

tikzphysics

TikZ-native physics diagrams

Version 1.0.0

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2026-08-12

Abstract

`tikzphysics` extends TikZ with reusable shapes and geometric anchors for classical-physics diagrams. It provides continuous contact surfaces, inclined planes, blocks, pulleys, and a curved optical lens without introducing a new drawing language. Every object remains an ordinary TikZ node or path.

```
In one line: \node[physicswedge, physics wedge angle=30, physics wedge width=6] (W)
at (0,0) {};
```

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1 Start here

1.1 Loading

Load every module with the package wrapper:

```
\usepackage{tikzphysics}
```

For smaller documents, load only the required TikZ libraries:

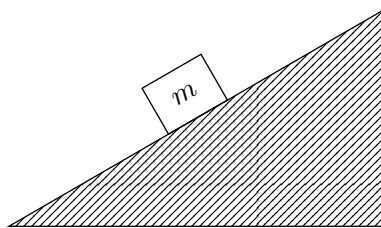
```
\usepackage{tikz}
\usetikzlibrary{tikzphysics.surface, tikzphysics.mechanics}
```

The available libraries are `tikzphysics.surface`, `tikzphysics.mechanics`, `tikzphysics.optics`, and `tikzphysics.core`. Each feature library loads `tikzphysics.core` automatically.

1.2 The design model

1. Choose a style such as `physicswedge`, `physicsblock`, or `physicslens`.
2. Set dimensions and geometry with keys whose names begin with `physics`.
3. Give the node a name and compose the diagram through its anchors.

```
\begin{tikzpicture}
  \node[physicswedge, physics wedge width=5, physics wedge angle=30] (W) at (0,0) {};
  \node[physicsblock, physics block width=0.9, physics block height=0.7,
        rotate=30, anchor=south] at (W.slope-mid) {$m$};
\end{tikzpicture}
```



1.3 Dimensions

All public size keys accept either a bare value or an explicit TeX dimension. A bare value is interpreted as centimetres, so `physics wedge width=4` and `physics wedge width=4cm` are equivalent. Values such as `12mm`, `18pt`, and `1in` retain their units. Sizes must be positive.

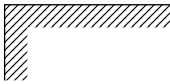
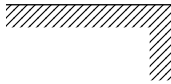
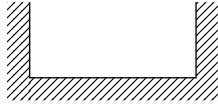
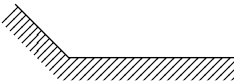
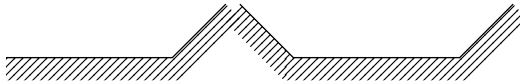
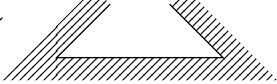
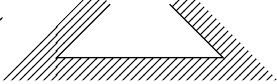
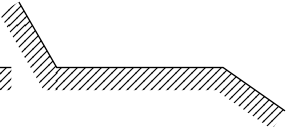
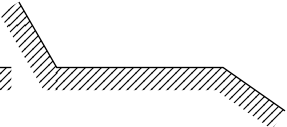
2 Contact surfaces and wedges

2.1 Bent platforms

The three platform styles share a horizontal floor strip. The left and right variants extend that strip through one bent wall; the both variant has two independently configurable bends. Each node is rendered as one continuous platform, without a hinge mark or seam. Wall direction is continuous rather than limited to presets, so the gallery below covers every distinct configuration class; intermediate angles use the same keys.

Style	Configuration
<code>physicsplatform-left</code>	One wall at the left floor corner.
<code>physicsplatform-right</code>	One wall at the right floor corner.
<code>physicsplatform-both</code>	Two walls; set both with <code>physics wall angle</code> , or set them independently with <code>physics left wall angle</code> and <code>physics right wall angle</code> .

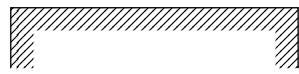
Variant gallery

			
down left -90	down right -90	down both -90/-90	up both 90/90
			
outward left 135	outward right 45	outward both 135/45	inward both 45/135
			
straight left 180	straight right 0	straight both 180/0	asymmetric 120/-35

Key	Meaning and default
<code>physics platform width</code>	Overall floor width; default 5cm.
<code>physics platform depth</code>	Wall length and nominal vertical extent; default 2cm.
<code>physics strip width</code>	Thickness of the floor and walls; default 0.3cm.
<code>physics wall angle</code>	Direction of every wall, measured counter-clockwise from the positive x-axis; default -90.
<code>physics left wall angle</code>	Left-wall override for <code>physicsplatform-both</code> .
<code>physics right wall angle</code>	Right-wall override for <code>physicsplatform-both</code> .

