

3

Subgraphs ($v \leq 7$)

Edge Posets & Vertex Deletions

(Thanks to Peter Adams, Roger Eggleton, James MacDougall, and Ebad Mahmoodian, Chapter 3 has been corrected in this Second Revised Edition of 2004.)

Edge Posets

Given a simple graph, what other graphs can be obtained by the addition or deletion of an edge? Such a question generates a poset (partially ordered set) of graphs, a structure that associates objects by virtue of an operation.

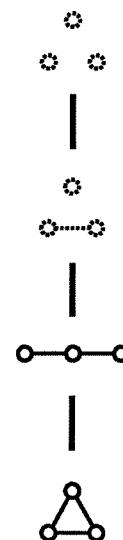
A poset of graphs can be diagrammed by a GRAPH of graphs, in which the VERTICES of the GRAPH are simple graphs, and an EDGE connects two graphs if one is obtained from the other by adding or deleting an edge. Using the diagram, one may discover a chain of edge additions and/or deletions that transforms one graph into another.

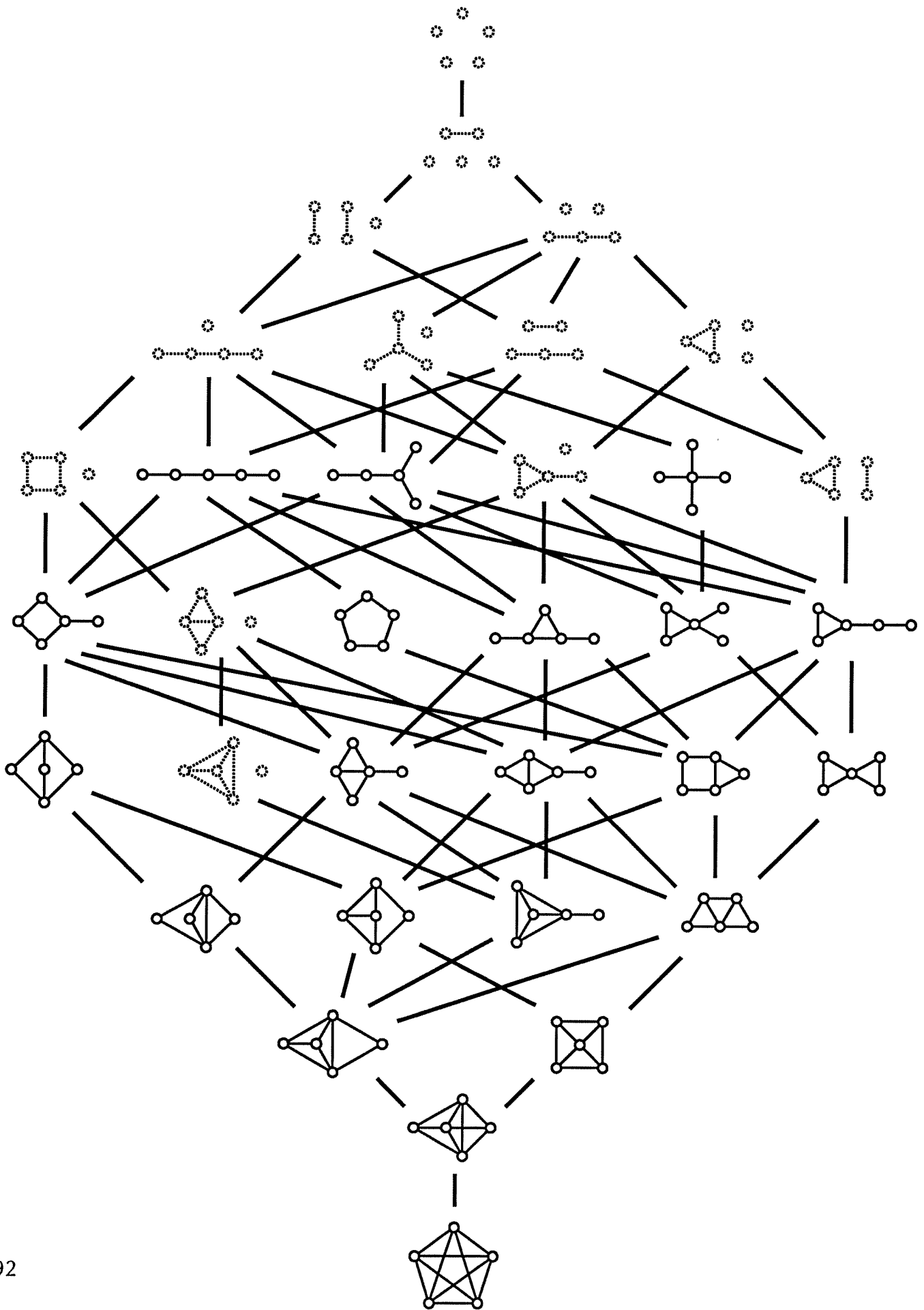
Poset diagrams are shown here only up to five vertices. Up to seven vertices, graphs are listed by the identification numbers given in Chapter 2. To the left and right of each number are listed the ID numbers of that graph's edge-deleted subgraphs and edge-added supergraphs. Multiple occurrences of subgraphs and supergraphs are not shown.

