1. $\mathcal{S}$
2. $a \neq 0$
3. $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
4. $X = \{x_1, x_2, \ldots, x_n\}$
5. $X = \{x : x \text{ satisfies } \mathcal{P}\}$
6. $-3 \notin E$
7. $\{4, 5, 8\} \subset \{2, 3, 4, 5, 6, 7, 8, 9\}$
8. $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R} \subset \mathbb{C}$
9. $A \not\subset B$
10. $\displaystyle\bigcup_{i=1}^{n} A_i = A_1 \cup \ldots \cup A_n$
11. $\displaystyle\bigcap_{i=1}^{n} A_i = A_1 \cap \ldots \cap A_n$
12. $A \setminus B = A \cap B' = \{x : x \in A \text{ and } x \notin B\}$
13. $A \stackrel{f}{\to} B$
14. $f : a \mapsto b$
15. $a_1 \neq a_2$
16. $(f \circ g)(x) = f(g(x)) = f(\sqrt[3]{x}\,) = (\sqrt[3]{x}\,)^3 = x$
17. $\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} ax + by \\ cx + dy \end{pmatrix}$
18. $\begin{pmatrix} 1 & 2 & 3 \\ \pi(1) & \pi(2) & \pi(3) \end{pmatrix} = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$
19. $g \circ f = id_A$
20. $x \sim y, x \cong y$
21. $psu = qru = qst$
22. $C = QBQ^{-1} = QPAP^{-1}Q^{-1} = (QP)A(QP)^{-1}$
23. $[x] = \{y \in X : y \sim x\}$
24. $r \equiv s \pmod{n}$
25. $A \times D = \emptyset$
26. $f(p/q) = \dfrac{3p}{3q}$
27. $mn > 0$
28. $|x - y| \leq 4$
29. $a^2 + b^2 \leq c^2 + d^2$

30. $\binom{n}{k} = \frac{n!}{k!(n-k)!}$

31. $\gcd(a, b) = ar + bs$

32. $2^{2^5} + 1 = 4{,}294{,}967{,}297$

33. $\sqrt[n]{a_1 a_2 \cdots a_n} \leq \frac{1}{n} \sum_{k=1}^{n} a_k$

34. $\lim_{n \to \infty} f_n / f_{n+1} = (\sqrt{5} - 1)/2$

35. $c = 4\,598\,037\,234$

36.

$\cdot$	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7
2	0	2	4	6	0	2	4	6
3	0	3	6	1	4	7	2	5
4	0	4	0	4	0	4	0	4
5	0	5	2	7	4	1	6	3
6	0	6	4	2	0	6	4	2
7	0	7	6	5	4	3	2	1

37. $\triangle ABC$

38. 120°

39. $\mu_1 \rho_1$

40.

$\circ$	id	ρ_1	ρ_2	μ_1	μ_2	μ_3
id	id	ρ_1	ρ_2	μ_1	μ_2	μ_3
ρ_1	ρ_1	ρ_2	id	μ_3	μ_1	μ_2
ρ_2	ρ_2	id	ρ_1	μ_2	μ_3	μ_1
μ_1	μ_1	μ_2	μ_3	id	ρ_1	ρ_2
μ_2	μ_2	μ_3	μ_1	ρ_2	id	ρ_1
μ_3	μ_3	μ_1	μ_2	ρ_1	ρ_2	id

41.

+	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	0
2	2	3	4	0	1
3	3	4	0	1	2
4	4	0	1	2	3

42. $a^{-1}(a^{-1})^{-1} = e$

43. $g^{-n} = \underbrace{g^{-1} \cdot g^{-1} \cdots g^{-1}}_{n \text{ times}}$

44. $\mathbb{Q}^* = \{p/q : p \text{ and } q \text{ are nonzero integers}\}$

45. $SL_2(\mathbb{R})$

46. $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$

47.
$$\begin{array}{c|cccc}
+ & (0,0) & (0,1) & (1,0) & (1,1) \\
\hline
(0,0) & (0,0) & (0,1) & (1,0) & (1,1) \\
(0,1) & (0,1) & (0,0) & (1,1) & (1,0) \\
(1,0) & (1,0) & (1,1) & (0,0) & (0,1) \\
(1,1) & (1,1) & (1,0) & (0,1) & (0,0)
\end{array}$$

