
  Graphics3D[{Dashed, Line[{{-x1, 0, -1}, {-1, 0, -1}}],
    Line[{{1, 0, -1}, {x1, 0, -1}}], Line[{{x1, 0, -1}, {x1, 2 x1 - 1, -1}}],
    Line[{{x1, 2 x1 + 1, -1}, {x1, 4 x1, -1}}],
    Line[{{-x1 - 3, 0, 0}, {-x1 - 3, 0, 1.5}}],
    Line[{{-x1 - 3, 0, 2.5}, {-x1 - 3, 0, 4}}],
    Line[{{-x1 - 3, 0, 5}, {0, 0, 5}}], Line[{{2, 0, 5}, {x1 + 3, 0, 5}}]}],
  Graphics3D[{Text["12", {0, 0, -1}], Text["18", {1, 0, 5}],
    Text["24", {x1, 2 x1, -1}], Text["4", {-x1 - 3, 0, 2}]}],
  PlotRange → {{-xo, xo}, {-3, yo}, {-2, zo}},
  Boxed → False, ImageSize → {400, 300}, ViewPoint → {3.5, -5.5, 3}]
```



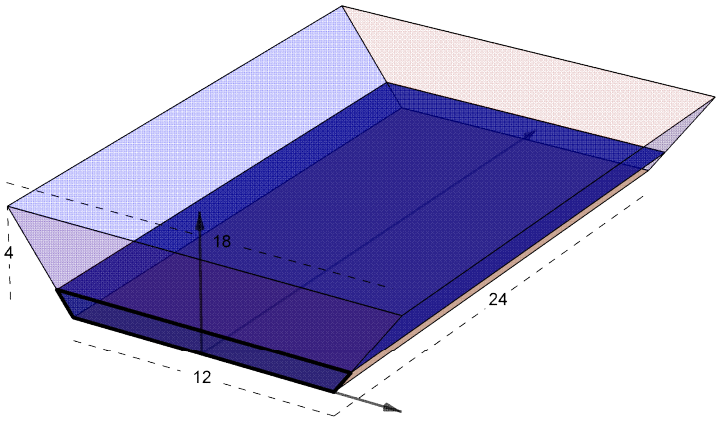
Problema 2

```
DynamicModule[{axis, drawAxes, xo = 9, yo = 25, zo = 6, x1 = 6, y, line},
```

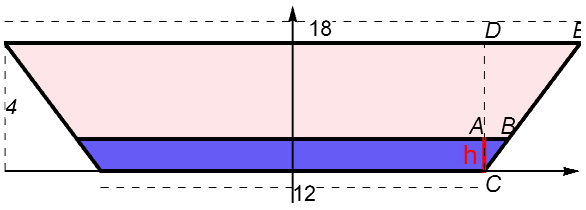
```
drawAxes[x_, y_, z_] :=
 {axis[(*Style["x",Italic],*), {x, 0, 0}],
  axis[(*Style["y",Italic],*), {0, y, 0}],
  axis[(*Style["z",Italic],*), {0, 0, z}]};
y[x_] := 4 x;
line[h_] := 3 h/4 + 6;
axis := {Arrowheads[Small],
   Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
manípulate[
 Row[{
   Show[
    Graphics3D[{Black, Opacity[0.4], drawAxes[xo, yo, zo]}],
    Graphics3D[{Opacity[0.9],
      Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {-x1, y[x1], 0}, {-x1, 0, 0}}]
     }],
    Graphics3D[{Blue, Opacity[0.2],
      Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {x1 + 3, y[x1], 4}, {x1 + 3, 0, 4}}],
      Polygon[{{-x1, 0, 0}, {-x1, y[x1], 0}, {-(x1 + 3), y[x1], 4},
        {-(x1 + 3), 0, 4}}]}],
    Graphics3D[{Red, Opacity[0.1], Polygon[{{x1, 0, 0},
        {x1 + 3, 0, 4}, {-(x1 + 3), 0, 4}, {-x1, 0, 0}}],
      Polygon[{{x1, y[x1], 0}, {x1 + 3, y[x1], 4},
        {-(x1 + 3), y[x1], 4}, {-x1, y[x1], 0}}]
     }],
    Graphics3D[{Opacity[0.8], Blue,
      Polygon[{{line@h, 0, h}, {line@h, y[x1], h},
        {-line@h, y[x1], h}, {-line@h, 0, h}}]}],
    Graphics3D[{Blue, Opacity[.8], EdgeForm[{Thick, Black}],
      Polygon[{{-x1, 0, 0}, {x1, 0, 0}, {line@h, 0, h}, {-line@h, 0, h}}]}],
    Graphics3D[{Dashed, Line[{{-x1, 0, -1}, {-1, 0, -1}}],
      Line[{{1, 0, -1}, {x1, 0, -1}}], Line[{{x1, 0, -1}, {x1, 2 x1 - 1, -1}}],
      Line[{{x1, 2 x1 + 1, -1}, {x1, 4 x1, -1}}], Line[{{-x1 - 3, 0, 0},
        {-x1 - 3, 0, 1.5}}], Line[{{-x1 - 3, 0, 2.5}, {-x1 - 3, 0, 4}}],
      Line[{{-x1 - 3, 0, 5}, {0, 0, 5}}], Line[{{2, 0, 5}, {x1 + 3, 0, 5}}]}],
    Graphics3D[{Text["12", {0, 0, -1}], Text["18", {1, 0, 5}],
      Text["24", {x1, 2 x1, -1}], Text["4", {-x1 - 3, 0, 2}]}],
    PlotRange → {{-xo, xo}, {-3, yo}, {-2, zo}},
```

```
  Boxed → False, ImageSize → {400, 300}, ViewPoint → {3.5, -5.5, 3}],
 Deploy@Column[{Style[Text["Sección Transversal"], Red, 20],
    Show[
     Graphics[{Dashed, Line[{{-x1, -0.5}, {x1, -0.5}}],
       Line[{{-x1 - 3, 4.7}, {x1 + 3, 4.7}}],
       Line[{{-x1 - 3, 0}, {-x1 - 3, 4}}],
       Style[Text["12", {0, -0.7}, {-1, 0}], 11, Background → White],
       Style[Text["18", {0.5, 4.1}, {-1, -1}], 11, Background → White],
       Style[Text[4, {-x1 - 3, 2}, {-1, 0}], 11, Background → White]}],
     Graphics[{Red, Opacity[.1], EdgeForm[{Thick, Black}],
       Polygon[{{-x1, 0}, {x1, 0}, {x1 + 3, 4}, {-(x1 + 3), 4}}]}],
     Graphics[{Blue, Opacity[.6], EdgeForm[{Thick, Black}],
       Polygon[{{-x1, 0}, {x1, 0}, {line@h, h}, {-line@h, h}}]}],
     Graphics[{Thick, Red, Line[{{x1, 0}, {x1, h}}],
       Style[Text["h", {x1 - .2, h / 2}, {1, 0}], 14]}],
     Graphics[{Black, Dashed, Line[{{x1, 0}, {x1, 4}}]}],
     Graphics[{Style[Text[A, {x1, h}, {1, -1}], 12],
       Style[Text[B, {line@h, h}, {0, -1}], 12],
       Style[Text[C, {x1, 0}, {-1, 1}], 12],
       Style[Text[D, {x1, 4}, {-1, -1}], 12],
       Style[Text[E, {9, 4}, {0, -1}], 12]}],
     PlotRange → {{-xo, xo}, {-1, zo - 0.8}},
     ImageSize → {300, 120},
     Axes → True,
     Ticks → None,
     AxesOrigin → {0, 0},
     AxesStyle → Directive[Thickness[0.003], Arrowheads[0.03]]
    ]}]}],
{{h, 1, "nivel del agua (en metros)"}, 0, 3.9, 0.1, ControlType → "Slider",
 Appearance → {"Labeled", "DownArrow"}, ImageSize → 500}]
```

nivel del agua (en metros) 1



Sección Transversal




```
DynamicModule[{line},
 line[h_] := 3 h/4 + 6;
 manípulate[
  Grid[{{"nivel del agua", h, "Volumen parcial",
     24 h (6 + line@h), "Procentaje", 100 h (6 + line@h)/(15 * 4)}}],
  {{h, 2, "nivel del agua (en metros)"}, 0, 4, 0.1, ControlType → "Slider",
   Appearance → {"Labeled", "DownArrow"}, ImageSize → 620}]]
```

nivel del agua (en metros)

nivel del agua 1.7 Volumen parcial 541.62 Procentaje 37.6125

Problema 3

```
Deploy@
 Style[Grid[{{"Parte del tanque que se desocupa al cabo de", …, …, …},
    {, "Una hora", "Dos horas", "Tres horas"},
    {"Manguera uno", Column[{"Medio", "1/2"}, Alignment → Center],
     Column[{"Todo", "2/2"}, Alignment → Center],
     Column[{"Uno completo y medio más", "3/2"}, Alignment → Center]},
    {"Manguera dos", Column[{"Una tercera parte", "1/3"}, Alignment → Center],
     Column[{"Dos terceras partes", "2/3"}, Alignment → Center], Column[
      {"Todo", "3/3"}, Alignment → Center]}}, Alignment → Center, Frame → All]]
```

Parte del tanque que se desocupa al cabo de			
	Una hora	Dos horas	Tres horas
Manguera uno	Medio $\frac{1}{2}$	Todo $\frac{2}{2}$	Uno completo y medio más $\frac{3}{2}$
Manguera dos	Una tercera parte $\frac{1}{3}$	Dos terceras partes $\frac{2}{3}$	Todo $\frac{3}{3}$

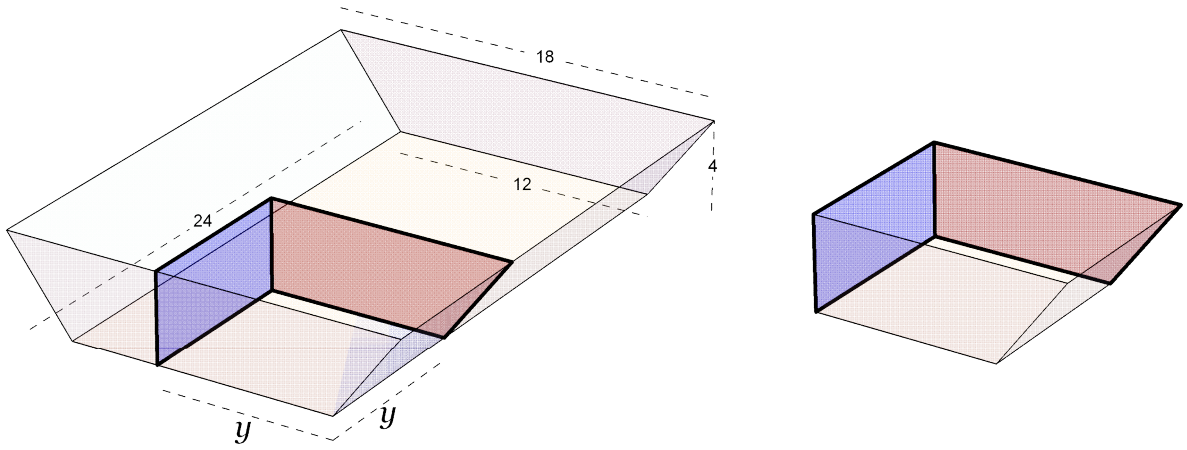
Situación: Almacenamiento de agua, parte 3

