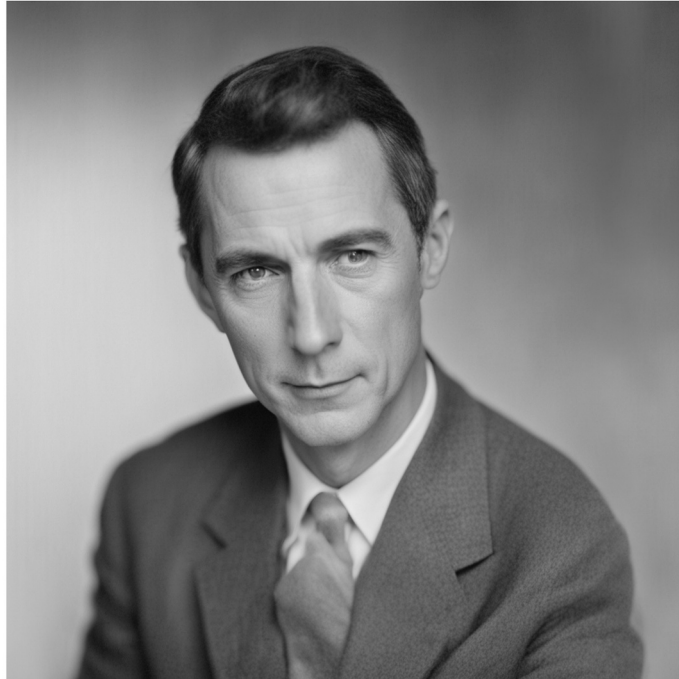


Shannon Problems



*Cryptographic puzzles inspired by
Claude Shannon's first publication.*

Dev Gaultieri

Tikalon Press

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Author's Forward

While at Bell Labs, Claude Shannon (1916-2001) published the foundation paper of information theory, "A Mathematical Theory of Communication," in two parts in the Bell System Technical Journal (vol. 27, no. 3, July, 1948, pp. 379-423, and vol. 27, no. 4, October, 1948, pp. 623-656.)

In March, 1934, at seventeen years of age, Shannon published his first paper. This was in The American Mathematical Monthly (vol. 41, no. 3), and it was a solution to a problem posed in the same journal in October, 1933, by R.M. Sutton of Haverford College, Pennsylvania.

The problem was a long division in which every digit was replaced in a cryptographic substitution by an alphabet character. Every number from 0 - 9 was included, and they were represented by characters from the set, J, L, M, N, R, S, T, U, X, and Y. As can be imagined, the solution of this cryptographic puzzle was a difficult undertaking in a time before spreadsheets, calculators, and computers.

This book is a collection of addition, subtraction, multiplication, and division problems of this same type. They are arranged by difficulty with the simplest problems being accessible to middle-school students, and the more difficult problems posing a challenge to any adult. Answers are included in the back pages. Also included are the source codes in C and Python for a brute-force solution of the Sutton-Shannon long division.

Note that in some cases, these puzzles have more than one solution, and your correct solution will be different from the solution shown.

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1 ADDITION WITH TWO UNKNOWNNS

$$\begin{array}{r} 87GL1 \\ + 3G658 \\ \hline 1LL079 \end{array}$$

$$\begin{array}{r} P6911 \\ + 2PPPH \\ \hline H1358 \end{array}$$

$$\begin{array}{r} 57V29 \\ + 8V226 \\ \hline Z40555 \end{array}$$

$$\begin{array}{r} 7897T \\ + T6034 \\ \hline 10W006 \end{array}$$

$$\begin{array}{r} 82030 \\ + 2D5DG \\ \hline 10657G \end{array}$$

$$\begin{array}{r} 97323 \\ + 11T53 \\ \hline 10877L \end{array}$$

$$\begin{array}{r} \text{SS65Y} \\ + \text{12175} \\ \hline \text{12834} \end{array}$$

$$\begin{array}{r} \text{9M261} \\ + \text{H8M87} \\ \hline \text{148348} \end{array}$$

$$\begin{array}{r} \text{70693} \\ + \text{77556} \\ \hline \text{G4F249} \end{array}$$

$$\begin{array}{r} \text{8641F} \\ + \text{P4783} \\ \hline \text{91195} \end{array}$$

$$\begin{array}{r} \text{64D43} \\ + \text{0E552} \\ \hline \text{72695} \end{array}$$

$$\begin{array}{r} \text{25S43} \\ + \text{61149} \\ \hline \text{A6A92} \end{array}$$

$$\begin{array}{r} \text{C7028} \\ + \text{6F865} \\ \hline \text{11089F} \end{array}$$

$$\begin{array}{r} \text{72829} \\ + \text{P2S34} \\ \hline \text{854S3} \end{array}$$

$$\begin{array}{r} \text{13E95} \\ + \text{4796T} \\ \hline \text{61E63} \end{array}$$

$$\begin{array}{r} X4208 \\ + X7943 \\ \hline 1321G1 \end{array}$$

$$\begin{array}{r} 1F733 \\ + 5H195 \\ \hline 669H8 \end{array}$$

$$\begin{array}{r} 7R590 \\ + 54361 \\ \hline 13L951 \end{array}$$

$$\begin{array}{r} E8765 \\ + 29Y84 \\ \hline Y8149 \end{array}$$

$$\begin{array}{r} 6977J \\ + 32680 \\ \hline J024VJ \end{array}$$

$$\begin{array}{r} 10475 \\ + 81062 \\ \hline N15B7 \end{array}$$

$$\begin{array}{r} 367V8 \\ + 22765 \\ \hline 59483 \end{array}$$

$$\begin{array}{r} 7864A \\ + 792M9 \\ \hline 1M7902 \end{array}$$

$$\begin{array}{r} 24635 \\ + 0M254 \\ \hline 3188J \end{array}$$

$$\begin{array}{r} 14F25 \\ + 6H13H \\ \hline F1962 \end{array}$$

$$\begin{array}{r} IB509 \\ + 8007I \\ \hline 12B583 \end{array}$$

$$\begin{array}{r} 59W46 \\ + 60W88 \\ \hline 1205V4 \end{array}$$

$$\begin{array}{r} EX149 \\ + 2773X \\ \hline 92884 \end{array}$$

$$\begin{array}{r} 26521 \\ + 33184 \\ \hline 59MN5 \end{array}$$

$$\begin{array}{r} XX346 \\ + 5385X \\ \hline 76N98 \end{array}$$

$$\begin{array}{r} 59484 \\ + 30W3W \\ \hline 8971I \end{array}$$

$$\begin{array}{r} 7218X \\ + 1864X \\ \hline 908S0 \end{array}$$

$$\begin{array}{r} 823X2 \\ + 32687 \\ \hline 11502U \end{array}$$

$$\begin{array}{r} 08913 \\ + B7B22 \\ \hline DD43B \end{array}$$

$$\begin{array}{r} 6489R \\ + 1R278 \\ \hline 8I173 \end{array}$$

$$\begin{array}{r} L767B \\ + 4388B \\ \hline 71568 \end{array}$$

$$\begin{array}{r} 448T2 \\ + 531J7 \\ \hline J805J \end{array}$$

$$\begin{array}{r} 814Z0 \\ + A1655 \\ \hline 173075 \end{array}$$

$$\begin{array}{r} 68C53 \\ + 5Y500 \\ \hline 127Y53 \end{array}$$

$$\begin{array}{r} 2B311 \\ + 65160 \\ \hline J9B71 \end{array}$$

$$\begin{array}{r} ZA753 \\ + Z8911 \\ \hline 9166Z \end{array}$$

$$\begin{array}{r} 73014 \\ + Y680Y \\ \hline 12N81N \end{array}$$

4 ADDITION WITH FIVE UNKNOWNNS

$$\begin{array}{r} \text{G65D0} \\ + \text{ED63X} \\ \hline \text{8TG5X} \end{array}$$

