Math 210 - Dr. Miller - Topics/Objectives List for Cumulative Final Exam, Spring 2024

2:00 class: Thursday, May 2, 10:30-12:30 **3:30 class: Tuesday, Apr. 30, 1:00-3:00**

The exam is in our regular classroom. – **You MUST take it at the SRU-assigned time for your section.**

The exam is cumulative across the entire semester. Material is weighted roughly 10-15% on our latest work with fractions, and the rest roughly equally spread across our previous three exam topics.
Compare this list to your notes, in-class materials, reading, online links, Bonus Study Prompts, Weekly Assessments, Required Practice, and extra problems. Refer to the study skills handout from earlier this semester. Using problem flashcards, studying together, and coming to office hours can help. We also have a Review Session Monday, April 29.

Problem Solving: Know that true problem solving involves new or unfamiliar situations. Don't panic!

1. Avoid tangling how (giving a process) versus telling why (giving reasons) in your explanations.
2. State Polya's Four Steps in order. Spell his name. Know we use the Steps for problem solving.
3. Memorize strategy names and complete characteristics from Summary #1. Use them for:
   (a) Given a problem, name several strategies that might/might NOT work in solving it.
   (b) Identify key characteristics of the problem to justify your strategy. That is, tell WHY to choose the strategy (what it is about the problem that fits the strategy), not HOW to use it.
4. Solve a problem, possibly unfamiliar; I may require a certain strategy vs. leave the choice to you.
5. Tables/diagrams/pictures/variables need clear labels. Guess and Check should explain improved guesses.
6. Practice flexibility - use new "tricks" you've seen - but prepare for VARIABLES to be forbidden.
7. Interpret, clearly label fractions kept vs given away in Work Backward charts. Solve such problems fully.

Sequences: Algebra/variables - other than a_1, a_2, etc. - will not be permitted in sequence problems.

1. Give meaningful VERBAL definitions for each of the five special types of sequences.
2. Classify given sequences: arithmetic, geometric, Fibonacci-type, repeating, or no special type.
3. Given an original sequence, find its difference sequence; and vice versa.
4. Identify common difference (CD), common ratio (CR) of a given sequence.
5. Sequences may use decimals, fractions, or negative numbers in general, or as CDs and CRs.
6. Make up arithmetic, geometric, or Fibonacci-type sequences satisfying given verbal information.
7. Find distant terms for arithmetic or repeating sequences. Prepare to explain, if asked.

Number Sentence Terminology, Scenarios: These can now involve whole numbers or FRACTIONS.

1. Name the 4 operations. Memorize and closely spell the terminology for parts of number sentences.
2. Create number sentences having given numbers in specified roles; recognize when you cannot.
3. Create whole number sentences w/more general behaviors; if not possible, explain if asked.
4. Given a number sentence or just a list of numbers, write the associated Fact Family.
5. Know when division involving 0 is possible/not; use Fact Family relationships to explain.
6. Memorize names of scenarios from Summary #3 and their characteristics.
7. Given a word problem, identify by name the scenario and/or operation it represents.
8. Write the complete number sentence represented in a given word problem.
9. Make up an original word problem requiring a given computation and scenario.
10. When asked, distinguish "objects" vs. "measurements" in reading or writing a word problem.

Algebra for Teachers: Explain in sentences the steps in the Order of Operations; listing names is not enough.

1. Apply the Order of Operations to simplify a numeric expression.
2. Place parentheses in an equality to make it correct, as in Problem #4 of practice HW #5P.
3. Recognize correct vs. incorrect use of = sign in examples; use it correctly in your OWN work.
4. Explain what each of the Properties from Summary #2 means in 3rd-5th grade language/words.
5. Given a 3rd-5th grade style description of a property, tell the name of the property described.
6. Given a number sentence, identify (closely spell) the COMPLETE name of the property it illustrates.
7. Complete a number sentence to illustrate a required property and ONLY that property.
8. Simplify an algebraic expression by using the Distributive Property and combining like terms.
9. Write an algebraic expression representing a given verbal description. Declare useful variables if needed.
   (a) Variables should be declared as things that can be numbers: "x = how many dimes" or "x = number of dimes" is good, while "x = dimes" is not.
10. Solve basic linear equations, clearly showing EACH step of work (same action on both sides) one step at a time.