$v = 2$



$v = 3$





v = 5

1 → 2

1 → **2** → 3, 4

2 → **3** → 5, 6, 7, 8

2 → **4** → 7, 8

3 → **5** → 9, 13

3 → **6** → 9, 11, 12

3, 4 → **7** → 9, 10, 12, 14

3, 4 → **8** → 12, 13, 14

5, 6, 7 → **9** → 15, 16, 19, 20

7 → **10** → 15, 18

6 → **11** → 20

6, 7, 8 → **12** → 16, 18, 19, 20

5, 8 → **13** → 16

7, 8 → **14** → 16, 17, 18, 19

9, 10 → **15** → 23, 24, 26

9, 12, 13, 14 → **16** → 21, 23, 25

14 → **17** → 21

10, 12, 14 → **18** → 21, 22, 23, 26

9, 12, 14 → **19** → 21, 23, 26

9, 11, 12 → **20** → 25, 26

16, 17, 18, 19 → **21** → 27, 28

18 → **22** → 27, 30

15, 16, 18, 19 → **23** → 27, 28, 29

15 → **24** → 29

16, 20 → **25** → 28

15, 18, 19, 20 → **26** → 28, 29, 30

21, 22, 23 → **27** → 31, 32

21, 23, 25, 26 → **28** → 31, 32

23, 24, 26 → **29** → 32

22, 26 → **30** → 32

27, 28 → **31** → 33

27, 28, 29, 30 → **32** → 33

31, 32 → **33** → 34

33 → **34**

v = 6

| | | |
|--|--|--------------|
| | 1 → 2 | e = 0 |
| | 1 → 2 → 3, 4 | e = 1 |
| | 2 → 3 → 5, 6, 7, 8 | e = 2 |
| | 2 → 4 → 7, 8, 9 | |
| | 3 → 5 → 10, 15 | e = 3 |
| | 3 → 6 → 10, 12, 13, 16 | |
| | 3, 4 → 7 → 10, 11, 13, 14, 17 | |
| | 3, 4 → 8 → 13, 14, 15, 16, 17, 18 | |
| | 4 → 9 → 17 | |
| | 5, 6, 7 → 10 → 19, 20, 21, 22, 28 | e = 4 |
| | 7 → 11 → 19, 23, 32 | |
| | 6 → 12 → 20, 25, 26 | |
| | 6, 7, 8 → 13 → 20, 21, 22, 23, 26, 27, 29, 30 | |
| | 7, 8 → 14 → 21, 22, 23, 24, 29, 30, 33 | |
| | 5, 8 → 15 → 22, 28, 31 | |
| | 6, 8 → 16 → 26, 28, 29 | |
| | 7, 8, 9 → 17 → 28, 30, 32, 33 | |
| | 8 → 18 → 27, 29, 31, 33 | |
| | 10, 11 → 19 → 34, 35, 36, 45 | e = 5 |
| | 10, 12, 13 → 20 → 35, 37, 40, 41, 43 | |
| | 10, 13, 14 → 21 → 35, 36, 38, 41, 42, 46 | |
| | 10, 13, 14, 15 → 22 → 36, 37, 38, 43, 46, 47, 50 | |
| | 11, 13, 14 → 23 → 35, 36, 38, 39, 44, 48, 49, 51 | |
| | 14 → 24 → 38, 52 | |
| | 12 → 25 → 40 | |
| | 12, 13, 16 → 26 → 40, 41, 43, 44 | |
| | 13, 18 → 27 → 41, 47, 48 | |
| | 10, 15, 16, 17 → 28 → 43, 45, 46, 50 | |
| | 13, 14, 16, 18 → 29 → 41, 44, 46, 47, 49, 50, 52 | |
| | 13, 14, 17 → 30 → 42, 43, 46, 48, 51, 52 | |
| | 15, 18 → 31 → 47, 50, 53 | |
| | 11, 17 → 32 → 45, 51 | |
| | 14, 17, 18 → 33 → 46, 48, 50, 51, 52, 54 | |
| | 19 → 34 → 55, 63 | e = 6 |
| | 19, 20, 21, 23 → 35 → 55, 56, 57, 59, 60, 61, 67 | |
| | 19, 21, 22, 23 → 36 → 55, 57, 58, 61, 62, 64, 70 | |
| | 20, 22 → 37 → 57, 65, 66 | |
| | 21, 22, 23, 24 → 38 → 57, 58, 68, 71, 72 | |
| | 23 → 39 → 56, 58, 69, 73 | |
| | 20, 25, 26 → 40 → 59, 65 | |
| | 20, 21, 26, 27, 29 → 41 → 59, 60, 61, 62, 66, 68 | |
| | 21, 30 → 42 → 61, 71 | |
| | 20, 22, 26, 28, 30 → 43 → 61, 65, 66, 67, 68, 74 | |
| | 23, 26, 29 → 44 → 59, 62, 68, 69, 74 | |
| | 19, 28, 32 → 45 → 63, 67, 70 | |
| | 21, 22, 28, 29, 30, 33 → 46 → 61, 64, 66, 67, 68, 70, 71, 72, 77 | |
| | 22, 27, 29, 31 → 47 → 62, 66, 72, 75 | |
| | 23, 27, 30, 33 → 48 → 61, 68, 72, 73, 76 | |
| | 23, 29 → 49 → 60, 64, 69, 72, 78 | |
| | 22, 28, 29, 31, 33 → 50 → 66, 70, 72, 74, 75, 77 | |
| | 23, 30, 32, 33 → 51 → 67, 70, 71, 73, 74, 76, 78 | |
| | 24, 29, 30, 33 → 52 → 68, 71, 72, 77, 78 | |
| | 31 → 53 → 75 | |
| | 33 → 54 → 76, 77 | |

v = 6

34, 35, 36 → **55** → 88, 97, 98, 101
35, 39 → **56** → 95, 98, 102
35, 36, 37, 38 → **57** → 89, 92, 96, 98, 100
36, 38, 39 → **58** → 83, 90, 91, 92, 98
35, 40, 41, 44 → **59** → 99, 100, 101, 102
35, 41, 49 → **60** → 93, 96, 97, 102
35, 36, 41, 42, 43, 46, 48 → **61** → 85, 89, 91, 95, 96, 97, 100
36, 41, 44, 47 → **62** → 84, 90, 96, 101
34, 45 → **63** → 88
36, 46, 49 → **64** → 79, 89, 90, 97
37, 40, 43 → **65** → 99, 100
37, 41, 43, 46, 47, 50 → **66** → 84, 86, 89, 96, 99
35, 43, 45, 46, 51 → **67** → 85, 88, 89, 93, 95, 99
38, 41, 43, 44, 46, 48, 52 → **68** → 85, 86, 87, 90, 91, 93, 96, 100
39, 44, 49 → **69** → 87, 90, 94, 102
36, 45, 46, 50, 51 → **70** → 79, 83, 84, 85, 88, 89
38, 42, 46, 51, 52 → **71** → 80, 85, 89, 91
38, 46, 47, 48, 49, 50, 52 → **72** → 80, 81, 83, 86, 87, 89, 90, 96
39, 48, 51 → **73** → 82, 83, 87, 91, 95
43, 44, 50, 51 → **74** → 84, 85, 87, 99
47, 50, 53 → **75** → 81, 84
48, 51, 54 → **76** → 80, 82, 85
46, 50, 52, 54 → **77** → 79, 80, 81, 85, 86
49, 51, 52 → **78** → 79, 80, 87, 93

e = 7

64, 70, 77, 78 → **79** → 105, 106, 108
71, 72, 76, 77, 78 → **80** → 103, 105, 107, 111
72, 75, 77 → **81** → 103, 106, 109
73, 76 → **82** → 104, 107, 110
58, 70, 72, 73 → **83** → 106, 107, 113, 114
62, 66, 70, 74, 75 → **84** → 106, 109, 118
61, 67, 68, 70, 71, 74, 76, 77 → **85** → 105, 107, 108, 109, 110, 111, 119
66, 68, 72, 77 → **86** → 105, 106, 111, 115, 119
68, 69, 72, 73, 74, 78 → **87** → 106, 107, 111, 112, 121
55, 63, 67, 70 → **88** → 108, 113, 118
57, 61, 64, 66, 67, 70, 71, 72 → **89** → 105, 109, 111, 113, 114, 116, 119
58, 62, 64, 68, 69, 72 → **90** → 106, 111, 112, 114, 122
58, 61, 68, 71, 73 → **91** → 107, 110, 111, 114, 116, 120
57, 58 → **92** → 114, 117, 120
60, 67, 68, 78 → **93** → 108, 111, 121
69 → **94** → 112, 123
56, 61, 67, 73 → **95** → 110, 113, 116, 121
57, 60, 61, 62, 66, 68, 72 → **96** → 109, 111, 114, 115, 116, 121, 122
55, 60, 61, 64 → **97** → 108, 116, 122
55, 56, 57, 58 → **98** → 113, 116, 117, 122
59, 65, 66, 67, 74 → **99** → 118, 119, 121
57, 59, 61, 65, 68 → **100** → 119, 120, 121, 122
55, 59, 62 → **101** → 118, 122
56, 59, 60, 69 → **102** → 121, 122, 123

e = 8

v = 6

80, 81 → **103** → 124
82 → **104** → 126
79, 80, 85, 86, 89 → **105** → 124, 127, 128, 133
79, 81, 83, 84, 86, 87, 90 → **106** → 124, 125, 127, 134
80, 82, 83, 85, 87, 91 → **107** → 124, 126, 128, 129, 135
79, 85, 88, 93, 97 → **108** → 128, 134
81, 84, 85, 89, 96 → **109** → 124, 127, 130, 134
82, 85, 91, 95 → **110** → 126, 128, 130, 135
80, 85, 86, 87, 89, 90, 91, 93, 96 → **111** → 124, 127, 128, 129, 135, 136
87, 90, 94 → **112** → 125, 129, 138
83, 88, 89, 95, 98 → **113** → 128, 131, 134
83, 89, 90, 91, 92, 96 → **114** → 127, 129, 131, 135, 137
86, 96 → **115** → 127, 136
89, 91, 95, 96, 97, 98 → **116** → 128, 130, 131, 136, 137
92, 98 → **117** → 131, 132, 137
84, 88, 99, 101 → **118** → 134
85, 86, 89, 99, 100 → **119** → 133, 134, 135, 136
91, 92, 100 → **120** → 135, 137
87, 93, 95, 96, 99, 100, 102 → **121** → 134, 135, 136, 138
90, 96, 97, 98, 100, 101, 102 → **122** → 134, 136, 137, 138
94, 102 → **123** → 138

e = 9

103, 105, 106, 107, 109, 111 → **124** → 139, 140, 143
106, 112 → **125** → 140, 146
104, 107, 110 → **126** → 139, 142
105, 106, 109, 111, 114, 115 → **127** → 140, 143, 144
105, 107, 108, 110, 111, 113, 116 → **128** → 139, 141, 143, 144
107, 111, 112, 114 → **129** → 140, 141, 142, 147
109, 110, 116 → **130** → 139, 144
113, 114, 116, 117 → **131** → 141, 144, 145
117 → **132** → 145
105, 119 → **133** → 143
106, 108, 109, 113, 118, 119, 121, 122 → **134** → 143, 144, 146
107, 110, 111, 114, 119, 120, 121 → **135** → 142, 143, 144, 147
111, 115, 116, 119, 121, 122 → **136** → 143, 144, 147
114, 116, 117, 120, 122 → **137** → 144, 145, 147
112, 121, 122, 123 → **138** → 146, 147