```
DynamicModule[{axis, drawAxes, xo = 9, yo = 25, zo = 6, x1 = 6, y, line},
 drawAxes[x_, y_, z_] :=
  {axis[(*Style["x",Italic],*), {x, 0, 0}],
   axis[(*Style["y",Italic],*), {0, y, 0}],
   axis[(*Style["z",Italic],*), {0, 0, z}]};
 y[x_] := 4 x;
 line[h_] := 3 h/4 + 6;
 axis := {Arrowheads[Small],
    Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
 manípulate[
  Row[{
```

```
10 |
Show[
 (*Bases*)
 Graphics3D[{Opacity[0.1],
   Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {-x1, y[x1], 0}, {-x1, 0, 0}}],
   Opacity[0.1], Blue,
   Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1, t, 0}, {x1, 0, 0}}]}],
 (*laterale*)
 Graphics3D[{White, Opacity[0.1],
   Polygon[{{x1, 0, 0}, {x1, y[x1], 0}, {x1 + 3, y[x1], 4}, {x1 + 3, 0, 4}}],
   Polygon[{{-x1, 0, 0},
     {-x1, y[x1], 0}, {-(x1 + 3), y[x1], 4}, {-(x1 + 3), 0, 4}}],
   Opacity[0.1],
   Polygon[{{x1, 0, 0}, {x1, t, 0}, {(x1 + 3), t, 4}, {(x1 + 3), 0, 4}}],
   Opacity[0.3], Blue, EdgeForm[Thick],
   Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1 - t, t, 4}, {x1 - t, 0, 4}}]
  }],
 (*frente y fondo 1*)
 Graphics3D[{White, Opacity[0.1],
   Polygon[{{x1, 0, 0}, {x1 + 3, 0, 4}, {-(x1 + 3), 0, 4}, {-x1, 0, 0}}],
   Polygon[{{x1, y[x1], 0},
     {x1 + 3, y[x1], 4}, {-(x1 + 3), y[x1], 4}, {-x1, y[x1], 0}}],
   Opacity[0.1],
   Polygon[{{x1, 0, 0}, {x1 + 3, 0, 4}, {x1 - t, 0, 4}, {x1 - t, 0, 0}}],
   Opacity[0.3], Red, EdgeForm[Thick],
   Polygon[{{x1, t, 0}, {x1 + 3, t, 4}, {x1 - t, t, 4}, {x1 - t, t, 0}}]
  }],
 Graphics3D[{Dashed,
   Line[{{-x1, 24, -1}, {-1, 24, -1}}], Line[{{1, 24, -1}, {x1, 24, -1}}],
   Line[{{-2 - x1, 0, 0}, {-2 - x1, 2 x1 - 1, 0}}],
   Line[{{-x1 - 2, 2 x1 + 1, 0}, {-2 - x1, 4 x1, 0}}],
   Line[{{x1 + 3, 24, 0}, {x1 + 3, 24, 1.5}}],
   Line[{{x1 + 3, 24, 2.5}, {x1 + 3, 24, 4}}],
   Line[{{-x1 - 3, 24, 5}, {0, 24, 5}}], Line[{{2, 24, 5}, {x1 + 3, 24, 5}}],
   Line[{{x1, 0, -1}, {x1 - t, 0, -1}}],
   Line[{{x1, 0, -1}, {x1, t, -1}}]}],
 Graphics3D[{Text["12", {0, 24, -1}], Text["18", {1, 24, 5}],
   Text["24", {-x1 - 2, 2 x1, 0}], Text["4", {x1 + 3, 24, 2}],
```

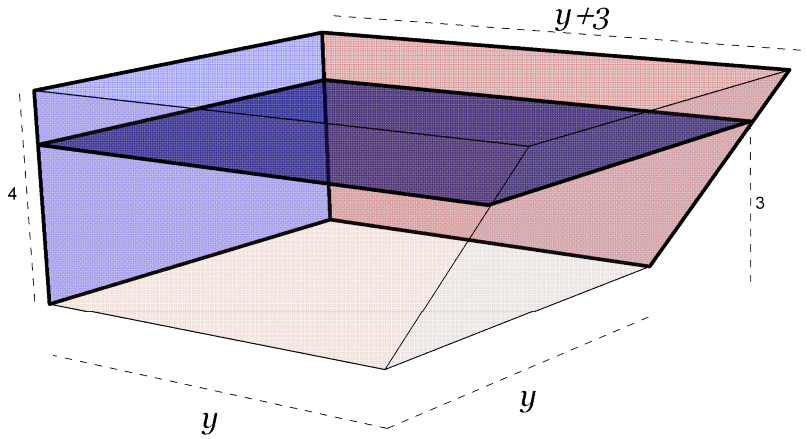
```
    Text[TraditionalForm@Style["y", "Text"], {((x1 - t) + x1)/2, 0, -1.5}],
    Text[TraditionalForm@Style["y", "Text"], {x1, t/2, -1.5}]}],
  PlotRange → {{-xo, xo}, {-3, yo}, {-2, zo}},
  Boxed → False, ImageSize → {400, 300}, ViewPoint → {3.5, -5.5, 3}],
 Show[
  (*Bases*)
  Graphics3D[{Opacity[0.1],
    Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1, t, 0}, {x1, 0, 0}}],
    Polygon[{{x1, 0, 0}, {x1, t, 0}, {(x1 + 3), t, 4}, {(x1 + 3), 0, 4}}],
    Polygon[{{x1, 0, 0}, {x1 + 3, 0, 4}, {x1 - t, 0, 4}, {x1 - t, 0, 0}}],
    Opacity[0.3], Blue, EdgeForm[Thick],
    Polygon[
     {{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1 - t, t, 4}, {x1 - t, 0, 4}}], Red,
    Polygon[{{x1, t, 0}, {x1 + 3, t, 4}, {x1 - t, t, 4}, {x1 - t, t, 0}}]}],
  Boxed → False, ImageSize → {300, 300}, ViewPoint → {3.5, -5.5, 3},
  PlotRange → {{x1 - 12, 12}, {0, 12}, {0, 4}}]
}], {{t, 8, "longitud del lado de la base (y)"}, 0.5, 12, 0.5, ControlType →
 "Slider", Appearance → {"Labeled", "DownArrow"}, ImageSize → 400}]
]
```

longitud del lado de la base (y) 8

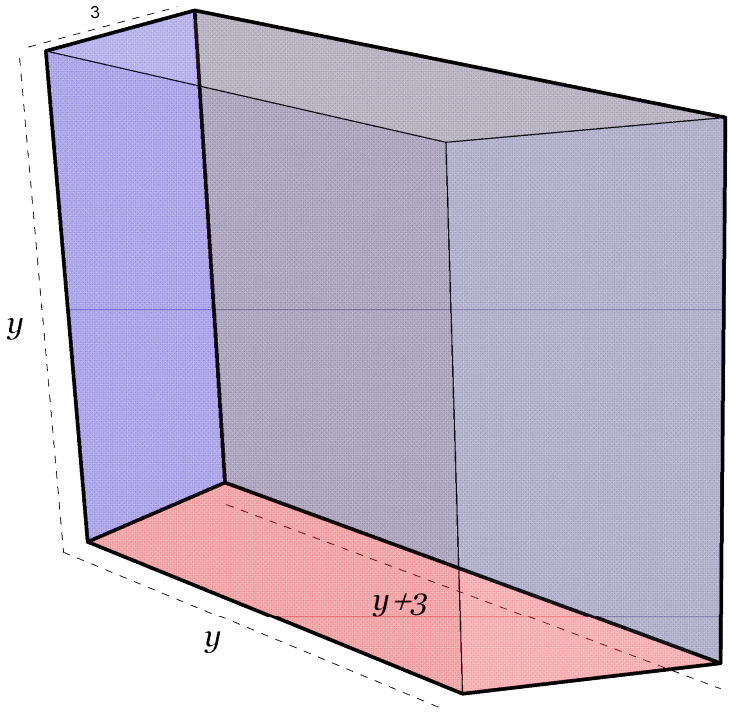


```
DynamicModule[{axis, drawAxes, xo = 9, yo = 25, zo = 6, x1 = 6, y, line, t = 8},
 drawAxes[x_, y_, z_] :=
  {axis[(*Style["x",Italic],*), {x, 0, 0}],
   axis[(*Style["y",Italic],*), {0, y, 0}],
   axis[(*Style["z",Italic],*), {0, 0, z}]};
 y[x_] := 4 x;
 line[h_] := 3 h/4 + 6;
 axis := {Arrowheads[Small],
    Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
 Show[
  Graphics3D[{Text["4", {x1 - 1.1 t, 0, 2}],
    Text["3", {x1 + 2.4, t, 1.5}],
    Text[TraditionalForm@Style["y", "Text"], {((x1 - t) + x1)/2, 0, -1.5}],
    Text[TraditionalForm@Style["y", "Text"], {x1, t/2, -1.5}],
    Text[TraditionalForm@Style["y+3", "Text"],
     {((x1 - t) + x1 + 3)/2, 1.2 t, 4.5}],
    Opacity[0.1],
    Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1, t, 0}, {x1, 0, 0}}],
    Polygon[{{x1, 0, 0}, {x1, t, 0}, {line[4], t, 4}, {line[4], 0, 4}}],
    Polygon[{{x1, 0, 0}, {line[4], 0, 4}, {x1 - t, 0, 4}, {x1 - t, 0, 0}}],
    Opacity[0.3], Blue, EdgeForm[Thick],
    Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1 - t, t, 4}, {x1 - t, 0, 4}}], Red,
    Polygon[{{x1, t, 0}, {line[4], t, 4}, {x1 - t, t, 4}, {x1 - t, t, 0}}],
    Opacity[0.6], Blue,
    Polygon[
     {{x1 - t, 0, 3}, {x1 - t, t, 3}, {x1 + 2.2, t, 3}, {x1 + 2.2, 0, 3}}]}],
  Graphics3D[{Dashed,
    Line[{{x1 - 1.05 t, 0, 0}, {x1 - 1.05 t, 0, 4}}],
    Line[{{x1 + 3, 1.05 t, 4.3}, {x1 - t, 1.05 t, 4.3}}],
    Line[{{x1, 0, -1}, {x1 - t, 0, -1}}],
    Line[{{x1, 0, -1}, {x1, t, -1}}],
    Line[{{x1 + 2.2, t, 3}, {x1 + 2.2, t, 0}}]}],
```

