Prince Edward Island
CANADA
Department of Education
English Programs

Mathematics Curriculum

Applied Mathematics

MAT801A

CURRICULUM

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Introduction

Background

Mathematics curriculum in Prince Edward Island is shaped by a vision which fosters the development of mathematically literate students who can extend and apply their learning and who are effective participants in an increasingly technological society.

Applied Mathematics 801A provides a relevant context for students to acquire foundational mathematical content, and opportunities to apply mathematical knowledge and skills to processes that are encountered everyday, particularly in the trades. Applied Mathematics uses the unifying themes of problem solving, communication, reasoning, and connections to deliver mathematical content in the hope that students will recognize that mathematics is much more than number and relationship operations. Students will continually be engaged in collecting and compiling data, performing number and relationship operations, and using their results to construct and communicate.

Rationale

The *Foundation for the Atlantic Canada Mathematics Curriculum* provides an overview of the philosophy and goals of the mathematics curriculum, presenting broad curriculum outcomes and addressing a variety of issues with respect to the learning and teaching of mathematics. This curriculum guide is one of several which provide greater specificity and clarity for the classroom teacher. The *Foundation for the Atlantic Canada Mathematics Curriculum* describes the mathematics curriculum in terms of a series of outcomes—General Curriculum Outcomes (GCOs), which relate to subject strands. This guide builds on the structure introduced in the foundation document, by relating Specific Curriculum Outcomes (SCOs) directly to corresponding General Curriculum Outcomes (GCOs).

This mathematics guide is based upon several key assumptions or beliefs about mathematics learning which have grown out of research and practice, including the following: (i) mathematics learning is an active and constructive process; (ii) learners are individuals who bring a wide range of prior knowledge and experiences, and who learn via various styles and at different rates; (iii) learning is most likely when placed in meaningful contexts and in an environment that supports exploration, risk taking, and critical thinking, and nurtures positive attitudes and sustained effort; (iv) learning is most effective when standards of expectation are made clear and assessment and feedback are ongoing; and (v) learners benefit, both socially and intellectually, from a variety of learning experinces, both independent and in collaboration with others.

Program Design and Components

Program Organization

The mathematics curriculum is designed to support the Atlantic Canada Essential Graduation Learnings (EGLs). The curriculum is designed to significantly contribute to students meeting each of the six EGLs, with the communication and problem solving EGLs relating particularly well with the curriculum's unifying ideas. (See the "Outcomes" section of the *Foundation for the Atlantic Canada Mathematics Curriculum*.).

This curriculum guide presents specific curriculum outcomes at the senior high level. These outcomes represent the step-by-step means by which students work toward accomplishing the general curriculum outcomes and, ultimately, the essential graduation learnings.

The presentation of the specific curriculum outcomes in this guide follows the outcome structure established in the *Foundation for the Atlantic Canada Mathematics Curriculum* and represents a suggested teaching sequence. While some outcomes will of necessity need to be addressed before others due to prerequisite skill requirements, a great deal of flexibility exists as to the structuring of the program. As well, some outcomes (e.g. Patterns and Operations) may be best addressed on an on-going basis in connection with other topics. It is expected that teachers will make individual decisions as to what sequence of topics/outcomes will best suit their classes. In most instances, this will occur in consultation with fellow staff members, department heads, and/or district-level personnel.

Unifying Ideas

The National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards* establishes mathematical problem solving, communication, reasoning, and connections as central elements of the mathematics curriculum. The *Foundation for the Atlantic Canada Mathematics Curriculum* (pp. 7-11) further emphasizes these unifying ideas and presents them as being integral to all aspects of the curriculum. Indeed, while the general curriculum outcomes are organized around content strands, every opportunity has been taken to infuse the specific curriculum outcomes with one or more of the unifying ideas.

These unifying concepts serve to link the content to methodology. They make it clear that mathematics is to be taught in a problem-solving mode; classroom activities and student assignments must be structured so as to provide opportunities for students to communicate mathematically; via teacher encouragement and questioning, students must explain and clarify their mathematical reasoning; and mathematics with which students are involved on a day-to-day basis must be connected to other mathematics, other disciplines, and/or the world around them.

