W1: *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 Let $\tau()$ and $\sigma()$ be the number-of and sum-of divisors, resp.. Then $\tau(4000) = $ �............................⌐

and $\sigma(4000) = $ ⌐.............................⌐ . (Please

leave each answer as a product of integers.)

b The Huffman code with letter-probabilities

$$I:\tfrac{12}{66} \qquad \mathcal{M}:\tfrac{5}{66} \qquad \mathcal{O}:\tfrac{7}{66} \qquad \mathcal{R}:\tfrac{4}{66} \qquad \mathcal{S}:\tfrac{32}{66} \qquad \mathcal{T}:\tfrac{6}{66}$$

codes these to bitstrings: $I:$ ⌐..........⌐ $\mathcal{M}:$ ⌐..........⌐

$\mathcal{O}:$ ⌐..........⌐ $\mathcal{R}:$ ⌐..........⌐ $\mathcal{S}:$ ⌐..........⌐ $\mathcal{T}:$ ⌐..........⌐ .

Bitstring `010010111001101` decodes to

⌐..................⌐ , answering: "*What you do to a castle?*"

c Bitstring "`1010100100000001001110010011110011001`",
via the Elias code, decodes to

⌐.....................⌐ ,

a sequence of *natnums* [gun-blip-blip], followed by noise-
bits ⌐.......⌐ .   The natnum-sequence decodes to rune-
string " ⌐...............⌐ ".

   Conv, Elias(89)= ⌐...........................⌐ (bitstring)

d Bits `010010101001000011100011011011000111` de-
code in Idx-form, e.g $\langle\mathbf{7}\rangle 1 \langle\mathbf{3}\rangle 1 \langle\mathbf{9}\rangle 0 \ldots \langle\mathbf{3}\rangle 1 \langle\mathbf{0}\rangle\langle\mathbf{4}\rangle$, to

⌐...................................⌐ . As 15 bits, it is

⌐...⌐ .

   Use *Ziv-Lempel* seeded with $\langle\mathbf{0}\rangle$=", $\langle\mathbf{1}\rangle$='1', and $\langle\mathbf{2}\rangle$='0'.
Using our fivebit-code, the 15 bits decode
to symbols ⌐......⌐   ⌐......⌐   ⌐......⌐ .

e Consider the three congruences C1: $z \equiv_{15} 11$,
C2: $z \equiv_{21} 5$, and C3: $z \equiv_{70} 61$. Let z_j be the *smallest*
natnum [or **DNE**] satisfying (C1) $\overset{\text{All}}{\ldots}$ (Cj). Then

$z_2=$ ⌐.....................⌐   ; $z_3=$ ⌐.....................⌐ .

W2: Essay question, OYOSOP:
   For a finite code $\mathcal{C}$ over alphabet $\{$A,B,E,O,L$\}$, state
–precisely– the Kraft-McMillan theorem, defining all the
terms you use.
   Also answer: "*Does every* <u>finite</u> *suffix code satisfy the Kraft-McMillan theorem?*"

<div style="border:1px solid blue;text-align:center">End of Class-W</div>

W1:	___ ___ ___	140pts
W2:	___ ___	45pts
Total:	___ ___ ___	185pts