```
Boxed → False, ImageSize → {450, Automatic}]]
```



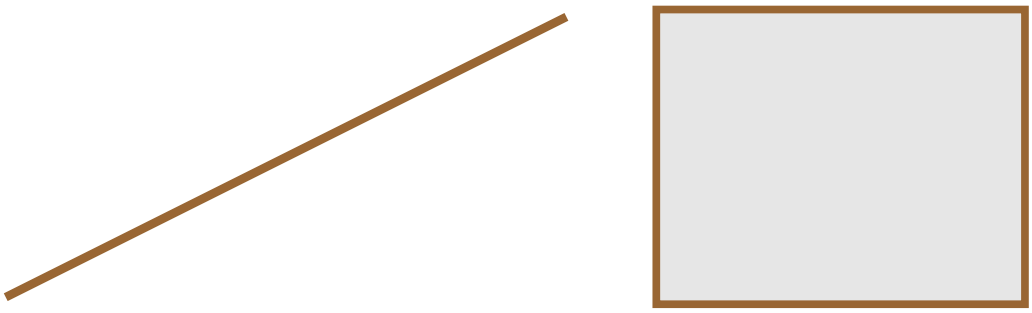
```
DynamicModule[{axis, drawAxes, xo = 9, yo = 25, zo = 6, x1 = 6, y, line, t = 8},
 drawAxes[x_, y_, z_] :=
  {axis[(*Style["x",Italic],*), {x, 0, 0}],
   axis[(*Style["y",Italic],*), {0, y, 0}],
   axis[(*Style["z",Italic],*), {0, 0, z}]};
 y[x_] := 4 x;
 line[h_] := 3 h/4 + 6;
 axis := {Arrowheads[Small],
    Arrow[Tube[{{0, 0, 0}, #2}, 0.05]], Style[Text[#1, 1.1 #2], 12]} &;
 Show[
  Graphics3D[{Text["3", {x1 - 1.15 t, 0, 2}],
    Text[TraditionalForm@Style["y", "Text"], {((x1 - t) + x1)/2, 8, -1}],
    Text[TraditionalForm@Style["y", "Text"], {x1 - t, t/2, -1}],
    Text[TraditionalForm@Style["y+3", "Text"], {(x1 - 4)/2, 1.2 t, 4}],
    Opacity[0.1],
    Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1, t, 0}, {x1, 0, 0}}],
    Polygon[{{x1, 0, 0}, {x1, t, 0}, {x1 + 2.2, t, 3}, {x1 + 2.2, 0, 3}}],
    Polygon[{{x1, 0, 0}, {x1 + 2.2, 0, 3}, {x1 - t, 0, 3}, {x1 - t, 0, 0}}],
    Opacity[0.3], Blue, EdgeForm[Thick],
    Polygon[{{x1 - t, 0, 0}, {x1 - t, t, 0}, {x1 - t, t, 3}, {x1 - t, 0, 3}}], Red,
    Polygon[{{x1, t, 0}, {x1 + 2.2, t, 3}, {x1 - t, t, 3}, {x1 - t, t, 0}}],
    Opacity[0.3], Blue,
    Polygon[
     {{x1 - t, 0, 3}, {x1 - t, t, 3}, {x1 + 2.2, t, 3}, {x1 + 2.2, 0, 3}}]},
   Graphics3D[{Dashed,
    Line[{{x1 - 1.05 t, 0, 0}, {x1 - 1.05 t, 0, 3}}],
    Line[{{x1 - t, 1.05 t, 3}, {x1 + 2.2, 1.05 t, 3}}],
    Line[{{x1, 8, -0.5}, {x1 - t, 8, -0.5}}],
    Line[{{x1 - t, 0, -0.5}, {x1 - t, t, -0.5}}]}],
   Boxed → False, ImageSize → {450, Automatic}]]
```


3
y
y+3
y

Problemas que involucran el uso de ecuaciones cuadráticas

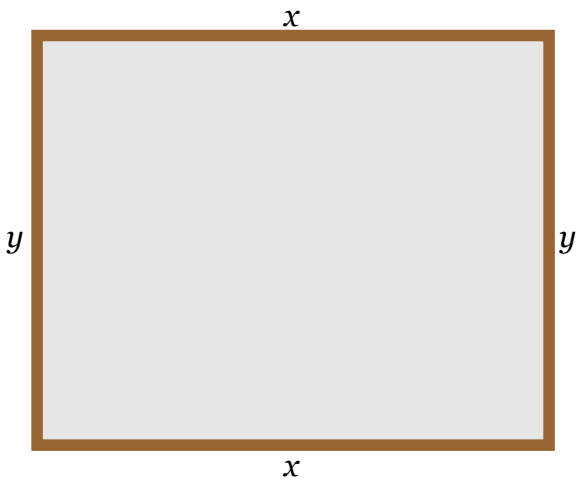
P1

```
Deploy@Pane@Row[{
    Show[
     Graphics[{Brown, Thickness@0.015, Line@{{0, 0}, {20, 10}}},
      ImageSize → 300]
    ],
    Show[
     Graphics[{EdgeForm[Directive[Brown, Thickness@0.02]], FaceForm[
        GrayLevel[0.9]], Polygon@{{0, 0}, {5, 0}, {5, 4}, {0, 4}, {0, 0}}}],
     ImageSize → 200]


  }, "          "]
```



```
Deploy@Pane@Show[
   Graphics[{Brown, Thickness@0.008, Line@{{0, 0}, {35, 0}}, Black,
     Style[Text["12 m", {35 / 2, -1}], 15]}],
   ImageSize → 600
  ]
```

```
Deploy@Pane@Show[
   Graphics[{EdgeForm[Directive[Brown, Thickness@0.02]], FaceForm[
      GrayLevel[0.9]], Polygon@{{0, 0}, {5, 0}, {5, 4}, {0, 4}, {0, 0}},
     Black, Text[TraditionalForm@Style["x", "Text"] , {5 / 2, -.2}],
     Text[TraditionalForm@Style["x", "Text"] , {5 / 2, 4.2}],
     Text[TraditionalForm@Style["y", "Text"] , {-.2, 2}],
     Text[TraditionalForm@Style["y", "Text"] , {5.2, 2}]}],
   ImageSize → 300]
```



2. Inecuaciones

Inecuaciones lineales

Problema 1. Mezcla: maní-nueces

```
Deploy@Style[Grid[{{Column[{"Libras maní:", "x"}],
     Column[{"Libras nueces:", "y"}], Column[{"Ingreso", 8000 x + 18 000 y},
      Alignment → Center]},
    {9, 6, Row[{"$ ", 180 000}]},
    {8.5, 6.5, Row[{"$ ", 185 000}]},
    {8, 7, Row[{"$ ", 190 000}]},
    {7.5, 7.5, Row[{"$ ", 195 000}]},
    {7, 8, Row[{"$ " , 200 000}]},
    {6.5, 8.5, Row[{"$ ", 205 000}]},
    {6, 9, Row[{"$ ", 210 000}]}}, Alignment → Center, Frame → All]]
```

Libras maní: x	Libras nueces: y	Ingreso $8000\,x + 18\,000\,y$
9	6	$ 180 000
8.5	6.5	$ 185 000
8	7	$ 190 000
7.5	7.5	$ 195 000
7	8	$ 200 000
6.5	8.5	$ 205 000
6	9	$ 210 000

```
Deploy@Style[Grid[{{Column[{"Libras maní:", "x"}],
     Column[{"Libras nueces:", "y"}], Column[{"Libras arándanos:", "z"}],
     Column[{"Libras necesarias:", "x + y + z"}]},
    {6, 6, 3, 15},
    {6.5, 6.5, "no se puede"},
    {7, 7, 3.5, 17.5},
    {7.5, 7.5, "no se puede"},
    {8, 8, 4, 20}}, Alignment → Center, Frame → All]]
```

Libras maní: x	Libras nueces: y	Libras arándanos: z	Libras necesarias: $x+y+z$
6	6	3	15
6.5	6.5	no se puede	
7	7	3.5	17.5
7.5	7.5	no se puede	
8	8	4	20

Libras de maní:
Intervalo para I
Intervalo para p

```
Deploy@Style[Grid[{{Column[{"Libras de maní:", "x"}],
     "Intervalo para I", "Intervalo para p"},
    {6, "195000 ≤ 5/2 (6) p ≤ 268000", "13000 ≤ p ≤ 17866.66"},
    {7, "195000 ≤ 5/2 (7) p ≤ 268000", "11142.56 ≤ p ≤ 15314.26"},
    {8, "195000 ≤ 5/2 (8) p ≤ 268000", "9750 ≤ p ≤ 13400"}},
   Alignment → Center, Frame → All]]
```

Libras de maní: x	**Intervalo para** I	**Intervalo para** p
6	$195000 \le \frac{5}{2}(6)\, p \le 268000$	$13000 \le p \le 17866.66$
7	$195000 \le \frac{5}{2}(7)\, p \le 268000$	$11142.56 \le p \le 15314.26$
8	$195000 \le \frac{5}{2}(8)\, p \le 268000$	$9750 \le p \le 13400$

```
Deploy@Style[Grid[{{"", "Libras", "% nueces", "Precio por libra"},
    {"Especial", 12, "30 %", "$ 15000"},
    {"Premium", 10, "20 %", "$ 16000"}
   }, Alignment → Center, Frame → All]]
```

	Libras	% nueces	Precio por libra
Especial	12	30 %	$ 15000
Premium	10	20 %	$ 16000

```
Deploy@Style[Grid[{{"", "Libras de triturado",
     "Concentración de nueces", "Libras de nueces"},
    {"Nueces trituradas puras", x, "1.00", "1 x"},
    {"Triturado especial", 12, "0.30", "12(0.3)"},
    {"Triturado resultante", "12 + x" , "0.45", "(12 + x)0.45"}

   }, Alignment → Center, Frame → All]]
```

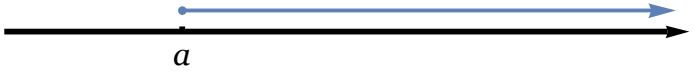
	Libras de triturado	Concentración de nueces	Libras de nueces
Nueces trituradas puras	x	1.00	$1\ x$
Triturado especial	12	0.30	12(0.3)
Triturado resultante	$12 + x$	0.45	$(12 + x)0.45$

```
Deploy@Style[Grid[{{"", "Libras de triturado",
     "Concentración de nueces", "Libras de nueces"},
    {"Nueces trituradas puras", x, "1.00", "1 x"},
    {"Triturado especial", 12, "0.30", "12(0.3)"},
    {"Triturado resultante", "12 + x" , "0.40", "(12 + x)0.4"}