$$\begin{array}{r} \text{28I81} \\ + \text{H486J} \\ \hline \text{1AW4IA} \end{array}$$

$$\begin{array}{r} \text{YE974} \\ + \text{DE4DP} \\ \hline \text{PDZ92} \end{array}$$

$$\begin{array}{r} \text{9RRLC} \\ + \text{570P5} \\ \hline \text{151RDL} \end{array}$$

$$\begin{array}{r} \text{S8SJ7} \\ + \text{PSU8P} \\ \hline \text{61SD0} \end{array}$$

$$\begin{array}{r} \text{3HX4Y} \\ + \text{HYJ81} \\ \hline \text{1X9AY3} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{N8H9X} \\ + \text{R788K} \\ \hline \text{9617K} \end{array}$$

$$\begin{array}{r} \text{YK998} \\ + \text{40M03} \\ \hline \text{KFM0I} \end{array}$$

$$\begin{array}{r} \text{HW10T} \\ + \text{N6N8L} \\ \hline \text{80L90} \end{array}$$

$$\begin{array}{r} \text{X5S79} \\ + \text{XE9E3} \\ \hline \text{34SIS} \end{array}$$

$$\begin{array}{r} \text{K2YU6} \\ + \text{702F2} \\ \hline \text{U627W8} \end{array}$$

$$\begin{array}{r} \text{80088} \\ + \text{A3977} \\ \hline \text{TKA0NX} \end{array}$$

$$\begin{array}{r} \text{BA933} \\ + \text{28B6V} \\ \hline \text{W9F9F} \end{array}$$

$$\begin{array}{r} \text{1RF38} \\ + \text{4YN8U} \\ \hline \text{YFF2Y} \end{array}$$

$$\begin{array}{r} \text{35KXX} \\ + \text{V5T2K} \\ \hline \text{5VLT4} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 6VKKU \\ + 57K75 \\ \hline K2E28N \end{array}$$

$$\begin{array}{r} DD5J8 \\ + I76N6 \\ \hline NGD44 \end{array}$$

$$\begin{array}{r} 042GW \\ + 6WJ21 \\ \hline JPWZ0 \end{array}$$

$$\begin{array}{r} 4N0TM \\ + 794AN \\ \hline INI5IT \end{array}$$

$$\begin{array}{r} XF33J \\ + 219J2 \\ \hline 692YF \end{array}$$

$$\begin{array}{r} EB7J5 \\ + 2MYB4 \\ \hline YB14M \end{array}$$

$$\begin{array}{r} Y8336 \\ + 2UJV9 \\ \hline UI3II \end{array}$$

$$\begin{array}{r} 80CBB \\ + BJH93 \\ \hline 1NC33C \end{array}$$

$$\begin{array}{r} SYM7 \\ + 1H227 \\ \hline M15GS \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{H98D8} \\ + \text{W0L99} \\ \hline \text{R202D7} \end{array}$$
$$\begin{array}{r} \text{76N82} \\ + \text{DHS17} \\ \hline \text{1XSNNN} \end{array}$$
$$\begin{array}{r} \text{V1LKV} \\ + \text{V3Y40} \\ \hline \text{16E03V} \end{array}$$
$$\begin{array}{r} \text{597D6} \\ + \text{6W7NN} \\ \hline \text{IMW53D} \end{array}$$
$$\begin{array}{r} \text{2WKZ7} \\ + \text{89ZKI} \\ \hline \text{SS4Z7K} \end{array}$$
$$\begin{array}{r} \text{X5863} \\ + \text{L3ZLF} \\ \hline \text{3Z787} \end{array}$$
$$\begin{array}{r} \text{V8B7I} \\ + \text{I26BB} \\ \hline \text{RVR2Y4} \end{array}$$
$$\begin{array}{r} \text{G65GC} \\ + \text{33CSJ} \\ \hline \text{597R5} \end{array}$$
$$\begin{array}{r} \text{8TK6A} \\ + \text{DDX74} \\ \hline \text{D006KT} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{MNP1H} \\ + \text{C691N} \\ \hline 127\text{C2H} \end{array}$$

$$\begin{array}{r} \text{FV5Y4} \\ + \text{I4U02} \\ \hline 1\text{V0IYV} \end{array}$$

$$\begin{array}{r} \text{H7H9H} \\ + \text{8LX4L} \\ \hline \text{SB00X8} \end{array}$$

$$\begin{array}{r} \text{LNZN9} \\ + \text{4DCC9} \\ \hline \text{N15ZC} \end{array}$$

$$\begin{array}{r} \text{8IE53} \\ + \text{1ZSZE} \\ \hline 1\text{0I0M5} \end{array}$$

$$\begin{array}{r} \text{5155U} \\ + \text{WGP27} \\ \hline 995\text{GT} \end{array}$$

$$\begin{array}{r} \text{GU500} \\ + \text{5P177} \\ \hline \text{E3C77} \end{array}$$

$$\begin{array}{r} \text{XA58X} \\ + \text{3N885} \\ \hline \text{S0H4XN} \end{array}$$

$$\begin{array}{r} \text{R8R1S} \\ + \text{4S9R6} \\ \hline \text{DD9HU} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{SDF5K} \\ + \text{S8911} \\ \hline \text{91CCS} \end{array}$$

$$\begin{array}{r} \text{1HSC8} \\ + \text{0S78G} \\ \hline \text{20YS7} \end{array}$$

$$\begin{array}{r} \text{FT02F} \\ + \text{204HS} \\ \hline \text{11TB16} \end{array}$$

$$\begin{array}{r} \text{WZZ29} \\ + \text{UC80U} \\ \hline \text{78WZD} \end{array}$$

$$\begin{array}{r} \text{5EHL7} \\ + \text{G1EGL} \\ \hline \text{120XGG} \end{array}$$

$$\begin{array}{r} \text{V83D1} \\ + \text{DNK71} \\ \hline \text{1V08ZN} \end{array}$$

$$\begin{array}{r} \text{F77FN} \\ + \text{M04E2} \\ \hline \text{F0IF75} \end{array}$$

$$\begin{array}{r} \text{JZ9Y8} \\ + \text{Y4JAL} \\ \hline \text{A28668} \end{array}$$

$$\begin{array}{r} \text{76A61} \\ + \text{SML8L} \\ \hline \text{1Y9YLA} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{XM3X9} \\ + \text{G8M20} \\ \hline \text{R0G9S9} \end{array}$$

