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sandipan_dey ~

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* Course / Review / Practice exam (untimed, with solutions)

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1/1 point (ungraded)

A hiker is hiking in a mountainous region. The height of the landscape at (x,y) is $h\left(x,y
ight)=xy+xy^2$. The hiker is at (1,1) when she reaches a fork. One path goes in a straight line towards (2,2) and the other path goes in a straight line towards $(\mathbf{3},\mathbf{1})$. Which path starts out more steeply?



 $igcolone{}{}$ The path that goes in a straight line towards (2,2) is steeper.

The path that goes in a straight line towards (3, 1) is steeper.

They are equally as steep.



Solution:

For convenience, we first compute the gradient at (1,1).

$$egin{aligned}
abla h\left(x,y
ight) &= (h_x,h_y) = (y+y^2,x+2xy) \
abla h\left(1,1
ight) &= (2,3) \,. \end{aligned}$$

Now we compare both paths.

1. Path to (2, 2)

Here, the hiker is walking toward the direction of $\langle 2,2 \rangle - \langle 1,1 \rangle = \langle 1,1 \rangle$. A unit normal vector in this direction is $\frac{1}{\sqrt{2}}\langle 1,1 \rangle$. Therefore the instantaneous steepness at (1,1) in the direction toward (2,2) is

$$D_{ec{u}}h\left(1,1
ight) =
abla h\left(1,1
ight) \cdot ec{u} = \langle 2,3
angle \cdot rac{1}{\sqrt{2}} \langle 1,1
angle = rac{5}{\sqrt{2}}$$

2. Path to (3, 1)

Here, the hiker is walking toward the direction of $\langle 3,1 \rangle - \langle 1,1 \rangle = \langle 2,0 \rangle$. A unit normal vector in this direction is $rac{1}{2}\langle 2,0
angle=\langle 1,0
angle$. Therefore the instantaneous steepness at (1,1) in the direction toward (3,1) is

$$D_{ec{u}}h\left(1,1
ight)=
abla h\left(1,1
ight)\cdotec{u}=\left\langle 2,3
ight
angle \cdot\left\langle 1,0
ight
angle =2.$$

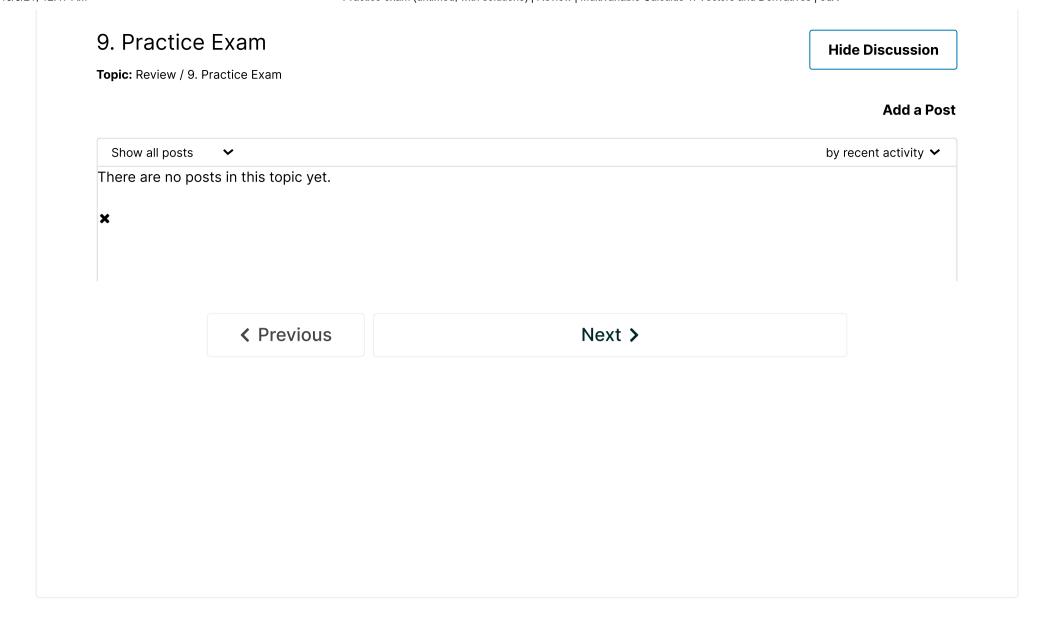
Since

$$rac{5}{\sqrt{2}}>2$$

we see that the path toward (2,2) starts out more steeply.

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1 Answers are displayed within the problem



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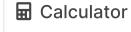


















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