2) (10 pts) ANL (Algorithm Analysis)

An algorithm that processes a grid of R rows and C columns runs in O(RlgC) time. It turns out that for any R by C grid, we can transpose the grid so that it has C rows and R columns instead and solve the problem on that grid to get the same answer. Fred ran the code with R = 10^6 and C = 10^2 and it took **<u>3 hours</u>** to run. Shanille transposed the grid and reran the code with R = 10^2 and C = 10^6 to prove to Fred how inefficient his technique was. How long, **<u>in seconds,</u>** would be expect Shanille's execution of the code to take? **<u>Please answer as a decimal to two places.</u>**

Let T(R, C) = kRlgC be the run-time of the algorithm on a grid with R rows and C columns, where k is a constant.

$T(10^6, 10^2) = k10^6 \lg(10^2) = 3\ hours$

$k(2 \times 10^6)\lg(10) = 3\ hours$ $\rightarrow k = \frac{3\ hours}{2\times10^6 \lg(10)}$

Now, we must solve for $T(10^2, 10^6)$:

$$T(10^2, 10^6) = (\frac{3\ hours}{2 \times 10^6 \lg(10)})10^2 \lg(10^6)$$

$$= (\frac{3\ hours}{2 \times 10^6 \lg(10)})10^2 (6) \lg 10$$

$$= (\frac{18\ hours}{2 \times 10^4}) \times \frac{60\ min}{1\ hour} \times \frac{60\ sec}{1\ min}$$

$$= (\frac{9\ hours}{10^4}) \times 3600 sec/hr$$

$$= (9)(.3600) sec$$

$$= \mathbf{3.24\ seconds}$$

Grading:
- **1 pt setting up equation for k**
- **2 pts solving for k no simplification**
- **2 pts setting up equation for Shanille**
- **2 pts correctly converting from hours to seconds**
- **1 pt log simplification**
- **2 pts rest of the simplification to the correct final form**