Students will be expected to address routine and/or non-routine mathematical problems on a daily basis. Over time, numerous problem-solving strategies should be modelled for students, and students should be encouraged to employ various strategies in many problem-solving situations. While choices with respect to the timing of the introduction of any given strategy will vary, strategies such as try-and-adjust, look for a pattern, draw a picture, act it out, use models, make a table or chart, and make an organized list should all become familiar to students during their early years of schooling, whereas working backward, logical reasoning, trying a simpler problem, changing point of view, and writing an open sentence or equation would be part of a student's repertoire in the later years.

Opportunities should be created frequently to link mathematics and career opportunities. During these important transitional years, students need to become aware of the importance of mathematics and the need for mathematics in so many career paths. This realization will help maximize the number of students who strive to develop and maintain the mathematical abilities required for success in higher-level mathematics programming in senior high mathematics and beyond.

Learning and Teaching Mathematics

The unifying ideas of the mathematics curriculum suggest quite clearly that the mathematics classroom needs to be one in which students are actively engaged each day in the doing of mathematics. No longer is it sufficient or proper to view mathematics as a set of concepts and algorithms for the teacher to transmit to students. Instead, students must come to see mathematics as a vibrant and useful tool for helping them understand their world, and as a discipline which lends itself to multiple strategies, student innovation, and, quite often, multiple solutions. (See the "Contexts for Learning and Teaching" section of the foundation document.)

The learning environment will be one in which students and teachers make regular use of manipulative materials and technology, and actively participate in discourse and conjecture, verify reasoning, and share solutions. This environment will be one in which respect is given to all ideas in which reasoning and sense making are valued above "getting the right answer." Students will have access to a variety of learning resources, will balance the acquisition of procedural skills with attaining conceptual understanding, will estimate routinely to verify the reasonableness of their work, will compute in a variety of ways while continuing to place emphasis on basic mental computation skills, and will engage in homework as a useful extension of their classroom experiences.

Meeting the Needs of All Learners

The *Foundation for the Atlantic Canada Mathematics Curriculum* stresses the need to deal successfully with a wide variety of equity and diversity issues. Not only must teachers be aware of, and adapt instruction to account for, differences in student readiness, but they must also remain aware of avoiding gender and cultural biasses in their teaching. Ideally, every student should find his/her learning opportunities maximized in the mathematics classroom.

The reality of individual student differences must not be ignored when making instructional decisions. While this curriculum guide presents specific curriculum outcomes for this level, it must be acknowledged that all students will not progress at the same pace and will not be equally positioned with respect to attaining any given outcome at any given time. The specific curriculum outcomes represent, at best, a reasonable framework for assisting students to ultimately achieve the key-stage and general curriculum outcomes.

As well, teachers must understand, and design instruction to accommodate differences in student learning styles. Different instructional modes are clearly appropriate, for example, for those students who are primarily visual learners versus those who learn best by doing. Further, the practice of designing classroom activities to support a variety of learning styles must be extended to the assessment realm; such an extension implies the use of a wide variety of assessment techniques, including journal writing, portfolios, projects, presentations, and structured interviews.

Support Resources

This curriculum guide represents the central resource for the teacher of mathematics for these grade levels. Other resources are ancillary to it. This guide should serve as the focal point for all daily, unit, and yearly planning, as well as a reference point to determine the extent to which the instructional outcomes should be met.

Nevertheless, other resources will be significant in the mathematics classroom. Textual and other print resources will be significant to the extent that they support the curriculum goals. Teachers will need professional resources as they seek to broaden their instructional and mathematical skills. Key among these are the NCTM publications, including the *Assessment Standards for School Mathematics, Curriculum and Evaluation Standards for School Mathematics*, *Professional Standards for Teaching Mathematics,* and the various NCTM yearbooks. As well, manipulative materials and appropriate access to technological resources should be available.

Role of Parents

Societal change dictates that students' mathematical needs today are in many ways different than were those of their parents. These differences are manifested not only with respect to mathematical content, but also with respect to instructional approach. As a consequence, it is important that educators take every opportunity to discuss with parents changes in mathematical pedagogy and why these changes are significant. Parents who understand the reasons for changes in instruction and assessment will be better able to support their children in mathematical endeavours by fostering positive attitudes towards mathematics, stressing the importance of mathematics in their children's lives, assisting children with mathematical activities at home, and, ultimately, helping to ensure that their children become confident, independent learners of mathematics.

