4. Let $f(x,y) = 2x^2 + 5y^3$ and let p be the point $p = (1,3)$. Find the directional derivative of f at the point p in the direction of $\vec{v} = 2\vec{i} + 5\vec{j}$.

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$\vec{\nabla} f = 4x\vec{i} + 15y^2\vec{j}$ $\quad \vec{\nabla} f|_{(1,3)} = 4\vec{i} + 135\vec{j}$

a unit vector in the direction of $\vec{v}$ is $\vec{u} = \frac{1}{\sqrt{29}}(2\vec{i} + 5\vec{j})$

$D_{\vec{u}} f(1,3) = \vec{\nabla} f|_{(1,3)} \cdot \vec{u} = \frac{8 + 5 \cdot 135}{\sqrt{29}}$

$\frac{683}{\sqrt{29}}$

5. Where do the lines

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4} \quad \text{and} \quad \frac{x-2}{1} = \frac{y}{2} = \frac{z+2}{3}$$

intersect?

The 1st line is $x = 1+2t$ $y = 2+3t$ $z = 3+4t$. If a point is on the 1st line and also on the 2nd line then

$$\frac{(1+2t)-2}{1} = \frac{2+3t}{2} = \frac{(3+4t)+2}{3}$$

$$\begin{cases} 2t - 1 = 1 + \frac{3}{2}t \\ 2t - 1 = \frac{5}{3} + \frac{4}{3}t \end{cases}$$

So $t = 4$

$x = 9$
$y = 14$
$z = 19$