   }, Alignment → Center, Frame → All]]
```

	Libras de triturado	Concentración de nueces	Libras de nueces
Nueces trituradas puras	x	1.00	$1\ x$
Triturado especial	12	0.30	12(0.3)
Triturado resultante	$12 + x$	0.40	$(12 + x)0.4$

Conceptos

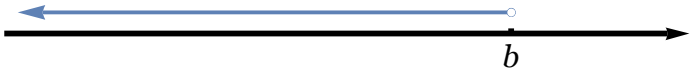
```
NumberLinePlot[x >= -3, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-3, Style["a", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```



```
NumberLinePlot[x > -3, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-3, Style["a", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```


```
NumberLinePlot[x <= 3, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{3, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```


```
NumberLinePlot[x < 3, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{3, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```



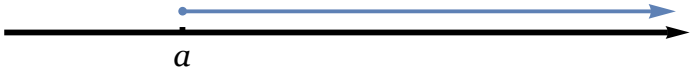

```
NumberLinePlot[-4 <= x <= 4, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-4, Style["a", "Text"]}, {4, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```

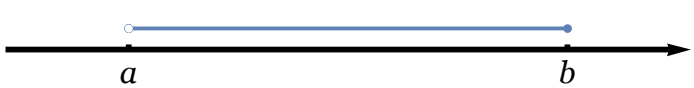

```
NumberLinePlot[-4 < x < 4, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-4, Style["a", "Text"]}, {4, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```

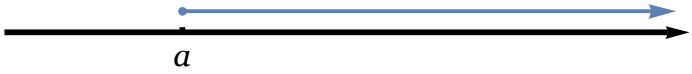
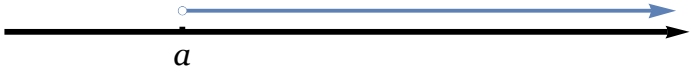
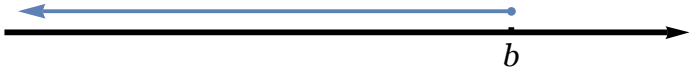

```
NumberLinePlot[-4 <= x < 4, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-4, Style["a", "Text"]}, {4, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```

```
NumberLinePlot[-4 < x <= 4, {x, -5, 5}, PlotStyle → Thick,
 Ticks → {{{-4, Style["a", "Text"]}, {4, Style["b", "Text"]}}},
 AxesStyle → Directive[Thickness[0.0085], Arrowheads[0.035]],
 ImageSize → Medium]
```

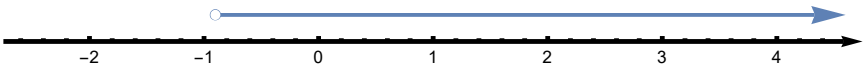

```
Deploy@Style[Grid[{
    {Column[{"Notación de", "intervalo"}], Column[{"Tipo de", "intervalo"}],
     Column[{"Notación de", " la inecuación"}], "Representación gráfica"},
    {"[a, ∞)", "Cerrado", "x ≥ a",
    {"(a, ∞)", "Abierto", "x > a",
    {"(-∞, b]", "Cerrado", "x ≤ b",
    {"(-∞, b)", "Abierto", "x < b",
    {"[a, b]", "Cerrado", "a ≤ x ≤ b",
    {"(a, b)", "Abierto", "a < x < b",
    {"[a, b)", "Mixto", "a ≤ x < b",
    {"(a, b] ", "Mixto", "a < x ≤ b",
  Alignment → Center, Frame → All]]
```





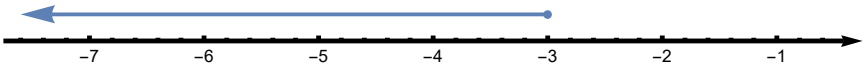
Notación de intervalo	Tipo de intervalo	Notación de la inecuación	Representación gráfica
$[a, \infty)$	Cerrado	$x \geq a$	
(a, ∞)	Abierto	$x > a$	
$(-\infty, b]$	Cerrado	$x \leq b$	
$(-\infty, b)$	Abierto	$x < b$	
$[a, b]$	Cerrado	$a \leq x \leq b$	
(a, b)	Abierto	$a < x < b$	
$[a, b)$	Mixto	$a \leq x < b$	
$(a, b]$	Mixto	$a < x \leq b$	

```
Deploy@NumberLinePlot[x > -9/10, {x, -2, 4}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



Ejemplos inecuaciones lineales

```
Deploy@NumberLinePlot[x ≤ -3, {x, -7, -1}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

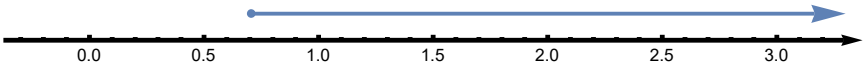



```
Deploy@NumberLinePlot[-2 < x ≤ 17/3, {x, -3, 6}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

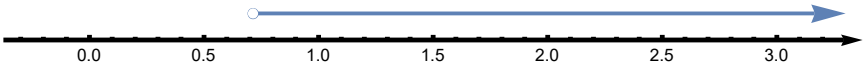
Ejercicios de refuerzo*

» Ejercicios procedimentales

```
Deploy@NumberLinePlot[x ≥ 12/17, {x, 0, 3}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

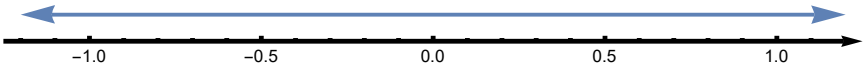



```
Deploy@NumberLinePlot[x > 5/7, {x, 0, 3}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

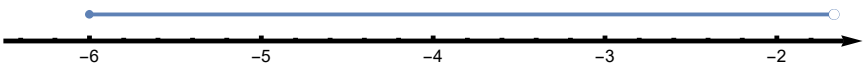



```
Deploy@NumberLinePlot[3 < x < 11/3, {x, 3, 4}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

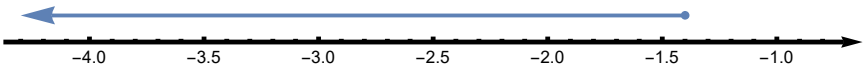

```
Deploy@NumberLinePlot[Interval[{-∞, ∞}], PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```




```
Deploy@NumberLinePlot[-6 ≤ x < -5/3, {x, -6, -2}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



```
Deploy@NumberLinePlot[x ≤ -7/5, {x, -4, -1}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



» Problemas de aplicación

Inecuaciones no lineales

```
Deploy@Style[Grid[{{"Inecuación lineal", "Inecuación no lineal"},
   {"x - (2 - x)/3 ≤ -5 x + 6", "x - (2 - x)/3 ≤ 5 x^2 + 6"},
   {"(-9 + 4 x - 2 (x - 1))/6 > -1", "(-9 + 4 x - 2 (x - 1))/(6 x) > -1"},
   {"-3 ≤ x - (2 + x)/5 < 5", "-3 ≤ x · ((2 + x)/5) < 5"}
  }, Alignment → Center, Frame → All]]
```

Inecuación lineal	Inecuación no lineal
$x-\frac{2-x}{3}\le -5x+6$	$x-\frac{2-x}{3}\le 5x^2+6$
$\frac{-9+4x-2(x-1)}{6}>-1$	$\frac{-9+4x-2(x-1)}{6x}>-1$
$-3\le x-\frac{2+x}{5}<5$	$-3\le x\cdot\left(\frac{2+x}{5}\right)<5$

Demanda

```
Deploy@DynamicModule[{framePane, textPane, tabImage, tabText,
   style1, style2, style3,
   color1 = ■, color2 = ■, color3 = ■,
   tama1 = 15, tama2 = 18, tama3 = 25, font1 = "Georgia",
   page1, page2, page3, page4, page5,
   titlePopUp, textPopUp, textPopUp2, panelWidth = 750, bodyWidth = 700},
  (*Inicializar page´s*)
  page1 = page2 = page3 = page4 = page5 = 1;
  (*estilos de los textos/recuadros*)
  framePane[s_String] := Pane[TextCell[Style[s, tama1], "Cuadro/Titulo",
     LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
      {0.9, 100, 0, 0, 0}]];
  textPane[s_String] := Pane[TextCell[Style[s, tama1], "EmphasisText",
```

```
   LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
style1[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
style2[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
style3[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
(*Estilos de las ventanas emergentes*)
titlePopUp[s_String] :=
 Pane[TextCell[Style[s, tama2, FontFamily → font1, color3, Italic],
   "Text", LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
textPopUp[s_String] := Pane[TextCell[Style[s, tama1, FontFamily → font1],
   "Text", LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
TextCell[
 Column[{Row[{"¿Qué es la ecuación de demanda? ⇒          ", "   ",
     MouseAppearance[Button[TextCell["  enlace  ", "Text"],
       CreateDialog[{
         Pane[Column[{
            titlePopUp["Ley de demanda"],
            textPopUp[
             "La ley de la demanda es una relación fundamental en
               cualquier análisis económico. La cantidad
               x de cualquier artículo que será adquirida
               por los consumidores depende del precio
               en que el artículo esté disponible. Una
               relación que especifique la cantidad
               de un artículo determinado que los
               consumidores están dispuestos a comprar,
               a varios niveles de precios, se denomina
               ley de la demanda. La ley más simple es
               una relación del tipo lineal p = m x + b
               en donde p es el precio por unidad del
               artículo y m y b son constantes. Aquí p
               se ha expresado en términos de x. Esto
               permite calcular el nivel de precio en
               que cierta cantidad x puede venderse."],
            textPopUp["Si el precio por unidad de un artículo
               aumenta, la demanda por el artículo
```

```
            disminuye porque menos consumidores podrán
            adquirirlo, mientras que si el precio por
            unidad disminuye (es decir, el artículo se
            abarata) la demanda se incrementará. "],
         textPopUp["Un ejemplo.  La relación de demanda lineal
            que rige el comportamiento de la venta
            de un artículo es p = -0, 5 x + 35.   Con
            este modelo se sabe que a un precio
            de $25 se venden 20 artículos y se
            venden 30 si el precio se fija en $20."]
        }], ImageSize → {panelWidth, bodyWidth}, Scrollbars →
        {False, True}]}, Background → White, Deployed → True],
     ImageSize → All], "LinkHand"]
  }]}]

, "Multimedia"]]
```

¿Qué es la ecuación de demanda? ⇒ enlace

» *Texto: ley de demanda*

La ley de la demanda es una relación fundamental en cualquier análisis económico. La cantidad x de cualquier artículo que será adquirida por los consumidores depende del precio en que el artículo esté disponible. Una relación que especifique la cantidad de un artículo determinado que los consumidores están dispuestos a comprar, a varios niveles de precios, se denomina *ley de la demanda*. La ley más simple es una relación del tipo lineal $p = m\,x + b$ en donde p es el precio por unidad del artículo y m y b son constantes. Aquí p se ha expresado en términos de x. Esto permite calcular el nivel de precio en que cierta cantidad x puede venderse.

Si el precio por unidad de un artículo aumenta, la demanda por el artículo disminuye porque menos consumidores podrán adquirirlo, mientras que si el precio por unidad disminuye (es decir, el artículo se abarata) la demanda se incrementará.

Un ejemplo. La relación de demanda lineal que rige el comportamiento de la venta de un artículo es $p = -0,\ 5\,x + 35$. Con este modelo se sabe que a un precio de $25 se venden 20 artículos y se venden 30 si el precio se fija en $20.

Solución ecuaciones no lineales

