

Binary, Encoding & Compression — By Hand

Name: _____ Period: _____ Your Seed # (last 2 digits of student ID): _____

AP objectives: DAT-1.A, DAT-1.C, DAT-1.D Points: 30

How this is AI-proof: your problems use numbers built from *your own Seed #*, so no two students have the same answers and there is nothing to copy. **Show every step** in the work rows — a correct final answer with no work earns half credit; the work is what proves it's yours.

Find your numbers first (write them in the boxes)

Label	How to build it from your Seed #	Your value
P	Seed # itself (00–99)	
Q	Seed # + 100	
R	Seed # + 156	

Part 1 · Decimal → Binary (12 pts, 4 each)

Convert each of your values to an 8-bit binary number. Show which place values (128 64 32 16 8 4 2 1) you turned on.

Value	Work (place values used)	8-bit binary
P = ____		
Q = ____		
R = ____		

1d. Which of your three values, if any, does *not* fit in 8 bits, and why? _____
(2 pts, part of P1)

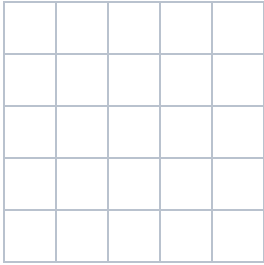
Part 2 · Encode your initials in ASCII (8 pts)

Write your first & last initial. Use A=65 ... Z=90 (uppercase). Show the decimal, then the 8-bit binary.

Initial	ASCII decimal	8-bit binary
1st: ____		
2nd: ____		

Part 3 · Encode a 5×5 black-&-white image (6 pts)

Shade any design you like (1 = black, 0 = white). Then write the 25-bit string row by row, left to right. **Your bit string must match your shading.**



Bit string (25 bits): _____

Total bits needed for this image: _____ If it were RGB color at 8 bits/channel, total bits would be:

Part 4 · Compression short answer (4 pts)

You want to email the image above so a friend can reproduce it *exactly*. Would you use lossless or lossy compression, and why? (1–2 sentences, must name the trade-off.)

TEACHER KEY (tear off before handing out). For any Seed # s (0–99): $P=s$, $Q=s+100$, $R=s+156$. So R ranges 156–255 (always fits in 8 bits; *none* overflow — the correct answer to 1d is "all fit; the largest possible R is 255"). Convert with place values 128/64/32/16/8/4/2/1. **Grading:** P1 3×4 pts (binary correct + work shown) — check their binary equals their stated $P/Q/R$; ASCII initials must match $A=65$ mapping; $5 \times 5 = 25$ bits, RGB version = $25 \times 24 = 600$ bits; P4 = lossless (must be able to reproduce exactly, size trade-off acceptable). Because each paper's $P/Q/R$ differ, a quick way to grade is: convert their *stated* $P/Q/R$ and compare — takes ~30 sec/paper.