48.
$$\begin{array}{c|cccc}
\circ & a & b & c & d \\
\hline
a & a & c & d & a \\
b & b & b & c & d \\
c & c & d & a & b \\
d & d & a & b & c
\end{array}$$

49.
$$\begin{array}{c|cccc}
\circ & a & b & c & d \\
\hline
a & a & b & c & d \\
b & b & a & d & c \\
c & c & d & a & b \\
d & d & c & b & a
\end{array}$$

50.
$$\begin{array}{c|cccc}
\circ & a & b & c & d \\
\hline
a & a & b & c & d \\
b & b & c & d & a \\
c & c & d & a & b \\
d & d & a & b & c
\end{array}$$

51.
$$\begin{array}{c|cccc}
\circ & a & b & c & d \\
\hline
a & a & b & c & d \\
b & b & a & c & d \\
c & c & b & a & d \\
d & d & d & b & c
\end{array}$$

52.
$$\begin{array}{c|cccc}
\cdot & 1 & 5 & 7 & 11 \\
\hline
1 & 1 & 5 & 7 & 11 \\
5 & 5 & 1 & 11 & 7 \\
7 & 7 & 11 & 1 & 5 \\
11 & 11 & 7 & 5 & 1
\end{array}$$

53. $\begin{pmatrix} 1 & x & y \\ 0 & 1 & z \\ 0 & 0 & 1 \end{pmatrix}$

54. $\begin{pmatrix} 1 & x & y \\ 0 & 1 & z \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & x' & y' \\ 0 & 1 & z' \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & x + x' & y + y' + xz' \\ 0 & 1 & z + z' \\ 0 & 0 & 1 \end{pmatrix}$

55. $\sigma = \begin{pmatrix} 1 & 2 & \cdots & n \\ a_1 & a_2 & \cdots & a_n \end{pmatrix}$

56. $H_2 = \{\mathrm{id}, \rho_1, \rho_2\}$

57. $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$

58. $G = \{a + b\sqrt{2} : a, b \in \mathbb{Q} \text{ and } a \text{ and } b \text{ are not both zero}\}$

59. $H = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} : a + d = 0 \right\}$

60. $(d_1, d_2, \ldots, d_{10}) \cdot (10, 9, \ldots, 1) \equiv 0 \pmod{11}$

61. $6.00000 + 0.00000i$

62. $\langle a \rangle = \{a^k : k \in \mathbb{Z}\}$

63. $z^{-1} = \dfrac{a - bi}{a^2 + b^2}$

64. $\overline{z} = a - bi$

65. $z = \operatorname{cis}\left(\dfrac{2k\pi}{n}\right)$

66. $*$

67. $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \qquad \text{and} \qquad B = \begin{pmatrix} 0 & -1 \\ 1 & -1 \end{pmatrix}$

68. $$\begin{array}{c|cccc} \circ & \text{id} & \sigma & \tau & \mu \\ \hline \text{id} & \text{id} & \sigma & \tau & \mu \\ \sigma & \sigma & \text{id} & \mu & \tau \\ \tau & \tau & \mu & \text{id} & \sigma \\ \mu & \mu & \tau & \sigma & \text{id} \end{array}$$

69. $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 6 & 3 & 5 & 1 & 4 & 2 & 7 \end{pmatrix} = (162354)$

70. $\tau = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 4 & 2 & 3 & 5 & 6 \end{pmatrix} = (243)$

71. $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 1 & 3 & 6 & 5 \end{pmatrix} = (1243)(56)$

72. $1 \mapsto 3, \qquad 3 \mapsto 5, \qquad 5 \mapsto 2, \qquad 2 \mapsto 1$

73. $(16)(253) = (16)(23)(25) = (16)(45)(23)(45)(25)$

74. $\lambda_\sigma : A_n \to B_n$

75. $\text{id}, \dfrac{360^\circ}{n}, 2 \cdot \dfrac{360^\circ}{n}, \ldots, (n-1) \cdot \dfrac{360^\circ}{n}$

