## Math 111 - Midterm 1 Review Problems

Here are some review problems for the first midterm. Two thirds of the exam will be based on problems just like these. The rest will be similar to the problems in the workshops and homework.

1. This pictures depicts (but does not prove!) a famous theorem from geometry. What theorem is it, and what does it say about the three squares in this picture?
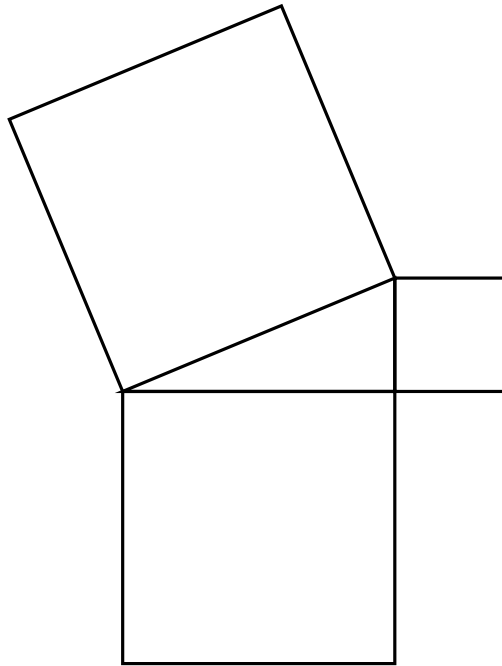
2. If it is 4 PM Greenwich Mean Time when the sun reaches the highest position in the sky where you are then what is your longitude? Are you East or West of England?

3. Describe in words how to tell if a number is divisible by 300.

4. How many prime numbers are there?

5. What is the difference between a rational and an irrational number.

6. How can you tell that the number $6.\overline{7} = 6.7777...$ is rational?

7. It is a fact that $17 \times 24 = 408$. Use this information to help find 413 mod 24 without a calculator.

8. What are the first 3 positive numbers that are equivalent to -13 modulo 11?

9. Is 67122 divisible by 33? How can you tell without a using a calculator or long division?

10. Explain why calculating mod 10's is so easy.

11. Compute the following moduli (without a calculator)

(a) 3564 mod 3

(b) 365723 mod 11

(c) 455417 mod 9

12. If it is 10 AM now, then what time will it be 17 hours from now? What about 37 hours from now?

13. If today is Monday, then what day of the week will it be 100 days from now? What day of the week would it be 777 days from now?

14. If I tell you that 216 days from now will be a Friday, then what day is it today?

15. Find the smallest positive solution to the equation $2x + 4 \equiv 3 \pmod{7}$.

16. What are the first 10 prime numbers?

17. Find the following moduli (without a calculator):

(a) 13 mod 5

(b) 7 mod 2

(c) 42 mod 3

18. Why do bar codes have a check digit? What does the check digit do?

19. Find the following without a calculator, and write your answer in scientific notation.

(a) $2,000 * (4.0 \times 10^6)$

(b) $\dfrac{6.0 \times 10^{13}}{2.0 \times 10^5}$

(c) $(3 \times 10^5)^3$

(d) 5 billion squared

(e) 100^6

(f) 4 million divided by 0.01.

20. Indicate where the numbers 25, 48, and 70/3 belong on the logarithmic scale below.
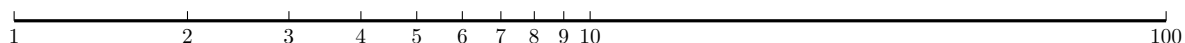
21. Use the following preference schedule to answer the questions below.

Class President Preferences			
Number of voters	**11**	**10**	**7**
1st choice	Alice	Bob	Carmen
2nd choice	Carmen	Carmen	Bob
3rd choice	Bob	Alice	Alice

(a) How many people prefer Bob as their second choice?

    (b) In a head to head competition between Alice and Bob, who would get more votes?

    (c) Is there a Condorcet candidate? Explain.

    (d) Who would win the election using the Borda count method?

    (e) Which candidate would be the first person eliminated in Instant Run-Off Voting?

22. Which is the only one of the following voting methods that will always elect a Condorcet candidate: Plurality, Borda Count, Instant Run-Off, or Pairwise Comparisons?

23. Which voting method can fail the Monotonicity criteria?

24. Suppose that in 2000, Ralph Nader had dropped out of the election and Al Gore won. This would be an example of a violation of which fairness criterion?

25. 500 kilometers is how many orders of magnitude larger than 5 cm?

26. The log(95,563) is closest to what whole number? Give a reason for your answer.

27. The speed of light is 3.0×10^8 meters per second. How far does light travel in 10 minutes?