```
Deploy@DynamicModule[{framePane, textPane, tabImage, tabText,
   style1, style2, style3,
   color1 = ■, color2 = ■, color3 = ■,
   tama1 = 15, tama2 = 18, tama3 = 25, font1 = "Georgia",
   page1, page2, page3, page4, page5,
   titlePopUp, textPopUp, textPopUp2, panelWidth = 750, bodyWidth = 700},
```

```
(*Inicializar page´s*)
page1 = page2 = page3 = page4 = page5 = 1;
(*estilos de los textos/recuadros*)
framePane[s_String] := Pane[TextCell[Style[s, tama1], "Cuadro/Titulo",
   LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
textPane[s_String] := Pane[TextCell[Style[s, tama1], "EmphasisText",
   LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
style1[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
style2[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
style3[txt_] := Style[txt, {FontFamily → font1, FontSize → 15}];
(*Estilos de las ventanas emergentes*)
titlePopUp[s_String] :=
 Pane[TextCell[Style[s, tama2, FontFamily → font1, color3, Italic],
   "Text", LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
textPopUp[s_String] := Pane[TextCell[Style[s, tama1, FontFamily → font1],
   "Text", LineIndent → 0, TextJustification → 0, LinebreakAdjustments →
    {0.9, 100, 0, 0, 0}]];
TextCell[Column[
  {Row[{"¿cómo resolver una inecuación no lineal? ⇒          ", "   ",
     MouseAppearance[Button[TextCell["  enlace  ", "Text"],
       CreateDialog[{
         Pane[Column[{
            titlePopUp["Método para resolver inecuaciones no lineales"],
            textPopUp[
             "Para resolver inecuaciones no lineales se puede seguir una
               serie de pasos que garantizan encontrar
               el conjunto solución de la inecuación,
               tenga en cuenta que este no es el
               único método y quizá no sea siempre el
               más efectivo, con práctica se podrán
               identificar atajos o alternativas que
               faciliten el desarrollo de la solución."],
            textPopUp["La inecuación 30 ≥ 10 x^2 - 5 x es no lineal
```

porque la variable x está elevada al cuadrado en en uno de los términos. Para encontrar el conjunto solución se proponen los siguientes pasos:"],

textPopUp["1. Organizar y comparar la inecuación con cero, es decir, $-10x^2+5x+30\geq 0$."],

textPopUp["2. Efectuar operaciones y simplificar: $2x^2-x-6\leqslant 0$."],

textPopUp["Efectuar operaciones y simplificar: $2x^2-x-6\leqslant 0$.

Para obtener el resultado anterior se multiplicó a ambos lados de la inecuación por $-\frac{1}{5}$, lo que permite hacer cálculos con cifras más pequeñas, además de *ajustar* el signo de término cuadrático.

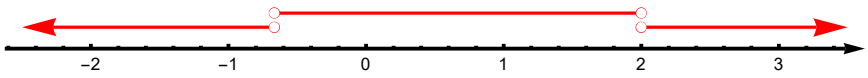
*De ser factorizable, como en este caso, se puede considerar el resultado equivalente:

$(x-2)(2x+3)\leqslant 0$."],

textPopUp["3. Asociar y resolver ecuación, es decir, resolver $2x^2-x-6=0$, las soluciones son $x=2$, $x=-\frac{2}{3}$."],

textPopUp["4. Considerar las restricciones sobre la variable, de existir. En este caso no hay, pero en otros casos se debe tener cuidado con las restricciones en los denominadores."],

textPopUp["5. Representar los números encontrados en los numerales 3. y 4. sobre una recta real e identificar los intervalos *generados* por estos: $\left\{-\frac{2}{3}, 2\right\}$ dividen la recta en tres intervalos, estos son: $\left(-\infty, -\frac{2}{3}\right)$, $\left(-\frac{2}{3}, 2\right)$ y $(2, \infty)$."],

textPopUp["  "],

textPopUp["6. Escoger un valor en cada intervalo (valor de prueba) y sustituirlo en alguna de las inecuaciones anteriores al punto 3."],

textPopUp["⇒ Del intervalo $\left(-\infty, -\frac{2}{3}\right)$ se toma, por ejemplo, $x = -2$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(-2)^2 - (-2) - 6 \leqslant 0$, es decir, $4 \leqslant 0$.

Lo anterior es **falso**, lo que implica que el intervalo al que pertenece $x = -2$ no hace parte del conjunto solución de la inecuación."],

textPopUp["⇒ Del intervalo $\left(-\frac{2}{3}, 2\right)$ se toma, por ejemplo, $x = 0$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(0)^2 - (0) - 6 \leqslant 0$, es decir, $-6 \leqslant 0$.

Lo anterior es **verdadero**, lo que implica que el intervalo al que pertenece $x = 0$ *hace parte del conjunto solución de la inecuación*."],

textPopUp["⇒ Del intervalo $(2, \infty)$ se toma, por ejemplo, $x = 3$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(3)^2 - (3) - 6 \leqslant 0$, es decir, $9 \leqslant 0$.

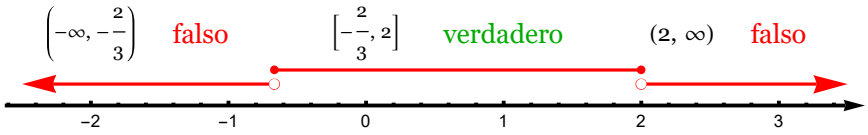
Lo anterior es **falso**, lo que implica que el intervalo al que pertenece $x = 3$ no hace parte del conjunto solución de la inecuación."],

textPopUp["7. El intervalo solución consiste en los intervalos en los que se llegó a una afirmación **verdadera**. El simbolo de la desigualdad $(\leq)$ indica que los extremos del intervalo son cerrados.

Por tanto, el conjunto solución de la inecuación $30 \geq 10x^2 - 5x$, o equivalentemente de la inecuación

```
2 x^2 - x - 6 ⩽ 0 es el intervalo [-2/3, 2]."],
```

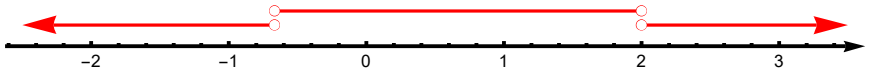
```
textPopUp["
```



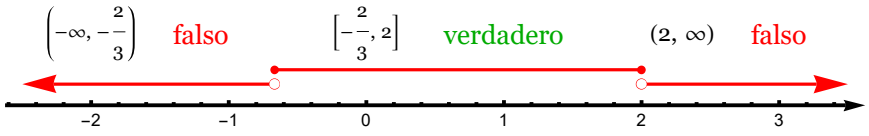

```
"]
}], ImageSize → {panelWidth, bodyWidth},
Scrollbars → {False, True}]}, Background → White, Deployed → True],
ImageSize → All], "LinkHand"]
}]}]

, "Multimedia"]]
```

¿cómo resolver una inecuación no lineal? ⇒ enlace

```
Deploy@Show[NumberLinePlot[{x < -2/3 || x > 2, -2/3 < x < 2},
{x, -2, 3}, PlotStyle → Red, Spacings → {0.3, 0.2}],
AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
ImageSize → {450, Automatic}]
```



```
Deploy@Show[NumberLinePlot[{x < -2/3 || x > 2, -2/3 <= x <= 2},
  {x, -2, 3}, PlotStyle → Red, Spacings → {0.3, 0.2}],
 Graphics[{Text[Style["(-∞, -2/3)", "Text", 10], {-2, 1}],
   Text[Style["[-2/3, 2]", "Text", 10], {0, 1}],
   Text[Style["(2, ∞)", "Text", 12], {2.3, 1}],
   Text[Style["falso", "Text", 14], {-1.2, 1}],
   Text[Style["verdadero", "Text", 14], {1, 1}],
   Text[Style["falso", "Text", 14], {3, 1}]}],
 AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
 ImageSize → {450, Automatic}]
```



» *Texto: Método*

Para resolver inecuaciones no lineales se puede seguir una serie de pasos que garantizan encontrar el conjunto solución de la inecuación, tenga en cuenta que este no es el único método y quizá no sea siempre el más efectivo, con práctica se podrán identificar atajos o alternativas que faciliten el desarrollo de la solución.

La inecuación $30 \geq 10\,x^2 - 5\,x$ es no lineal porque la variable x está elevada al cuadrado en en uno de los términos. Para encontrar el conjunto solución se proponen los siguientes pasos:

1. Organizar y comparar la inecuación con cero, es decir, $-10\,x^2 + 5\,x + 30 \geq 0$.

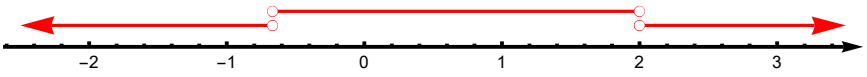
2. Efectuar operaciones y simplificar: $2\,x^2 - x - 6 \leqslant 0$.

Para obtener el resultado anterior se multiplicó a ambos lados de la inecuación por $-\frac{1}{5}$, lo que permite hacer cálculos con cifras más pequeñas, además de *ajustar* el signo de término cuadrático.
*De ser factorizable, como en este caso, se puede considerar el resultado equivalente:
$(x-2)\,(2\,x+3) \leqslant 0$.

3. Asociar y resolver ecuación, es decir, resolver $2\,x^2 - x - 6 = 0$, las soluciones son $x = 2$, $x = -\frac{2}{3}$.

4. Considerar las restricciones sobre la variable, de existir. En este caso no hay, pero en otros casos se debe tener cuidado con las restricciones en los deno
minadores.

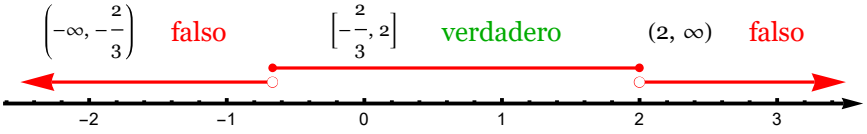
5. Representar los números encontrados en los numerales **3.** y **4.** sobre una recta real e identificar los intervalos *generados* por estos: $\left\{-\frac{2}{3},\ 2\right\}$ dividen la recta en tres intervalos, estos son: $\left(-\infty,\ -\frac{2}{3}\right)$, $\left(-\frac{2}{3},\ 2\right)$ y $(2,\ \infty)$.



6. Escoger un valor en cada intervalo (valor de prueba) y sustituirlo en alguna de las inecuaciones anteriores al punto **3.**

- Del intervalo $\left(-\infty, -\frac{2}{3}\right)$ se toma, por ejemplo, $x = -2$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(-2)^2 - (-2) - 6 \leqslant 0$, es decir, $4 \leqslant 0$.
  Lo anterior es falso, lo que implica que el intervalo al que pertenece $x = -2$ no hace parte del conjunto solución de la inecuación.
- Del intervalo $\left(-\frac{2}{3}, 2\right)$ se toma, por ejemplo, $x = 0$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(0)^2 - (0) - 6 \leqslant 0$, es decir, $-6 \leqslant 0$.
  Lo anterior es verdadero, lo que implica que el intervalo al que pertenece $x = 0$ ***hace parte del conjunto solución de la inecuación***.
- Del intervalo $(2, \infty)$ se toma, por ejemplo, $x = 3$ y se sustituye en la inecuación $2x^2 - x - 6 \leqslant 0$. Esto deja como resultado $2(3)^2 - (3) - 6 \leqslant 0$, es decir, $9 \leqslant 0$.
  Lo anterior es falso, lo que implica que el intervalo al que pertenece $x = 3$ no hace parte del conjunto solución de la inecuación.

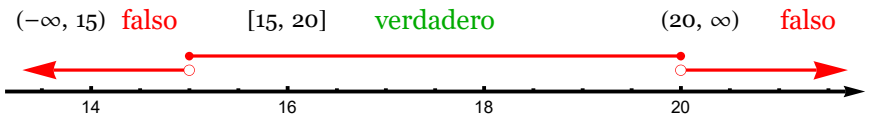
7. **El intervalo solución consiste en los intervalos en los que se llegó a una afirmación verdadera.** El simbolo de la desigualdad "≤" indica que los extremos del intervalo son cerrados.
Por tanto, el conjunto solución de la inecuación $30 \geq 10x^2 - 5x$, o equivalentemente de la inecuación $2x^2 - x - 6 \leqslant 0$ es el intervalo $\left[-\frac{2}{3}, 2\right]$.



» Solución