76. $D_n = \{1, r, r^2, \ldots, r^{n-1}, s, sr, sr^2, \ldots, sr^{n-1}\}$

77. $Z(G) = \{g \in G : gx = xg \text{ for all } x \in G\}$

78. $\mathcal{O}_{x,\sigma} = \{y : x \sim y\}$

79. $\phi : \mathcal{L}_H \to \mathcal{R}_H$

80. $[G : K] = \dfrac{|G|}{|K|} = \dfrac{|G|}{|H|} \cdot \dfrac{|H|}{|K|} = [G : H][H : K]$

81. $(1), (123), (132), (243), (243)^{-1} = (234), (142), (142)^{-1} = (124)$

82. $p \nmid a$

83. $\phi(n) = n\left(1 - \dfrac{1}{p_1}\right)\left(1 - \dfrac{1}{p_2}\right)\cdots\left(1 - \dfrac{1}{p_k}\right)$

84. $\mathbf{b} = (2, 2)^{\mathrm{t}}$

85. $\mathrm{A} = 00, \mathrm{B} = 02, \ldots, \mathrm{Z} = 25$

86. $169^{191} \bmod 667 = 25$

87. $y^D = x^{km+1} = x^{km}x = (1+tq)x = x + tq(rp) = x + trn = x \bmod n$

88. $n = 3551, E = 629, x = 31$

89. $2^{15-1} \equiv 2^{14} \equiv 4 \pmod{15}$

90. $(x_1, x_2, \ldots, x_n) \mapsto (x_1, x_2, \ldots, x_n, x_1, x_2, \ldots, x_n, x_1, x_2, \ldots, x_n)$

91. $(0.999)^{10,000} \approx 0.00005$

92. $\binom{n}{k} q^k p^{n-k}$

93. $\binom{n}{1} qp^{n-1} = 500(0.005)(0.995)^{499} \approx 0.204$

94. $\binom{n}{2} q^2 p^{n-2} = \frac{500 \cdot 499}{2}(0.005)^2(0.995)^{498} \approx 0.257$

95. $H \in \mathbb{M}_{m \times n}(\mathbb{Z}_2)$

96. $H\mathbf{x} = \mathbf{0}$

97. $\mathrm{Null}(H)$

98. $\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1,n-m} \\ a_{21} & a_{22} & \cdots & a_{2,n-m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{m,n-m} \end{pmatrix}$

99. $G = \left(\frac{I_{n-m}}{A} \right)$

100. $G = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}$

101. $\mathbf{x} = (x_1, x_2, x_3, x_4, x_5, x_6)$

102. $\begin{array}{cccc} (000000) & (001101) & (010110) & (011011) \\ (100011) & (101110) & (110101) & (111000). \end{array}$

103. $\delta_{ij} = \begin{cases} 1 & i = j \\ 0 & i \neq j \end{cases}$

104. $\begin{pmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$

105. $H\mathbf{x} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, H\mathbf{y} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}, H\mathbf{z} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$

106. $\begin{pmatrix} 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 \end{pmatrix}$

107. $G = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 0 \\ 1 & 1 \\ 0 & 1 \\ 1 & 1 \end{pmatrix}$

108. $C^{\perp} = \{\mathbf{x} \in \mathbb{Z}_2^n : \mathbf{x} \cdot \mathbf{y} = 0 \text{ for all } \mathbf{y} \in C\}$

109. $2^k \left(\binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \cdots + \binom{n}{\frac{d-1}{2}} \right) = 2^n$

110. $\phi(a \cdot b) = \phi(a) \circ \phi(b)$

111. $G \cong H$

112. $\begin{array}{c|ccc} + & 0 & 1 & 2 \\ \hline 0 & 0 & 1 & 2 \\ 1 & 1 & 2 & 0 \\ 2 & 2 & 0 & 1 \end{array}$