Connections Across the Curriculum

The teacher should take advantage of the various opportunities available to integrate mathematics and other subjects. This integration not only serves to show students how mathematics is used in daily life, but it helps strengthen the students' understanding of mathematical concepts and provides them with opportunities to practise mathematical skills. There are many possibilities for integrating learning experiences—through learning centres, teacher-directed activities, group or independent exploration, and other opportune learning situations. However, it should be remembered that certain aspects of mathematics are sequential, and need to be developed in the context of structured learning experiences.

The concepts and skills developed in mathematics are applied in many other disciplines. These include science, social studies, music, technology education, art, physical education, and home economics. Efforts should be made to make connections and use examples which apply across a variety of discipline areas.

The concepts and skills related to real number operations, measurement, and spatial sense are continously applied in context of various trades.

In science, the concepts and skills of measurement are applied in the context of scientific investigations. Likewise, statistical concepts and skills are applied as students collect, present, and analyse data.

In social studies, measurement is used to read scale on a map, to measure land areas, and in various measures related to climatic conditions. As well, students read, interpret, and construct tables, charts, and graphs in a variety of contexts such as demography.

In addition, there are many opportunities to reinforce fraction concepts and operations in music, as well as opportunities to connect concepts such as symmetry and perspective drawings of art to aspects of 2-D and 3-D geometry.

Assessment and Evaluation

Assessing Student Learning

Assessment and evaluation are integral to the process of teaching and learning. Ongoing assessment and evaluation are critical, not only with respect to clarifying student achievement and thereby motivating student performance, but also for providing a basis upon which teachers make meaningful instructional decisions. (See "Assessing and Evaluating Student Learning" in the *Foundation for the Atlantic Canada Mathematics Curriculum*.)

Characteristics of good student assessment should include the following: i) using a wide variety of assessment strategies and tools; ii) aligning assessment strategies and tools with the curriculum and instructional techniques; and iii) ensuring fairness both in application and scoring. The *Principles for Fair Student Assessment Practices for Education in Canada* elaborate good assessment practice and serve as a guide with respect to student assessment for the mathematics foundation document.

Program Assessment

Program assessment will serve to provide information to educators as to the relative success of the mathematics curriculum and its implementation. It will address such questions as the following: Are students meeting the curriculum outcomes? Is the curriculum being equitably applied across the region? Does the curriculum reflect a proper balance between procedural knowledge and conceptual understanding? Is technology fulfilling a proper role?

Assessment Techniques

Assessment techniques should match the style of learning and instruction employed. Several options are suggested in this curriculum guide from which teachers may choose, depending on the curriculum outcomes, the class, and school/district policies. It is important that students know the purpose of an assessment, the method used, and the marking scheme being used. In order that formative assessment support learning, the results, when reported to students, should indicate the improvements expected.

Observation (formal or informal)

This technique provides a way of gathering information fairly quickly while a lesson is in progress. When used formally, the student(s) would be made aware of the observation and the criteria being assessed. Informally, it could be a frequent, but brief, check on a given criterion. Observation may offer information about the participation level of a student for a given task, use of a piece of equipment or application of a given process. The results may be recorded in the form of checklists, rating scales or brief written notes. It is important to plan in order that specific criteria are identified, suitable recording forms are ready, and that all students are observed in a reasonable period time.

Performance

This curriculum encourages learning through active participation. Many of the curriculum outcomes found in the guide promote skills and their application. There is a balance between mathematical processes and content. In order that students appreciate the importance of skill development, it is important that assessment provide feedback on the various skills. These may be the correct manner in which to use a piece of equipment, the ability to interpret and follow instructions, or to research, organize and present information. Assessing performance is most often achieved through observing the process.

Journal

Although not assessed in a formal manner, journals provide opportunity for students to express thoughts and ideas in a reflective way. By recording feelings, perceptions of success, and responses to new concepts, a student may be helped to identify his or her most effective learning style.

Knowing how to learn in an effective way is powerful information. Journal entries also give indicators of developing attitudes to mathematical concepts, processes, and skills, and how these may be applied in the context of society. Self-assessment, through a journal, permits a student to consider strengths and weaknesses, attitudes, interests, and new ideas. Developing patterns may help in career decisions and choices of further study.

Interview

This curriculum promotes understanding and applying mathematical concepts. Interviewing a student allows the teacher to confirm that learning has taken place beyond simply factual recall. Discussion allows a student to display an ability to use information and clarify understanding. Interviews may be brief discussions between teacher and student or they may be more extensive and include student, parent, and teacher. Such conferences allow a student to be pro-active in displaying understanding. It is helpful for students to know which criteria will be used to assess formal interviews. This assessment technique provides an opportunity to students whose verbal presentation skills are stronger than their written skills.

