Math review for the final exam

Exam conditions The final exam will be "open book, open notes". You may bring to the exam anything additional to help you which is *non-living.**

Rules
- In each case, you should show your work, explain your answer, etc.: an answer alone generally will *not* be sufficient for full credit!
- Write answers to "mod" questions in standard form: although $20 = 2 = -16$ mod 18 etc., the standard form would be **2**: always an integer between 0 and the modulus.

Problem 1 Which of $\left(10^{44}\right)^{55}$ and $\left(10^{44}\right) \cdot \left(10^{55}\right)$ is larger?

Problem 2 What is 56 mod 6?

Problem 3 What is 3798107541 mod 9?

Problem 4 What is 3798107541 mod 11?

Problem 5 What is $7^{322222224512}$ mod 8? ($7 = 8 - 1$.)

Problem 6 What is $7^{322222224512}$ mod 7?

Problem 7 What is $7^{322222224512}$ mod 6? ($7 = 6 + 1$).

Problem 8 What is $3 \cdot (6^{200}) + 2 \cdot (8^{333}) + 4$ mod 7? ($6 = \ldots$ and $8 = \ldots$.)

Problem 9 What is $42^{1234567}$ mod 4?

Problem 10 What is the table of addition mod 5?

Problem 11 What is the table of multiplication mod 5?

Problem 12 Solve $2x + 1 = 4$ mod 5.

Problem 13 Solve $2x + 1 = 4$ mod 6.

Problem 14 Solve $3x + 1 = 4$ mod 6.

Problem 15 Define **prime number**. Explain briefly why arithmetic mod a prime number is more like standard arithmetic than arithmetic mod a non-prime number.

Problem 16 What is 23 in binary?

Problem 17 What is 10110001 in decimal?

Problem 18 How many different bitstrings 7 bits long are there?

Problem 19 What is the xor of the bitstrings 11001 11100 and 10101 00111?

Problem 20 Which is more work ("work"=one-digit arithmetic operations): squaring one hundred numbers 50 decimal digits long or adding ten pairs of numbers 5,000 decimal digits long?

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* The instructor will judge if something is "alive". I included this stipulation because of the following story: At Caltech one semester, a physics instructor said that on the final exam, students could use "anything they could carry in." One student carried in Richard Feynman. You should know who Richard Feynman is (ground-breaking theoretical physicist) and something of his character (first-class crazy person) to appreciate this.