Key-by-key variants

Each public platform key can be varied independently and combined with any configuration from the preceding gallery. These examples isolate the visual effect of all six keys.



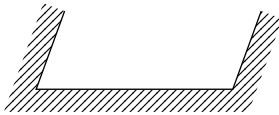
wide floor
physics platform width=3.8



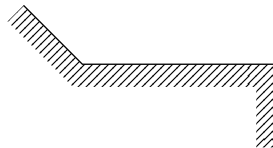
deep walls
physics platform depth=1.5



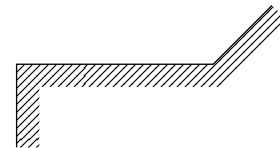
thick material
physics strip width=0.5



shared direction
physics wall angle=70



left override
physics left wall angle=135



right override
physics right wall angle=45

The floor and wall contact lines meet at a fixed **corner**. The complete floor-and-wall body is one closed polygon: its outer contact line and inner edge both meet in exact, sharp V-shaped miters. The two-wall style exposes **left-corner** and **right-corner**; these lie on the same continuous geometry rather than on separately assembled parts. Angles may vary continuously; only a left wall at 0° and a right wall at 180° (modulo 360°) are excluded because they retrace the floor and have no finite miter.



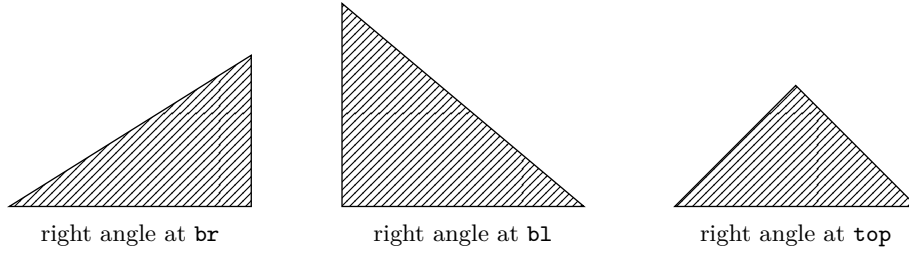
Platform anchors

Family	Available anchors
Surface corner	corner; for the two-wall style, left-corner and right-corner.
Floor corners	floor-tl, floor-tr, floor-br, floor-bl.
Floor midpoints	floor-top-mid, floor-bottom-mid, floor-left-mid, floor-right-mid, floor-center.
Wall corners	wall-A, wall-B, wall-C, wall-D, ordered as outer-near, inner-miter, inner-far, outer-far.
Wall midpoints	wall-outer-mid, wall-inner-mid, wall-near-mid, wall-far-mid, wall-center.
Two-wall prefixes	Use left-wall-... and right-wall-... for wall corners, midpoints, and numeric wall edges.

Every floor and wall edge also provides integer anchors from 0 through 100, for example **floor-top-25**, **wall-outer-50**, and **right-wall-inner-75**.

2.2 Wedges

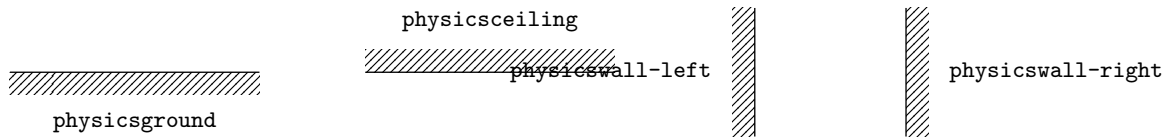
`physicswedge` creates a right triangle for inclined-plane diagrams.



Key	Meaning and default
<code>physics wedge width</code>	Base width; default 4cm.
<code>physics wedge height</code>	Explicit height when no angle is supplied.
<code>physics wedge angle</code>	Authoritative acute angle; default is 30 degrees for <code>bl/br</code> , and 45 degrees for <code>top</code> .
<code>physics wedge right angle at</code>	One of <code>br</code> (default), <code>bl</code> , or <code>top</code> .

