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11. Applications to physics

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Lecture due Aug 18, 2021 20:30 IST Completed

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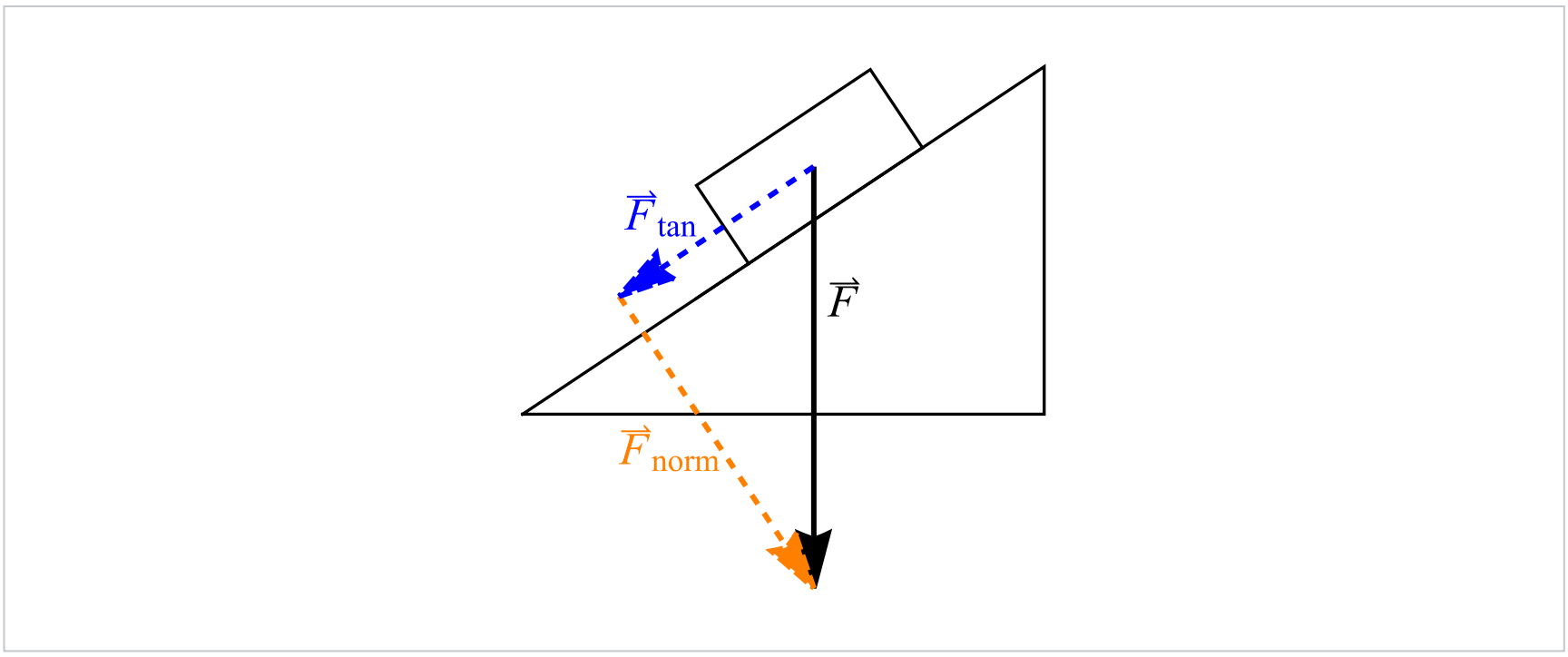
Find the vector decomposition

3.0/3 points (graded)

Consider a block of mass 1kg sitting on a plane inclined to an angle of $\theta = \pi/6$. Approximate the force due to gravity to be 10N pointing straight down. Find the vector decomposition into tangent and perpendicular vector components by following the method on the previous page.

(Decompose vectors with respect to the coordinate system where $\hat{i}$ points horizontally to the right, and $\hat{j}$ points vertically upwards.)



Find a vector $\vec{F}$ representing the force due to gravity. (Enter vectors surrounded by square brackets: e.g. `[1,0]`.)

$\vec{F} =$ [0,-10] ✔ **Answer:** [0,-10]

Find a vector $\vec{u}$ tangent to the inclined plane. Use the vector $\vec{u}$ and the vector $\vec{F}$ to find the vector $\vec{a}$ that is the component of the vector $\vec{F}$ tangent to the inclined plane.

(Enter vectors surrounded by square brackets: e.g. `[1,0]`.)

$\vec{a} =$ [-5*sqrt(3)/2,-5/2] ✔ **Answer:** [-5*cos(pi/6),-5*sin(pi/6)]

Find the vector $\vec{b}$ normal to the inclined plane so that $\vec{F} = \vec{a} + \vec{b}$. (Enter vectors surrounded by square brackets: e.g. `[1,0]`.)

$\vec{b} =$ [5*sqrt(3)/2,-15/2] ✔ **Answer:** [5*cos(pi/6),-15/2]

Solution:

The vector $\vec{F}$ in the standard coordinate system is

$$\vec{F} = \langle 0, -10 \rangle.$$

A vector $\vec{u}$ tangent to the inclined plane is

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$$\vec{u} = \langle \cos(\pi/6), \sin(\pi/6) \rangle \, (= \langle \sqrt{3}/2, 1/2 \rangle) \, .$$

Note that any vector that points in the same (or opposite) direction as this vector works!

Now to find the vector $\vec{a}$ we use the dot product as in the worked example on the previous page.

$$\begin{aligned} \vec{a} &= \frac{\vec{F} \cdot \vec{u}}{\vec{u} \cdot \vec{u}} \vec{u} \\ &= \frac{\langle 0, -10 \rangle \cdot . \langle \cos(\pi/6), \sin(\pi/6) \rangle}{\langle \cos(\pi/6), \sin(\pi/6) \rangle \cdot \langle \cos(\pi/6), \sin(\pi/6) \rangle} \langle \cos(\pi/6), \sin(\pi/6) \rangle \\ &= \frac{-5}{1} \langle \cos(\pi/6), \sin(\pi/6) \rangle = \langle -5\sqrt{3}/2, -5/2 \rangle . \end{aligned}$$

The vector $\vec{b}$ is found using vector subtraction

$$\vec{b} = \vec{F} - \vec{a} = \langle 0, -10 \rangle - \langle -5\sqrt{3}/2, -5/2 \rangle = \langle 5\sqrt{3}/2, -15/2 \rangle .$$

Submit You have used 2 of 10 attempts

Answers are displayed within the problem

11. Applications to physics

Topic: Unit 2: Geometry of Derivatives / 11. Applications to physics

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- This one was poorly worded and confusing. — 5
  I kept getting the wrong answer due to confusion with coordinates. Did anyone else have that issue? :(
- Where is the origin? — 2
  Where is the origin? Any hints about this problem?
- units — 2
  F, Ftan (= a) and Fnorm (= b) are forces, so they have to have a unit (Newton). But the system does not allow put a unit ("N", for exa...
- Strange wording and not enough tries — 5
  I had a similar problem to a few of the others. It was strangely worded. It took me a while to finally figure out what you really wanted....
- [Staff] Just Say No to Default Coordinate Systems — 3
- STAFF: The last question should be asking for b not a. — 6 new 11
  The last question should be asking for b not a.

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