e = 10

124, 126, 128, 130 → **139** → 149
124, 125, 127, 129 → **140** → 148, 149, 150
128, 129, 131 → **141** → 149, 151
126, 129, 135 → **142** → 149, 152
124, 127, 128, 133, 134, 135, 136 → **143** → 149, 150
127, 128, 130, 131, 134, 135, 136, 137 → **144** → 149, 150, 151
131, 132, 137 → **145** → 151
125, 134, 138 → **146** → 150
129, 135, 136, 137, 138 → **147** → 150, 151, 152

e = 11

140 → **148** → 153
139, 140, 141, 142, 143, 144 → **149** → 153, 154
140, 143, 144, 146, 147 → **150** → 153, 154
141, 144, 145, 147 → **151** → 154
142, 147 → **152** → 154

e = 12

148, 149, 150 → **153** → 155
149, 150, 151, 152 → **154** → 155

e = 13

153, 154 → **155** → 156

e = 14

155 → **156**

e = 15

v = 7

| | |
|---|--------------|
| 1 → 2 | e = 0 |
| 1 → 2 → 3, 4 | e = 1 |
| 2 → 3 → 5, 6, 7, 8 2 → 4 → 7, 8, 9 | e = 2 |
| 3 → 5 → 10, 15 3 → 6 → 10, 12, 13, 16 3, 4 → 7 → 10, 11, 13, 14, 17 3, 4 → 8 → 13, 14, 15, 16, 17, 18, 19 4 → 9 → 17, 19 | e = 3 |
| 5, 6, 7 → 10 → 20, 21, 22, 23, 29 7 → 11 → 20, 24, 33 6 → 12 → 21, 26, 27, 35 6, 7, 8 → 13 → 21, 22, 23, 24, 27, 28, 30, 31, 36 7, 8 → 14 → 22, 23, 24, 25, 30, 31, 32, 39 5, 8 → 15 → 23, 29, 34, 38 6, 8 → 16 → 27, 29, 30, 35, 36, 37 7, 8, 9 → 17 → 29, 31, 32, 33, 36, 39, 40 8 → 18 → 28, 30, 32, 34, 37, 40 8, 9 → 19 → 36, 38, 39, 40 | e = 4 |
| 10, 11 → 20 → 41, 42, 43, 52 10, 12, 13 → 21 → 42, 44, 47, 48, 50, 65 10, 13, 14 → 22 → 42, 43, 45, 48, 49, 53, 68 10, 13, 14, 15 → 23 → 43, 44, 45, 50, 53, 54, 57, 71 11, 13, 14 → 24 → 42, 43, 45, 46, 51, 55, 56, 58, 74 14 → 25 → 45, 59, 80 12 → 26 → 47, 62, 63 12, 13, 16 → 27 → 47, 48, 50, 51, 63, 64, 66, 67 13, 18 → 28 → 48, 54, 56, 64, 70 10, 15, 16, 17 → 29 → 50, 52, 53, 57, 65, 68, 71, 72 13, 14, 16, 18 → 30 → 48, 51, 53, 54, 55, 57, 59, 66, 69, 70, 75, 76 13, 14, 17 → 31 → 49, 50, 53, 56, 58, 59, 67, 70, 76, 77 14, 17, 18 → 32 → 53, 56, 57, 58, 59, 60, 75, 76, 81 11, 17 → 33 → 52, 58, 74, 79 15, 18 → 34 → 54, 57, 61, 72, 73, 78 12, 16 → 35 → 63, 65, 66 13, 16, 17, 19 → 36 → 65, 67, 68, 70, 71, 74, 75, 76 16, 18 → 37 → 64, 66, 69, 72, 73, 75 15, 19 → 38 → 71, 78 14, 17, 19 → 39 → 68, 71, 74, 76, 77, 80, 81 17, 18, 19 → 40 → 70, 72, 75, 76, 78, 79, 81 | e = 5 |

v = 7

e = 6

20 → **41** → 82, 91
20, 21, 22, 24 → **42** → 82, 83, 84, 86, 87, 88, 94, 112
20, 22, 23, 24 → **43** → 82, 84, 85, 88, 89, 90, 97, 119
21, 23 → **44** → 84, 92, 93, 123
22, 23, 24, 25 → **45** → 84, 85, 95, 98, 99, 129
24 → **46** → 83, 85, 96, 100, 130
21, 26, 27 → **47** → 86, 92, 106, 107, 110
21, 22, 27, 28, 30 → **48** → 86, 87, 88, 89, 93, 95, 107, 108, 109, 113, 114
22, 31 → **49** → 88, 98, 109, 120
21, 23, 27, 29, 31 → **50** → 88, 92, 93, 94, 95, 101, 110, 114, 115, 124, 125
24, 27, 30 → **51** → 86, 89, 95, 96, 101, 111, 117, 118, 126
20, 29, 33 → **52** → 91, 94, 97, 112, 119, 128
22, 23, 29, 30, 31, 32 → **53** → 88, 90, 93, 94, 95, 97, 98, 99, 104, 113, 114, 120, 121, 131, 132
23, 28, 30, 34 → **54** → 89, 93, 99, 102, 115, 116, 121, 134
24, 30 → **55** → 87, 90, 96, 99, 105, 118, 122, 136
24, 28, 31, 32 → **56** → 88, 95, 99, 100, 103, 117, 122, 135
23, 29, 30, 32, 34 → **57** → 93, 97, 99, 101, 102, 104, 124, 131, 133, 134, 141
24, 31, 32, 33 → **58** → 94, 97, 98, 100, 101, 103, 105, 126, 135, 136, 137, 142
25, 30, 31, 32 → **59** → 95, 98, 99, 104, 105, 127, 138, 139, 143
32 → **60** → 103, 104, 144
34 → **61** → 102, 140
26 → **62** → 106
26, 27, 35 → **63** → 106, 107, 110, 111
27, 28, 37 → **64** → 107, 108, 115, 116, 117
21, 29, 35, 36 → **65** → 110, 112, 113, 123, 124
27, 30, 35, 37 → **66** → 107, 111, 113, 116, 118, 124, 127
27, 31, 36 → **67** → 109, 110, 114, 117, 125, 126, 127
22, 29, 36, 39 → **68** → 112, 114, 119, 120, 129, 131
30, 37 → **69** → 108, 118, 121, 133, 139
28, 30, 31, 36, 40 → **70** → 109, 113, 114, 115, 117, 121, 122, 134, 135, 137, 138
23, 29, 36, 38, 39 → **71** → 119, 123, 125, 129, 132, 134, 141
29, 34, 37, 40 → **72** → 115, 121, 124, 128, 131, 133, 140, 141
34, 37 → **73** → 116, 133, 140
24, 33, 36, 39 → **74** → 112, 119, 126, 129, 130, 135, 136, 142
30, 32, 36, 37, 40 → **75** → 113, 117, 121, 127, 131, 133, 136, 137, 139, 141, 144
30, 31, 32, 36, 39, 40 → **76** → 114, 120, 122, 124, 126, 131, 132, 134, 135, 136, 138, 139, 142, 143, 144
31, 39 → **77** → 120, 125, 135, 143
34, 38, 40 → **78** → 134, 140, 141, 145
33, 40 → **79** → 128, 137, 142, 145
25, 39 → **80** → 129, 143
32, 39, 40 → **81** → 131, 132, 135, 138, 141, 142, 143, 144, 146

