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**Proposition 14.** If  $H$  and  $K$  are subgroups of a group,  $HK$  is a subgroup if and only if  $HK = KH$ .

*Proof:* Assume first that  $HK = KH$  and let  $a, b \in HK$ . We prove  $ab^{-1} \in HK$  so  $HK$  is a subgroup by the subgroup criterion. Let

$$a = h_1 k_1 \quad \text{and} \quad b = h_2 k_2,$$

for some  $h_1, h_2 \in H$  and  $k_1, k_2 \in K$ . Thus  $b^{-1} = k_2^{-1}h_2^{-1}$ , so  $ab^{-1} = h_1k_1k_2^{-1}h_2^{-1}$ . Let  $k_3 = k_1k_2^{-1} \in K$  and  $h_3 = h_2^{-1}$ . Thus  $ab^{-1} = h_1k_3h_3$ . Since  $HK = KH$ ,

$$k_3 h_3 = h_4 k_4, \quad \text{for some } h_4 \in H, \quad k_4 \in K.$$

Thus  $ab^{-1} = h_1h_4k_4$ , and since  $h_1h_4 \in H$ ,  $k_4 \in K$ , we obtain  $ab^{-1} \in HK$ , as desired.

Conversely, assume that  $HK$  is a subgroup of  $G$ . Since  $K \leq HK$  and  $H \leq HK$ , by the closure property of subgroups,  $KH \subseteq HK$ . To show the reverse containment let  $hk \in HK$ . Since  $HK$  is assumed to be a subgroup, write  $hk = a^{-1}$ , for some  $a \in HK$ . If  $a = h_1k_1$ , then

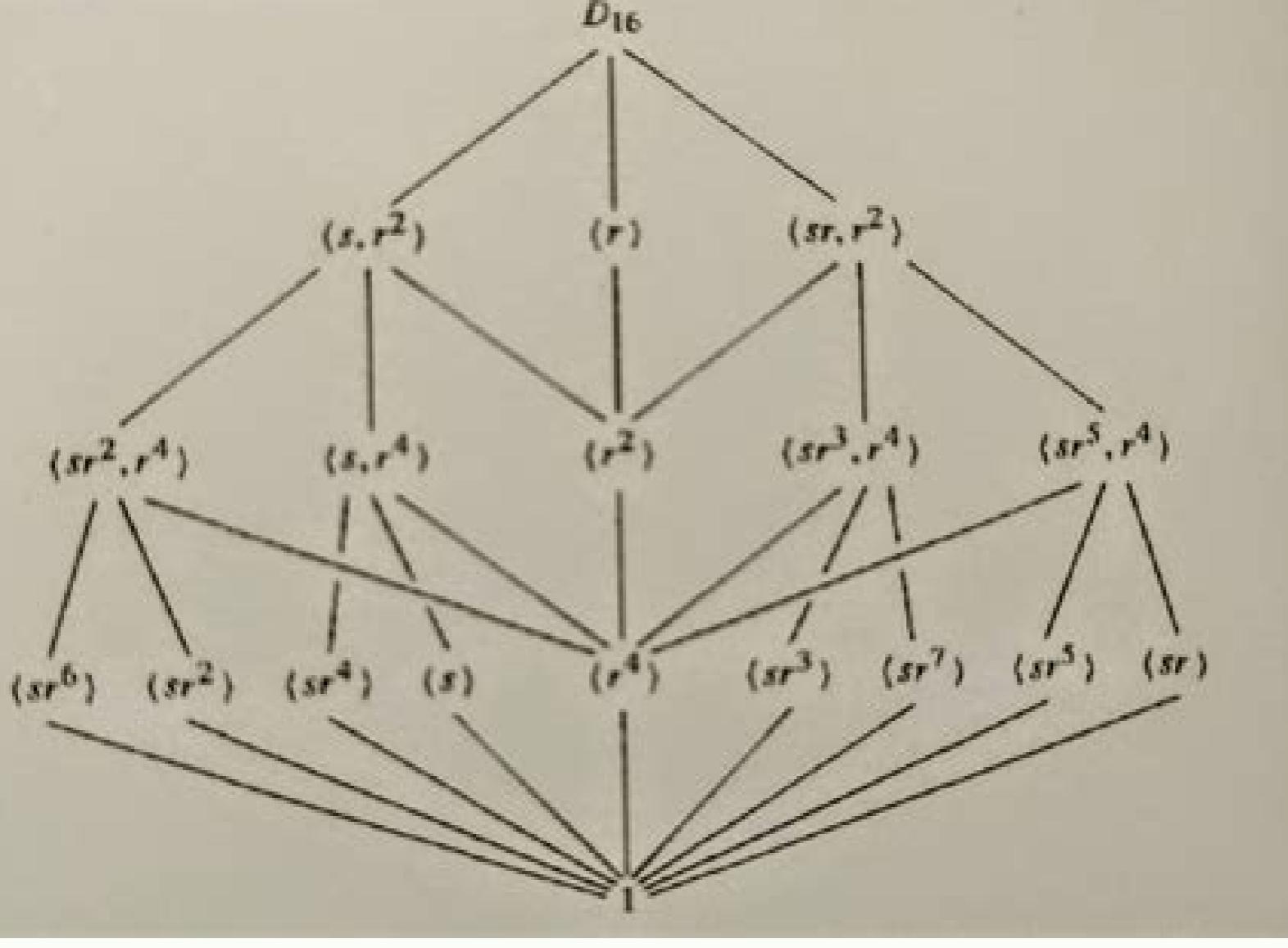
$$hk = (h_1 k_1)^{-1} = k_1^{-1} h_1^{-1} \in KH,$$

completing the proof.

Rank	Name	Latest Team	Matches played	Total points
1.	Rahul Chaudhari Raider		99	875
2.	Pardeep Narwal Raider		83	848
3.	Deepak Niwas Hooda All Rounder		102	772
4.	Ajay Thakur Raider		100	731

To prove (3), it suffices by induction to prove that if  $P_1 \subseteq P_2$  and  $Q_1$  is a prime of  $S$  with  $Q_1 \cap R = P_1$  then there is a prime  $Q_2$  of  $S$  with  $Q_1 \subseteq Q_2$  and  $Q_2 \cap R = P_2$ . Since  $\bar{S} = S/Q_1$  is an integral extension of  $\bar{R} = R/P_1$ , the first part of (2) shows that there exists a prime  $\bar{Q}_2$  of  $\bar{S}$  with  $\bar{Q}_2 \cap \bar{R} = P_2/P_1$ . Then the preimage  $Q_2$  of  $\bar{Q}_2$  in  $S$  is a prime ideal containing  $Q_1$  with  $Q_2 \cap R = P_2$ .

(6) The lattice of  $D_{16}$  is not a planar graph (cannot be drawn on a plane without lines crossing). One way of drawing it is



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This is done in each chapter; That's why it's more easier for the reader to understand the concepts. The students, who prefer self-study, find this book a phenomenal communicator and do not face any problem during the study. It clarifies every concept of topology that defines A The authorsâ €™ â™ capabilities and mathematical skills to solve complicated problems.â basic mathematics: by Serge Langine Book is considered one of the best mathematical books for students who want to explore the new of the calculation.This book is separated into four different sections: intuitive geometry, Ä LGEBA, Miscellaneous and Geometry of Coordinates.Caur Section has a series of problem exercises for readers so that they can practice and polish their resolution capabilities of problems. Some expert in Mathematics, the author has built a solid base for students to help them improve their knowledge of mathematical concepts. 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