3. Shortest distance between level curves

Bookmark this page

Review

Find the shortest distance between level curves

So suppose one way--

one way to go to the line is to go at a right angle.

And suppose I compare that with some other way.

I claim that this one is shorter than that one.

I think you could sort of see it visually in the picture,

but it also follows from the Pythagorean Theorem.

So this is a right triangle.

Those are the two legs, and this is the hypotenuse.

And of course the hypotenuse is longer than the legs.

So the white is longer than the blue.

OK, cool.

OK, so that's a clue that's going

to help me find this point, that I have a right angle here.

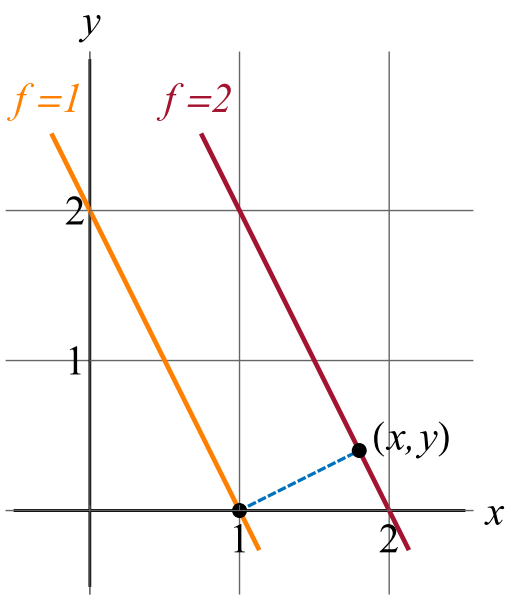
Video
Download video file

Transcripts
Download SubRip (.srt) file
Download Text (.txt) file

The figure below shows the level curves of the function

$$f(x,y) = x + \frac{1}{2}y \tag{7.12}$$

at the heights 1 and 2. The shortest distance from $(1,0)$ to the level curve of height 2 is indicated by the dashed blue line segment. The point along the line $f(x,y) = 2$ that is closest to $(1,0)$ is labeled (x,y).



The two questions we want to answer are:

1. What is the point (x,y)?

2. How far away is (x,y) from the point $(1,0)$?

Calculator Hide Notes

As we saw in the video, the line segment from the point $(1, 0)$ to (x, y) is perpendicular to the level curve $x + \frac{1}{2}y = 2$. To help us answer the two questions above, we will first answer a related question.

Vector perpendicular to level curve

0 points possible (ungraded)

Which of the following vectors is perpendicular to the level curve $x + \frac{1}{2}y = 2$?

- ◉ $\langle 1, 1/2 \rangle$
- ○ $\langle 1/2, 1 \rangle$
- ○ $\langle 1, 2 \rangle$
- ○ $\langle 1, 0 \rangle$

✔

Solution:

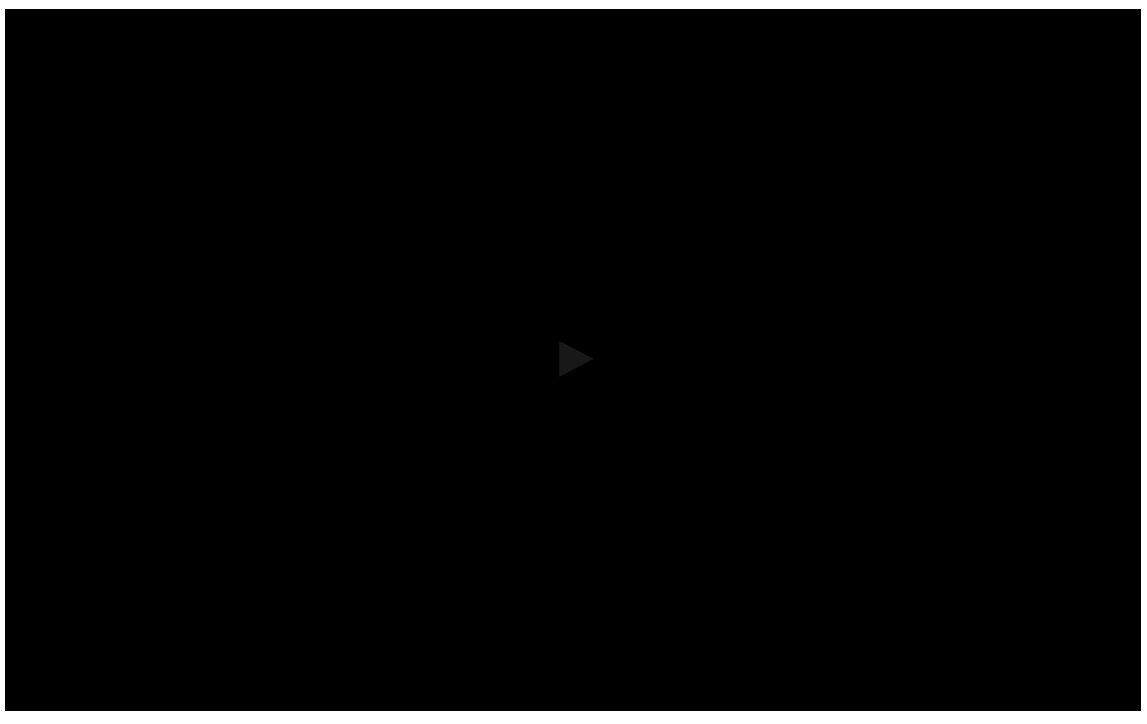
Recall that the vector $\langle a, b \rangle$ is normal to the line $ax + by + c = 0$. So the vector $\langle 1, 1/2 \rangle$ is normal to

$$x + \frac{1}{2}y = 2. \tag{7.13}$$

Submit

ℹ Answers are displayed within the problem

Poll solution and another question



that we know in pictures or maybe in words that that blue segment is perpendicular to the red line.

And we have to turn that into an equation that involves x and y.

And that will help us to find x and y.

So here's what I want you all to do,

we know that the blue is perpendicular to the red.

And I want you to translate that into an equation about x and y.

I'm going to write some choices on the board.

Go ahead and talk with your neighbor,

and try to figure out which one of these choices

says that the blue is perpendicular to the red.

▶ 1:44 / 1:44 2.0x

Video Transcripts

Calculator Hide Notes

Download video file

Download SubRip (.srt) file
Download Text (.txt) file

Now that we have convinced ourselves that the line segment from $(1, 0)$ to (x, y) is perpendicular to the level curve $x + \frac{1}{2}y = 2$, we need to translate this idea into a mathematical statement. Use what we know about vectors to answer the following poll. Use the forum to discuss your reasoning.

Which of the following expressions means that the line segment from $(1, 0)$ to (x, y) is perpendicular to the level curve $x + \frac{1}{2}y = 2$?

1. $\langle x, y\rangle \cdot \langle 1, 1/2\rangle = 0$
2. $\langle x, y\rangle = \lambda\langle 1, 1/2\rangle$ for some scalar λ
3. $\langle x - 1, y\rangle \cdot \langle 1, 1/2\rangle = 0$
4. $\langle x - 1, y\rangle = \lambda\langle 1, 1/2\rangle$ for some scalar λ

POLL
Choose the number corresponding to the best answer to the question in the above text.

RESULTS

1.	**7%**
2.	**4%**
3.	**36%**
4.	**54%**

Submit

Results gathered from 28 respondents.

FEEDBACK
Your response has been recorded

---

3. Shortest distance between level curves

Hide Discussion

Topic: Review / 3. Shortest distance between level curves

Add a Post

Show all posts by recent activity

There are no posts in this topic yet.

✖

< Previous Next >

Calculator Hide Notes

edX

About
Affiliates
edX for Business
Open edX
Careers
News

Legal

Terms of Service & Honor Code
Privacy Policy
Accessibility Policy
Trademark Policy
Sitemap

Connect

Blog
Contact Us
Help Center
Media Kit
Donate

Calculator Hide Notes