$$\begin{array}{r} 413\text{X9} \\ + 4\text{S2JX} \\ \hline \text{XXE4S} \end{array}$$

$$\begin{array}{r} 44161 \\ + \text{DPICI} \\ \hline 69\text{R9R} \end{array}$$

$$\begin{array}{r} 3\text{M2Z8} \\ + \text{PRZG5} \\ \hline \text{Z6663} \end{array}$$

$$\begin{array}{r} \text{W761D} \\ + 3\text{PPW9} \\ \hline 1\text{Z3ZL3} \end{array}$$

$$\begin{array}{r} 84\text{AL8} \\ + \text{F1KT4} \\ \hline 13\text{LK42} \end{array}$$

$$\begin{array}{r} 8\text{RY4E} \\ + 302\text{V4} \\ \hline \text{PPE20P} \end{array}$$

$$\begin{array}{r} \text{HHRR9} \\ + 0\text{V5U9} \\ \hline \text{H630F} \end{array}$$

$$\begin{array}{r} \text{KJ85Y} \\ + 9\text{J08G} \\ \hline 1\text{KC9K8} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 19XS1 \\ + FX173 \\ \hline 83FZX \end{array}$$

$$\begin{array}{r} M544I \\ + J3MLJ \\ \hline F0J744 \end{array}$$

$$\begin{array}{r} UGLU5 \\ + 0T854 \\ \hline UUUE9 \end{array}$$

$$\begin{array}{r} I34X3 \\ + Z6Z84 \\ \hline 39M3M \end{array}$$

$$\begin{array}{r} ET665 \\ + IIEY2 \\ \hline G17E7 \end{array}$$

$$\begin{array}{r} 7BA7A \\ + TG769 \\ \hline N54G4N \end{array}$$

$$\begin{array}{r} A1F4F \\ + J4J2L \\ \hline 9FDL2 \end{array}$$

$$\begin{array}{r} 6G3UA \\ + N24U4 \\ \hline 1A1PUG \end{array}$$

$$\begin{array}{r} GW6G1 \\ + 77274 \\ \hline 11MRLM \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 764EY \\ + L067D \\ \hline EB70D2 \end{array}$$

$$\begin{array}{r} 1W16N \\ + 16H2F \\ \hline HI4WI \end{array}$$

$$\begin{array}{r} 5U4D3 \\ + LU1US \\ \hline USS7D \end{array}$$

$$\begin{array}{r} X4XYU \\ + 24Y5A \\ \hline 88988 \end{array}$$

$$\begin{array}{r} 408KF \\ + 6KD0T \\ \hline W03F3K \end{array}$$

$$\begin{array}{r} S2UNU \\ + 8JU6N \\ \hline 959US \end{array}$$

$$\begin{array}{r} 7F7L3 \\ + 3WX3W \\ \hline WWR654 \end{array}$$

$$\begin{array}{r} C7E5W \\ + 756L3 \\ \hline E22JC3 \end{array}$$

$$\begin{array}{r} P62TZ \\ + D6P4V \\ \hline 1P2332 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 53K00 \\ + BT58U \\ \hline G048U \end{array}$$

$$\begin{array}{r} 19YV6 \\ + DP11Y \\ \hline 56D58 \end{array}$$

$$\begin{array}{r} 8A3VV \\ + C8V2K \\ \hline K53L98 \end{array}$$

$$\begin{array}{r} 1L6NN \\ + ZL054 \\ \hline P66Y6 \end{array}$$

$$\begin{array}{r} 3BUPX \\ + U04J9 \\ \hline 4BJ5U \end{array}$$

$$\begin{array}{r} VDH85 \\ + 6HHP4 \\ \hline 84P5C \end{array}$$

$$\begin{array}{r} LH11S \\ + KKA83 \\ \hline AL895 \end{array}$$

$$\begin{array}{r} 376RK \\ + PP37A \\ \hline 5999P \end{array}$$

$$\begin{array}{r} 9L4TA \\ + 44XYL \\ \hline Y36990 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 78NR7 \\ + 28MN1 \\ \hline 1MYW38 \end{array}$$

$$\begin{array}{r} U6SKK \\ + L6E76 \\ \hline 73S31 \end{array}$$

$$\begin{array}{r} Z513W \\ + 28321 \\ \hline T3L58 \end{array}$$

$$\begin{array}{r} 3FT4C \\ + ZTF01 \\ \hline FFM48 \end{array}$$

$$\begin{array}{r} 7K5WW \\ + 05M8T \\ \hline 8W7N4 \end{array}$$

$$\begin{array}{r} 135K5 \\ + KTLU7 \\ \hline 18T7S \end{array}$$

$$\begin{array}{r} HE58F \\ + 51HL3 \\ \hline 99GH5 \end{array}$$

$$\begin{array}{r} 1UZ9L \\ + 2V5D1 \\ \hline L12U5 \end{array}$$

$$\begin{array}{r} U9567 \\ + NM6M2 \\ \hline YMM79 \end{array}$$

7 SUBTRACTION WITH TWO UNKNOWNNS

$$\begin{array}{r} 7N725 \\ - L0589 \\ \hline 4NNL6 \end{array}$$

$$\begin{array}{r} 93275 \\ - 3S61H \\ \hline 54665 \end{array}$$

$$\begin{array}{r} 6CE20 \\ - 28396 \\ \hline 3572C \end{array}$$

$$\begin{array}{r} 8820U \\ - U1E7E \\ \hline 56729 \end{array}$$

$$\begin{array}{r} JJ4Z2 \\ - 02119 \\ \hline J5363 \end{array}$$

$$\begin{array}{r} 9V3V5 \\ - 4L279 \\ \hline 57L06 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 47834 \\ - X8564 \\ \hline 1JX70 \end{array}$$

$$\begin{array}{r} 8M455 \\ - 13B46 \\ \hline 68B09 \end{array}$$

$$\begin{array}{r} J4029 \\ - J2J56 \\ \hline VV73 \end{array}$$

$$\begin{array}{r} 8098R \\ - 297R8 \\ \hline J1236 \end{array}$$

$$\begin{array}{r} 56308 \\ - 0688J \\ \hline 4M421 \end{array}$$

$$\begin{array}{r} 82G46 \\ - F1G80 \\ \hline 50966 \end{array}$$

$$\begin{array}{r} X7097 \\ - 32N58 \\ \hline 34939 \end{array}$$

$$\begin{array}{r} 61C94 \\ - HC071 \\ \hline 8C2C \end{array}$$

$$\begin{array}{r} B8078 \\ - 15117 \\ \hline N2961 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{H2861} \\ - \text{43653} \\ \hline \text{2C208} \end{array}$$

$$\begin{array}{r} \text{2T593} \\ - \text{Z8884} \\ \hline \text{7709} \end{array}$$

$$\begin{array}{r} \text{64WL8} \\ - \text{L915L} \\ \hline \text{34876} \end{array}$$

$$\begin{array}{r} \text{63959} \\ - \text{M5689} \\ \hline \text{4827I} \end{array}$$