v = 7

41, 42, 43 → **82** → 147, 149, 150, 156, 177
42, 46 → **83** → 147, 151, 154, 185
42, 43, 44, 45 → **84** → 147, 148, 152, 153, 155, 190
43, 45, 46 → **85** → 147, 148, 157, 158, 159, 204
42, 47, 48, 51 → **86** → 149, 151, 152, 160, 171, 172, 173, 182
42, 48, 55 → **87** → 150, 151, 153, 161, 172, 175, 187
42, 43, 48, 49, 50, 53, 56 → **88** → 150, 152, 153, 154, 155, 158, 164, 173, 175, 176, 178, 193, 194
43, 48, 51, 54 → **89** → 149, 153, 157, 163, 174, 176, 179, 195
43, 53, 55 → **90** → 150, 155, 157, 170, 178, 179, 206
41, 52 → **91** → 156, 177, 205
44, 47, 50 → **92** → 152, 160, 180, 181, 211
44, 48, 50, 53, 54, 57 → **93** → 153, 155, 160, 163, 165, 181, 186, 191, 192, 214
42, 50, 52, 53, 58 → **94** → 154, 155, 156, 160, 161, 164, 182, 187, 193, 196, 215
45, 48, 50, 51, 53, 56, 59 → **95** → 152, 153, 157, 158, 161, 164, 165, 166, 183, 188, 199, 200, 201, 219
46, 51, 55 → **96** → 151, 157, 162, 166, 184, 189, 203, 221
43, 52, 53, 57, 58 → **97** → 155, 156, 159, 163, 164, 170, 194, 195, 206, 207, 225
45, 49, 53, 58, 59 → **98** → 155, 158, 164, 169, 197, 199, 208, 226
45, 53, 54, 55, 56, 57, 59 → **99** → 153, 155, 157, 159, 165, 166, 167, 169, 198, 200, 201, 208, 209, 227
46, 56, 58 → **100** → 154, 158, 159, 166, 168, 202, 203, 210, 229
50, 51, 57, 58 → **101** → 160, 163, 164, 166, 212, 216, 217, 218
54, 57, 61 → **102** → 163, 167, 213, 224
56, 58, 60 → **103** → 164, 168, 169, 220, 228
53, 57, 59, 60 → **104** → 164, 165, 167, 169, 170, 222, 230, 231, 232
55, 58, 59 → **105** → 161, 166, 169, 170, 223, 233, 234
47, 62, 63 → **106** → 171, 180
47, 48, 63, 64, 66 → **107** → 171, 172, 173, 174, 181, 183
48, 64, 69 → **108** → 172, 176, 186, 188
48, 49, 67, 70 → **109** → 173, 175, 176, 191, 197, 199
47, 50, 63, 65, 67 → **110** → 173, 180, 181, 182, 183, 211, 212
51, 63, 66 → **111** → 171, 174, 183, 184, 212
42, 52, 65, 68, 74 → **112** → 177, 182, 185, 187, 190, 194, 215
48, 53, 65, 66, 70, 75 → **113** → 173, 179, 183, 186, 187, 194, 197, 201, 214, 222
48, 50, 53, 67, 68, 70, 76 → **114** → 175, 178, 181, 182, 187, 188, 192, 193, 195, 199, 200, 216, 219, 222
50, 54, 64, 70, 72 → **115** → 176, 181, 186, 196, 200, 213, 218
54, 64, 66, 73 → **116** → 174, 186, 198, 213
51, 56, 64, 67, 70, 75 → **117** → 173, 176, 183, 188, 198, 200, 202, 203, 218, 220
51, 55, 66, 69 → **118** → 172, 179, 184, 189, 198, 201, 217, 223
43, 52, 68, 71, 74 → **119** → 177, 190, 193, 195, 204, 206, 225
49, 53, 68, 76, 77 → **120** → 178, 191, 193, 194, 199, 208, 226, 230
53, 54, 69, 70, 72, 75 → **121** → 176, 179, 192, 196, 198, 201, 207, 208, 224, 231
55, 56, 70, 76 → **122** → 175, 178, 200, 201, 203, 209, 210, 228, 233
44, 65, 71 → **123** → 190, 211, 214
50, 57, 65, 66, 72, 76 → **124** → 181, 194, 201, 212, 213, 214, 215, 217, 222, 236
50, 67, 71, 77 → **125** → 191, 193, 211, 218, 219, 236
51, 58, 67, 74, 76 → **126** → 182, 195, 199, 203, 212, 216, 219, 220, 221, 223, 235
59, 66, 67, 75 → **127** → 183, 197, 198, 222, 223, 236
52, 72, 79 → **128** → 196, 205, 207, 215, 225, 237
45, 68, 71, 74, 80 → **129** → 190, 204, 219, 226, 227
46, 74 → **130** → 185, 204, 221, 229
53, 57, 68, 72, 75, 76, 81 → **131** → 192, 194, 200, 206, 208, 215, 216, 222, 224, 225, 227, 230, 232, 241
53, 71, 76, 81 → **132** → 193, 206, 209, 214, 219, 226, 231, 241
57, 69, 72, 73, 75 → **133** → 186, 198, 207, 217, 224, 232, 238
54, 57, 70, 71, 76, 78 → **134** → 191, 195, 209, 213, 214, 218, 224, 227, 231, 239
56, 58, 70, 74, 76, 77, 81 → **135** → 193, 194, 199, 208, 210, 218, 219, 220, 227, 228, 229, 233, 240
55, 58, 74, 75, 76 → **136** → 187, 203, 206, 208, 217, 221, 223, 227, 228, 234, 242
58, 70, 75, 79 → **137** → 196, 197, 202, 207, 216, 228, 234, 239
59, 70, 76, 81 → **138** → 199, 200, 209, 222, 231, 233, 234, 240
59, 69, 75, 76 → **139** → 188, 201, 208, 223, 231, 232, 234, 243
61, 72, 73, 78 → **140** → 213, 224, 237, 238
57, 71, 72, 75, 78, 81 → **141** → 214, 218, 224, 225, 227, 231, 236, 238, 239, 241
58, 74, 76, 79, 81 → **142** → 215, 216, 225, 226, 228, 229, 234, 235, 239, 240, 242
59, 76, 77, 80, 81 → **143** → 219, 226, 227, 230, 233, 236, 240, 243
60, 75, 76, 81 → **144** → 220, 222, 228, 230, 231, 232, 241, 242, 243
78, 79 → **145** → 237, 239
81 → **146** → 240, 241

e = 7

- 82, 83, 84, 85 → **147** → 244, 245, 246, 249, 280
 84, 85 → **148** → 244, 247, 248, 249
 82, 86, 89 → **149** → 245, 254, 265, 266, 277
 82, 87, 88, 90 → **150** → 245, 246, 259, 266, 267, 285
 83, 86, 87, 96 → **151** → 245, 250, 251, 268, 269, 273, 297
 84, 86, 88, 92, 95 → **152** → 245, 247, 251, 253, 270, 272, 276, 303
 84, 87, 88, 89, 93, 95, 99 → **153** → 245, 246, 248, 251, 252, 255, 257, 271, 272, 274, 282, 283, 308
 83, 88, 94, 100 → **154** → 246, 249, 251, 256, 273, 275, 284, 309
 84, 88, 90, 93, 94, 97, 98, 99 → **155** → 246, 248, 249, 253, 255, 257, 262, 276, 281, 282, 283, 290, 320
 82, 91, 94, 97 → **156** → 249, 254, 259, 277, 285, 291, 321
 85, 89, 90, 95, 96, 99 → **157** → 245, 248, 257, 258, 260, 279, 286, 287, 293, 329
 85, 88, 95, 98, 100 → **158** → 246, 247, 248, 256, 257, 261, 278, 286, 288, 294, 328
 85, 97, 99, 100 → **159** → 248, 249, 260, 261, 292, 293, 294, 339
 86, 92, 93, 94, 101 → **160** → 251, 253, 254, 295, 296, 300, 301
 87, 94, 95, 105 → **161** → 251, 257, 259, 298, 313, 314
 96 → **162** → 250, 258, 299, 317
 89, 93, 97, 101, 102 → **163** → 254, 255, 260, 302, 307, 318, 319
 88, 94, 95, 97, 98, 101, 103, 104 → **164** → 253, 255, 256, 257, 259, 261, 262, 304, 310, 311, 322, 323, 324
 93, 95, 99, 104 → **165** → 252, 253, 257, 260, 262, 305, 312, 326, 327
 95, 96, 99, 100, 101, 105 → **166** → 251, 257, 258, 260, 261, 306, 315, 316, 330, 331
 99, 102, 104 → **167** → 255, 260, 264, 325, 338
 100, 103 → **168** → 256, 261, 263, 332, 340
 98, 99, 103, 104, 105 → **169** → 257, 261, 262, 264, 333, 334, 335, 341
 90, 97, 104, 105 → **170** → 259, 260, 262, 336, 337, 342
 86, 106, 107, 111 → **171** → 265, 268, 270, 295
 86, 87, 107, 108, 118 → **172** → 266, 268, 269, 271, 272, 296, 298
 86, 88, 107, 109, 110, 113, 117 → **173** → 266, 270, 271, 272, 273, 276, 278, 301, 304
 89, 107, 111, 116 → **174** → 265, 271, 279, 302
 87, 88, 109, 114, 122 → **175** → 267, 272, 273, 274, 282, 288, 310, 313
 88, 89, 108, 109, 115, 117, 121 → **176** → 266, 271, 272, 274, 275, 281, 286, 307, 311
 82, 91, 112, 119 → **177** → 277, 280, 285, 321
 88, 90, 114, 120, 122 → **178** → 267, 276, 282, 283, 284, 286, 322, 337
 89, 90, 113, 118, 121 → **179** → 266, 279, 281, 283, 287, 319, 336
 92, 106, 110 → **180** → 270, 295, 343
 92, 93, 107, 110, 114, 115, 124 → **181** → 272, 276, 295, 296, 300, 301, 302, 305, 345
 86, 94, 110, 112, 114, 126 → **182** → 273, 276, 277, 295, 297, 298, 300, 303, 304, 344
 95, 107, 110, 111, 113, 117, 127 → **183** → 270, 271, 278, 279, 298, 304, 305, 306, 345
 96, 111, 118 → **184** → 268, 279, 299, 306, 346
 83, 112, 130 → **185** → 280, 297, 309
 93, 108, 113, 115, 116, 133 → **186** → 271, 281, 296, 307, 312, 347
 87, 94, 112, 113, 114, 136 → **187** → 273, 283, 285, 296, 297, 298, 308, 310, 314, 349
 95, 108, 114, 117, 139 → **188** → 272, 286, 298, 311, 312, 315, 348
 96, 118 → **189** → 269, 287, 299, 316, 350
 84, 112, 119, 123, 129 → **190** → 280, 289, 303, 308, 320
 93, 109, 120, 125, 134 → **191** → 282, 301, 307, 326, 352
 93, 114, 121, 131 → **192** → 274, 283, 290, 300, 312, 318, 326, 360
 88, 94, 114, 119, 120, 125, 132, 135 → **193** → 282, 284, 285, 290, 301, 303, 308, 311, 313, 322, 324, 328, 359
 88, 97, 112, 113, 120, 124, 131, 135 → **194** → 276, 283, 285, 294, 304, 307, 308, 309, 310, 320, 323, 337, 359
 89, 97, 114, 119, 126, 134 → **195** → 277, 282, 293, 302, 308, 311, 318, 329, 336, 354
 94, 115, 121, 128, 137 → **196** → 275, 281, 291, 300, 314, 324, 351