```
Deploy@Show[NumberLinePlot[{x < 15 || x > 20, 15 < x < 20},
    {x, 14, 21}, PlotStyle → Red, Spacings → {0.3, 0.2}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

```
Deploy@Show[NumberLinePlot[{x < 15 || x > 20, 15 <= x <= 20},
    {x, 14, 21}, PlotStyle → Red, Spacings → {0.3, 0.2}],
  Graphics[{Text[Style["(-∞, 15)", "Text", 12], {13.7, 1}],
    Text[Style["[15, 20]", "Text", 12], {16, 1}],
    Text[Style["(20, ∞)", "Text", 12], {20.2, 1}],
    Text[Style["falso", "Text", 14], {14.6, 1}],
    Text[Style["verdadero", "Text", 14], {17.5, 1}],
    Text[Style["falso", "Text", 14], {21.3, 1}]}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```




```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, 15)", 13, "14 ⩽ 0: falso"},
    {"(15, 20)", 18, "-6 ⩽ 0: verdadero"},
    {"(20, ∞)", 21, "6 ⩽ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(−∞, 15)	13	14 ⩽ 0: falso
(15, 20)	18	−6 ⩽ 0: verdadero
(20, ∞)	21	6 ⩽ 0: falso

```
Deploy@Show[NumberLinePlot[{15 <= x <= 20},
    {x, 14, 21}, PlotStyle → Red, Spacings → {0.3, 0.2}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

Ejemplos de solución de inecuaciones

» Ejemplo 1:

```
Deploy@
 Show[NumberLinePlot[{x < 1}, {x, 0, 2.5}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 3/2}, {x, 0, 2.5}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{1 < x < 3/2},
   {x, 0, 2.5}, PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

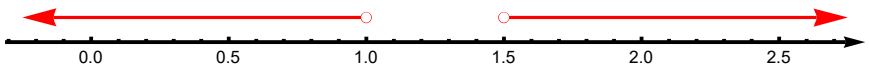

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, 1)", 0, "3 > 0: verdadero"},
    {"(1, 3/2)", 1.2, "-0.12 > 0: falso"},
    {"(3/2, ∞)", 2, "1 > 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, 1)$	0	$3 > 0$: verdadero
$(1, \frac{3}{2})$	1.2	$-0.12 > 0$: falso
$(\frac{3}{2}, \infty)$	2	$1 > 0$: verdadero

```
2 t^2 - 5 t + 3 /. t → {0, 1.2, 2}
```

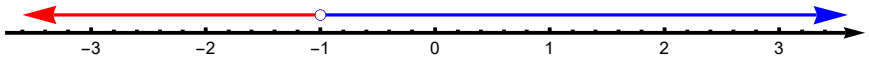
{3, −0.12, 1}

```
Deploy@Show[NumberLinePlot[{x < 1, x > 3/2},
   {x, 0, 2.5}, PlotStyle → {Red}, Spacings → {0.3, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



» Ejemplo 2:

```
Deploy@Show[NumberLinePlot[{x < -1, x > -1},
   {x, -3, 3}, PlotStyle → {Red, Blue}, Spacings → {0.2, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



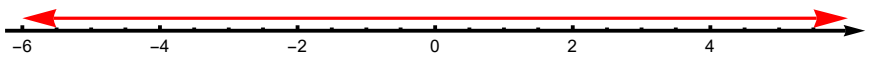

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, -1)", -2, "54 ≥ 0: verdadero"},
    {"(-1, ∞)", 0, "6 ≥ 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, -1)$	-2	$54 \geq 0$: verdadero
$(-1, \infty)$	0	$6 \geq 0$: verdadero

```
6 z^2 - 12 z + 6 /. z → {-2, 0}
```

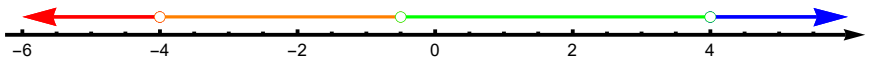
{54, 6}

```
Deploy@Show[
  NumberLinePlot[{x^2 ≥ 0}, {x, -5, 5}, PlotStyle → {Red}, Spacings → {0.3, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



» Ejemplo 3:

```
Deploy@Show[NumberLinePlot[{x < -4, x > 4},
    {x, -5, 5}, PlotStyle → {Red, Blue}, Spacings → {0.2, 0}],
  NumberLinePlot[{x < -4, x > 4, -4 < x < -1 / 2, -1 / 2 < x < 4}, {x, -5, 5},
   PlotStyle → {Red, Blue, Orange, Green}, Spacings → {0.2, 0, 0, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



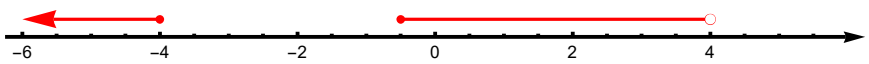

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, -4)", -5, "-1 ⩽ 0: verdadero"},
    {"(-4, -1/2)", -3, "5/7 ⩽ 0: falso"},
    {"(-1/2, 4)", 0, "-1 ⩽ 0: verdadero"},
    {"(4, ∞)", 5, "99 ⩽ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, -4)$	-5	$-1 \leqslant 0$: verdadero
$\left(-4, -\frac{1}{2}\right)$	-3	$\frac{5}{7} \leqslant 0$: falso
$\left(-\frac{1}{2}, 4\right)$	0	$-1 \leqslant 0$: verdadero
$(4, \infty)$	5	$99 \leqslant 0$: falso

```
(-2 m^2 - 9 m - 4) / (4 - m) /. m → {-5, -3, 0, 5}
```

$$\left\{-1, \frac{5}{7}, -1, 99\right\}$$

```
Deploy@Show[NumberLinePlot[{x <= -4, -1 / 2 <= x < 4},
    {x, -5, 5}, PlotStyle → {Red}, Spacings → {0.2, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



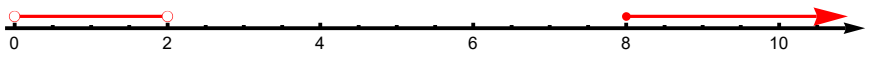
» Ejemplo 4:

```
Deploy@Show[
  NumberLinePlot[0 < x < 2, {x, 0.5, 10}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[2 < x < 8, {x, 0.5, 10}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[x > 8, {x, 0.5, 10}, PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{1, 10}, Automatic},
  ImageSize → {450, Automatic}]
```


```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 2)", 1, "14 ⩾ 0: verdadero"},
    {"(2, 8)", 5, "-11/5 ⩾ 0: falso"},
    {"(8, ∞)", 12, "3/5 ⩾ 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 2)	1	$14 \geqslant 0$: verdadero
(2, 8)	5	$-\frac{11}{5} \geqslant 0$: falso
(8, ∞)	12	$\frac{3}{5} \geqslant 0$: verdadero

```
Deploy@Show[
  NumberLinePlot[0 < x < 2, {x, 0.5, 10}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[x >= 8, {x, 0.5, 10}, PlotStyle → {Red}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{1, 10}, Automatic},
  ImageSize → {450, Automatic}]
```

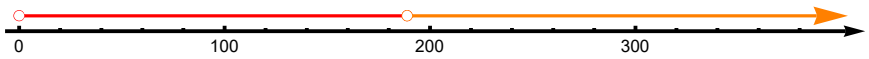


Problema 2. Mezcla *maní-nueces:* nuevas presentaciones.

```
Deploy@Style[Grid[{{"Mezcla", "Valor", …, …, … },
    {⋮, "Cuarto de libra", "Media libra", "Una libra", "Dos libras"},
    {"Maní-nueces", "$ 4500 a $ 5000 ", "$ 9000 a $ 10000", "$ 15000 a $ 18500",
     "$ 29000 a $ 36000"}}, Alignment → Center, Frame → All], 15]
```

Mezcla	Valor			
	Cuarto de libra	Media libra	Una libra	Dos libras
Maní –nueces	$ 4500 a $ 5000	$ 9000 a $ 10000	$ 15000 a $ 18500	$ 29000 a $ 36000

```
Deploy@Show[NumberLinePlot[0 < x < 1700/9,
   {x, 0.5, 250}, PlotStyle → {Red}, Spacings → {0.7}],
  NumberLinePlot[x > 1700/9, {x, 0.5, 370},
   PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{35, 370}, Automatic},
  ImageSize → {450, Automatic}]
```