Whole Number Basics and Numeration: CLEARLY explain meanings of (see notes!): place value, base ten.

1. Know the difference between whole numbers and counting numbers.
2. Understand the term "digit" in context.
3. Convert between forms for base ten numerals: standard, word, all three types of expanded.
4. Put a list of place values in order by size, as on WA and Bonus Study Prompt.
5. Round whole numbers to a given place. Identify whether you rounded up versus down.
6. Find one or more numbers that round TO a desired result, including rounding up vs. down.
7. Find one or more Hindu-Arabic numerals that satisfy a given set of clues.
8. Tell what a "numeration system" is; correctly spell the name for ours.
9. Name AND describe the three key features of our system of numeration.
10. Write one or more Hindu-Arabic numerals that follow or precede a given numeral, including skip-counting (by 2s, 5s, 10s, 20s, 100s, 400s, 1000s, etc.).
11. Identify largest/smallest of numerals among standard, word, and/or expanded forms.
12. Fill in missing numbers in a counting grid (10s grid), possibly with only certain squares showing.
    (a) Indicate if any numbers are impossible because they go "out of bounds."
13. List Hindu-Arabic numerals that precede or follow given ones, both immediately and when we skip-count.

Arithmetic Algorithms, Manipulatives: *Algorithms must display PERFECT markings, suited to a teacher.*

1. Explain steps - including WHY to trade! - to find sums, differences using base blocks.
2. Add, subtract, multiply, divide using the Standard Algorithms.
3. Remember to cross OUT a number if it's been changed or is no longer relevant during by-hand work.
4. Demonstrate Scratch Addition, Lattice Addition, Balancing Subtraction (Equal Addends).
5. Add/subtract mixed measurements such as inches-feet-yards, time, etc., as in text practice.
6. Demonstrate: Lattice Multiplication, Partial Products Algorithm, Area Model for multiplication.
7. Demonstrate the Partial Quotients Algorithm for division (expect around 6 steps).
8. Fill in the blanks in partway-done algorithms; create largest/smallest answers, as in practice, SPs, WAs.

Number Theory: Understand, convert between: factor, divisor, multiple, divisible, and divides.

1. Use FORMAL definition of divides (box, number sentence, WHOLE #) in explanations, including with the synonyms.
2. Know, use, understand short-hand notation $x|y$ for "x is a factor of y" (and $x \nmid y$ when x isn't a factor).
3. Do NOT confuse the | symbol with a fraction bar, ÷ symbol, or division.
4. Identify true/false statements or create your own sentences using synonyms or | or $\nmid$ symbols.
5. Especially know how the synonyms pertain to the numbers zero and one.
6. List all counting or whole numbers that are factors or multiples of a given number.
7. List factors or multiples meeting extra conditions: even, odd, prime, composite, certain size, etc.
8. Know that all natural numbers can be classified as prime, composite, or unit; sort examples.
9. Memorize the primes up to 50; be able to test/recognize higher numbers as prime vs composite.
10. Prime factor a given number, using your choice of a Factor Tree (or" fallen tree") vs. Division Tower.
11. Be careful not to stop a tree/tower too early; check that unusual-looking final factors *are* prime (using the PNT).
12. Prime factor numbers that are products or already have exponents. Use exponent rules to simplify.
13. Apply the Prime Number Test to a given number, showing ALL steps. Be sure to draw a conclusion!
14. Use all methods to find GCDs, LCMs: listing, prime factors, Euclidean Algorithm/formula.
15. Use Euclidean formula to find unknown numbers.