| | | | | |
|--|---|------------|---|---|
| 98, 109, 113, 127, 137 | → | 197 | → | 278, 281, 310, 334, 352 |
| 99, 116, 117, 118, 121, 127, 133 | → | 198 | → | 271, 279, 281, 292, 312, 316, 325, 335, 353 |
| 95, 98, 109, 114, 120, 126, 135, 138 | → | 199 | → | 276, 282, 286, 288, 304, 310, 311, 313, 326, 330, 333, 334, 356 |
| 95, 99, 114, 115, 117, 122, 131, 138 | → | 200 | → | 274, 276, 286, 293, 305, 312, 314, 315, 324, 325, 331, 333, 355 |
| 95, 99, 113, 118, 121, 122, 124, 139 | → | 201 | → | 272, 283, 287, 294, 306, 312, 314, 316, 323, 325, 327, 334, 361 |
| 100, 117, 137 | → | 202 | → | 275, 278, 292, 315, 332, 357 |
| 96, 100, 117, 122, 126, 136 | → | 203 | → | 273, 286, 293, 306, 315, 316, 317, 331, 332, 358 |
| 85, 119, 129, 130 | → | 204 | → | 280, 289, 328, 329, 339 |
| 91, 128 | → | 205 | → | 291, 321, 364 |
| 90, 97, 119, 131, 132, 136 | → | 206 | → | 285, 290, 293, 319, 320, 322, 329, 336, 342, 373 |
| 97, 121, 128, 133, 137 | → | 207 | → | 281, 291, 292, 318, 323, 342, 365 |
| 98, 99, 120, 121, 131, 135, 136, 139 | → | 208 | → | 283, 286, 290, 294, 323, 324, 326, 330, 334, 335, 338, 341, 372 |
| 99, 122, 132, 134, 138 | → | 209 | → | 282, 293, 325, 327, 331, 341, 366 |
| 100, 122, 135 | → | 210 | → | 284, 288, 294, 331, 332, 340, 369 |
| 92, 110, 123, 125 | → | 211 | → | 301, 303, 343, 345 |
| 101, 110, 111, 124, 126 | → | 212 | → | 295, 302, 304, 306, 344, 345, 346 |
| 102, 115, 116, 124, 134, 140 | → | 213 | → | 302, 307, 325, 347, 351, 353 |
| 93, 113, 123, 124, 132, 134, 141 | → | 214 | → | 301, 308, 319, 320, 327, 345, 347, 352, 360 |
| 94, 112, 124, 128, 131, 142 | → | 215 | → | 300, 309, 314, 320, 321, 323, 344, 349, 351, 359 |
| 101, 114, 126, 131, 137, 142 | → | 216 | → | 300, 310, 315, 318, 322, 330, 344, 354, 355, 362 |
| 101, 118, 124, 133, 136 | → | 217 | → | 296, 316, 319, 323, 346, 353, 362 |
| 101, 115, 117, 125, 134, 135, 141 | → | 218 | → | 301, 307, 311, 324, 331, 345, 353, 355, 357 |
| 95, 114, 125, 126, 129, 132, 135, 143 | → | 219 | → | 303, 308, 313, 322, 326, 328, 329, 331, 345, 348, 355, 356, 361 |
| 103, 117, 126, 135, 144 | → | 220 | → | 304, 311, 332, 333, 335, 348, 355, 358 |
| 96, 126, 130, 136 | → | 221 | → | 297, 317, 329, 330, 346, 350, 358 |
| 104, 113, 114, 124, 127, 131, 138, 144 | → | 222 | → | 304, 305, 310, 312, 325, 334, 336, 337, 349, 359, 360, 361, 362 |
| 105, 118, 126, 127, 136, 139 | → | 223 | → | 298, 306, 316, 334, 335, 336, 350, 361, 362, 363 |
| 102, 121, 131, 133, 134, 140, 141 | → | 224 | → | 307, 318, 319, 325, 338, 351, 353, 365, 367 |
| 97, 119, 128, 131, 141, 142 | → | 225 | → | 318, 320, 321, 324, 339, 342, 354, 359, 365, 373 |
| 98, 120, 129, 132, 142, 143 | → | 226 | → | 320, 322, 328, 341, 352, 356, 372 |
| 99, 129, 131, 134, 135, 136, 141, 143 | → | 227 | → | 308, 320, 326, 329, 331, 338, 339, 341, 353, 355, 361, 366, 372 |
| 103, 122, 135, 136, 137, 142, 144 | → | 228 | → | 310, 322, 323, 324, 332, 334, 340, 341, 355, 358, 366, 370, 374 |
| 100, 130, 135, 142 | → | 229 | → | 309, 328, 330, 339, 340, 357, 358, 369 |
| 104, 120, 131, 143, 144 | → | 230 | → | 322, 326, 333, 337, 338, 359, 371, 372 |
| 104, 121, 132, 134, 138, 139, 141, 144 | → | 231 | → | 311, 324, 325, 326, 327, 336, 341, 342, 360, 361, 367, 368, 372 |
| 104, 131, 133, 139, 144 | → | 232 | → | 312, 323, 335, 338, 342, 362, 367, 371 |
| 105, 122, 135, 138, 143 | → | 233 | → | 313, 331, 333, 337, 341, 361, 369, 370 |
| 105, 136, 137, 138, 139, 142 | → | 234 | → | 314, 315, 330, 334, 341, 342, 362, 363, 368, 370 |
| 126, 142 | → | 235 | → | 344, 354, 356, 358, 363 |
| 124, 125, 127, 141, 143 | → | 236 | → | 345, 352, 353, 359, 361 |
| 128, 140, 145 | → | 237 | → | 351, 364, 365 |
| 133, 140, 141 | → | 238 | → | 347, 353, 365, 367 |
| 134, 137, 141, 142, 145 | → | 239 | → | 351, 352, 354, 357, 365, 366, 368 |
| 135, 138, 142, 143, 146 | → | 240 | → | 355, 356, 359, 366, 369, 370, 372 |
| 131, 132, 141, 144, 146 | → | 241 | → | 355, 359, 360, 366, 367, 372, 373 |
| 136, 142, 144 | → | 242 | → | 349, 358, 362, 368, 372, 373, 374 |
| 139, 143, 144 | → | 243 | → | 348, 361, 370, 371, 372 |