113. $\prod_{i=1}^{n} G_i = G_1 \times G_2 \times \cdots \times G_n$

114. $\prod G_i$

115. $\underbrace{(a, b) + (a, b) + \cdots + (a, b)}_{mn/d \text{ times}} = (0, 0)$

116. $\mathbb{Z}_{p_1^{e_1}} \times \cdots \times \mathbb{Z}_{p_k^{e_k}}$

117. $a * b = a + b + ab$

118. $A = \begin{pmatrix} \omega & 0 \\ 0 & \omega^{-1} \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

119. $\begin{pmatrix} \pm 1 & k \\ 0 & 1 \end{pmatrix}$

120. $\operatorname{Inn}(G) = \operatorname{Aut}(G)$

121. $g \mapsto \rho_g$

122. $G \times H \cong \overline{G} \times \overline{H}$

123. $\langle m \rangle \cap \langle n \rangle = \langle l \rangle$

124. $\{z^i y^j \mid 0 \leq i < p, 0 \leq j < 2\}$

125. $\begin{array}{c|cc} & N & (12)N \\ \hline N & N & (12)N \\ (12)N & (12)N & N \end{array}$

126. $\begin{array}{c|ccc} + & 0+3\mathbb{Z} & 1+3\mathbb{Z} & 2+3\mathbb{Z} \\ \hline 0+3\mathbb{Z} & 0+3\mathbb{Z} & 1+3\mathbb{Z} & 2+3\mathbb{Z} \\ 1+3\mathbb{Z} & 1+3\mathbb{Z} & 2+3\mathbb{Z} & 0+3\mathbb{Z} \\ 2+3\mathbb{Z} & 2+3\mathbb{Z} & 0+3\mathbb{Z} & 1+3\mathbb{Z} \end{array}$

127. $[(ij)(ak)](ija)^2[(ij)(ak)]^{-1} = (ijk)$

128. $\sigma^{-1}(a_1a_2a_4)\sigma(a_1a_2a_4)^{-1} \in N$

129. $(a_1a_2a_4)\sigma(a_1a_2a_4)^{-1} \in N$

130. $\ker\phi = SL_2(\mathbb{R})$

131. $\eta(g_1K) = \psi(g_1) = \psi(g_1)\psi(k) = \psi(g_1k) = \psi(g_2) = \eta(g_2K)$

132. $\mathbb{Z}/\ker\phi = \mathbb{Z}/m\mathbb{Z} \cong G$

133. $(hn)^{-1} = n^{-1}h^{-1} = h^{-1}(hn^{-1}h^{-1})$

134. $G \to G/N \to \dfrac{G/N}{H/N}$

135. $\begin{pmatrix} 3/5 & -4/5 \\ 4/5 & 3/5 \end{pmatrix}, \quad \begin{pmatrix} 1/2 & -\sqrt{3}/2 \\ \sqrt{3}/2 & 1/2 \end{pmatrix}, \quad \begin{pmatrix} -1/\sqrt{2} & 0 & 1/\sqrt{2} \\ 1/\sqrt{6} & -2/\sqrt{6} & 1/\sqrt{6} \\ 1/\sqrt{3} & 1/\sqrt{3} & 1/\sqrt{3} \end{pmatrix}$

136. $\|\mathbf{x}\| = \sqrt{\langle \mathbf{x}, \mathbf{x} \rangle} = \sqrt{x_1^2 + \cdots + x_n^2}$

137. $\langle A\mathbf{x}, A\mathbf{y} \rangle = \langle \mathbf{x}, \mathbf{y} \rangle$

138. $(2) \Rightarrow (3)$

139. $\langle \mathbf{x}, \mathbf{y} \rangle = \dfrac{1}{2}\left[\|\mathbf{x}+\mathbf{y}\|^2 - \|\mathbf{x}\|^2 - \|\mathbf{y}\|^2\right]$

140. $T_\phi = \begin{pmatrix} \cos\phi & -\sin\phi \\ \sin\phi & \cos\phi \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} \cos\phi & \sin\phi \\ \sin\phi & -\cos\phi \end{pmatrix}$

