6. The temperature of a plate at the point (x, y) is $T(x, y) = 10 + x^2 - 3y^2$. Find the path that a heat seeking particle would travel if it starts at the point $(1, 3)$. (The particle always moves in the direction of the greatest increase in temperature.)

Let $\vec{r} = x(t)\vec{i} + y(t)\vec{j}$ be the path of the particle

$\vec{r}'(t) = c(t)\vec{\nabla}T$

so $x'(t)\vec{i} + y'(t)\vec{j} = c(t)[2x\vec{i} - 6y\vec{j}]$

$x' = c\,2x$

$y' = -6cy$

$\frac{x'}{2x} = \frac{y'}{-6y}$

$-3\frac{x'}{x} = \frac{y'}{y}$

$-3\ln|x| + k = \ln|y|$

$\frac{e^k}{|x|^3} = |y|$

$\frac{K}{x^3} = y$

But $x = 1$ $y = 3$ is the initial point so

$\frac{K}{1} = 3$

$K = 3$

$\frac{3}{x^3} = y$ is the path of the particle

7. **(There is no partial credit for this problem. Make sure your answer is correct.)** Find the equation of the plane through $(2, 2, 1)$, $(1, 2, 3)$, and $(4, 4, 6)$.

$P_1 =$ $P_2 =$ $P_3 =$

$$\overrightarrow{P_1P_2} \times \overrightarrow{P_1P_3} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 0 & 2 \\ 2 & 2 & 5 \end{vmatrix} = -4\vec{i} + 9\vec{j} - 2\vec{k}$$

$-4(x - 2) + 9(y - 2) - 2(z - 1) = 0$

$\boxed{-4x + 9y - 2z = 8}$