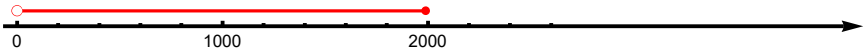

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 1700/9)", 1000, "-89/10 ≤ 0: verdadero"},
    {"(1700/9, ∞)", 300, "10/3 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$\left(0, \frac{1700}{9}\right)$	1000	$-\frac{89}{10} \leq 0$: verdadero
$\left(\frac{1700}{9}, \infty\right)$	300	$\frac{10}{3} \leq 0$: falso

```
(9 y - 17900)/y /. y → {1000, 3000}
```

$$\left\{-\frac{89}{10}, \frac{91}{30}\right\}$$

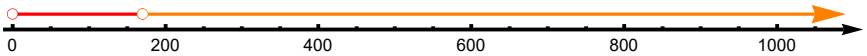
```
Deploy@Show[NumberLinePlot[0 < x <= 17900/9,
   {x, 0.5, 3700}, PlotStyle → {Red}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{350, 3700}, Automatic},
  ImageSize → {450, Automatic}]
```




```
{Reduce[4500 ≤ 850000/y, y],
 Reduce[{850000/y ≤ 5000 && y > 0}, y], Reduce[4500 ≤ 850000/y ≤ 5000, y]}
```

$$\left\{0 < y \leq \frac{1700}{9},\ y \geq 170,\ 170 \leq y \leq \frac{1700}{9}\right\}$$

```
Deploy@Show[NumberLinePlot[0 < x < 170,
   {x, 0.5, 1000}, PlotStyle → {Red}, Spacings → {0.7}],
  NumberLinePlot[x > 170, {x, 0.5, 1000},
   PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{100, 1000}, Automatic},
  ImageSize → {450, Automatic}]
```



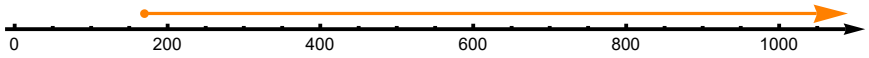

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 170)", 100, "-7/10 ≥ 0: falso"},
    {"(170, ∞)", 1000, "83/100 ≥ 0: verdadero"}},
   Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 170)	100	$-\frac{7}{10} \geq 0$: falso
(170, ∞)	1000	$\frac{83}{100} \geq 0$: verdadero

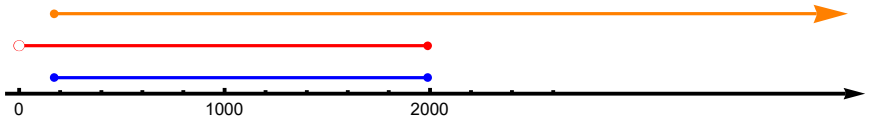
```
(y - 170)/y /. y → {100, 1000}
```

$$\left\{-\frac{7}{10}, \frac{83}{100}\right\}$$

```
Deploy@Show[
  NumberLinePlot[x >= 170,
   {x, 0.5, 1000}, PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{100, 1000}, Automatic},
  ImageSize → {450, Automatic}]
```




```
Deploy@Show[NumberLinePlot[{170 ≤ x <= 17900/9, 0 < x <= 17900/9, x >= 170},
   {x, 0.5, 3700}, PlotStyle → {Blue, Red, Orange}, Spacings → {0.2, 0.4, 0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{350, 3700}, {0, 1}},
  ImageSize → {450, Automatic}]
```



Ejercicios de refuerzo*

» Ejercicios procedimientales

1. $3z^2 + 6z > 9$

```
Deploy@Show[
  NumberLinePlot[{x < -3}, {x, -4, 2.5}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 1}, {x, -4, 2.5}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{-3 < x < 1},
   {x, -4, 2.5}, PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

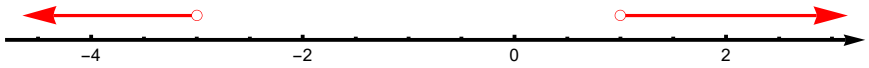
```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, -3)", -4, "5 > 0: verdadero"},
    {"(-3, 1)", 0, "-3 > 0: falso"},
    {"(1, ∞)", 2, "5 > 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, -3)$	-4	$5 > 0$: verdadero
$(-3, 1)$	0	$-3 > 0$: falso
$(1, \infty)$	2	$5 > 0$: verdadero

```
x^2 + 2 x - 3 /. x → {-4, 0, 2}
```

$\{5, -3, 5\}$

```
Deploy@Show[NumberLinePlot[{x < -3, x > 1},
    {x, -4, 2.5}, PlotStyle → {Red}, Spacings → {0.3, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



2. $-t^3 + 6\,t^2 - 8\,t < 0$

```
Deploy@
 Show[NumberLinePlot[{x < 0}, {x, -1, 5}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 4}, {x, -1, 5}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{0 < x < 2},
   {x, -1, 5}, PlotStyle → {Orange}, Spacings → {0.4}],
  NumberLinePlot[{2 < x < 4}, {x, -1, 5},
   PlotStyle → {Green}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, -3)", -4, "56 ≤ 0: falso"},
    {"(-3, 0)", -1, "-4 ≤ 0: verdadero"},
    {"(0, 3)", 2, "4/5 ≤ 0: falso"},
    {"(3, ∞)", 5, "-5/2 ≤ 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, -3)$	-4	$56 \le 0$: falso
$(-3, 0)$	-1	$-4 \le 0$: verdadero
$(0, 3)$	2	$\frac{4}{5} \le 0$: falso
$(3, \infty)$	5	$-\frac{5}{2} \le 0$: verdadero

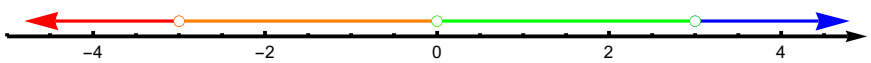
```
2 x (x - 3)/(- (x + 3)) /. x → {-4, -1, 2, 5}
```

$$\left\{56, -4, \frac{4}{5}, -\frac{5}{2}\right\}$$

```
Deploy@Show[
  NumberLinePlot[{0 < x < 2}, {x, -1, 5}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 4}, {x, -1, 5}, PlotStyle → {Red}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

3. $\frac{2u^2-5u+3}{-u-3} \le -1$

```
Deploy@Show[
  NumberLinePlot[{x < -3}, {x, -4, 4}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 3}, {x, -4, 4}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{-3 < x < 0},
   {x, -4, 4}, PlotStyle → {Orange}, Spacings → {0.4}],
  NumberLinePlot[{0 < x < 3}, {x, -4, 4},
   PlotStyle → {Green}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



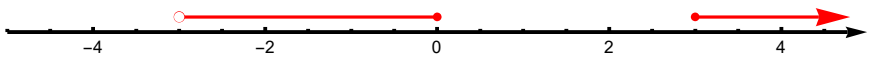
```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, 0)", -1, "15 < 0: falso"},
    {"(0, 2)", 1, "-3 < 0: verdadero"},
    {"(2, 4)", 3, "3 < 0: falso"},
    {"(4, ∞)", 5, "15 < 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, 0)$	-1	$15 < 0$: falso
$(0, 2)$	1	$-3 < 0$: verdadero
$(2, 4)$	3	$3 < 0$: falso
$(4, \infty)$	5	$15 < 0$: verdadero

```
-x^3 + 6 x^2 - 8 x /. x → {-1, 1, 3, 5}
```

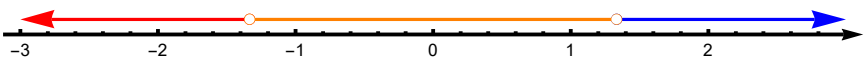
$\{15, -3, 3, -15\}$

```
Deploy@Show[
  NumberLinePlot[{-3 < x ≤ 0}, {x, -4, 4}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x ≥ 3}, {x, -4, 4}, PlotStyle → {Red}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



4. $9x^2 > 16$

```
Deploy@Show[NumberLinePlot[{x < -4/3},
    {x, -2.5, 2.5}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 4/3}, {x, -2.5, 2.5},
   PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{-4/3 < x < 4/3}, {x, -2.5, 2.5},
   PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(-∞, -4/3)", -2, "20 < 0: falso"},
    {"(-4/3, 4/3)", 1, "-7 < 0: verdadero"},
    {"(4/3, ∞)", 3, "65 < 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(-\infty, -\frac{4}{3})$	-2	$20 < 0$: falso
$(-\frac{4}{3}, \frac{4}{3})$	1	$-7 < 0$: verdadero
$(\frac{4}{3}, \infty)$	3	$65 < 0$: falso

```
9 x^2 - 16 /. x → {-2, 1, 3}
```

$\{20, -7, 65\}$

```
Deploy@Show[NumberLinePlot[{-4/3 < x < 4/3},
   {x, -2.5, 2.5}, PlotStyle → {Red}, Spacings → {0.3, 0}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

» Problemas de aplicación

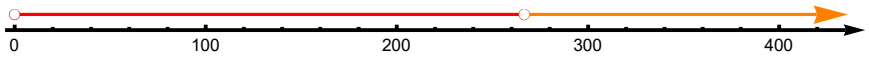
1.

2.

```
{Reduce[(9000 n - 2 400 000)/n ≤ 0, n],
 Reduce[{2 400 000/n ≤ 10 000 && n > 0}, n], Reduce[9000 <= 2 400 000/n ≤ 10 000, n]}
```

$\left\{0 < n \le \frac{800}{3}, n \ge 240, 240 \le n \le \frac{800}{3}\right\}$

```
Deploy@Show[NumberLinePlot[0 < x < 800/3,
   {x, 0.5, 400}, PlotStyle → {Red}, Spacings → {0.7}],
  NumberLinePlot[x > 800/3, {x, 0.5, 400},
   PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{40, 400}, Automatic},
  ImageSize → {450, Automatic}]
```



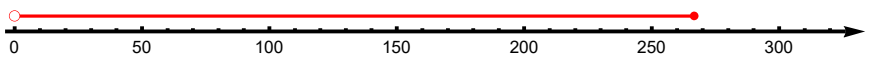

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 800/3)", 200, "-1 ≤ 0: verdadero"},
    {"(800/3, ∞)", 600, "5/3 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
$(0, \frac{800}{3})$	200	$-1 \leq 0$: verdadero
$(\frac{800}{3}, \infty)$	600	$\frac{5}{3} \leq 0$: falso

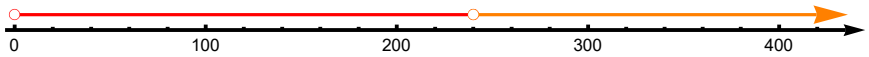
```
(3 n - 800)/n /. n → {200, 600}
```

$$\left\{-1, \frac{5}{3}\right\}$$

```
Deploy@Show[NumberLinePlot[0 < x <= 800/3,
   {x, 0.5, 400}, PlotStyle → {Red}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{30, 300}, Automatic},
  ImageSize → {450, Automatic}]
```



```
Deploy@Show[NumberLinePlot[0 < x < 240,
    {x, 0.5, 400}, PlotStyle → {Red}, Spacings → {0.7}],
  NumberLinePlot[x > 240, {x, 0.5, 400},
   PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{40, 400}, Automatic},
  ImageSize → {450, Automatic}]
```



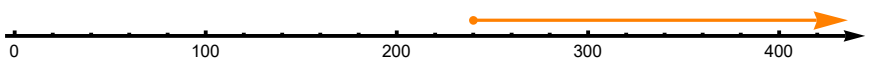

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 240)", 100, "-7/5 ≥ 0: falso"},
    {"(240, ∞)", 300, "1/5 ≥ 0: verdadero"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 240)	100	$-\frac{7}{5} \geq 0$: falso
(240, ∞)	300	$\frac{1}{5} \geq 0$: verdadero