141. $\begin{pmatrix} 4/\sqrt{5} & 0 & 3/\sqrt{5} \\ -3/\sqrt{5} & 0 & 4/\sqrt{5} \\ 0 & -1 & 0 \end{pmatrix}$

142. $E(n) = \{(A, \mathbf{x}) : A \in O(n) \text{ and } \mathbf{x} \in \mathbb{R}^n\}$

143. $G = H_n \supset H_{n-1} \supset \cdots \supset H_1 \supset H_0 = \{e\}$

144. $\mathbb{Z}_{p_1^{\alpha_1}} \times \cdots \times \mathbb{Z}_{p_n^{\alpha_n}}$

145. $\{g_i \in G : i \in I\}$

146. $g^{-1} = (g_{i_1}^{k_1} \cdots g_{i_n}^{k_n})^{-1} = (g_{i_n}^{-k_n} \cdots g_{i_1}^{-k_1})$

147. $(gh)^{p_i^t} = g^{p_i^t}h^{p_i^t} = 1 \cdot 1 = 1$

148. $|g| = p_1^{\beta_1}p_2^{\beta_2} \cdots p_k^{\beta_k}$

149. $g = g^{a_1b_1 + \cdots + a_kb_k} = g^{a_1b_1} \cdots g^{a_kb_k}$

150. $g^{(a_ib_i)p_i^{\beta_i}} = g^{b_i|g|} = e$

151. $G^{(0)} = G \supset G^{(1)} \supset G^{(2)} \supset \cdots$

152. $Z_3 \rtimes Z_4$

153. $\phi(ab) = gabg^{-1} = gag^{-1}gbg^{-1} = \phi(a)\phi(b)$

154. $\displaystyle\sum_{y \in \mathcal{O}_x} |G_y| = |\mathcal{O}_x| \cdot |G_x|$

155. $|\widetilde{X}_{(13)(24)}| = 2^2 = 4$

156. $|\mathcal{S}| = |\text{orbit of } P| = [G : N(P)]$

157. $q \not\equiv 1 \pmod{p}$

158. $p \nmid \dbinom{p^k m}{p^k}$

159. $44\,352\,000$

160. $\begin{pmatrix} \alpha & \beta \\ -\overline{\beta} & \overline{\alpha} \end{pmatrix}$

161. $(a_1 + b_1\mathbf{i} + c_1\mathbf{j} + d_1\mathbf{k})(a_2 + b_2\mathbf{i} + c_2\mathbf{j} + d_2\mathbf{k}) = \alpha + \beta\mathbf{i} + \gamma\mathbf{j} + \delta\mathbf{k}$

162. $T = \left\{ \begin{pmatrix} a & b \\ 0 & c \end{pmatrix} : a, b, c \in \mathbb{R} \right\}$

163. $A = \begin{pmatrix} a & b \\ 0 & c \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} a' & b' \\ 0 & c' \end{pmatrix}$

164. $F = \left\{ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \right\}$

165. $\dfrac{a}{a^2 - 2b^2} + \dfrac{-b}{a^2 - 2b^2}\sqrt{2}$

166. $R/I \cong \dfrac{R/J}{I/J}$

167. $\left\{ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}, \right\}$

168. $f(x) = \displaystyle\sum_{i=0}^{n} a_i x^i = a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n$

169. $c_i = \displaystyle\sum_{k=0}^{i} a_k b_{i-k} = a_0 b_i + a_1 b_{i-1} + \cdots + a_{i-1} b_1 + a_i b_0$

170. $p(x) = \dfrac{b_0}{c_0} + \dfrac{b_1}{c_1} x + \cdots + \dfrac{b_n}{c_n} x^n$

171. $p(x) = \alpha(x)\beta(x) = \dfrac{c_1 c_2}{d_1 d_2} \alpha_1(x)\beta_1(x) = \dfrac{c}{d}\alpha_1(x)\beta_1(x)$