$$\begin{array}{r} \text{408K2} \\ - \text{01109} \\ \hline \text{397S3} \end{array}$$

$$\begin{array}{r} \text{68870} \\ - \text{2304R} \\ \hline \text{4N829} \end{array}$$

$$\begin{array}{r} \text{8N791} \\ - \text{074N4} \\ \hline \text{7G367} \end{array}$$

$$\begin{array}{r} \text{W6A81} \\ - \text{34510} \\ \hline \text{622A1} \end{array}$$

$$\begin{array}{r} \text{G9722} \\ - \text{51IG4} \\ \hline \text{3G63G} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 68M90 \\ - 07358 \\ \hline 6113U \end{array}$$

$$\begin{array}{r} 97I15 \\ - J0135 \\ \hline 37280 \end{array}$$

$$\begin{array}{r} 6V223 \\ - 2U769 \\ \hline 38454 \end{array}$$

$$\begin{array}{r} 72976 \\ - 0467I \\ \hline 6830B \end{array}$$

$$\begin{array}{r} 6787H \\ - 41D78 \\ \hline 26301 \end{array}$$

$$\begin{array}{r} 99179 \\ - 307A9 \\ \hline W8420 \end{array}$$

$$\begin{array}{r} 96600 \\ - 6FPP7 \\ \hline 2F153 \end{array}$$

$$\begin{array}{r} 79905 \\ - P5722 \\ \hline 6BP83 \end{array}$$

$$\begin{array}{r} 86832 \\ - 057X8 \\ \hline 8Y034 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 69336 \\ - V051Y \\ \hline 48819 \end{array}$$

$$\begin{array}{r} 940B8 \\ - 1680N \\ \hline 77BB3 \end{array}$$

$$\begin{array}{r} 21961 \\ - W7258 \\ \hline 147WA \end{array}$$

$$\begin{array}{r} 7050R \\ - C6359 \\ \hline 2C1C9 \end{array}$$

$$\begin{array}{r} 2518E \\ - 04414 \\ \hline 207W9 \end{array}$$

$$\begin{array}{r} K862E \\ - E1450 \\ \hline 6717E \end{array}$$

$$\begin{array}{r} A476H \\ - 43847 \\ \hline 1091A \end{array}$$

$$\begin{array}{r} 88396 \\ - 81YFF \\ \hline 6874 \end{array}$$

$$\begin{array}{r} 9G798 \\ - YG551 \\ \hline 60G47 \end{array}$$

14 MULTIPLICATION WITH THREE UNKNOWN S

$$\begin{array}{r} \times \quad T622 \\ \quad \quad \underline{7T} \\ 2V110 \\ 3Y3T4 \\ \hline 4216T0 \end{array}$$

$$\begin{array}{r} \times \quad V096 \\ \quad \quad \underline{64} \\ \quad \quad YTY4 \\ 1V576 \\ \hline 1T4144 \end{array}$$

$$\begin{array}{r} \times \quad 2M77 \\ \quad \quad \underline{25} \\ K2385 \\ M95M \\ \hline 6K925 \end{array}$$

$$\begin{array}{r} \times \quad KC96 \\ \quad \quad \underline{19} \\ YY364 \\ KC96 \\ \hline 163324 \end{array}$$

$$\begin{array}{r} \times \quad 8H54 \\ \quad \quad \underline{H9} \\ A518Z \\ 250Z2 \\ \hline H2580Z \end{array}$$

$$\begin{array}{r} \times \quad J664 \\ \quad \quad \underline{U8} \\ 773P2 \\ 48320 \\ \hline U60UP2 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times 2814 \\ 74 \\ \hline 1125U \\ 1DUD8 \\ \hline 2H823U \end{array}$$

$$\begin{array}{r} \times 15P3 \\ PC \\ \hline P252 \\ 9378 \\ \hline 1JJJ32 \end{array}$$

$$\begin{array}{r} \times AAJU \\ 6J \\ \hline 35J96 \\ 26922 \\ \hline 305116 \end{array}$$

$$\begin{array}{r} \times H04H \\ 8N \\ \hline 27V47 \\ 72NH2 \\ \hline 75V067 \end{array}$$

$$\begin{array}{r} \times 26R0 \\ L5 \\ \hline 1L450 \\ 80S0 \\ \hline R4150 \end{array}$$

$$\begin{array}{r} \times 6644 \\ 7S \\ \hline 199SK \\ 46D08 \\ \hline 48D01K \end{array}$$

$$\begin{array}{r} \times C032 \\ 9L \\ \hline 40B60 \\ 722CC \\ \hline 763040 \end{array}$$

$$\begin{array}{r} \times 2A4R \\ 34 \\ \hline 1MR8M \\ 793R \\ \hline 8993M \end{array}$$

$$\begin{array}{r} \times WI96 \\ 95 \\ \hline 1WI80 \\ WWI6I \\ \hline WB71W0 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad \text{EK23} \\ \quad \text{EU} \\ \hline 54138 \\ 812\text{K}7 \\ \hline 8\text{UU}2\text{K}8 \end{array}$$

$$\begin{array}{r} \times \quad \text{R547} \\ \quad \text{E1} \\ \hline \text{R547} \\ 2\text{H}641 \\ \hline 2\text{R}5\text{R}57 \end{array}$$

$$\begin{array}{r} \times \quad 6\text{M}59 \\ \quad \text{A7} \\ \hline 4\text{S}81\text{S} \\ \text{AAAA} \\ \hline 4\text{S}81\text{S} \end{array}$$

$$\begin{array}{r} \times \quad \text{A869} \\ \quad 49 \\ \hline 7821 \\ \text{X}476 \\ \hline 42\text{T}81 \end{array}$$

$$\begin{array}{r} \times \quad 218\text{I} \\ \quad 2\text{X} \\ \hline 1093\text{X} \\ 43\text{I}4 \\ \hline \text{X}4\text{TIX} \end{array}$$

$$\begin{array}{r} \times \quad 57\text{E}2 \\ \quad 16 \\ \hline \text{Y}46\text{A}2 \\ 57\text{E}2 \\ \hline \text{A}2512 \end{array}$$

$$\begin{array}{r} \times \quad 82\text{KW} \\ \quad 54 \\ \hline 328\text{S}6 \\ 4\text{K}0\text{W}5 \\ \hline 443826 \end{array}$$

$$\begin{array}{r} \times \quad \text{UM}67 \\ \quad 3\text{G} \\ \hline 4\text{MU}36 \\ 1\text{U}2\text{M}1 \\ \hline 192\text{U}46 \end{array}$$

$$\begin{array}{r} \times \quad \text{H7CD} \\ \quad 3\text{C} \\ \hline \text{H}51\text{D}4 \\ 8388 \\ \hline 10\text{C}044 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad 5J06 \\ \quad 42 \\ \hline 11412 \\ 22Y24 \\ \hline 2K9652 \end{array}$$

$$\begin{array}{r} \times \quad HM68 \\ \quad 27 \\ \hline 38276 \\ 1U936 \\ \hline 1M7636 \end{array}$$

$$\begin{array}{r} \times \quad A484 \\ \quad 7H \\ \hline T2904 \\ T8T88 \\ \hline 41H784 \end{array}$$

