**Lesson Plan 5**

Review Day 2

Purpose and Central Focus

This lesson is the end of a learning segment on the roots of polynomials. The purpose of this lesson is to consolidate unit learning about polynomials, including techniques and approaches for finding roots in light of more fulsome knowledge of these. This consolidation is useful in its own right, but it will also provide an opportunity to deepen understanding and engagement with the earlier material. On a more pedestrian level, this lesson serves as a first chance to revise and review for a forthcoming unit test. This test review is central to the lesson, which has a number of moving parts to enable targeted review in areas of need, as determined by formative assessment.

As with the previous review day, the concepts and procedures here have rich connections to other areas of mathematics, our own previous and future work. For instance, the pending unit on inverse functions and roots will draw heavily on our work with polynomials, in essence providing the answer to “When and how can we say what went into a polynomial function to get a give output?”

Illinois Learning Standards/Common Core Standards/Content Area Standards

* HSA.APR.B.3 – Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
* HSA.SSE.A.2 – Use the structure of an expression to identify ways to rewrite it. For example, see *x*4 – *y*4 as (*x*2)2 – (*y*4)2, thus recognizing it as a difference of squares that can be factored as (*x*2 – *y*2)(*x*2 + *y*2).
* HSA.APR.D.6 – Rewrite simple rational expressions in different forms; write *a*(*x*) ÷ *b*(*x*) in the form *q*(*x*) + *r*(*x*)/*b*(*x*), where *a*(*x*), *b*(*x*), *q*(*x*), and *r*(*x*) are polynomials with the degree of *r*(*x*) less than the degree of *b*(*x*), using inspection, long division, or, for the more complicated examples, a computer algebra system.

Objectives

1. Given a polynomial *P* over the rationals (C), the learner (A) will flexibly apply techniques including synthetic substitution, the Rational Zero Theorem, and the Fundamental Theorem of Algebra to find all of the zeros of *P* (B) in 80% of cases (D).
2. Given a rational expression (C), the student (A) will flexibly apply techniques including long division, synthetic division, cancellation, and exponent properties to reduce the expression to standard form AND state whether the reduced form is a polynomial (B) in 90% of cases (D).

Duration

47 minutes.

Materials and Equipment

* Student note packet.
* Video tutorials for direct presentation and example exercises.
  + Website to disseminate of these.
* Student and teacher textbooks (McGraw Hill *Integrated Math 3*).
  + Practice worksheets on a variety of topics, indicated by formative assessment and previous lesson exit ticket.
    - Anticipate coverage of at least: **4-1**, **4-5**, and **4-7**.
    - If possible, generate customized review worksheet using publisher’s eAssessment tool.
  + Student answer sheets for worksheets, to check results during study/revision.
  + Student answer sheets for marking previous work (**4-R: 11-47 & 53-56**).
    - Fully worked sheet of same problems.
* Graphing calculators.

Gaining Attention/Introduction/Anticipatory Set (2 minutes)

Pay off exit ticket from previous lesson by explaining use of “Trace” function to quickly assess zero candidates from Rational Zero Theorem (R.Z.T.). Show example problem:  
“Using the R.Z.T. on *x*3 – 2*x*2 – 21*x* – 18 gives us candidate zeros ±1, ±2, ±3, ±6, ±9, and ±18. Graphing this on [-18,18] × [-75,25] and using trace to check at the candidate values quickly shows that -2, -1, and 6 are zeros. Our calculator isn’t perfectly precise in the locations it finds, so we can make sure by using synthetic substitution.”

Inform Learners of Objectives (2 minutes)

Students are likely to respond to a simple statement of our objective: “Today, we want to continue to practice and review our whole array of techniques for dealing with polynomials. We have work ready for exactly what you wanted to review, and we’re going to work on that together.” I’ll write a simple form of this statement on a side board.

Stimulate Recall of Prior Learning (3 minutes)

Students mark their own results on classwork from previous lesson (**4-R: 11-47 & 53-56**). Students may ask for review of certain exercises and it is appropriate to address these to a moderate degree in this lesson, continuing to encourage students and/or groups to show and explain their results to the extent possible.

Present the Content/Provide Learning Guidance (5-10 minutes)

Distribute first worksheet and carefully monitor groups’ progress, assessing and advancing as appropriate. As groups near completion, select exercises of special interest to be presented by one group. Note differences in technique that reached the same result for purposes of creating dialogue.

As this is a review section, we can expect that students are at least familiar with each kind of problem encountered. Further, scope for guidance covers entire unit, so exact concerns depend on problems engaged (which depends in turn on outcome of pending assessment). In general, concerns are identical to previous lesson:

* Correct use of exponent properties in reductions.
* Proper reduction.
  + Elimination of decimals and negative exponents
* Selection of effective division technique.
* Use of *u*-substitution in factoring.
* Evaluation by efficient synthetic substitution (as opposed to direct evaluation).
* Use of depressed polynomial methods when available.

Assessing questions for student understanding include:

* How do you know this is fully simplified?
* Why didn’t you use [a different technique] here?
* What if someone suggested [a different value] for [degree, lead coefficient, constant coefficient, candidate zero]?
* How did you obtain this [factorization, set of roots/zeros]?

Provide Feedback I (3-5 minutes – mainly in succeeding lesson & built into classwork)  
As groups complete first worksheet, engage presentations, with groups going in rotation. Groups that don’t present this round can do so next time.

As noted before, nature of informal assessment of presentations depends on questions, which are not yet set by design. In general, however, correctness and the same concerns from the Present the Content/Provide Learning Guidance act here. Additionally, as has been noted, students should be encouraged to share alternate routes to the same correct results.

Provide Learning Guidance II/Elicit Performance (Practice)/Provide Feedback II (25-31 minutes)

Repeat cycles of targeted worksheets and presentations, with increasingly faded prompting during work time. Remaining worksheets should be disseminated as practice, with answers available later.

Assess Performance (0 minutes)

Main avenue of formal evaluation is unit test, occurring after segment. As in prior lessons, semi-formal assessment is obtained by work product, self-marks on classwork, obtained in succeeding lesson. Assessment of presentations, characterization of work, and responses to assessing prompts in previous items provide further scope for informal assessment.

Enhance Retention and Transfer (1 minute)

Distribute any remaining worksheets and answer sheets to enable study. Remind students to use their resources to prepare well for the pending test. Finally, remind them of the central idea of the review sections: that they now have a large number of powerful tools to deal with polynomials, and that these work very well together.