

First note that,  $kA$  has no nonzero nil ideals. Since  $kA$  is commutative, this simply means that the only nilpotent element of  $kA$  is zero. For  $\alpha = \sum_{a \in A} \alpha_a a \in kA$ , let  $\alpha^* = \sum_{a \in A} \alpha_a a^{-1}$ . This defines an involution on  $kA$ , with  $x\alpha = \alpha^* x$  for any  $\alpha \in kA$ . Any element  $\sigma \in kG$  can be expressed uniquely in the form  $\alpha + \beta x$ , with  $\alpha, \beta \in kA$ . Let  $I$  be any nil ideal in  $kG$ , and let  $\sigma \in I$ . Then  $(\alpha + \beta x)(\alpha^* + x\beta^*) = \alpha\alpha^* + \beta\beta^* + (\beta\alpha + \alpha\beta)x = \alpha\alpha^* + \beta\beta^* \in kA$ . Since this element is nilpotent, we must have  $\alpha\alpha^* = \beta\beta^*$ .

Therefore,

$$(\alpha + \beta x)^2 = \alpha^2 + \beta x\beta x + \alpha\beta x + \beta x\alpha = \alpha^2 + \beta\beta^* + (\alpha\beta + \beta\alpha^*)x = \alpha^2 + \alpha\alpha^* + (\alpha\beta + \alpha^*\beta)x = (\alpha + \alpha^*)(\alpha + \beta x).$$

Say  $(\alpha + \beta x)^n = 0$ .

Then we have  $0 = (\alpha + \alpha^*)^{n-1}(\alpha + \beta x)$ , so that  $(\alpha + \alpha^*)^{n-1}\alpha = 0$ . But then  $0 = x[(\alpha + \alpha^*)^{n-1}\alpha]x = (\alpha + \alpha^*)^{n-1}\alpha^*$ . Therefore, by addition,  $(\alpha + \alpha^*)^n = 0$ , so  $\alpha = \alpha^*$ . Now consider any  $b \in A$ . Then  $b(\alpha + \beta x) \in I$  implies  $ba = (ba)^*$ . Suppose  $\alpha \neq 0$ ; say  $\alpha$  involves some group element  $b-1 \in A$ . Then  $1 \in \text{supp}(ba)$ , and  $ba = (ba)^*$  implies that  $|\text{supp}(\alpha)| = |\text{supp}(ba)|$  is odd, since  $A$  has no element of order 2. But if  $\text{supp}(\alpha)$  misses some element  $c-1 \in A$ , then  $1 \notin \text{supp}(ca)$ , and  $ca = (ca)^*$  would imply that  $|\text{supp}(\alpha)| = |\text{supp}(ca)|$  is even. Therefore, we must have  $\text{supp}(\alpha) = A$ . If  $A$  is infinite, this is impossible. In this case, we conclude that  $\alpha = 0$ , and since  $\sigma x = \beta x^2 = \beta$  is nilpotent,  $\beta = 0$  too, so  $\sigma = 0$ . This completes the proof.