$$\begin{array}{r} \times \quad JJ44 \\ \quad 58 \\ \hline 9J52 \\ 5U2A \\ \hline 66352 \end{array}$$

$$\begin{array}{r} \times \quad Z68A \\ \quad 98 \\ \hline 61AZ2 \\ 69156 \\ \hline Z53M32 \end{array}$$

$$\begin{array}{r} \times \quad 9D54 \\ \quad 59 \\ \hline DD6D6 \\ 49IJ0 \\ \hline 5D13D6 \end{array}$$

$$\begin{array}{r} \times \quad A0R5 \\ \quad 81 \\ \hline A0R5 \\ 2Z760 \\ \hline 2506R5 \end{array}$$

$$\begin{array}{r} \times \quad RSW6 \\ \quad 8R \\ \hline 17R2R \\ SR8R8 \\ \hline S6W90R \end{array}$$

$$\begin{array}{r} \times \quad 0V1X \\ \quad 78 \\ \hline 335G \\ GX33 \\ \hline 3G68G \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad 725V \\ \quad 68 \\ \hline 58S24 \\ 4V518 \\ \hline 4ZV2S4 \end{array}$$

$$\begin{array}{r} \times \quad U2E2 \\ \quad 29 \\ \hline 295UE \\ 6564 \\ \hline 95A7E \end{array}$$

$$\begin{array}{r} \times \quad 7P27 \\ \quad K7 \\ \hline P268K \\ 67743 \\ \hline 730LLK \end{array}$$

$$\begin{array}{r} \times \quad 4J4B \\ \quad 5B \\ \hline 29W7B \\ 2423W \\ \hline 27137B \end{array}$$

$$\begin{array}{r} \times \quad 1B52 \\ \quad 75 \\ \hline E260 \\ 12E64 \\ \hline 1UBE00 \end{array}$$

$$\begin{array}{r} \times \quad 6JI6 \\ \quad 59 \\ \hline 5XXJJ \\ 32080 \\ \hline 3X85JJ \end{array}$$

$$\begin{array}{r} \times \quad 3318 \\ \quad 23 \\ \hline 99AD \\ 6636 \\ \hline 7631D \end{array}$$

$$\begin{array}{r} \times \quad 9169 \\ \quad 31 \\ \hline 9169 \\ 2Y5KY \\ \hline 28N239 \end{array}$$

$$\begin{array}{r} \times \quad 533D \\ \quad 38 \\ \hline D26P2 \\ 16002 \\ \hline 2026F2 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad \text{V695} \\ \quad \text{59} \\ \hline \text{7V255} \\ \text{C3C75} \\ \hline \text{513YY5} \end{array}$$

$$\begin{array}{r} \times \quad \text{169L} \\ \quad \text{ID} \\ \hline \text{6780} \\ \text{3390} \\ \hline \text{D0680} \end{array}$$

$$\begin{array}{r} \times \quad \text{5T69} \\ \quad \text{49} \\ \hline \text{5H9AH} \\ \text{A30T6} \\ \hline \text{A8A68H} \end{array}$$

$$\begin{array}{r} \times \quad \text{3939} \\ \quad \text{48} \\ \hline \text{31Y12} \\ \text{1YNYI} \\ \hline \text{1890N2} \end{array}$$

$$\begin{array}{r} \times \quad \text{814L} \\ \quad \text{L4} \\ \hline \text{32588} \\ \text{5L02D} \\ \hline \text{R028L8} \end{array}$$

$$\begin{array}{r} \times \quad \text{1RCR} \\ \quad \text{2F} \\ \hline \text{478R} \\ \text{F1C0} \\ \hline \text{F668R} \end{array}$$

$$\begin{array}{r} \times \quad \text{K1T0} \\ \quad \text{75} \\ \hline \text{20D00} \\ \text{2D260} \\ \hline \text{313500} \end{array}$$

$$\begin{array}{r} \times \quad \text{D46F} \\ \quad \text{56} \\ \hline \text{88D4} \\ \text{7345} \\ \hline \text{82264} \end{array}$$

$$\begin{array}{r} \times \quad \text{X9V2} \\ \quad \text{42} \\ \hline \text{13904} \\ \text{2U808} \\ \hline \text{291984} \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad 4155 \\ \quad 57 \\ \hline 2UYM5 \\ 2Y775 \\ \hline 236M35 \end{array}$$

$$\begin{array}{r} \times \quad M385 \\ \quad 29 \\ \hline 66V65 \\ RVMM0 \\ \hline 2RVR65 \end{array}$$

$$\begin{array}{r} \times \quad J562 \\ \quad JM \\ \hline 66JG4 \\ 86058 \\ \hline J2M514 \end{array}$$

$$\begin{array}{r} \times \quad V88V \\ \quad 86 \\ \hline 17V9V \\ VI056 \\ \hline VZ785V \end{array}$$

$$\begin{array}{r} \times \quad 8AE4 \\ \quad 84 \\ \hline 35B1B \\ 71232 \\ \hline 747A3B \end{array}$$

$$\begin{array}{r} \times \quad 184K \\ \quad 7L \\ \hline 92P0 \\ 12922 \\ \hline 1P84L0 \end{array}$$

$$\begin{array}{r} \times \quad 428T \\ \quad 68 \\ \hline 34280 \\ 2TH10 \\ \hline 2Y1380 \end{array}$$

$$\begin{array}{r} \times \quad 26JT \\ \quad 3T \\ \hline 1347T \\ P0PT \\ \hline J432T \end{array}$$

$$\begin{array}{r} \times \quad I43I \\ \quad 54 \\ \hline 97IV \\ 1I16W \\ \hline 1313IV \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \times \quad 7537 \\ \quad \quad V3 \\ \hline 22L11 \\ 301VB \\ \hline 32V091 \end{array}$$

$$\begin{array}{r} \times \quad X43H \\ \quad \quad Y9 \\ \hline 57942 \\ X43H \\ \hline Y22322 \end{array}$$

$$\begin{array}{r} \times \quad 4644 \\ \quad \quad 45 \\ \hline 2322M \\ Z8576 \\ \hline 2M8I8M \end{array}$$

$$\begin{array}{r} \times \quad 8H31 \\ \quad \quad 84 \\ \hline 34B24 \\ HD048 \\ \hline 72B004 \end{array}$$

$$\begin{array}{r} \times \quad 5VG3 \\ \quad \quad V9 \\ \hline 468V7 \\ SG4G6 \\ \hline S5G887 \end{array}$$

$$\begin{array}{r} \times \quad 6ZZ2 \\ \quad \quad 95 \\ \hline E44B0 \\ 6B9EZ \\ \hline 65E790 \end{array}$$

$$\begin{array}{r} \times \quad W7N7 \\ \quad \quad 2W \\ \hline 87363 \\ 1W414 \\ \hline 281SN3 \end{array}$$

$$\begin{array}{r} \times \quad Z1W2 \\ \quad \quad W5 \\ \hline 30U10 \\ 2W5Z8 \\ \hline 2UZ390 \end{array}$$

$$\begin{array}{r} \times \quad 457I \\ \quad \quad 4H \\ \hline IB5H4 \\ 1H292 \\ \hline 219504 \end{array}$$

