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The Algebra of $1+1=1$

Group G is abelian iff

$(ab)^2 = a^2b^2$ for all

a, b in G . Ravi Vakil:

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Exercise 49.

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(Associated primes, 4

points) 1. Let p

$\in \text{Ass}(N)$; there is a n

$\in N$, such that $\text{Ann}(n)$

$= p$; since $n \in M$, we

get $p \in \text{Ass}(M)$ i.e.

$\text{Ass}(N) \supseteq \text{Ass}(M)$. Now,

let $p \in \text{Ass}(M)$ and

$m \in M$ such that

$\text{Ann}(m) = p$. If $m = 0$

$\in M = N$, then $m \in N$ and

we get $p \in \text{Ass}(N)$.

Otherwise, $m \neq 0$

$\in M = N$ and $\delta a^2 p$, $am =$

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$am=0$

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PROBLEMS AND

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(a) Hilbert's

Nullstellensatz in
commutative algebra
says that for an
algebraically closed
field k , and for any
finitely generated
polynomial ideal J the
ideal of

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Exercise 33.

(Extension under α
ring homomorphisms)

(one direction is
obvious) Assume

$\text{MaxSpec}(A) \xrightarrow{\text{im}(\alpha)}$

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and consider a A -module such that $M \neq 0$. If $M \neq 0$, take $0 \neq m \in M$. The cyclic submodule $\langle m \rangle$ generated by m is isomorphic to A/I for a (left) ideal I of A (since $0 \neq m$) the annihilator of m (look at $A \cdot m$, $a \cdot m$; its kernel is the annihilator of m and it is surjective onto ...

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Solutions for exercises, Algebra I (Commutative Algebra ...

Exercises, Algebra I
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Exercise 38 (Going-
up property, 3 points)
Solutions to be
handed in before
Tuesday June 2, 4pm
Putting things
together, let $V(b)$

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$\hat{A} \text{Spec}(B)$ be closed
subset. As B is
Noetherian, B/b is
also Noetherian. So
 $V(b) \text{Spec}(B/b)$ is a
Noetherian

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Exercise 15 (Scalar
extension of Ext and
Tor) Remember that a
module P is projective
if and only if it is a
direct summand of a
free module ie $i2IA'P$
 Q for a A -module
 Q and a set I Then we
get

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Exercise 15 (Scalar
extension of Ext and

Tor) Remember that a
module P is projective

if and only if it is a

direct summand of a
free module ie $i_2 I A' P$

Q for a A -module

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Q and a set I . Then we
get $i_2 B' = (i_2 A) \cdot A B' \cdot P$
 $B \cdot Q \cdot B$; thus $P \cdot B$ is
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First exercise class:
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and first steps
towards algebraic
geometry.

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This course provides an introduction to commutative algebra as a foundation for and first steps towards algebraic geometry. We shall cover approximately the material from most of the textbook by Atiyah-MacDonald or the first half of the textbook by Bosch. ... solutions; Exercise

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sheet 1: September
28: Solution sheet 1:
Exercise sheet 2:
October ...

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\provided hints, and
sometimes complete
solutions, to the hard"
exercises. More-over,
they developed a
signi cant amount of

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the main content in the exercises. By contrast, in the present book, the exercises are integrated into the development, and complete solutions are given at the end of the book. There are well over two hundred exercises below.

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the given solution,
possibly discussing it
with others, but
always making sure
they can eventually
solve the whole
exercise entirely on

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their own. In any event, students v vi Preface should read the given solution, even if they think they already know it, just to make sure; also, some

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Solution: $xyz = 1$

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implies that $x(yz) = 1$: Let $yz = a$. Then we have $xa = 1$ and so $ax = 1$ since a is invertible and $a^{-1} = x$: (See solution 6) It follows that $(yz)x = 1$: Hence $yzx = 1$: On the other hand, if $xyz = 1$; it is not always true that $yxz = 1$: To see this, let G be the group of 2×2 real matrices and let $x = \begin{pmatrix} 1 & 2 \\ 0 & 2 \end{pmatrix}$ $y =$

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0 1 2 1! and $z = 1 = 2$
 $3 = 4 1 1!$: Then $xyz = 1$
 $0 0 1! = 1$

EXERCISES AND SOLUTIONS IN GROUPS RINGS AND FIELDS

The converse follows from exercise 1 and exercise 2, (ii). (ii) If $f(x)$ is nilpotent, then we can apply induction to n to show

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that all its coefficients are nilpotent. The case $n=0$ is a tautology. In the general case, it's apparent that the leading coefficient will be a_m for suitable $m \in \mathbb{N}$ hence a

**Solutions to Atiyah
and MacDonald's
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By Allen ALTMAN and
Steven KLEIMAN

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“provided hints, and sometimes complete solutions, to the hard” exercises. More-over, they developed a significant amount of the main content in the exercises. By

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If $x^2 \in q$, then $x^{2n} \in q$ for all n , so $x^{2n} = r(q)$, and there exists $m > 0$ such that $x^{2m} = (x^2)^m \in q$. Thus q is primary. Let a be the intersection of the ideals $S_p(0)$ as p runs through the minimal prime ideals of A . Show that a is contained in the nilradical of A . Let P

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$\text{Spec}(A)$ be the set of
minimal prime ideals.

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Solution to Abstract
Algebra by Dummit &
Foote 3rd edition

Chapter 7.4 Exercise
7.4.31. Solution: We
begin with a lemma.

Lemma: Let R be a
commutative ring and
let $I \subseteq R$ be
an ideal. Also let J
 $\subseteq R$ is an
ideal containing I .

Then J/I is radical

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in \mathbb{R} / \mathbb{I} if and only if
 \mathbb{J} is radical in \mathbb{R} .

**In a commutative
ring, prime ideals
are radical ...**

Commutative Algebra
is the study of
commutative rings,
and their modules and
ideals. This theory
has developed over
the last 150 years not
just as an area of

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Algebra considered for its own sake, but as a tool in the study of two enormously important branches of mathematics: algebraic geometry and algebraic number theory.

**MA3G6
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If $f(a) \equiv 0 \pmod{f_0(a)^2}$ (f has an approximate solution) then

$\exists b \in R$ with $f(b) = 0$

$\exists b \in R$ such that $b \equiv a \pmod{f_0(a)}$

(f has a solution near a)

2. If in 1. $f_0(a) \in R$

is a non-zero

divisor, then $b \in R$ in 1.

is unique. Prof. o 1. f is

a polynomial in $R[T]$

and set $e = f_0(a)$. We

can write $f(a + eT) = f(a)$

$+ f_0(a)eT + h(T)e^2 + \dots$

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Algebra II -
r some $h_2R[T]$.

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