1. For each of the following ideals of $\mathbb{Q}[X, Y]$, list all monomials in $M(X, Y)$ which do not belong to the given ideal. (Use the solution of the membership problem for monomial ideals, Proposition 6.5.)

   (a) $\langle Y^4, X^3Y, X^5 \rangle$;

   (b) $\langle X^2Y^3, X^4Y^2, X^5Y^2 \rangle$.

Q1 Solution:

(a) Let $I = \langle Y^4, X^3Y, X^5 \rangle$.

Y^m is in I if and only if $Y^4 \mid Y^m$ i.e. $m \geq 4$, so the following are not in I: $1, Y, Y^2, Y^3$.

$X Y^n$ is in I if and only if $Y^4 \mid X Y^n$ i.e. $n \geq 4$ (note that X^3Y or X^5 never divide $X Y^n$), so the following are not in I: X, XY, XY^2, XY^3.
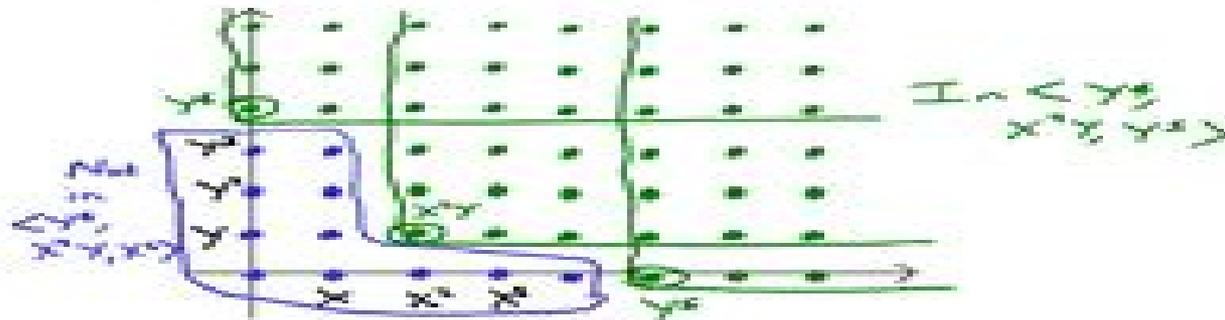
$X^2 Y^n$ is in I if and only if $X^3Y \mid X^2 Y^n$ (or $Y^4 \mid X^2 Y^n$, but that is implied by $X^3Y \mid X^2Y^n$), so the following are not in I: X^2.

For $X^3 Y^n$ and $X^4 Y^n$, again these are in I if and only if they are divisible by X^3Y i.e. when $n \geq 1$. We are left with the following not in I: X^3, X^4.

If $m \geq 5$, then $X^m Y^n$ is always divisible by X^5 so always in I.

In conclusion, there are 11 monomials which are not in I:
$1, Y, Y^2, Y^3, X, XY, XY^2, XY^3, X^2, X^3, X^4$.

(b) Let $J = \langle X^2Y^3, X^4Y^2, X^5Y^2 \rangle$.

Y^m or $X Y^n$ are never divisible by any of X^2Y^3, X^4Y^2 or X^5Y^2, so they are never in J.

$X^2 Y^n$ is in J if and only if $X^2Y^3 \mid X^2 Y^n$ i.e. if and only if $n \geq 3$. Then the following are not in J: X^2, X^2Y, X^2Y^2.

Similarly, $X^3 Y^n$ or $X^4 Y^n$ are in J if and only if they are divisible by X^2Y^3 i.e. if and only if $n \geq 3$ (note that we don't need to consider divisibility by X^4Y^2 because $X^4Y^2 \in \langle X^2Y^3 \rangle$ so omitting X^4Y^2 from our generating set wouldn't change anything). Then the following are not in J: $X^3, X^3Y, X^3Y^2, X^4, X^4Y, X^4Y^2$.

Commutative Algebra Exercises Solutions

Andrea Bandini,Patrizia Gianni,Enrico Sbarra

Commutative Algebra Exercises Solutions:

Computational Algebra: Course And Exercises With Solutions Ihsen Yengui,2021-05-17 This book intends to provide material for a graduate course on computational commutative algebra and algebraic geometry highlighting potential applications in cryptography Also the topics in this book could form the basis of a graduate course that acts as a segue between an introductory algebra course and the more technical topics of commutative algebra and algebraic geometry This book contains a total of 124 exercises with detailed solutions as well as an important number of examples that illustrate definitions theorems and methods This is very important for students or researchers who are not familiar with the topics discussed Experience has shown that beginners who want to take their first steps in algebraic geometry are usually discouraged by the difficulty of the proposed exercises and the absence of detailed answers Therefore exercises and their solutions as well as examples occupy a prominent place in this course This book is not designed as a comprehensive reference work but rather as a selective textbook The many exercises with detailed answers make it suitable for use in both a math or computer science course *Commutative Algebra through Exercises* Andrea Bandini,Patrizia Gianni,Enrico Sbarra,2024-07-12 This book provides a first introduction to the fundamental concepts of commutative algebra What sets it apart from other textbooks is the extensive collection of 400 solved exercises providing readers with the opportunity to apply theoretical knowledge to practical problem solving fostering a deeper and more thorough understanding of the subject The topics presented here are not commonly found in a single text Consequently the first part presents definitions properties and results crucial for understanding and solving the exercises serving also as a valuable reference The second part contains the exercises and a section titled with True or False questions which serves as a valid self assessment test Considerable effort has been invested in crafting solutions that provide the essential details aiming for a well balanced presentation We intend to guide students systematically through the challenging process of writing mathematical proofs with formal correctness and clarity Our approach is constructive aiming to illustrate concepts by applying them to the analysis of multivariate polynomial rings and modules over a principal ideal domain PID whenever feasible Algorithms for computing these objects facilitate the generation of diverse examples In particular the structure of finitely generated modules over a PID is analyzed using the Smith canonical form of matrices Furthermore various properties of polynomial rings are investigated through the application of Buchberger s Algorithm for computing Gr bner bases This book is intended for advanced undergraduates or master s students assuming only basic knowledge of finite fields Abelian groups and linear algebra This approach aims to inspire the curiosity of readers and encourages them to find their own proofs while providing detailed solutions to support their learning It also provides students with the necessary tools to pursue more advanced studies in commutative algebra and related subjects **Computational Commutative Algebra and Algebraic Geometry** Ihsen Yengui,2019 **Basic Abstract Algebra: Exercises And Solutions** Mohammed Hichem Mortad,2022-02-10 This book is mainly intended for first

year University students who undertake a basic abstract algebra course as well as instructors It contains the basic notions of abstract algebra through solved exercises as well as a True or False section in each chapter Each chapter also contains an essential background section which makes the book easier to use **The William Lowell Putnam Mathematical Competition 1985–2000: Problems, Solutions, and Commentary** Kiran S. Kedlaya,Bjorn Poonen,Ravi Vakil,2020-01-16 This third volume of problems from the William Lowell Putnam Competition is unlike the previous two in that it places the problems in the context of important mathematical themes The authors highlight connections to other problems to the curriculum and to more advanced topics The best problems contain kernels of sophisticated ideas related to important current research and yet the problems are accessible to undergraduates The solutions have been compiled from the American Mathematical Monthly Mathematics Magazine and past competitors Multiple solutions enhance the understanding of the audience explaining techniques that have relevance to more than the problem at hand In addition the book contains suggestions for further reading a hint to each problem separate from the full solution and background information about the competition The book will appeal to students teachers professors and indeed anyone interested in problem solving as a gateway to a deep understanding of mathematics **Convexity from the Geometric Point of View: Exercises and Solutions** Vitor Balestro,Horst Martini,Ralph Teixeira,2025-08-04 This book provides the solutions to all 347 exercises contained in the text Convexity from the Geometric Point of View published in the same Cornerstones series All these exercises are restated and numbered analogously to those in the original text The corresponding solutions follow each exercise Besides the discussion of all solutions some additional facts about the main text are sprinkled throughout Sections of further reading are posted to the ends of each chapter supplying the reader with background literature to selected notions and tools that play a role in the exercises and or solutions to the chapter The original text gives a comprehensive introduction to the common core of convex geometry and is suitable as a primary text for courses in convex geometry and in discrete geometry including polytopes Additionally it can be used as a single reference for a complete introduction to convex geometry The content coverage is sufficiently broad that the reader may gain a glimpse of the entire breadth of the field various subfields and interesting connections to neighboring disciplines Mainly directed to graduate and advanced undergraduates the original text is self contained in such a way that it can be read by anyone who has standard undergraduate knowledge of analysis and of linear algebra The same is true for this book of solutions **Abstract Algebra** Paul B. Garrett,2007-09-25 Designed for an advanced undergraduate or graduate level course Abstract Algebra provides an example oriented less heavily symbolic approach to abstract algebra The text emphasizes specifics such as basic number theory polynomials finite fields as well as linear and multilinear algebra This classroom tested how to manual takes a more narrative approach than the stiff formalism of many other textbooks presenting coherent storylines to convey crucial ideas in a student friendly accessible manner An unusual feature of the text is the systematic characterization of objects by universal