SHANNON PROBLEMS

20 DIVISION WITH THREE UNKNOWNNS

$$\begin{array}{r}
 \text{ECJ} \overline{) \begin{array}{l} 53 \\ 503JE \\ \hline C710 \\ \hline 3JJ E \\ J8J6 \\ \hline C03 \end{array}}
 \end{array}$$

$$\begin{array}{r}
 679 \overline{) \begin{array}{l} 4M \\ 33172 \\ \hline 2716 \\ \hline 6Z12 \\ D432 \\ \hline DMZ \end{array}}
 \end{array}$$

$$\begin{array}{r}
 2C4 \overline{) \begin{array}{l} 14 \\ 04033 \\ \hline 02C4 \\ \hline 1193 \\ 1136 \\ \hline TN \end{array}}
 \end{array}$$

$$\begin{array}{r}
 34M \overline{) \begin{array}{l} 8M \\ E786A \\ \hline E7E8 \\ \hline 058A \\ 034M \\ \hline E48 \end{array}}
 \end{array}$$

$$\begin{array}{r}
 861 \overline{) \begin{array}{l} 9H \\ 81L35 \\ \hline LLH9 \\ \hline HCH5 \\ 3HHH \\ \hline 801 \end{array}}
 \end{array}$$

$$\begin{array}{r}
 8IE \overline{) \begin{array}{l} 36 \\ 3E101 \\ \hline E616 \\ \hline 59Z1 \\ 5E3E \\ \hline I09 \end{array}}
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} 4E \\ \hline Z29 \) \ 228C8 \\ \quad 211C \\ \hline \quad \quad 1708 \\ \quad \quad 1Z87 \\ \hline \quad \quad \quad 121 \end{array}$$

$$\begin{array}{r} 61 \\ \hline 71C \) \ CC103 \\ \quad \quad CAMC \\ \hline \quad \quad \quad 1A63 \\ \quad \quad \quad 071C \\ \hline \quad \quad \quad \quad 5C9 \end{array}$$

$$\begin{array}{r} V5 \\ \hline 8B7 \) \ 80V8B \\ \quad \quad 7623 \\ \hline \quad \quad \quad B75B \\ \quad \quad \quad B235 \\ \hline \quad \quad \quad \quad 5HV \end{array}$$

$$\begin{array}{r} J3 \\ \hline K42 \) \ 399JJ \\ \quad \quad 3K10 \\ \hline \quad \quad \quad 2LJJ \\ \quad \quad \quad 2226 \\ \hline \quad \quad \quad \quad 629 \end{array}$$

$$\begin{array}{r} 3F \\ \hline 53F \) \ F6642 \\ \quad \quad F5Y3 \\ \hline \quad \quad \quad W7F2 \\ \quad \quad \quad W53F \\ \hline \quad \quad \quad \quad F8F \end{array}$$

$$\begin{array}{r} KE \\ \hline 879 \) \ 37K63 \\ \quad \quad 3516 \\ \hline \quad \quad \quad E3U3 \\ \quad \quad \quad 1758 \\ \hline \quad \quad \quad \quad 5K5 \end{array}$$

$$\begin{array}{r} 57 \\ \hline 344 \) \ CA756 \\ \quad \quad C7F0 \\ \hline \quad \quad \quad F556 \\ \quad \quad \quad F408 \\ \hline \quad \quad \quad \quad C48 \end{array}$$

$$\begin{array}{r} 9H \\ \hline H3M \) \ HW6M2 \\ \quad \quad 4779 \\ \hline \quad \quad \quad 2822 \\ \quad \quad \quad 26HH \\ \hline \quad \quad \quad \quad M67 \end{array}$$

$$\begin{array}{r} 82 \\ \hline 29I \) \ 24H24 \\ \quad \quad 2H60 \\ \hline \quad \quad \quad 0R24 \\ \quad \quad \quad 0I90 \\ \hline \quad \quad \quad \quad 1H4 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r}
 \text{A2} \\
 959 \overline{) \text{A0952}} \\
 \underline{2\text{T}77} \\
 2\text{WT}2 \\
 \underline{\text{W9WT}} \\
 264
 \end{array}$$

$$\begin{array}{r}
 5\text{N} \\
 29\text{N} \overline{) 15819} \\
 \underline{14\text{S}5} \\
 11\text{S}9 \\
 \underline{\text{M}879} \\
 29\text{M}
 \end{array}$$

$$\begin{array}{r}
 8\text{X} \\
 \text{X}84 \overline{) 58934} \\
 \underline{5472} \\
 42\text{J}4 \\
 \underline{4\text{JN}4} \\
 \text{JJN}
 \end{array}$$

$$\begin{array}{r}
 47 \\
 \text{DN}4 \overline{) \text{N}4858} \\
 \underline{\text{N}256} \\
 2298 \\
 \underline{2\text{N}98} \\
 \text{NAA}
 \end{array}$$

$$\begin{array}{r}
 26 \\
 872 \overline{) 23346} \\
 \underline{\text{E}744} \\
 \text{PJ}06 \\
 \underline{\text{P}232} \\
 674
 \end{array}$$

$$\begin{array}{r}
 6\text{L} \\
 5\text{L}7 \overline{) \text{LT}1\text{L}9} \\
 \underline{\text{LJ}JJ} \\
 1919 \\
 \underline{1611} \\
 \text{L}08
 \end{array}$$

$$\begin{array}{r}
 46 \\
 314 \overline{) 14\text{G}34} \\
 \underline{1256} \\
 21\text{G}4 \\
 \underline{1\text{LL}4} \\
 2\text{B}0
 \end{array}$$

$$\begin{array}{r}
 38 \\
 778 \overline{) 30\text{J}5\text{J}} \\
 \underline{\text{J}33\text{T}} \\
 \text{R}91\text{J} \\
 \underline{\text{R}JJ\text{T}} \\
 \text{R}88
 \end{array}$$

$$\begin{array}{r}
 9\text{C} \\
 84\text{C} \overline{) 78\text{CU}7} \\
 \underline{7578} \\
 \text{C}4\text{C}7 \\
 \underline{1\text{J}84} \\
 743
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r}
 64 \\
 504 \overline{) \text{BN6B7}} \\
 \underline{\text{B0N4}} \\
 \text{NBG7} \\
 \underline{\text{N016}} \\
 \text{B81}
 \end{array}$$

$$\begin{array}{r}
 63 \\
 \text{B01} \overline{) 51020} \\
 \underline{\text{TB06}} \\
 2\text{D60} \\
 \underline{2\text{T03}} \\
 557
 \end{array}$$

$$\begin{array}{r}
 59 \\
 \text{D1D} \overline{) \text{HD796}} \\
 \underline{\text{H090}} \\
 7\text{D96} \\
 \underline{7\text{U62}} \\
 5\text{UH}
 \end{array}$$