Paper and Pencil (assignment or test)

These techniques can be formative or summative. Several curriculum outcomes call for displaying ideas, data, and conclusions. These can be in written form for display or direct teacher assessment. Whether as part of learning, or a final statement, students should know the expectations for the exercise and the rubric by which it will be assessed. Written assignments and tests can be used to assess knowledge, understanding, and application concepts. They are less successful assessing skills, processes, and attitudes. The purpose of the assessment should determine what form of pencil and paper exercise is used.

Presentation

The curriculum includes outcomes that require students to analyze and interpret information, to identify relationships between mathematics and other subjects, to be able to work in teams, and to communicate information. Although it can be time consuming, these activities are best displayed and assessed through presentations. These can be given orally, in written/pictorial form, by project summary, or by using electronic systems such as video or computer software. Whatever the level of complexity or format used, it is important to consider the curriculum outcomes as a guide to assessing the presentation. The outcomes indicate the process, concepts, and context for which and about which a presentation is made.

Portfolio

Portfolios offer another option for assessing student progress in meeting curriculum outcomes over a more extended period of time. This form of assessment allows the student to be central in the process. There are decisions about the portfolio and its contents which can be made by the student. What is placed in the portfolio, the criteria for selection, how the portfolio is used, how and where it is stored, how it is evaluated, are some of the questions to consider when planning to collect and display student work in this way. The portfolio should provide a long-term record of growth in learning and skills. This record of growth is important for individual reflection and self-assessment, but it is also important to share with others. For many students, it is exciting to review a portfolio and see the record of development over time.

Designing an Instructional Plan

It is important to design an instructional plan for the school year. This plan should reflect the fact that Specific Curriculum Outcomes (SCOs) falling under any given General Curriculum Outcome (GCO) should not be taught in isolation. There are many opportunities for connections and integration across the various strands of the mathematics curriculum.

Consideration should be given to the relative weighting for outcomes under each GCO so that this can be reflected in the amount of time devoted to each aspect of the curriculum. Naturally, time spent must be sensitive to the background of students as well as to cross-curricular issues. Without an instructional plan, it is easy to run out of time in a school year before all aspects of the mathematics curriculum have been addressed. A plan for instruction that is comprehensive enough to cover all outcomes and strands will help to highlight the need for time management. Although *Applied Mathematics* (MAT801A) is 110 hours (~90 classes) in duration, the suggested instructional pacing provided at the beginning of each unit accounts for approximately 100 hours (~82 classes). The remaining 10 hours (~8 classes) can be used for assessment considerations.

It is often advisable to use pre-testing to determine what students have retained from previous grades relative to a given set of outcomes. In some cases, pre-testing may also identify students who have already acquired skills relevant to the current grade level. Pre-testing is often most useful when it occurs one to two weeks prior to the start of a set of outcomes. In this case, a set of outcomes may define a topic or unit of work, such as fraction concepts and operations. When the pre-test is done early enough and exposes deficiencies in prerequisite knowledge/skills for individual students, sufficient time is available to address these deficiencies prior to the start of the topic/unit. When the whole group is identified as having prerequisite deficiencies, it may point to a lack of adequate development or coverage in the previous grades. This may imply that an adjustment is required to the starting point for instruction, as well as a meeting with other grade level teachers to address these concerns.

Many topics in mathematics are also addressed in other disciplines, even though the nature and focus of the desired outcome is different. Whenever possible, it is valuable to connect the related outcomes of various disciplines. This can result in an overall savings in time for both disciplines. The most obvious of these connections relate to the use of measurement and operations in the trade- and science-related courses.

Curriculum Outcomes

The pages that follow provide details regarding specific curriculum outcomes. Within this document, the specific curriculum outcomes are presented on individual two-page spreads. At the top of each page, the overarching unit title is presented. (see diagram on following page)

The specific curriculum outcomes are always located in the first column of the layout and define *what the student is expected to know, or be able to do*. The letter associated with each specific curriculum outcome identifies the general curriculum to which it belongs.