Geometry precedence is `physics wedge angle`, then `physics wedge height`, then the mode default. The principal anchors are `bl`, `br`, `top`, `base-mid`, `right-mid`, `slope-mid`, `slope-right-mid`, and `centroid`. Numeric edge families are `base-0..100`, `right-0..100`, and `slope-0..100`.

2.3 Ground, ceiling, and walls



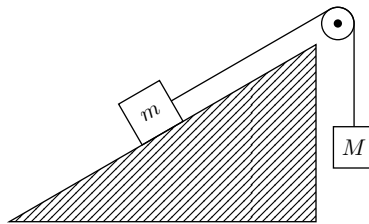
The sizing keys are grouped by shape:

<code>physicsground</code>	<code>physics ground width</code> , <code>physics ground depth</code>
<code>physicsceiling</code>	<code>physics ceiling width</code> , <code>physics ceiling depth</code>
<code>physicswall-left</code> , <code>physicswall-right</code>	<code>physics wall thickness</code> , <code>physics wall height</code>

Each shape exposes four corners, four edge midpoints, `center`, and `surface`, plus numeric `top/right/bottom/left-0..100` edge anchors.

3 Blocks and pulleys

The `tikzphysics.mechanics` library supplies thin styles over TikZ's rectangle and circle shapes. Both styles retain the standard rectangle/circle compass anchors.

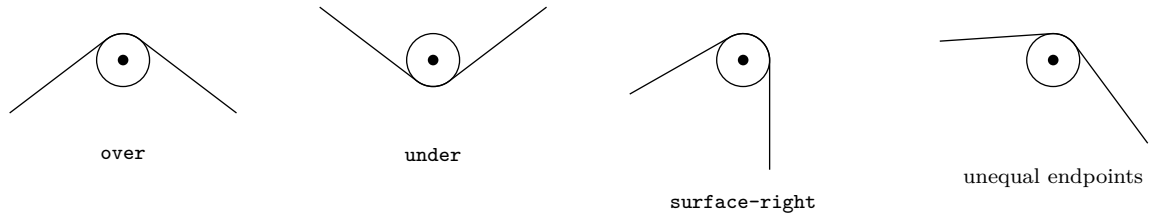


`\physicsstringoverpulley{start}{pulley}{end}` draws a single physical string. Both straight portions meet the circular pulley tangentially, and the intervening portion follows the pulley arc. The default `surface-right` route matches the layout shown above: the pulley is just beyond the

incline's right end, the first string portion is parallel to the slope, the contact arc passes over the upper rim, and the second portion descends vertically on the right.

3.1 String-routing variants

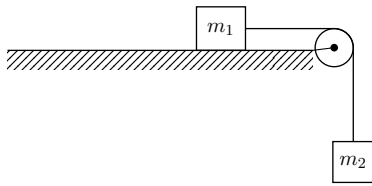
The endpoint coordinates may be placed at any unequal positions outside the pulley. The named routes below include two common left-to-right wraps and the default surface-to-right-hanging turn. **shortest** keeps the selected tangent pair and chooses the shorter contact arc. For other endpoint orderings, select tangent solutions and wrap direction explicitly.



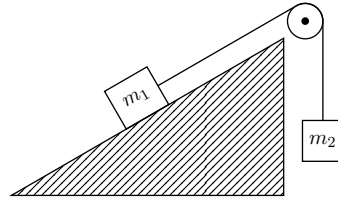
Key	Meaning and default
<code>physics block width</code>	Block width; default 1cm.
<code>physics block height</code>	Block height; default 1cm.
<code>physics pulley diameter</code>	Pulley diameter; default 1cm.
<code>physics pulley axle radius</code>	Axle-dot radius; default 2pt. Use <code>none</code> to hide the dot.
<code>physics pulley axle color</code>	Axle-dot colour; default <code>black</code> .
<code>physics string start solution</code>	Start-side tangent, 1 or 2; default 2.
<code>physics string end solution</code>	End-side tangent, 1 or 2; default 1.
<code>physics string route</code>	<code>surface-right</code> (default), <code>over</code> , <code>under</code> , or <code>shortest</code> .
<code>physics string wrap</code>	<code>clockwise</code> (default), <code>counterclockwise</code> , or <code>shortest</code> .

