Staple!

Sets and Logic
MHF3202 8768

Class-X

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X4:	___ ___	90pts
X5:	___ ___	45pts
Total:	___ ___ ___	135pts

X4: Short answer. Show no work.
Please write **DNE** in a blank if the described object does not exist or if the indicated operation cannot be performed.

a For $Y := \{1,2,3,4\}$, consider $f: Y \to \mathcal{P}(Y)$ by

$$f(1) := \{3,4\}, \qquad f(2) := Y,$$
$$f(3) := \varnothing, \qquad f(4) := \{1,4\}.$$

The set $B := \{x \in Y \mid f(x) \not\ni x\}$ is $\{$ .... $\}$.

b An explicit bijection $\psi: \mathbb{Z} \hookrightarrow\!\!\!\rightarrow \mathbb{N}$ is this:
If $n \geqslant 0$, then $\psi(n) :=$ ....
If $n < 0$, then $\psi(n) :=$ ....

c Define fncs $G, P: [1\,..\,12] \circlearrowleft$, where $G(n)$ is the number of letters in the n^{th} Gregorian month [so $G(2) = 8$; the 2^{nd} month "February" has 8 letters], and $P(n) := 13 - n$.
The *set* of posints k with $G^{\circ k}(1) = G^{\circ k}(2)$ is ....
Let $f := P \circ G$. Then $f^{\circ 2}(11) =$ ....

d On a 5-element set, the number of reflexive symmetric binrels is ....
On a 3-element set, there are ...... many equivalence relations.

e On $\Omega := [1\,..\,29] \times [1\,..\,29]$, define binary-relation $\mathbf{C}$ by: $(x, \alpha) \mathbf{C} (y, \beta)$ IFF $x \cdot \beta \equiv_{30} y \cdot \alpha$. Statement "*Relation* **C** *is an* ***equivalence relation***" is: *T* *F*

OYOP: *In grammatical English sentences, write your essay on every third line* (usually)*, so that I can easily write between the lines. Do* **not** *restate the question.*

X5: For natnum n, define

$$S_n := 3^n + 7^n + 11^n - 6^n.$$

Prove, for *odd* posints n, that S_n is composite. [*Hint:* Use modular arithmetic.]