$$\begin{array}{r}
 74 \\
 89\text{N} \overline{) 66\text{N4P}} \\
 \underline{6\text{PCN}} \\
 \text{C74P} \\
 \underline{\text{C56N}} \\
 18\text{P}
 \end{array}$$

$$\begin{array}{r}
 98 \\
 8\text{T9} \overline{) 8\text{R962}} \\
 \underline{7731} \\
 76\text{T2} \\
 \underline{6872} \\
 78\text{H}
 \end{array}$$

$$\begin{array}{r}
 47 \\
 729 \overline{) 348\text{BL}} \\
 \underline{29\text{BL}} \\
 5\text{L5L} \\
 \underline{5\text{BX3}} \\
 553
 \end{array}$$

$$\begin{array}{r}
 29 \\
 \text{UU9} \overline{) 1\text{MM4U}} \\
 \underline{\text{M6K8}} \\
 \text{U26U} \\
 \underline{\text{UM51}} \\
 212
 \end{array}$$

$$\begin{array}{r}
 82 \\
 85\text{P} \overline{) \text{P0531}} \\
 \underline{6856} \\
 1\text{CP1} \\
 \underline{1\text{P1A}} \\
 25\text{P}
 \end{array}$$

$$\begin{array}{r}
 7\text{W} \\
 8\text{JW} \overline{) \text{JW1J5}} \\
 \underline{\text{JV83}} \\
 8335 \\
 \underline{7821} \\
 514
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r}
 \text{Y4} \\
 \hline
 47\text{Y} \) \ \text{R0Y0E} \\
 \quad \text{28EY} \\
 \hline
 \quad \text{204E} \\
 \quad \text{1904} \\
 \hline
 \quad \text{141}
 \end{array}$$

$$\begin{array}{r}
 \text{LJ} \\
 \hline
 78\text{L} \) \ \text{TTJ28} \\
 \quad \text{392L} \\
 \hline
 \quad \text{L378} \\
 \quad \text{T710} \\
 \hline
 \quad \text{JJ8}
 \end{array}$$

$$\begin{array}{r}
 \text{Y5} \\
 \hline
 636 \) \ \text{B8717} \\
 \quad \text{B5YY} \\
 \hline
 \quad \text{3B77} \\
 \quad \text{318R} \\
 \hline
 \quad \text{97}
 \end{array}$$

$$\begin{array}{r}
 \text{7U} \\
 \hline
 \text{E46} \) \ \text{39264} \\
 \quad \text{3822} \\
 \hline
 \quad \text{UL44} \\
 \quad \text{LE46} \\
 \hline
 \quad \text{498}
 \end{array}$$

$$\begin{array}{r}
 \text{85} \\
 \hline
 62\text{X} \) \ \text{5T46C} \\
 \quad \text{50T2} \\
 \hline
 \quad \text{T14C} \\
 \quad \text{T145} \\
 \hline
 \quad \text{02}
 \end{array}$$

$$\begin{array}{r}
 \text{6S} \\
 \hline
 8\text{U5} \) \ \text{5U442} \\
 \quad \text{4890} \\
 \hline
 \quad \text{2542} \\
 \quad \text{2445} \\
 \hline
 \quad \text{9B}
 \end{array}$$

$$\begin{array}{r}
 \text{75} \\
 \hline
 \text{I67} \) \ \text{IL145} \\
 \quad \text{186P} \\
 \hline
 \quad \text{1455} \\
 \quad \text{1335} \\
 \hline
 \quad \text{1IL}
 \end{array}$$

$$\begin{array}{r}
 \text{BY} \\
 \hline
 89\text{P} \) \ \text{65516} \\
 \quad \text{62YP} \\
 \hline
 \quad \text{Y216} \\
 \quad \text{26BP} \\
 \hline
 \quad \text{546}
 \end{array}$$

$$\begin{array}{r}
 \text{7D} \\
 \hline
 37\text{R} \) \ \text{282D0} \\
 \quad \text{26G3} \\
 \hline
 \quad \text{1710} \\
 \quad \text{1G16} \\
 \hline
 \quad \text{1RD}
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r} \text{FI1} \quad \overline{51} \\) \quad 3Z305 \\ \underline{3805} \\ 1255 \\ \underline{0FI1} \\ 4Z4 \end{array}$$

$$\begin{array}{r} \quad \overline{F8} \\ 63H \quad) \quad 62R7F \\ \underline{567F} \\ 528F \\ \underline{5R48} \\ 24H \end{array}$$

$$\begin{array}{r} \quad \overline{W8} \\ 944 \quad) \quad WW433 \\ \underline{4EG0} \\ 8G33 \\ \underline{EWWG} \\ 681 \end{array}$$

$$\begin{array}{r} \quad \overline{7P} \\ 5P3 \quad) \quad 4289X \\ \underline{394X} \\ 348X \\ \underline{3378} \\ XJ3 \end{array}$$

$$\begin{array}{r} \quad \overline{14} \\ 422 \quad) \quad 0E157 \\ \underline{0422} \\ 1N37 \\ \underline{1EXX} \\ 24N \end{array}$$

$$\begin{array}{r} \quad \overline{23} \\ 5DC \quad) \quad 13CI8 \\ \underline{1128} \\ 2198 \\ \underline{1D92} \\ 50D \end{array}$$

$$\begin{array}{r} \quad \overline{3D} \\ 2MD \quad) \quad 0Z667 \\ \underline{073D} \\ 1317 \\ \underline{122D} \\ 92 \end{array}$$

$$\begin{array}{r} \quad \overline{9D} \\ D83 \quad) \quad DFD28 \\ \underline{D04D} \\ F258 \\ \underline{548R} \\ DDD \end{array}$$

$$\begin{array}{r} \quad \overline{YK} \\ Y1K \quad) \quad J913J \\ \underline{J512} \\ K01J \\ \underline{325J} \\ 7J0 \end{array}$$

SHANNON PROBLEMS

23 DIVISION WITH SIX UNKNOWNNS

$$\begin{array}{r}
 1W \\
 \hline
 5U6 \) \ 0KB5B \\
 \underline{05U6} \\
 B1KB \\
 \underline{R6VU} \\
 51U
 \end{array}$$

$$\begin{array}{r}
 9W \\
 \hline
 TWD \) \ TTUW9 \\
 \underline{TUC2} \\
 5U59 \\
 \underline{4W4T} \\
 4UZ
 \end{array}$$

$$\begin{array}{r}
 2E \\
 \hline
 3R2 \) \ U0ARA \\
 \underline{0GMA} \\
 2E5A \\
 \underline{2352} \\
 302
 \end{array}$$

$$\begin{array}{r}
 8Z \\
 \hline
 BUR \) \ LL34A \\
 \underline{4ZBR} \\
 L74A \\
 \underline{LL8R} \\
 ABA
 \end{array}$$

$$\begin{array}{r}
 LR \\
 \hline
 30N \) \ JR13N \\
 \underline{JBRJ} \\
 JB1N \\
 \underline{J1Z3} \\
 J5Z
 \end{array}$$