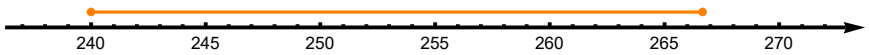
```
(n - 240)/n /. n → {100, 300}
```

$$\left\{-\frac{7}{5}, \frac{1}{5}\right\}$$

```
Deploy@Show[
  NumberLinePlot[x >= 240,
   {x, 0.5, 400}, PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{40, 400}, Automatic},
  ImageSize → {450, Automatic}]
```



```
Deploy@Show[
  NumberLinePlot[240 <= x <= 800/3,
   {x, 0.5, 400}, PlotStyle → {Orange}, Spacings → {0.7}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  PlotRange → {{240, 270}, Automatic},
  ImageSize → {450, Automatic}]
```



3.

```
Reduce[-x^2 + 80 x - 300 ≥ 400, x]
```

$10 \le x \le 70$

```
Deploy@Show[
  NumberLinePlot[{0 < x < 10}, {x, 8, 80}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 70}, {x, 8, 80}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{10 < x < 70},
   {x, 8, 80}, PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

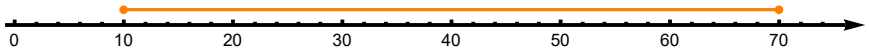

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 10)", 5, "325 ≤ 0: falso"},
    {"(10, 70)", 30, "-800 ≤ 0: verdadero"},
    {"(70, ∞)", 80, "700 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 10)	5	$325 \le 0$: falso
(10, 70)	30	$-800 \le 0$: verdadero
(70, ∞)	80	$700 \le 0$: falso

```
x^2 - 80 x + 700 /. x → {5, 30, 80}
```

{325, −800, 700}

```
Deploy@Show[NumberLinePlot[{10 <= x <= 70},
    {x, 7, 70}, PlotStyle → {Orange}, Spacings → {0.4}],
   AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
   ImageSize → {450, Automatic}]
```



4.

```
Reduce[-x^2 + 250 x - 15 000 ≥ 0, x]
```

$100 \le x \le 150$

```
Deploy@Show[NumberLinePlot[{0 < x < 100},
    {x, 20, 200}, PlotStyle → {Red}, Spacings → {0.4}],
   NumberLinePlot[{x > 150}, {x, 20, 200}, PlotStyle → {Blue}, Spacings → {0.4}],
   NumberLinePlot[{100 < x < 150},
    {x, 20, 200}, PlotStyle → {Orange}, Spacings → {0.4}],
   AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
   ImageSize → {450, Automatic}]
```


```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 101)", 70, "2400 ≤ 0: falso"},
    {"(100, 150)", 110, "-400 ≤ 0: verdadero"},
    {"(150, ∞)", 200, "5000 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 101)	70	2400 ≤ 0: falso
(100, 150)	110	−400 ≤ 0: verdadero
(150, ∞)	200	5000 ≤ 0: falso

```
x^2 - 250 x + 15 000 /. x → {70, 110, 200}
```

{2400, −400, 5000}

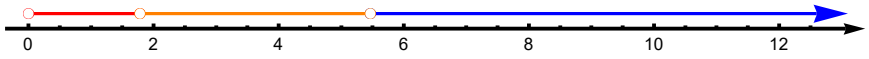
```
Deploy@Show[NumberLinePlot[{100 <= x <= 150},
    {x, 100, 150}, PlotStyle → {Orange}, Spacings → {0.4}],
   AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
   ImageSize → {450, Automatic}]
```

5.

```
Reduce[4 t^2 - 29 t + 39 ≤ 0, t] // N
```

$1.78364 \le t \le 5.46636$

```
Deploy@Show[NumberLinePlot[{0 < x < 1.783},
    {x, 1, 12}, PlotStyle → {Red}, Spacings → {0.4}],
  NumberLinePlot[{x > 5.466}, {x, 1, 12}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{1.783 < x < 5.466},
    {x, 1, 12}, PlotStyle → {Orange}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



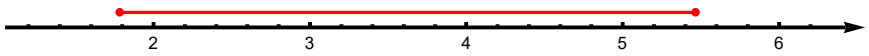

```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 1.783)", 1, "14 ≤ 0: falso"},
    {"(1.783, 5.466)", 3, "-12 ≤ 0: verdadero"},
    {"(5.466, ∞)", 11, "204 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 1.783)	1	$14 \le 0$: falso
(1.783, 5.466)	3	$-12 \le 0$: verdadero
(5.466, ∞)	11	$204 \le 0$: falso

```
4 t^2 - 29 t + 39 /. t → {1, 3, 11}
```

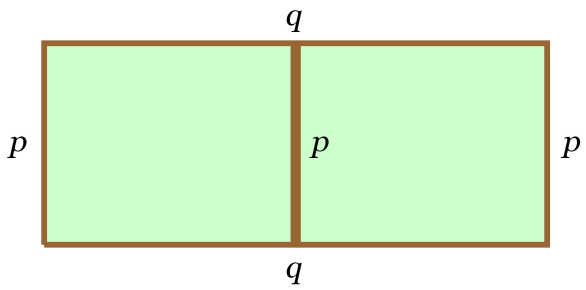
{14, −12, 204}

```
Deploy@Show[NumberLinePlot[{1.783 <= x <= 5.466},
    {x, 1.6, 6}, PlotStyle → {Red}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



6.

```
Deploy@Pane@Show[
  Graphics[{EdgeForm[Directive[Brown, Thickness@0.01]],
    FaceForm[Directive[Green, Opacity@0.2]],
    Polygon@{{0, 0}, {10, 0}, {10, 4}, {0, 4}, {0, 0}},
    Brown, Thickness@0.018, Line[{{5, 0.1}, {5, 3.9}}],
    Black, Text[TraditionalForm@Style["q", "Text"] , {5, -.5}],
    Text[TraditionalForm@Style["q", "Text"] , {5, 4.5}],
    Text[TraditionalForm@Style["p", "Text"] , {-.5, 2}],
    Text[TraditionalForm@Style["p", "Text"] , {10.5, 2}],
    Text[TraditionalForm@Style["p", "Text"] , {5.5, 2}]}],
  ImageSize → 300]
```




```
Reduce[12 (1800/q) + 6 q ≤ 2310, q]
```

$$q < 0 \vee \frac{5}{2}\left(77 - \sqrt{5353}\right) \le q \le \frac{5}{2}\left(77 + \sqrt{5353}\right)$$

```
Reduce[(q^2 - 385 q + 600)/q <= 0, q]
```

$$q < 0 \vee \frac{5}{2}\left(77 - \sqrt{5833}\right) \le q \le \frac{5}{2}\left(77 + \sqrt{5833}\right)$$

```
NSolve[q^2 - 385 q + 600 == 0, q]
```

$$\{\{q \to 1.5648\}, \{q \to 383.435\}\}$$

```
(q^2 - 385 q + 600)/q /. q → {1, 300, 500}
```

$$\left\{216, -83, \frac{581}{5}\right\}$$

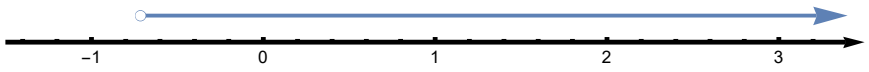
```
Deploy@
 Style[Grid[{{"Intervalo", "Valor de prueba", "Evaluado en la inecuación"},
    {"(0, 1.565)", 1, "216 ≤ 0: falso"},
    {"(1.565, 383.435)", 300, "-83 ≤ 0: verdadero"},
    {"(383.435, ∞)", 500, "581/5 ≤ 0: falso"}}, Alignment → Center, Frame → All]]
```

Intervalo	Valor de prueba	Evaluado en la inecuación
(0, 1.565)	1	216 ≤ 0: falso
(1.565, 383.435)	300	−83 ≤ 0: verdadero
(383.435, ∞)	500	$\frac{581}{5}$ ≤ 0: falso

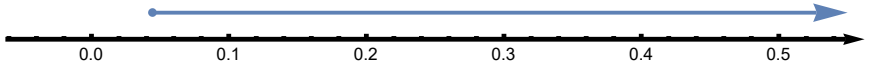
Resumen inecuaciones

Ejemplos inecuaciones lineales

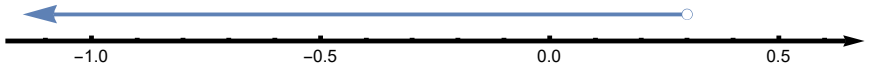
```
Deploy@NumberLinePlot[4 x + 4 > (x + 3)/2, {x, -1, 3}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```




```
Deploy@NumberLinePlot[x ≥ 2/45, {x, 0, .5}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



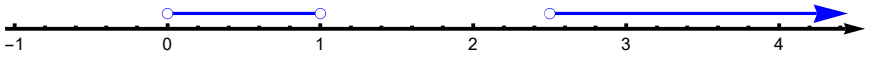

```
Deploy@NumberLinePlot[x < 3/10, {x, -1, 0.5}, PlotStyle → Thick,
  AxesStyle → Directive[Thickness[0.0055], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



Ejemplos inecuaciones no lineales

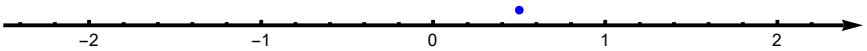
1. $\frac{-2x^2-9x-4}{1-x} > -4$

```
Deploy@Show[
  NumberLinePlot[{x > 5/2}, {x, -0.5, 4}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{0 < x < 1}, {x, -1, 3}, PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



2. $16\,m - 16\,m^2 \geq 4$

```
Deploy@Show[
  NumberLinePlot[{x = 1/2}, {x, -2, 2}, PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```



3. $\frac{-3\,y^2+16\,y-16}{-y-1} \leq 0$

```
Deploy@Show[
  NumberLinePlot[{x < -1}, {x, -2, 4.5}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{4/3 <= x ≤ 4}, {x, -2, 4.5},
   PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

4. $m^2 - 2\,m \leq 8$

```
Deploy@Show[NumberLinePlot[{-2 <= x ≤ 4},
    {x, -2, 4.5}, PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

5. $3\,y^2 - 6\,y > 9$

```
Deploy@Show[NumberLinePlot[{x < 1 || x > 3},
    {x, -2, 5}, PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```

6. $\frac{2u^2-8}{4-u} \leq -2$

```
Deploy@Show[
  NumberLinePlot[{x > 4}, {x, -0.5, 5}, PlotStyle → {Blue}, Spacings → {0.4}],
  NumberLinePlot[{0 <= x <= 1}, {x, -1, 3},
   PlotStyle → {Blue}, Spacings → {0.4}],
  AxesStyle → Directive[Thickness[0.0045], Arrowheads[0.025]],
  ImageSize → {450, Automatic}]
```