172. $\omega^i \sqrt[3]{-\dfrac{q}{2} + \sqrt{\dfrac{p^3}{27} + \dfrac{q^2}{4}}} + \omega^{2i} \sqrt[3]{-\dfrac{q}{2} - \sqrt{\dfrac{p^3}{27} + \dfrac{q^2}{4}}}$

173. $D[x]$

174. $c_{r+s} = a_0 b_{r+s} + a_1 b_{r+s-1} + \cdots + a_{r+s-1} b_1 + a_{r+s} b_0$

175. $O \preceq \cdots \preceq b_3 \preceq b_2 \preceq b_1 \preceq b$

176. $a \npreceq c$

177. $a = a \wedge b = a \wedge (a_1 \vee \cdots \vee a_n) = (a \wedge a_1) \vee \cdots \vee (a \wedge a_n)$

178. $(a \wedge b') \vee (a' \wedge b) = O \Rightarrow a \vee b = (a \vee a) \vee b = a \vee (a \vee b) = a \vee [I \wedge (a \vee b)] = a \vee [(a \vee a') \wedge (a \vee b)] = [a \vee (a \wedge b')] \vee [a \vee (a' \wedge b)] = a \vee [(a \wedge b') \vee (a' \wedge b)] = a \vee 0 = a$

179. $u + v = (u_1, \ldots, u_n) + (v_1, \ldots, v_n) = (u_1 + v_1, \ldots, u_n + v_n)$

180. $u + v = (\alpha_1 + \beta_1)v_1 + (\alpha_2 + \beta_2)v_2 + \cdots + (\alpha_n + \beta_n)v_n$

181. $v_k = -\dfrac{\alpha_1}{\alpha_k}v_1 - \cdots - \dfrac{\alpha_{k-1}}{\alpha_k}v_{k-1} - \dfrac{\alpha_{k+1}}{\alpha_k}v_{k+1} - \cdots - \dfrac{\alpha_n}{\alpha_k}v_n$

182. $E = \mathbb{Z}_2[x]/\langle x^2 + x + 1\rangle$

183.

$+$	0	1	α	$1+\alpha$
0	0	1	α	$1+\alpha$
1	1	0	$1+\alpha$	α
α	α	$1+\alpha$	0	1
$1+\alpha$	$1+\alpha$	α	1	0

184.

$\cdot$	0	1	α	$1+\alpha$
0	0	0	0	0
1	0	1	α	$1+\alpha$
α	0	α	$1+\alpha$	1
$1+\alpha$	0	$1+\alpha$	1	α

185. $\{1, \sqrt{5}\, i, \sqrt[3]{5}, (\sqrt[3]{5}\,)^2, (\sqrt[6]{5}\,)^5 i, (\sqrt[6]{5}\,)^7 i = 5\sqrt[6]{5}\, i$ or $\sqrt[6]{5}\, i\}$

186. $0 = f(\beta) = f\left(\dfrac{p(\alpha)}{q(\alpha)}\right) = a_0 + a_1\left(\dfrac{p(\alpha)}{q(\alpha)}\right) + \cdots + a_n\left(\dfrac{p(\alpha)}{q(\alpha)}\right)^n$

187. $(a+b)^p = \displaystyle\sum_{k=0}^{p} \binom{p}{k} a^k b^{p-k}$

188. $(a+b)^{p^{n+1}} = ((a+b)^p)^{p^n} = (a^p + b^p)^{p^n} = (a^p)^{p^n} + (b^p)^{p^n} = a^{p^{n+1}} + b^{p^{n+1}}$

189. $G_1 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad \text{and} \quad G_2 = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$

190.
$$\begin{array}{ccccccc} (000) & \mapsto & (000000) & \qquad & (100) & \mapsto & (100100) \\ (001) & \mapsto & (001001) & & (101) & \mapsto & (101101) \\ (010) & \mapsto & (010010) & & (110) & \mapsto & (110110) \\ (011) & \mapsto & (011011) & & (111) & \mapsto & (111111). \end{array}$$