$$\begin{array}{r}
 4E \\
 \hline
 52T \) \ 22G6G \\
 \underline{2NN6} \\
 NJFG \\
 \underline{N5GJ} \\
 N2N
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r}
 056 \overline{) 5L} \\
 \underline{0I9CI} \\
 0IK0 \\
 \underline{0NCI} \\
 0N6K \\
 \underline{0U}
 \end{array}$$

$$\begin{array}{r}
 X79 \overline{) 7D} \\
 \underline{I7X6S} \\
 I1HI \\
 \underline{I9IS} \\
 IDI2 \\
 \underline{99}
 \end{array}$$

$$\begin{array}{r}
 6K7 \overline{) KY} \\
 \underline{M20J2} \\
 2JHH \\
 \underline{6U72} \\
 JH2M \\
 \underline{MKY}
 \end{array}$$

$$\begin{array}{r}
 JVV \overline{) 13} \\
 \underline{ZKTJD} \\
 ZJVJ \\
 \underline{1KZD} \\
 1J82 \\
 \underline{12T}
 \end{array}$$

$$\begin{array}{r}
 NUJ \overline{) J5} \\
 \underline{L5JUV} \\
 L2LB \\
 \underline{321V} \\
 3U35 \\
 \underline{1V3}
 \end{array}$$

$$\begin{array}{r}
 YF5 \overline{) KY} \\
 \underline{YVHYV} \\
 YH60 \\
 \underline{0RYV} \\
 05F0 \\
 \underline{1HV}
 \end{array}$$

$$\begin{array}{r}
 SF7 \overline{) A4} \\
 \underline{FNFSS} \\
 N9AF \\
 \underline{NANS} \\
 NSYJ \\
 \underline{SY5}
 \end{array}$$

$$\begin{array}{r}
 6B4 \overline{) B6} \\
 \underline{IBFN4} \\
 I472 \\
 \underline{42D4} \\
 4DE4 \\
 \underline{DDE}
 \end{array}$$

$$\begin{array}{r}
 54P \overline{) N6} \\
 \underline{L4ND5} \\
 LC86 \\
 \underline{P4P5} \\
 PN58 \\
 \underline{LJJ}
 \end{array}$$

SHANNON PROBLEMS

$$\begin{array}{r}
 \text{GLP} \overline{) \begin{array}{l} \text{Y7} \\ \text{YL66C} \\ \text{0GLP} \\ \hline \text{6PLC} \\ \text{CG9L} \\ \hline \text{TCY} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 314 \overline{) \begin{array}{l} 4\text{I} \\ 14\text{G34} \\ 1\text{YFI} \\ \hline \text{Y1G4} \\ 1\text{LL4} \\ \hline \text{YB0} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 997 \overline{) \begin{array}{l} \text{YS} \\ \text{YSL97} \\ \text{X99S} \\ \hline \text{SX57} \\ 39\text{JJ} \\ \hline \text{XD9} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 \text{SB9} \overline{) \begin{array}{l} 9\text{Y} \\ \text{SJ6YS} \\ \text{Y46D} \\ \hline 6\text{J6S} \\ 5\text{SJI} \\ \hline \text{B65} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 4\text{GC} \overline{) \begin{array}{l} \text{J8} \\ 444\text{P7} \\ 40\text{P8} \\ \hline \text{E787} \\ \text{EPLP} \\ \hline \text{L7L} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 \text{KTY} \overline{) \begin{array}{l} \text{TC} \\ 38399 \\ 3\text{KJF} \\ \hline \text{FK99} \\ \text{FKTY} \\ \hline 4\text{K} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 9\text{NI} \overline{) \begin{array}{l} 97 \\ 9\text{R66R} \\ \text{IUCN} \\ \hline 7\text{E4R} \\ 6496 \\ \hline 644 \end{array}}
 \end{array}$$

$$\begin{array}{r}
 8\text{T8} \overline{) \begin{array}{l} 7\text{Z} \\ 6\text{TZ76} \\ \text{Z866} \\ \hline \text{U9G6} \\ \text{UG9C} \\ \hline 7\text{R6} \end{array}}
 \end{array}$$

$$\begin{array}{r}
 \text{XJ9} \overline{) \begin{array}{l} \text{P3} \\ \text{EIE10} \\ \text{G9J3} \\ \hline 31\text{X0} \\ \text{IGJP} \\ \hline \text{E33} \end{array}}
 \end{array}$$

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$$\begin{array}{r} \text{K6} \\ \hline 6\text{UK} \) \ \text{U986Z} \\ \quad \text{U6UK} \\ \hline \quad \text{Z8HZ} \\ \quad \text{Z6U6} \\ \hline \quad \text{SF7} \end{array}$$

$$\begin{array}{r} \text{LV} \\ \hline 91\text{L} \) \ \text{L19VZ} \\ \quad \text{TZVZ} \\ \hline \quad \text{VT9Z} \\ \quad \text{LV70} \\ \hline \quad \text{FDZ} \end{array}$$

$$\begin{array}{r} \text{24} \\ \hline 7\text{GI} \) \ \text{G72PM} \\ \quad \text{G4X8} \\ \hline \quad \text{288M} \\ \quad \text{287P} \\ \hline \quad \text{LI} \end{array}$$

$$\begin{array}{r} \text{16} \\ \hline 648 \) \ \text{1TBA1} \\ \quad \text{T648} \\ \hline \quad \text{4TD1} \\ \quad \text{F888} \\ \hline \quad \text{CTF} \end{array}$$

$$\begin{array}{r} \text{PZ} \\ \hline 9\text{E4} \) \ \text{PTT44} \\ \quad \text{54Z4} \\ \hline \quad \text{74X4} \\ \quad \text{7LET} \\ \hline \quad \text{9T} \end{array}$$

$$\begin{array}{r} \text{CS} \\ \hline \text{F82} \) \ \text{38P32} \\ \quad \text{34RE} \\ \hline \quad \text{4832} \\ \quad \text{4SS4} \\ \hline \quad \text{C8} \end{array}$$

$$\begin{array}{r} \text{E5} \\ \hline \text{FGL} \) \ \text{6GEIF} \\ \quad \text{56JI} \\ \hline \quad \text{45GF} \\ \quad \text{4GI5} \\ \hline \quad \text{49L} \end{array}$$

$$\begin{array}{r} \text{ZM} \\ \hline \text{G4T} \) \ \text{39DT4} \\ \quad \text{3EDD} \\ \hline \quad \text{M044} \\ \quad \text{0G4T} \\ \hline \quad \text{49E} \end{array}$$

$$\begin{array}{r} \text{4E} \\ \hline \text{E4T} \) \ \text{HY02E} \\ \quad \text{2LZ4} \\ \hline \quad \text{YH8E} \\ \quad \text{YT8E} \\ \hline \quad \text{200} \end{array}$$

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About the Author



Dev Gualtieri received his PhD in 1974 and had a thirty-five year research career in physics and materials science.

He is listed as an inventor on thirty-six US patents, and on numerous international patents. His eclectic research interests included superconductivity, chemical thermodynamics, magnetism, optics, electronics and computer science. At one time, he was an internationally recognized expert in crystal growth.

Dr. Gualtieri is now retired, and he resides in Northern New Jersey with his wife, Anne. They have a son and daughter who reside with their families in Pennsylvania.