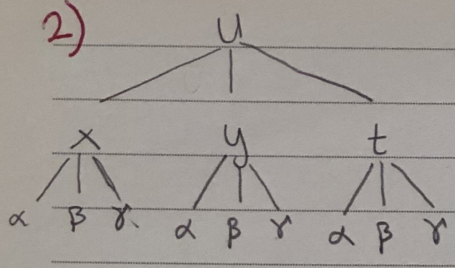
2) 

When $\alpha=-1$, $\beta=2$ and $\gamma=1$, we have $x=2$, $y=4$ and $t=-1$.

With the help of this tree diagram, we have

$$\frac{\partial u}{\partial \alpha} = \frac{\partial u}{\partial x}\cdot\frac{\partial x}{\partial \alpha} + \frac{\partial u}{\partial y}\cdot\frac{\partial y}{\partial \alpha} + \frac{\partial u}{\partial t}\cdot\frac{\partial t}{\partial \alpha} = e^{ty}(2\alpha\beta) + x t e^{ty}\cdot 0 + x y e^{ty}\cdot\gamma^2$$

So, when $(\alpha,\beta,\gamma)=(-1,2,1)$, we have $\frac{\partial u}{\partial \alpha} = e^{-4}\cdot 2(-1)\cdot 2 + 0 + 2\cdot 4 e^{-4}\cdot 1^2$

$= 4e^{-4}$

$\frac{\partial u}{\partial \beta}$ and $\frac{\partial u}{\partial \gamma}$ can be obtained in a similar manner.

Warning!!! don't write such things

3) Clearly, the profit function of x and y is

$$P(x,y) = R(x,y) - C(x,y) = 20x + 4y - 5x^2 - 2y^2 - 2xy - 4$$

To find which values of x and y maximize the profit, we need to find all critical points and determine which one gives us the absolute maximum.

$$\left.\begin{aligned} P_x(x,y) &= 20 - 10x - 2y = 0 \Rightarrow 10x + 2y = 20 \\ P_y(x,y) &= 4 - 4y - 2x = 0 \Rightarrow 2x + 4y = 4 \end{aligned}\right\} \Rightarrow x=2 \text{ and } y=0$$

So we have a single critical point $(2,0)$. Now.

$P_{xx} = -10$, $P_{yy} = -4$, $P_{xy} = -2$. So $D = P_{xx}P_{yy} - (P_{xy})^2 = (-10)\cdot(-4) - (-2)^2$

$= 40 - 4 = 36 > 0$

and $P_{xx} = -10 < 0$.

Thus $(2,0)$ is the location of a maximum. Therefore, the profit is maximized when $x=2$ and $y=0$. Moreover the maximum profit is

$$P(2,0) = 16 \text{ thousand dollars.}$$