

Number Theory II: Problems with Solutions

Greg Gamble

1. Show $7 \mid 2222^{5555} + 5555^{2222}$.

Solution. By Fermat's Little Theorem, for any natural number n

$$n^7 = n \pmod{7}.$$

So for natural numbers q and r ,

$$\begin{aligned} n^{7q+r} &= (n^7)^q \cdot n^r \pmod{7} \\ &= n^q \cdot n^r \pmod{7} \\ &= n^{q+r} \pmod{7}. \end{aligned}$$

Below we will use this result repeatedly. First though, observe that

$$2222 = 3 \pmod{7} \quad \text{and} \quad 5555 = 4 = -3 \pmod{7}.$$

Thus

$$\begin{aligned} 2222^{5555} + 5555^{2222} &= 3^{5555} + (-3)^{2222} \pmod{7} \\ &= 3^{7 \cdot 793 + 4} + (-3)^{3 \cdot 737 + 3} \pmod{7} \\ &= 3^{13+6} + (-3)^{10+5} \pmod{7} \\ &= 3^{17+0} + (-3)^{7+1} \pmod{7} \\ &= 3^{2+3} + (-3)^{1+1} \pmod{7} \\ &= 3^2(3^2 + 1) \pmod{7} \\ &= 3^2 \cdot 28 \pmod{7} \\ &= 0 \pmod{7}. \end{aligned}$$

Hence $7 \mid 2222^{5555} + 5555^{2222}$.

Solution. (Alternative) The above solution is not a particularly clever way of using Fermat's Little Theorem. Since $n^7 - n$ factorises as $n(n^6 - 1)$, it follows from Fermat's Little Theorem that:

If n is a natural number and $n \not\equiv 0 \pmod{7}$ then $n^6 = 1 \pmod{7}$.

So for natural numbers n , q and r , if $n \not\equiv 0 \pmod{7}$ then

$$\begin{aligned} n^{6q+r} &= (n^6)^q \cdot n^r \pmod{7} \\ &= 1^q \cdot n^r \pmod{7} \\ &= n^r \pmod{7}. \end{aligned}$$

Number Theory Problems Solutions

Richard Guy



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Table of Contents Number Theory Problems Solutions

1. Understanding the eBook Number Theory Problems Solutions
 - The Rise of Digital Reading Number Theory Problems Solutions
 - Advantages of eBooks Over Traditional Books
2. Identifying Number Theory Problems Solutions
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Number Theory Problems Solutions
 - User-Friendly Interface
4. Exploring eBook Recommendations from Number Theory Problems Solutions
 - Personalized Recommendations
 - Number Theory Problems Solutions User Reviews and Ratings
 - Number Theory Problems Solutions and Bestseller Lists
5. Accessing Number Theory Problems Solutions Free and Paid eBooks
 - Number Theory Problems Solutions Public Domain eBooks
 - Number Theory Problems Solutions eBook Subscription Services

- Number Theory Problems Solutions Budget-Friendly Options
- 6. Navigating Number Theory Problems Solutions eBook Formats
 - ePub, PDF, MOBI, and More
 - Number Theory Problems Solutions Compatibility with Devices
 - Number Theory Problems Solutions Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Number Theory Problems Solutions
 - Highlighting and Note-Taking Number Theory Problems Solutions
 - Interactive Elements Number Theory Problems Solutions
- 8. Staying Engaged with Number Theory Problems Solutions
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Number Theory Problems Solutions
- 9. Balancing eBooks and Physical Books Number Theory Problems Solutions
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Number Theory Problems Solutions
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Number Theory Problems Solutions
 - Setting Reading Goals Number Theory Problems Solutions
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Number Theory Problems Solutions
 - Fact-Checking eBook Content of Number Theory Problems Solutions
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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Chapter 10 Investigation Worksheet ... exploring geology Chapter 10 Investigation Worksheet: page 4 and C Table 3. Interpreted Relationship Between Adjacent Features Related Possible ... Appendix 2: Answers to Review Questions The following are suggested answers to the review questions at the end of chapters in Physical Geology. Answers to the exercises are provided in Appendix 3. Exploring Geology 4th Edition by Reynolds Johnson Morin ... Exploring Geology 4th Edition by Reynolds Johnson Morin Carter ISBN Solution ... 2.0 Investigating Geologic Questions • 2.1 What Can We Observe in Landscapes? daycare profit and loss statement template Complete non-shaded fields, only. 9, INCOME. 10, TUITION INCOME. DAYCARE PROFIT AND LOSS STATEMENT TEMPLATE DAYCARE. PROFIT AND LOSS. STATEMENT TEMPLATE. Template begins on page 2. Page 2. ORGANIZATION NAME. START DATE. END DATE. REFERENCE ID. NO. ENROLLED. MONTHLY ... daycare profit and loss statement - PDFfiller A daycare profit and loss statement should include information about total revenue, cost of goods sold, operating expenses, employee wages and benefits, taxes, ... Daycare Profit And Loss Statement Template - Iranianstudy Feb 22, 2023 - Daycare profit and loss statement template - A statement is a created or spoken declaration of fact or opinion. How to Create a Profit/Loss Statement - Tom Copeland Mar 28, 2017 — What is a Profit/Loss Statement and how can a family child care provider make use of one? A Profit/Loss Statement is a financial statement ... Daycare profit and loss template: Fill out & sign online Edit, sign, and share daycare profit and loss statement online. No need to install software, just go to DocHub, and sign up instantly and for free. How to Calculate Profit & Loss for Home Daycare - Sapling A P&L Statement is a list of your income and expenses, broken down into categories that show you where your money is coming from and what type of expenses you ... Daycare Profit and Loss Template Form - Fill Out and Sign ... In Home Daycare Tax Deduction Worksheet. Check out how easy it is to complete and eSign documents online using fillable templates and a powerful editor. DAY CARE INCOME and EXPENSE WORKSHEET AUTO EXPENSE: Keep records of mileage for Day Care meetings, shopping trips for supplies, banking, education, taking children home, to doctor or to events. FOOD.