

Final Answers

MATH312 December 2009

How to use this resource

- When you feel reasonably confident, simulate a full exam and grade your solutions. [For your grading you can get the full solutions here.](#)
- If you're not quite ready to simulate a full exam, we suggest you thoroughly and slowly work through each problem. Use this document with the final answers only to check if your answer is correct, without spoiling the full solution.
- Should you need more help, check out the hints and video lecture on the [Math Educational Resources](#).

Tips for Using Previous Exams to Study: Work through problems

Resist the temptation to read any of the final answers below before completing each question by yourself first! We recommend you follow the guide below.

1. **How to use the final answer:** *The final answer is not a substitution for the full solution!* The final answer alone will not give you full marks. The final answer is provided so that you can check the correctness of your work without spoiling the full solution.
 - To answer each question, only use what you could also use in the exam. [Download the raw exam here.](#)
 - If you found an answer, how could you verify that it is correct from your work only? E.g. check if the units make sense, etc. Only then compare with our result.
 - If your answer is correct: good job! Move on to the next question.
 - Otherwise, go back to your work and check it for improvements. Is there another approach you could try? If you still can't get to the right answer, you can check the full solution on the [Math Educational Resources](#).
2. **Reflect on your work:** Generally, reflect on how you solved the problem. Don't just focus on the final answer, but whether your mental process was correct. If you were stuck at any point, what helped you to go forward? What made you confident that your answer was correct? What can you take away from this so that, next time, you can complete a similar question without any help?
3. **Plan further studying:** Once you feel confident enough with a particular topic, move on to topics that need more work. Focus on questions that you find challenging, not on those that are easy for you. Once you are ready to tackle a full exam, follow the advice for the [full exam \(click here\)](#).

Please note that all final answers were extracted automatically from the full solution. It is possible that the final answer shown here is not complete, or it may be missing entirely. In such a case, please notify mer-wiki@math.ubc.ca. Your feedback helps us improve.

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Question 1 (a)

FINAL ANSWER. Hence $3^n \mid (3n)!$ and combining these results (since 2 and 3 are coprime) gives us our result.

Question 1 (b)

FINAL ANSWER. Finally, it's clear that $(a + b, 2)$ is 1 or 2. This completes the proof.

Question 2 (a)

FINAL ANSWER. In fact $209 = 11 \cdot 19$.

Question 2 (b)

FINAL ANSWER. $2820 = 2^2 \cdot 3 \cdot 5 \cdot 47$. Hence 2821 is a Carmichael number.

Question 3 (a)

FINAL ANSWER. $7^{999} \equiv 7^{199} \equiv 7^{-1} \equiv 143 \pmod{1000}$ completing the question.

Question 3 (b)

FINAL ANSWER. $\equiv 28 \pmod{31}$

Question 4 (a)

FINAL ANSWER. $P_4 \equiv 15(1 - 11) \equiv 15(-10) \equiv -150 \equiv 6 \equiv G \pmod{26}$ Thus, the plaintext was the word TRIG.

Question 4 (b)

FINAL ANSWER. $\equiv (-1)^{(p+1)/2} \pmod{p}$ and this was what we wanted to show.

Question 5 (a)

FINAL ANSWER. $S(n) = 0$. This completes the proof.

Question 5 (b)

FINAL ANSWER. $\left\{0, 1, \frac{2}{3}, \frac{7}{10}, \frac{30}{43}\right\}$

Question 6 (a)

FINAL ANSWER. Thus $\sqrt{6}$ is irrational and hence so is $\sqrt{3} + \sqrt{2}$ by the above argument as required.

Question 6 (b)

FINAL ANSWER. Thus 10 divides $a(a^{4n} - 1)$ completing the proof.