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2. Planes, normal vectors, and tangent planes

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Part A due Oct 5, 2021 20:30 IST



**Practice** 

### 5A-2

1/1 point (graded)

Let P be the plane defined by x+2y+3z=17. Find a vector which is normal to this plane. (It doesn't have to be a unit vector.)

[1,2,3]

**✓ Answer:** [1,2,3]

? INPUT HELP

#### **Solution:**

A normal vector can be taken as

$$ec{n}=
abla\left(x+2y+3z
ight)=\left[\langle 1,2,3
angle .
ight]$$

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You have used 1 of 3 attempts

**1** Answers are displayed within the problem

## 5A-3

1/1 point (graded)

Find the equation of a plane which is perpendicular to the vector  $\langle 3,2,1 \rangle$  and passes through the point (1,1,1).

(Express the plane in the format 0 = ax + by + cz + d. We provide the 0 = for you, so you do not need to type that part.)

#### Solution:

To find the equation of the plane we can use the fact that for any other point in the plane (x,y,z) the vector from (1,1,1) to (x,y,z), which is  $\langle x-1,y-1,z-1\rangle$  is normal to the vector  $\langle 3,2,1\rangle$ . That is the dot product between these two vectors is zero.

Therefore equation of the plane is

$$\langle 3,2,1\rangle \cdot \langle x-1,y-1,z-1\rangle = 0 \tag{6.261}$$

$$3(x-1)+2(y-1)+(z-1) = 0 (6.262)$$

, or equivalently,  $oxed{3x+2y+z-6=0.}$ 

Alternatively, we only need that a normal vector is (3,2,1), so the plane takes the form 3x + 2y + z + d = 0. We can plug in the point (1,1,1) as it lies on the plane.

This gives





$$3(1) + 2(1) + (1) + d = 0 (6.263)$$

$$6 + d = 0 (6.264)$$

$$d = -6 \tag{6.265}$$

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You have used 1 of 3 attempts

**1** Answers are displayed within the problem

# 5A-4

2/2 points (graded)

Suppose that  $f(x,y,z)=xz-yz^2+xy$ . Suppose that we start at the point (2,1,1) and increase z slightly. Does f increase, decrease, or stay the same?

 $\bigcirc$  f increases

lacksquare f decreases

 $m{f}$  stays the same



Is  $f_z\left(2,1,1
ight)$  positive, negative, or zero?

positive

negative

zero

# **Solution:**

A direct calculation yields

$$f(2,1,1+t)-f(2,1,1)=-t^2<0.$$

Hence f decreases.

Computing the partial derivative, you find that

$$f_z\left(x,y,z\right) = x - 2yz \tag{6.266}$$

$$f_z(2,1,1) = 2-2(1)(1) = 0$$
 (6.267)

Can you see why the function can both decrease as z increases, but have a zero partial derivative? (Hint, the function is not equal to its linear approximation.)

Submit

You have used 2 of 2 attempts

**1** Answers are displayed within the problem

## 5A-5

1/1 point (graded)

Let S be the surface defined by  $x^2+4y^2+4z^2=3$ . The point (1,0.5,0.5) lies in S. Find a normal vector to the surface S at the point (1,0.5,0.5). (It does not have to be a unit vector.)

[2,4,4] **Answer:** [2,4,4]

? INPUT HELP

#### **Solution:**

A normal vector is

$$\nabla (x^2 + 4y^2 + 4z^2) (1, 0.5, 0.5) = \langle 2x, 8y, 8z \rangle |_{(1, 0.5, 0.5)}$$
(6.268)

$$= \langle 2(1), 8(0.5), 8(0.5) \rangle \tag{6.269}$$

$$= \boxed{\langle 2, 4, 4 \rangle}. \tag{6.270}$$

Note that any constant multiple is also correct.

**Submit** 

You have used 1 of 3 attempts

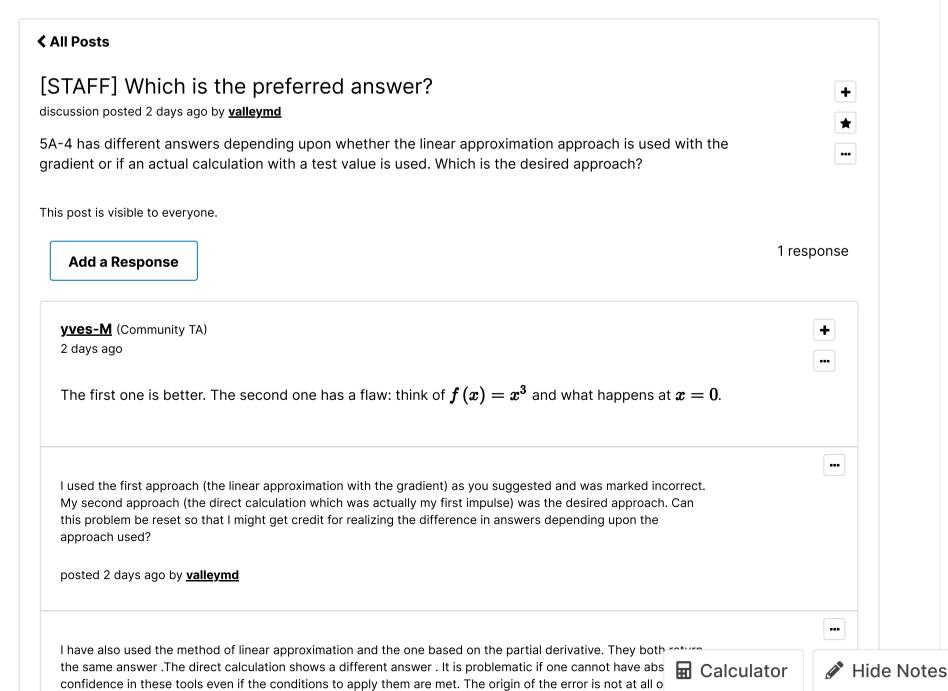
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# 2. Planes, normal vectors, and tangent planes

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	onfusion arises from the fact that we often ask the opposite question: Is the sign of $f_z$ positive, zero. But truly, despite the fact that the $z$ direction is tangent to the level curve here, it is in fact	•••
guess this i	is a problem with how this question is posed! I will reword, reframe, and reset attempts.	
posted a day	y ago by <b>jfrench</b> (Staff)	
A variable ch that's stayinç	nange of 0.1% results in a total change of 0.0001%. As far as I'm concerned, for estimation purposes, g the same.	•••
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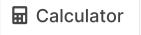
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