Ratio and Proportion: Decimals ARE allowed on tasks listed below. **Bring an approved calculator.**

1. Use, understand ways to give ratios: words "for/out of every" or "per"; notation colon, "to," (fractions if forced).
2. Convert ratios given in "for/out of every" words to ratios in a sentence with notation, and vice versa.
3. Identify part-to-part vs. part-to-whole ratios; convert between them, as in notes, practice, Prompts.
4. Draw and fully label rectangle diagrams for ratios. Understand "all" versus "all other."
5. Use given ratios to FIND related ratios, such as "If 5 out of every 7 pens are blue, what is the ratio of non-blue pens to blue pens?" or "The ratio of dogs to cats is 3:8; what is the ratio of cats to dogs?"
6. Solve proportion problems, possibly using MY choice of method; prepare to explain if asked.
    (a) Methods are: representative sets, unit-rate, scaling, proportional equation, other algebraic methods.
    (b) Recognize the differences between all methods. Label which one you've used when asked.

(c) Know which of these methods are algebraic/not; use only those permitted in a given problem.
(d) For representative sets, include a clear legend for your picture, such as $C = 1\ cat$, not $C = cat$.
(e) For scaling or unit-rate, show clear, thorough arithmetic steps from original ratio to final target.
(f) Know that *successful* unit-rate scaling requires us to find about 1 of the *target* item.
(g) Distinguish between additive vs. direct scaling if asked; otherwise you can mix them or go hybrid.
(h) When you create proportional equations, charts are allowed but not required. Labeling *is* required, either in your chart or in the equation itself.

7. Find the scale factor from an original ratio to a target in scaling.
8. Solve problems with multi-number ratios, such as fair-share pay, inheritances, "parts," etc.
9. Know to include units when appropriate. Round answers where indicated.

Fraction Basics, Meanings, Comparison Methods: **Decimals are NOT allowed on this material.**

1. Explain clearly what whole, numerator, denominator represent in part-of-a-whole meaning.
   (a) DON'T say/write things like "In 3/5, 5 is the whole"!!!!
2. Know which part of a fraction can/cannot be zero; FULLY explain using the part-of-a-whole meaning.
3. Define "equivalent fractions"; find fractions equivalent to a given one, including like 6-1A #14.
4. State the FLF verbally; show it - with good notation - to create equivalent fractions/lowest terms.
5. Apply all 5 methods to order two fractions; choose the most effective; use MY choice when asked.
   (a) Take special care in the "Use meanings of numerator, denominator" method.
6. Put a set of more than two fractions in order. Clearly define the term "denseness."
7. Find one or more fractions between two others. Use correct notation for mediant.

Fraction Arithmetic: **Decimals are NOT allowed on this material.**

1. Explain why a common denominator (CD) is required for adding/subtracting.
2. Explain how the part-of-a-whole meaning of fractions is interpreted in fraction multiplication.
3. Explain why invert-and-multiply works to give a division answer, using your choice of (1) definition of division or (2) definition of reciprocal with the division meaning of fractions.
4. Create Fact Families involving fractions, as in the whole number setting.
5. Find a missing number from a fraction number sentence, as in Study Prompts.
6. By-hand algorithms to add, subtract, multiply, divide fractions will be assessed on OPTIONAL WA #12, in the context of word problems.

You will have the entire 2-hour period to take the exam. When you finish, you may hand it in and leave.

You may use a basic calculator (not cell phone, no alphabet), but no other aids are permitted.

Students with documented accommodations should speak with me and process ODS requests ASAP.
ODS should proctor your accommodations since our classroom and my schedule are not automatically free.

End-of-Course Information:

- The Final Exam is worth 120 points out of 580 total points for the course.
  - See the syllabus AND minor corrections announcement from Week One.
- Material will be split roughly equally among the 3 earlier exams' content, with about 10-15% for newest topics.
- I don't expect to have ANY finals graded earlier than Saturday evening, and am often still grading on Tuesday.
- Please don't email/phone for your grade - that only slows me (and your other professors) down.
- I'll post scores on D2L when available; I try to update D2L before the Tuesday afternoon MySRU deadline.
- D2L grades are NEVER official per SRU rules - only the grade reported by your professor on MySRU is official.
- If you think there's an *error* calculating your score, I will definitely look into that ASAP.
- But - there's no extra credit or re-do's after-the-fact: **YOU must take action NOW to ensure the grade you want.**