3.2 Complete pulley systems

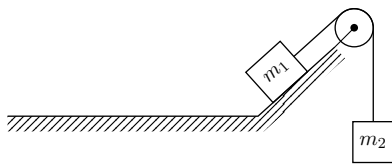
The mechanics shapes compose directly with every surface family. In each diagram below, one call to `\physicsstringoverpulley` draws both straight tangent portions and the circular contact arc; no pulley compass anchor is used as a substitute for the contact point.



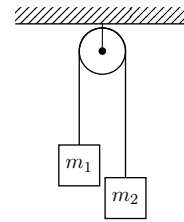
Horizontal plane



Inclined plane



Continuous bent platform



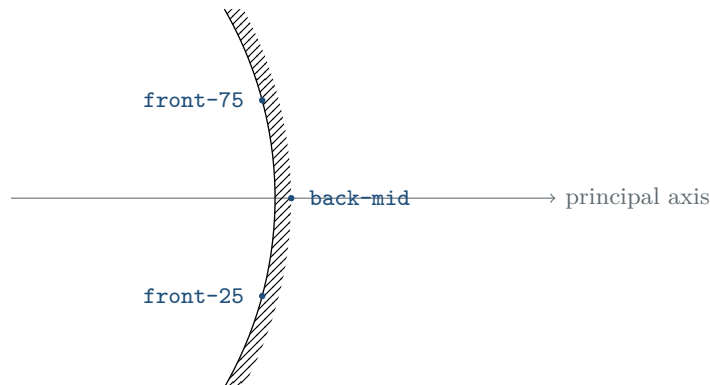
Two hanging masses

Copy-ready standalone sources are included in the `examples` directory:

- `mechanics-pulley-flat-plane.tex` and `mechanics-block-pulley.tex`;
- `mechanics-pulley-bent-platform.tex` and `mechanics-pulley-two-masses.tex`;
- `mechanics-pulley-string-variants.tex`, a gallery of six endpoint and wrapping arrangements.

4 Optical lens

`physicslens` draws a curved element between two circular arcs. Its node centre lies halfway between the on-axis front and back vertices.



Key	Meaning and default
<code>physics lens radius</code>	Radius of the front optical surface; default 5cm.
<code>physics lens thickness</code>	On-axis separation of the two surfaces; default 0.25cm.
<code>physics lens aperture angle</code>	Front-arc half-angle; default 30 degrees. The value must be strictly between 0 and 90 degrees.

Named anchors include `vertex`, `front-mid`, `back-mid`, `front-top`, `front-bottom`, `back-top`, `back-bottom`, `top`, and `bottom`. The arc families `front-0..100` and `back-0..100` run from bottom to top.

5 Shared tools

5.1 Parametric anchors

Integer parametric anchors make it easy to place an object at a repeatable fraction of an edge without coordinate arithmetic:

```
\node[physicsblock, anchor=south] at (W.slope-50) {$m$};
\draw[->] (L.front-25) -- ++(-1,0);
```

For a family `name-0..100`, 0 is the documented start of the edge or arc, 50 is its midpoint, and 100 is its endpoint.

5.2 Debug overlays

The core library can label registered anchors and display the keys accepted by a shape:

```
\begin{tikzpicture}[physics debug/anchors=true]
  \node[physicswedge, physics wedge width=4, physics wedge angle=30] (W) {};
\end{tikzpicture}
```

Use `physics debug/anchors=true`, `physics debug/keys=true`, or `physics debug/all=true`. These options are intended for diagram development; remove them from final artwork.

6 Installation and development

The package requires LaTeX2e and PGF/TikZ. It does not require shell escape, external executables, special fonts, or a platform-specific runtime.

For manual installation, place `tikzphysics.sty` and every `tikzlibrarytikzphysics*.code.tex` file in a directory searched by TeX.

The source distribution uses `l3build`:

```
l3build check    # run coordinate and anchor regression tests
l3build doc      # build tikzphysics.pdf
l3build ctan     # create the CTAN and TDS archives
```

Standalone examples are stored in `examples/`. The command-line helper `tikzphysics-help` prints a compact key and anchor reference.

7 License

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