191.
$$\begin{array}{ccccccc} (000) & \mapsto & (000000) & \qquad & (100) & \mapsto & (111100) \\ (001) & \mapsto & (001111) & & (101) & \mapsto & (110011) \\ (010) & \mapsto & (011110) & & (110) & \mapsto & (100010) \\ (011) & \mapsto & (010001) & & (111) & \mapsto & (101101). \end{array}$$

192. $G = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

193. $G = \begin{pmatrix} g_0 & 0 & \cdots & 0 \\ g_1 & g_0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ g_{n-k} & g_{n-k-1} & \cdots & g_0 \\ 0 & g_{n-k} & \cdots & g_1 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & g_{n-k} \end{pmatrix}$

194. $H = \begin{pmatrix} 0 & \cdots & 0 & 0 & h_k & \cdots & h_0 \\ 0 & \cdots & 0 & h_k & \cdots & h_0 & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ h_k & \cdots & h_0 & 0 & 0 & \cdots & 0 \end{pmatrix}$

195. $\det \begin{pmatrix} 1 & 1 & \cdots & 1 \\ \alpha_1 & \alpha_2 & \cdots & \alpha_n \\ \alpha_1^2 & \alpha_2^2 & \cdots & \alpha_n^2 \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_1^{n-1} & \alpha_2^{n-1} & \cdots & \alpha_n^{n-1} \end{pmatrix} = \prod_{1 \leq j < i \leq n} (\alpha_i - \alpha_j)$

196. $p(x) = \det \begin{pmatrix} 1 & 1 & \cdots & 1 & 1 \\ \alpha_1 & \alpha_2 & \cdots & \alpha_{n-1} & x \\ \alpha_1^2 & \alpha_2^2 & \cdots & \alpha_{n-1}^2 & x^2 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ \alpha_1^{n-1} & \alpha_2^{n-1} & \cdots & \alpha_{n-1}^{n-1} & x^{n-1} \end{pmatrix}$

197. $\beta = (-1)^{n+n} \det \begin{pmatrix} 1 & 1 & \cdots & 1 \\ \alpha_1 & \alpha_2 & \cdots & \alpha_{n-1} \\ \alpha_1^2 & \alpha_2^2 & \cdots & \alpha_{n-1}^2 \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_1^{n-2} & \alpha_2^{n-2} & \cdots & \alpha_{n-1}^{n-2} \end{pmatrix}$

198. $\beta = (-1)^{n+n} \prod_{1 \leq j < i \leq n-1} (\alpha_i - \alpha_j)$

199. $\begin{pmatrix} (\omega^{i_0})^r & (\omega^{i_1})^r & \cdots & (\omega^{i_{s-1}})^r \\ (\omega^{i_0})^{r+1} & (\omega^{i_1})^{r+1} & \cdots & (\omega^{i_{s-1}})^{r+1} \\ \vdots & \vdots & \ddots & \vdots \\ (\omega^{i_0})^{r+s-1} & (\omega^{i_1})^{r+s-1} & \cdots & (\omega^{i_{s-1}})^{r+s-1} \end{pmatrix}$

200. $H = \begin{pmatrix} 1 & \omega & \omega^2 & \cdots & \omega^{n-1} \\ 1 & \omega^2 & \omega^4 & \cdots & \omega^{(n-1)(2)} \\ 1 & \omega^3 & \omega^6 & \cdots & \omega^{(n-1)(3)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & \omega^{2r} & \omega^{4r} & \cdots & \omega^{(n-1)(2r)} \end{pmatrix}$

201. $$H\mathbf{x} = \begin{pmatrix} a_0 + a_1\omega + \cdots + a_{n-1}\omega^{n-1} \\ a_0 + a_1\omega^2 + \cdots + a_{n-1}(\omega^2)^{n-1} \\ \vdots \\ a_0 + a_1\omega^{2r} + \cdots + a_{n-1}(\omega^{2r})^{n-1} \end{pmatrix} = \begin{pmatrix} f(\omega) \\ f(\omega^2) \\ \vdots \\ f(\omega^{2r}) \end{pmatrix} = 0$$