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11. Practice Exam

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11(a)

1/1 point (ungraded)
Find the equation for the tangent plane to the level surface

$$f(x,y,z) = xy^2 + xz - y + 3z = 8$$

at the point $(1,1,2)$.

(Enter in the format `a*x+b*y+c*z+d=0`. The $= 0$ is provided for you! Do not type it.)

3*x+y+4*z-12 =0 ✔ **Answer:** 3*x+y+4*z-12

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Solution:

$$\nabla f = \begin{pmatrix} y^2 + z \\ 2xy - 1 \\ x + 3 \end{pmatrix} \tag{7.2}$$

$$\nabla f(1,1,2) = \begin{pmatrix} 3 \\ 1 \\ 4 \end{pmatrix} \tag{7.3}$$

The tangent plane equation is

$$3x + y + 4z + d = 0$$

We solve for d by plugging in the point $(1,1,2)$, which gives $d = -12$.

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Answers are displayed within the problem

11(b)

2.0/2 points (ungraded)
Find the time(s) t when the parametric curve

$$\vec{r}(t) = \begin{pmatrix} t \\ t^2 - 2 \\ -t + 3 \end{pmatrix}$$

intersects the tangent plane above.

(For more than one time, separate answers by commas: e.g. `0, 1, 2`.)

-1,2 ✔ **Answer:** 2,-1

Find the speed of the parametric curve at that(those) time(s).

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(For more than one speed, separate answers by commas: e.g. `0, 1, 2`.)

sqrt(6),3*sqrt(2) ✔ **Answer:** sqrt(6),sqrt(18)

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Solution:

We plug in the formula for the parametric curve into the equation for the tangent plane found in the previous problem.

$$3(t)+t^2-2+4(-t+3)-12 = 0 \quad (7.4)$$
$$t^2-t-2 = 0 \quad (7.5)$$
$$(t-2)(t+1) = 0 \quad (7.6)$$

Therefore the parametric curve intersects the plane when $t=-1$ and $t=2$.

The velocity of the parametric curve is the vector

$$\vec{r}\,'(t) = \begin{pmatrix} 1 \\ 2t \\ -1 \end{pmatrix}$$

The speed is the magnitude of this vector. When $t=-1$, the speed is $\sqrt{6}$. When $t=2$, the speed is $\sqrt{18}$.

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