v = 7

e = 9

147, 148 → **244** → 375, 376, 377, 399
147, 149, 150, 151, 152, 153, 157 → **245** → 376, 378, 379, 381, 390, 391, 393, 396, 418
147, 150, 153, 154, 155, 158 → **246** → 376, 377, 379, 380, 385, 392, 393, 394, 401, 426
148, 152, 158 → **247** → 376, 382, 395, 398, 435
148, 153, 155, 157, 158, 159 → **248** → 376, 377, 382, 383, 384, 397, 398, 402, 403, 448
147, 154, 155, 156, 159 → **249** → 377, 381, 385, 396, 400, 401, 439
151, 162 → **250** → 378, 404, 407
151, 152, 153, 154, 160, 161, 166 → **251** → 378, 379, 381, 382, 405, 406, 409, 415, 416
153, 165 → **252** → 379, 383, 408, 425
152, 155, 160, 164, 165 → **253** → 379, 381, 382, 386, 410, 413, 414, 432
149, 156, 160, 163 → **254** → 381, 411, 417, 433
153, 155, 163, 164, 167 → **255** → 380, 381, 383, 388, 412, 424, 438
154, 158, 164, 168 → **256** → 380, 382, 385, 389, 422, 430, 446, 447
153, 155, 157, 158, 161, 164, 165, 166, 169 → **257** → 379, 382, 383, 384, 385, 388, 420, 421, 428, 429, 444, 445
157, 162, 166 → **258** → 378, 384, 387, 423, 431, 449
150, 156, 161, 164, 170 → **259** → 381, 385, 419, 427, 440
157, 159, 163, 165, 166, 167, 170 → **260** → 381, 383, 387, 388, 434, 441, 442, 443, 455
158, 159, 164, 166, 168, 169 → **261** → 382, 384, 385, 388, 389, 436, 450, 451, 452, 456
155, 164, 165, 169, 170 → **262** → 383, 385, 386, 388, 437, 453, 454, 459
168 → **263** → 389, 458
167, 169 → **264** → 388, 457
149, 171, 174 → **265** → 390, 411
149, 150, 172, 173, 176, 179 → **266** → 390, 391, 392, 393, 417, 419
150, 175, 178 → **267** → 393, 394, 427
151, 171, 172, 184 → **268** → 390, 404, 405, 460
151, 172, 189 → **269** → 391, 404, 406, 462
152, 171, 173, 180, 183 → **270** → 390, 395, 405, 410, 463
153, 172, 173, 174, 176, 183, 186, 198 → **271** → 390, 392, 397, 406, 408, 412, 420, 465
152, 153, 172, 173, 175, 176, 181, 188, 201 → **272** → 391, 393, 398, 405, 406, 408, 409, 412, 413, 414, 421, 467
151, 154, 173, 175, 182, 187, 203 → **273** → 393, 396, 405, 406, 407, 409, 416, 422, 466
153, 175, 176, 192, 200 → **274** → 393, 402, 408, 409, 424, 429, 472
154, 176, 196, 202 → **275** → 392, 400, 409, 430, 471
152, 155, 173, 178, 181, 182, 194, 199, 200 → **276** → 393, 396, 398, 410, 412, 413, 415, 416, 421, 432, 437, 476
149, 156, 177, 182, 195 → **277** → 396, 411, 418, 419, 433, 475
158, 173, 183, 197, 202 → **278** → 392, 395, 397, 421, 422, 436, 478
157, 174, 179, 183, 184, 198 → **279** → 390, 397, 420, 423, 434, 479
147, 177, 185, 190, 204 → **280** → 399, 418, 426, 439
155, 176, 179, 186, 196, 197, 198, 207 → **281** → 392, 397, 400, 413, 424, 428, 453, 482
153, 155, 175, 178, 191, 193, 195, 199, 209 → **282** → 394, 396, 402, 412, 414, 416, 424, 425, 429, 444, 454, 483
153, 155, 178, 179, 187, 192, 194, 201, 208 → **283** → 393, 401, 403, 413, 415, 420, 424, 425, 428, 438, 454, 498
154, 178, 193, 210 → **284** → 394, 401, 416, 430, 446, 499
150, 156, 177, 187, 193, 194, 206 → **285** → 396, 401, 417, 418, 419, 426, 427, 440, 493
157, 158, 176, 178, 188, 199, 200, 203, 208 → **286** → 393, 398, 402, 420, 421, 428, 429, 430, 431, 442, 451, 487
157, 179, 189, 201 → **287** → 391, 403, 423, 428, 443, 500
158, 175, 199, 210 → **288** → 394, 398, 422, 429, 452, 488
148, 190, 204 → **289** → 399, 435, 448
155, 192, 193, 206, 208 → **290** → 401, 402, 432, 438, 444, 453, 518

