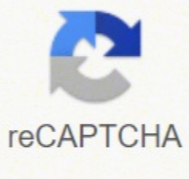




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see the length of path 5 is divisible by 3. Especially, for the given graph , we can know that any vertex X which is not on the circle Z cannot have edges incident to two distinct vertices of Z. It means that the edges which are induced by the vertices on Z but not on the cycle should be incident to distinct vertices, respectively. Let us construct a graph G

1 • Collapse all vertices  $A_1, A_2, \dots, A_{3k}$  on the cycle Z of G into one vertex A and keep all the vertices which are not on the cycle and their incident edges. Join the A and the vertices on the Z one by one. It is easy to know the degree of A is no less than  $3k$ . The number of vertices in  $G_1$  is less than that of G and the degree of every vertex is still more than 2. According to above conclusion , the length of any cycle in  $G_1$  is divisible by 3. We arrive at a contradiction . In view of the above proof, we can know G is the Graph Theory 128 graph satisfying these properties and with the least vertices. Then in a graph the degrees of its vertices are all more than 2, there must exist a cycle whose length can be divided by 3. Then we only need to apply this assertion to our problem. We denote the city by a vertex and the path by the edge. Exercise 5.1 When  $n \equiv 2 \pmod 3$  is odd,  $K_n$  is a cycle. When  $n = 2$ ,  $K_2$  is a chain. When  $m, n$  are both even,  $K_{m \times n}$  is a cycle. 2 Suppose G contains at least  $2k$  odd vertices. Delete one edge to get  $G'$ . There are three cases: e1) The number of odd vertices of  $G'$  decreases by 2, then  $G'$  need at least  $k - 1$  strokes to draw. (2) The number of odd vertices increases by 2,  $G'$  need at least  $k + 1$  strokes to draw. (3) The number of odd vertices does not change,  $G'$  need at least  $k$  strokes to draw. 3 These two graphs are all unicursal, that is, they can be drawn in one stroke, and start and end at the same vertex. 4 When  $n$  is odd, the graph is unicursal; when  $n$  is even, the graph is not unicursal. 5 Draw G as follows. We denote the persons by vertices. If two person have exchanged views, then join the corresponding vertices. Take the longest chain  $1-2-3-\dots$ . Let  $V_1$  be an end of  $1-2-3-\dots$  then  $0$  vertices  $V_2, \dots, V_{S+1}$  adjacent to  $V_1$  are all on the chain  $1-2-3-\dots$ . Otherwise,  $1-2-3-\dots$  can still be extended. Go along the  $1-2-3-\dots$  through vertices  $V_2, V_3, \dots, V_{S+1}$  and then return to  $v_1$ . This is a cycle whose length is more than  $0$ .  $v_j$ : 6 Take a point ( $j = 1, 2, 3, 4$ ) on every face. If the two faces have common edges, join the two points. Then we get a new graph  $G^*$  which we call the dual graph of G. In the graph G, going from a face to another face through the edge  $e_i$  is equivalent to going from one vertex to another vertex along an edge in the  $G^*$ . Therefore, if  $G \sim V_j$  Fig. 6 Solutions 129 contains a broken line  $\Gamma$  satisfying conditions (1) and (2), then  $G^*$  is a chain ( $Q_1$  and  $Q_2$  are not on a face) or a cycle ( $Q_1$  and  $Q_2$  are on a face), i. e. the graph  $G^*$  is unicursal or it can be drawn in one stroke. But if the four vertices of  $G^*$  are all odd, the graph  $G^*$  needs two strokes to draw. 7 Suppose that there are  $k$  lines and that one vertex corresponds to one number  $a_i = 1; V_i$  at in the following way. If is blue, then  $a_i = -1, 1 = 1, 2, \dots, n$ .  $V_i$  is red, then  $V_i$  Then hence  $k$  is odd. 8 A  $1^k$  Series: Mathematical Olympiad SERIES 3 Year: 2,010 Pages: 156 sidor ; 22.9 cm Pages In File: 159 Language: English Identifier: 9789814271127,9814271128 Org File Size: 21,019,586 Extension: pdf



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