Start: ________ **Stop:** ________ **Name:** ______________________

Sets and Logic MHF3202 | **Online-A** | Prof. JLF King Wedn., 30Sep2020

WELCOME: *You have 90 minutes for this exam. This is a closed-book, no calculator nor computer, exam, to be done "by hand". It is due, submitted to Canvas, no later than **4PM** on Wedn., 30Sep2020. If you are able to print this exam sheet, then fill-in the blanks and scan the sheet and your essay pages. Otherwise, write your short answers on a sheet, and photograph it and your essay sheets; submit that to Canvas as a single* PDF.

A1: Short answer. Show no work.
Write **DNE** if the object does not exist or the operation cannot be performed. NB: DNE $\neq \{\} \neq 0$.

a 15 Given sets with cardinalities $|B| = 4$ and $|E| = 5$, the number of non-constant fncs in B^E is ______.

b 15 10 The physics lab has atomic *zinc, tin, silver* and *gold*. I'm allowed to take 6 atoms, so I have [expressed as single integer] ______ many possibilities.

This number *also* equals the number-of-ways of picking K candies from L many types of candy, where $K =$ ______ $\notin \{1, 6\}$ and $L =$ ______ $\notin \{1, 4\}$.

c 10 5 10 Let N be the number of permutations of the letters in ABRACADABRA. As a multinomial-coeff, $N = \binom{\quad}{\ldots}$. [Write the bottom integers in **increasing** order, $p_1 \leq p_2 \leq \ldots$. The bottom integers should sum to the top integer.] Written as product-of-binomials, $N =$ ______.

Evaluate each binomial as an integer, and write N as a product of these integers: $N =$ ______.

d 5 5 10 Stmt $C \Rightarrow B$ has *contrapositive* ______ and *converse* ______. Recall $\wedge, \vee, \neg$ mean AND, OR, NOT. Using *only* symbols $\wedge, \vee, \neg, \boldsymbol{B}, \boldsymbol{C},], [$, write $C \Rightarrow B$ as ______.

e 15 15 LBolt gives $G := \text{GCD}(413, 294) =$ ______. And $413S + 294T = G$, where $S =$ ______ & $T =$ ______ are integers.

f 15 15 Mod K:=51, the reciprocal $\langle \frac{1}{20} \rangle_K =$ ______ $\in [0..K)$. [*Hint:* ↯] So $x =$ ______ $\in [0..K)$ solves $5 - 20x \equiv_K 2$.

ESSAY QUESTION: *Start your (A2) essay on a new sheet-of-paper. Write LARGE, and on every-2nd, or every 3rd-line. Don't squish! Please don't use a* **comma** *for "then"; use a word or rewrite the sentence. Every (complete, grammatical)* ***sentence*** *must start with a word, not a math symbol, and end with a* **visible** *period, or question/exclamation mark.*

A2: Each dot of W many, gets one of 4 colors. The minimum W *guaranteeing* that at least 3 dots have the same color is $W =$ ______. *Prove* your answer, and show that $W-1$ is insufficient.

With this W, the ***W×H-grid*** is $\mathbf{G} := [1..W] \times [1..H]$, for an H you will determine. A subset $\mathbf{S} \subset \mathbf{G}$ of form

$$\mathbf{S} := \{x_1, x_2, x_3\} \times \{y_1, y_2\}$$

where $x_1 < x_2 < x_3 \leq W$ and $y_1 < y_2 \leq H$ are positive integers, is a ***3×2-subgrid*** of $\mathbf{G}$. The minimum H *guaranteeing* that each 4-coloring of $\mathbf{G}$ admits a *monochromatic* 3×2-***subgrid*** is $H =$ ______. *Prove* that your H is sufficient. Prove that $H-1$ is *not* sufficient.

End of Online-A

A1:	___ ___ ___	145pts
A2:	___ ___	50pts
Total:	___ ___ ___	195pts

HONOR CODE: *"I have neither requested nor received help on this exam other than from my professor."*

Signature: ______________________