| | | | |
|---|--|-------|--|
| | 156, 196, 205, 207 | → 291 | → 400, 433, 440, 502 |
| | 159, 198, 202, 207 | → 292 | → 397, 400, 441, 450, 505 |
| 157, 159, 195, 200, 203, 206, 209 | | → 293 | → 396, 402, 434, 441, 443, 445, 449, 451, 504 |
| | 158, 159, 194, 201, 208, 210 | → 294 | → 398, 401, 403, 436, 442, 445, 447, 450, 452, 514 |
| | 160, 171, 180, 181, 182, 212 | → 295 | → 405, 410, 411, 460, 463, 464 |
| | 160, 172, 181, 186, 187, 217 | → 296 | → 406, 413, 417, 460, 465, 468 |
| | 151, 182, 185, 187, 221 | → 297 | → 407, 415, 418, 460, 462, 466 |
| 161, 172, 182, 183, 187, 188, 223 | | → 298 | → 405, 406, 419, 420, 421, 462, 467, 468, 469 |
| | 162, 184, 189 | → 299 | → 404, 423, 461, 470 |
| | 160, 181, 182, 192, 196, 215, 216 | → 300 | → 409, 413, 415, 432, 433, 464, 468, 474, 477 |
| 160, 173, 181, 191, 193, 211, 214, 218 | | → 301 | → 414, 416, 417, 432, 463, 465, 477, 478 |
| | 163, 174, 181, 195, 212, 213 | → 302 | → 411, 412, 434, 465, 474, 479 |
| | 152, 182, 190, 193, 211, 219 | → 303 | → 416, 418, 432, 435, 463, 467, 476 |
| 164, 173, 182, 183, 194, 199, 212, 220, 222 | | → 304 | → 410, 412, 419, 420, 422, 436, 437, 466, 467, 476, 477, 480 |
| | 165, 181, 183, 200, 222 | → 305 | → 408, 410, 421, 434, 437, 468, 477, 481 |
| | 166, 183, 184, 201, 203, 212, 223 | → 306 | → 405, 420, 423, 434, 436, 469, 470, 480, 481 |
| | 163, 176, 186, 191, 194, 213, 218, 224 | → 307 | → 412, 417, 424, 442, 465, 471, 482, 484 |
| 153, 187, 190, 193, 194, 195, 214, 219, 227 | | → 308 | → 416, 418, 425, 426, 438, 445, 448, 465, 467, 472, 483, 498 |
| | 154, 185, 194, 215, 229 | → 309 | → 415, 426, 439, 447, 466, 471, 499 |
| 164, 175, 187, 194, 197, 199, 216, 222, 228 | | → 310 | → 413, 421, 422, 424, 427, 452, 454, 466, 472, 483, 494, 495 |
| 164, 176, 188, 193, 195, 199, 218, 220, 231 | | → 311 | → 412, 414, 419, 429, 430, 451, 453, 467, 472, 484, 487, 489 |
| 165, 186, 188, 192, 198, 200, 201, 222, 232 | | → 312 | → 408, 413, 420, 428, 441, 442, 453, 468, 473, 484, 485, 496 |
| | 161, 175, 193, 199, 219, 233 | → 313 | → 416, 427, 429, 444, 467, 488, 495 |
| | 161, 187, 196, 200, 201, 215, 234 | → 314 | → 409, 415, 428, 440, 445, 468, 469, 486, 495 |
| | 166, 188, 200, 202, 203, 216, 234 | → 315 | → 409, 421, 431, 441, 451, 469, 473, 489, 492 |
| | 166, 189, 198, 201, 203, 217, 223 | → 316 | → 406, 423, 428, 443, 450, 470, 473, 490, 497 |
| | 162, 203, 221 | → 317 | → 407, 431, 449, 470, 491 |
| | 163, 192, 195, 207, 216, 224, 225 | → 318 | → 424, 433, 438, 441, 455, 474, 484, 501, 511 |
| | 163, 179, 206, 214, 217, 224 | → 319 | → 417, 438, 443, 479, 482, 511 |
| 155, 190, 194, 206, 214, 215, 225, 226, 227 | | → 320 | → 426, 432, 438, 439, 445, 448, 459, 476, 482, 483, 498, 518 |
| | 156, 177, 205, 215, 225 | → 321 | → 433, 439, 440, 475, 493, 502 |
| 164, 178, 193, 206, 216, 219, 226, 228, 230 | | → 322 | → 427, 432, 438, 444, 446, 451, 454, 476, 483, 487, 512, 516 |
| 164, 194, 201, 207, 208, 215, 217, 228, 232 | | → 323 | → 413, 428, 438, 440, 447, 450, 459, 480, 484, 494, 503, 512 |
| 164, 193, 196, 200, 208, 218, 225, 228, 231 | | → 324 | → 424, 430, 432, 440, 445, 453, 456, 477, 489, 495, 503, 516 |
| 167, 198, 200, 201, 209, 213, 222, 224, 231 | | → 325 | → 412, 424, 434, 441, 442, 443, 457, 485, 486, 490, 503, 508 |
| 165, 191, 192, 199, 208, 219, 227, 230, 231 | | → 326 | → 425, 429, 432, 442, 444, 454, 455, 477, 484, 496, 509, 517 |
| | 165, 201, 209, 214, 231 | → 327 | → 414, 425, 443, 445, 459, 481, 485, 509 |
| | 158, 193, 204, 219, 226, 229 | → 328 | → 426, 435, 444, 446, 448, 456, 478, 487, 488, 514 |
| | 157, 195, 204, 206, 219, 221, 227 | → 329 | → 418, 444, 448, 449, 455, 479, 487, 500, 504 |
| | 166, 199, 208, 216, 221, 229, 234 | → 330 | → 415, 431, 444, 452, 455, 480, 489, 497, 510 |
| 166, 200, 203, 209, 210, 218, 219, 227, 233 | | → 331 | → 416, 429, 442, 445, 449, 451, 456, 481, 490, 492, 506, 510 |
| | 168, 202, 203, 210, 220, 228 | → 332 | → 422, 430, 436, 450, 451, 458, 491, 492, 506, 507 |
| | 169, 199, 200, 220, 230, 233 | → 333 | → 429, 437, 451, 457, 495, 496, 510 |
| 169, 197, 199, 201, 208, 222, 223, 228, 234 | | → 334 | → 421, 428, 436, 452, 453, 454, 457, 494, 495, 497, 509, 515 |
| | 169, 198, 208, 220, 223, 232 | → 335 | → 420, 450, 453, 457, 496, 497, 508 |
| 170, 179, 195, 206, 222, 223, 231 | | → 336 | → 419, 434, 443, 453, 454, 498, 500, 511, 513 |
| | 170, 178, 194, 222, 230, 233 | → 337 | → 427, 437, 442, 454, 498, 499, 512 |

v = 7

e = 9

167, 208, 224, 227, 230, 232 → **338** → 438, 442, 455, 457, 503, 508, 521
159, 204, 225, 227, 229 → **339** → 439, 448, 455, 456, 504, 505, 514
168, 210, 228, 229 → **340** → 446, 447, 452, 456, 458, 506, 507, 520
169, 208, 209, 226, 227, 228, 231, 233, 234 → **341** → 444, 445, 451, 454, 456, 457, 459, 508, 509, 510, 515, 519
170, 206, 207, 225, 231, 232, 234 → **342** → 440, 441, 453, 455, 459, 511, 512, 513, 522
180, 211 → **343** → 463
182, 212, 215, 216, 235 → **344** → 464, 466, 469, 474, 475, 476, 480
181, 183, 211, 212, 214, 218, 219, 236 → **345** → 463, 465, 467, 476, 477, 478, 479, 481
184, 212, 217, 221 → **346** → 460, 470, 479, 480
186, 213, 214, 238 → **347** → 465, 482, 485
188, 219, 220, 243 → **348** → 467, 487, 492, 496
187, 215, 222, 242 → **349** → 466, 468, 486, 493, 494, 498
189, 221, 223 → **350** → 462, 470, 497, 500
196, 213, 215, 224, 237, 239 → **351** → 471, 474, 482, 486, 502, 503
191, 197, 214, 226, 236, 239 → **352** → 478, 482, 483, 509
198, 213, 217, 218, 224, 227, 236, 238 → **353** → 465, 479, 482, 484, 490, 503, 505, 508
195, 216, 225, 235, 239 → **354** → 474, 475, 483, 489, 501, 504, 513
200, 216, 218, 219, 220, 227, 228, 240, 241 → **355** → 472, 476, 477, 484, 487, 492, 495, 504, 506, 508, 510, 516
199, 219, 226, 235, 240 → **356** → 476, 483, 487, 488, 510, 515, 517
202, 218, 229, 239 → **357** → 471, 478, 489, 505, 506
203, 220, 221, 228, 229, 235, 242 → **358** → 466, 480, 487, 489, 491, 497, 504, 507, 510
193, 194, 215, 222, 225, 230, 236, 240, 241 → **359** → 476, 477, 483, 484, 493, 495, 498, 499, 503, 512, 514, 518
192, 214, 222, 231, 241 → **360** → 472, 477, 485, 498, 509, 511, 518
201, 219, 222, 223, 227, 231, 233, 236, 243 → **361** → 467, 481, 490, 495, 496, 498, 500, 508, 509, 512, 514, 515
216, 217, 222, 223, 232, 234, 242 → **362** → 468, 473, 480, 494, 497, 508, 511, 512, 513
223, 234, 235 → **363** → 469, 497, 513, 515
205, 237 → **364** → 502
207, 224, 225, 237, 238, 239 → **365** → 482, 501, 502, 503, 505, 522
209, 227, 228, 239, 240, 241 → **366** → 483, 503, 504, 506, 509, 519
224, 231, 232, 238, 241 → **367** → 484, 485, 503, 508, 511, 521, 522
231, 234, 239, 242 → **368** → 486, 489, 509, 513, 519, 522
210, 229, 233, 240 → **369** → 488, 499, 506, 510, 514, 520
228, 233, 234, 240, 243 → **370** → 492, 495, 510, 512, 515, 519, 520
230, 232, 243 → **371** → 496, 512, 521
208, 226, 227, 230, 231, 240, 241, 242, 243 → **372** → 487, 498, 508, 509, 510, 512, 514, 516, 517, 518, 519, 521
206, 225, 241, 242 → **373** → 493, 504, 511, 516, 518, 522
228, 242 → **374** → 494, 507, 516, 519