mapping properties rather than by constructions whose technical details are irrelevant Addresses Common Curricular Weaknesses In addition to standard introductory material on the subject such as Lagrange s and Sylow s theorems in group theory the text provides important specific illustrations of general theory discussing in detail finite fields cyclotomic polynomials and cyclotomic fields The book also focuses on broader background including brief but representative discussions of naive set theory and equivalents of the axiom of choice quadratic reciprocity Dirichlet s theorem on primes in arithmetic progressions and some basic complex analysis Numerous worked examples and exercises throughout facilitate a thorough understanding of the material   *An Undergraduate Primer in Algebraic Geometry* Ciro Ciliberto,2021-05-05 This book consists of two parts The first is devoted to an introduction to basic concepts in algebraic geometry affine and projective varieties some of their main attributes and examples The second part is devoted to the theory of curves local properties affine and projective plane curves resolution of singularities linear equivalence of divisors and linear series Riemann Roch and Riemann Hurwitz Theorems The approach in this book is purely algebraic The main tool is commutative algebra from which the needed results are recalled in most cases with proofs The prerequisites consist of the knowledge of basics in affine and projective geometry basic algebraic concepts regarding rings modules fields linear algebra basic notions in the theory of categories and some elementary point set topology This book can be used as a textbook for an undergraduate course in algebraic geometry The users of the book are not necessarily intended to become algebraic geometers but may be interested students or researchers who want to have a first smattering in the topic The book contains several exercises in which there are more examples and parts of the theory that are not fully developed in the text Of some exercises there are solutions at the end of each chapter   **Student Solutions Guide for Elementary Algebra, Fourth Edition, Larson/Hostetler** Carolyn F. Neptune,2005   Arithmetic Algebraic Geometry Brian David Conrad, The articles in this volume are expanded versions of lectures delivered at the Graduate Summer School and at the Mentoring Program for Women in Mathematics held at the Institute for Advanced Study Park City Mathematics Institute The theme of the program was arithmetic algebraic geometry The choice of lecture topics was heavily influenced by the recent spectacular work of Wiles on modular elliptic curves and Fermat s Last Theorem The main emphasis of the articles in the volume is on elliptic curves Galois representations and modular forms One lecture series offers an introduction to these objects The others discuss selected recent results current research and open problems and conjectures The book would be a suitable text for an advanced graduate topics course in arithmetic algebraic geometry   **Student Solutions Manual Intermediate Algebra** Julie Miller,2007-01-09   **The American Mathematical Monthly** ,1906 Includes section Recent publications   **NCERT Exemplar Problems-Solutions MATHEMATICS class 6th** Arihant Experts,2015-09-25 Questions are the root cause of success The more new authentic questions you will have the more new authentic knowledge you will have Considering this fact the Department of Education in Mathematics Mathematics DESM with an aim to improve the quality of teaching learning

process in schools has made an attempt to develop resource books of Exemplar Problems in different subjects at secondary and higher secondary stage These specialized resource books named NCERT Exemplars are not meant to serve merely as question banks for examinations but are primarily meant to discourage rote learning The first and the only books of its kind by Arihant Publications is an attempt at providing comprehensive guide to NCERT Exemplar Problems Solutions for Class 6th to 12th The present book for Class 6th Mathematics contains different types of questions of varying difficulty level Also detailed explanation for comprehensive understanding has been given for all objective and subjective problems The present book has been divided into nine chapters namely Number System Geometry Integers Fractions Decimals Data Handling Mensuration Algebra Ratio Proportion and Symmetry Practical Geometry The problems provided in the book will test comprehension information recall analytical thinking and problem solving ability creativity and speculative ability The book will also be highly useful for school examinations and to build foundation for entrance examinations As the book contains detailed and comprehensive solutions for NCERT Exemplar problems for Class 6th Mathematics it for sure will act as a catalyst in helping discourage rote learning   Study Guide with Solutions to Selected Odd-numbered Exercises for Gustafson and Frisk's Intermediate Algebra George Grisham,1992   **Electromagnetic Theory; Problems and Solutions** Keith Foster,R. Anderson,1970   **Problems & Solutions in Euclidean Geometry** M. N. Aref,William Wernick,1968   Student's Solutions Manual Intermediate Algebra Judith A. Penna,Marvin L. Bittinger,David J. Ellenbogen,2005-08   **Student Solutions Manual for Stewart/Redlin/ Watson's College Algebra, Fourth Edition** John Banks,2004   **New Technical Books** New York Public Library,1994   **Student's Solutions Manual** Tom Carson,Ellyn Gillespie,2005-05-26

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