244 → **375** → 584, 641
 244, 245, 246, 247, 248 → **376** → 622, 639, 640, 641, 654, 655, 667
 244, 246, 248, 249 → **377** → 575, 583, 585, 638, 639, 640, 641
 245, 250, 251, 258 → **378** → 648, 650, 653, 655, 669
 245, 246, 251, 252, 253, 257 → **379** → 625, 635, 637, 640, 652, 666
 246, 255, 256 → **380** → 576, 581, 636, 640
 245, 249, 251, 253, 254, 255, 259, 260 → **381** → 609, 623, 624, 635, 640, 647, 650, 663
 247, 248, 251, 253, 256, 257, 261 → **382** → 611, 626, 633, 634, 635, 640, 649, 655, 664
 248, 252, 255, 257, 260, 262 → **383** → 564, 578, 582, 629, 631, 635, 640
 248, 257, 258, 261 → **384** → 566, 580, 582, 585, 627, 628, 634, 655
 246, 249, 256, 257, 259, 261, 262 → **385** → 565, 577, 579, 581, 585, 630, 632, 635, 640
 253, 262 → **386** → 608, 635, 659
 258, 260 → **387** → 567, 582, 610, 650
 255, 257, 260, 261, 262, 264 → **388** → 568, 569, 581, 582, 613, 635
 256, 261, 263 → **389** → 570, 571, 581, 612, 634
 245, 265, 266, 268, 270, 271, 279 → **390** → 661, 663, 666, 667, 669
 245, 266, 269, 272, 287 → **391** → 642, 647, 652, 654, 669
 246, 266, 271, 275, 278, 281 → **392** → 614, 630, 636, 638, 652, 667
 245, 246, 266, 267, 272, 273, 274, 276, 283, 286 → **393** → 617, 624, 632, 636, 637, 639, 652, 653, 654, 666
 246, 267, 282, 284, 288 → **394** → 572, 577, 636, 637, 639
 247, 270, 278 → **395** → 658, 664, 667
 245, 249, 273, 276, 277, 282, 285, 293 → **396** → 595, 623, 625, 632, 639, 647, 648, 663
 248, 271, 278, 279, 281, 292 → **397** → 596, 627, 629, 638, 649, 667
 247, 248, 272, 276, 286, 288, 294 → **398** → 602, 626, 628, 631, 633, 639, 649, 654, 664
 244, 280, 289 → **399** → 575, 584, 622
 249, 275, 281, 291, 292 → **400** → 554, 579, 623, 638
 246, 249, 283, 284, 285, 290, 294 → **401** → 548, 576, 577, 579, 583, 624, 625, 630, 639
 248, 274, 282, 286, 290, 293 → **402** → 555, 578, 580, 629, 633, 639
 248, 283, 287, 294 → **403** → 545, 578, 583, 626, 627, 654
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 254, 266, 285, 296, 301, 307, 319 → **417** → 593, 614, 624, 647, 661
 245, 277, 280, 285, 297, 303, 308, 329 → **418** → 595, 609, 617, 622, 625, 642, 648, 661
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 259, 267, 285, 310, 313, 322, 337 → **427** → 551, 572, 577, 617, 624, 632
 257, 281, 283, 286, 287, 312, 314, 316, 323, 334 → **428** → 547, 558, 569, 573, 578, 579, 618, 619, 626, 627, 652
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 256, 275, 284, 286, 311, 324, 332 → **430** → 556, 559, 571, 574, 579, 621, 630, 633, 636

v = 7

e = 10

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256, 294, 309, 323, 340 → **447** → 532, 556, 565, 570, 576, 605, 626
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261, 288, 294, 310, 330, 334, 340 → **452** → 534, 552, 561, 568, 577, 605, 612, 626, 628
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299 → **461** → 646, 670
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295, 300, 344 → **464** → 656, 657, 660, 665
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299, 306, 316, 317, 346, 350 → **470** → 597, 606, 619, 646, 668
275, 307, 309, 351, 357 → **471** → 554, 556, 614, 615
274, 308, 310, 311, 355, 360 → **472** → 550, 555, 561, 616, 617, 621
312, 315, 316, 362 → **473** → 546, 557, 562, 618, 619, 651
300, 302, 318, 344, 351, 354 → **474** → 587, 589, 594, 599, 615, 656
277, 321, 344, 354 → **475** → 587, 595, 598, 656
276, 303, 304, 320, 322, 344, 345, 355, 356, 359 → **476** → 586, 588, 592, 594, 595, 600, 602, 604, 607, 617, 657
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278, 301, 328, 345, 352, 357 → **478** → 590, 596, 603, 604, 614, 658
279, 302, 319, 329, 345, 346, 353 → **479** → 589, 596, 597, 600, 661
304, 306, 323, 330, 344, 346, 358, 362 → **480** → 586, 589, 598, 600, 605, 606, 619, 660
305, 306, 327, 331, 345, 361 → **481** → 586, 590, 597, 601, 607, 620, 662
281, 307, 319, 320, 347, 351, 352, 353, 365 → **482** → 535, 553, 554, 558, 594, 596, 614
282, 308, 310, 320, 322, 352, 354, 356, 359, 366 → **483** → 533, 537, 549, 553, 555, 561, 572, 594, 595, 603, 604
307, 311, 312, 318, 323, 326, 353, 355, 359, 367 → **484** → 535, 536, 539, 550, 556, 562, 573, 593, 594, 600, 616
312, 325, 327, 347, 360, 367 → **485** → 528, 535, 557, 558, 601, 616
314, 325, 349, 351, 368 → **486** → 529, 538, 558, 599, 615

$v = 7$

$e = 10$

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288, 313, 328, 356, 369 → **488** → 534, 560, 572, 602, 604
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317, 332, 358 → **491** → 540, 543, 563, 574, 606, 645
315, 331, 332, 348, 355, 370 → **492** → 542, 544, 562, 563, 607, 621
285, 321, 349, 359, 373 → **493** → 538, 548, 551, 593, 595
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316, 330, 334, 335, 350, 358, 362, 363 → **497** → 527, 531, 546, 547, 552, 606, 619, 644
283, 308, 320, 336, 337, 349, 359, 360, 361, 372 → **498** → 530, 533, 545, 548, 549, 550, 558, 591, 592, 601, 617
284, 309, 337, 359, 369 → **499** → 532, 548, 556, 572, 592
287, 329, 336, 350, 361 → **500** → 531, 545, 547, 597, 642
318, 354, 365 → **501** → 525, 539, 553, 587
291, 321, 351, 364, 365 → **502** → 538, 554, 587
323, 324, 325, 338, 351, 353, 359, 365, 366, 367 → **503** → 526, 529, 535, 538, 539, 541, 553, 556, 558, 589, 594
293, 329, 339, 354, 355, 358, 366, 373 → **504** → 531, 537, 539, 540, 542, 555, 589, 595
292, 339, 353, 357, 365 → **505** → 539, 541, 554, 596
331, 332, 340, 355, 357, 366, 369 → **506** → 523, 540, 541, 542, 544, 556, 561, 590, 604
332, 340, 358, 374 → **507** → 523, 542, 543, 552, 559, 605
325, 335, 338, 341, 353, 355, 361, 362, 367, 372 → **508** → 526, 527, 529, 531, 535, 536, 541, 550, 562, 600, 601
326, 327, 334, 341, 352, 360, 361, 366, 368, 372 → **509** → 524, 528, 531, 533, 535, 537, 549, 558, 561, 590, 603
330, 331, 333, 341, 355, 356, 358, 369, 370, 372 → **510** → 523, 527, 534, 536, 537, 542, 560, 561, 563, 586, 592
318, 319, 336, 342, 360, 362, 367, 373 → **511** → 525, 530, 531, 535, 550, 557, 589, 593
322, 323, 337, 342, 359, 361, 362, 370, 371, 372 → **512** → 526, 530, 532, 533, 536, 547, 551, 562, 586, 591
336, 342, 354, 362, 363, 368 → **513** → 525, 531, 533, 546, 598, 599
294, 328, 339, 359, 361, 369, 372 → **514** → 532, 534, 536, 537, 541, 545, 548, 590, 602
334, 341, 356, 361, 363, 370 → **515** → 524, 527, 533, 534, 547, 607
322, 324, 355, 372, 373, 374 → **516** → 526, 537, 542, 550, 551, 559, 588
326, 356, 372 → **517** → 524, 536, 549, 560, 588
290, 320, 359, 360, 372, 373 → **518** → 530, 535, 537, 548, 555, 588
341, 366, 368, 370, 372, 374 → **519** → 523, 524, 526, 529, 533, 537, 542
340, 369, 370 → **520** → 523, 532, 534, 544
338, 367, 371, 372 → **521** → 526, 528, 530, 536
342, 365, 367, 368, 373 → **522** → 525, 526, 535, 538, 539

This completes the *sparse* graphs on 7 vertices. To find a subgraph-to-supergraph chain for a *dense* graph, first find the identification number of its complement. Then find that number's chain bundle in the list above, change all ID numbers in the chain bundle to their complementary ID numbers, and reverse the arrows. Any ID number in this list can easily be transformed to its complement by subtracting it from 1045.

Example: To find graph # **834**, either use Chapter 2 to look up its complement, or subtract: $1045 - 834 = 211$. Now find the chain bundle for 211 —

92, 110, 123, 125 → **211** → 301, 303, 343, 345

— subtract all from 1045, and reverse the arrows:

953, 935, 922, 920 ← **834** ← 744, 742, 702, 700.