The second column of the layout is entitled "Elaborations-Instructional Strategies/Suggestions" and provides a clarification of the specific curriculum outcome(s), as well as some suggestions of possible strategies and/or activities which might be used to achieve the outcome(s). While the strategies and/or suggestions presented are not intended to be rigidly applied, they will help to further clarify the specific curriculum outcome(s) and to illustrate ways to work toward the outcome(s) while maintaining an emphasis on problem solving, communications, reasoning, and connections.

The third column of the two-page spread, "Worthwhile Tasks for Instruction and/or Assessment," might be used for assessment purposes or serve to further clarify the specific curriculum outcome(s). As well, those tasks regularly incorporate one or more of the four unifying ideas of the curriculum. These sample tasks are intended as examples only, and teachers may want to tailor them to meet the needs and interests of the students in their classrooms.

The final column of the layout is entitled "Suggested Resources" and will, over time, become a collection of useful references to resources which are particularly valuable with respect to achieving the outcome(s).

The Four-Column Spread

All units have a two-page layout of four columns as illustrated below. In some cases, the four-column spread continues to the next two-page layout. Outcomes are grouped by a topic indicated at the top of the left page.

Two-Page, Four-Column Spread

Page One		Page Two	
Topic		Topic	
Outcomes	Elaborations—Strategies for Learning and Teaching	Tasks for Instruction and/or Assessment	Resources/Notes
Students will be expected to • Specific curriculum outcome • Specific curriculum outcome	elaboration of outcome and strategies for learning and teaching elaboration of outcome and strategies for learning and teaching	*Informal/Formal Observation* *Performance* *Journal* *Interview* *Paper and Pencil* *Presentation* *Portfolio*	• reference to additional resources, including specific links to provincial resources • teachers may wish to record their own notes in this space

Curriculum Outcomes GCOs / SCOs

Specific curriculum outcomes for mathematics are organized into seven distinct categories know as General Curriculum Outcomes (GCOs). Below are six of the seven general curriculum outcomes, and their related specific curriculum outcomes, that are addressed in *Applied Mathematics 801A.*

GCO A: Students will demonstrate number sense and apply number theory concepts.

A1 demonstrate an understanding of simple fractional parts

A2 identify and describe factions and mixed numbers concretely, pictorially, and symbolically

A3 rename fractions

A4 compare and order fractions

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

B1 use mental math and estimation strategies for operations involving integers and decimal fractions

B2 apply mental math and estimation strategies in problem situations when appropriate

B3 perform operations involving integers and decimal fractions in practice and problem situations using the most appropriate method

B4 add and subtract fractions concretely, pictorially, and symbolically

B5 add and subtract fractions in problem situations using the most appropriate method

B6 convert common fractions to decimal fractions

B7 convert decimal fractions to a common 16th fraction

B8 add and subtract denominate numbers

B9 multiply and divide denominate numbers by whole numbers

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

B12 apply the concept of ratio in problem situations related to rafter: span, height, line, and pitch

B13 estimate material quantities and cost in problem situations

B14 apply percent in problem situations

B15 calculate lumber quantities using lineal feet and board feet

B16 calculate total voltage for dry cells connected in series and parallel

Curriculum Outcomes GCOs / SCOs *continued...*

GCO C: Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.

C1 apply the Pythagorean Theorem in problem situations related to identifying right angles

C2 analyse, explain, and construct developments in problem situations pertaining to real number operations and the concept of scale

C3 apply the Pythagorean Theorem in problem situations related to rafter: span, height, and line

C4 solve for single variables in problem situations using the Pythagorean Theorem

C5 calculate the total (equivalent) resistance for resistors when connected in series and parallel

C6 solve for single variables in problem situations using Ohm's Law

C7 analyse series and parallel ciruits to determine the voltage, current, and resistance at any devise (resistor) using the most appropriate method

C8 solve for single variables in problem situations involving electrical power

C9 solve for single variables in problem situations involving electrical energy

C10 identify and describe patterns between perimeter and surface area

GCO D: Students will demonstrate an understanding of and apply concepts and skills associated with measurement.

D1 select and use appropriate measuring devices involving metric measurement

D2 select and use appropriate measuring devices involving imperial measurement

D3 construct and use appropriate measuring devices related to the concept of scale

D4 select and use appropriate measuring devices involving electrical quantitites

Curriculum Outcomes
GCOs / SCOs
continued...

GCO E: Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.

E1 construct shapes from mat plans and 3 - view orthographic
drawings

E2 create 3-view orthographic drawings from mat plans and vice versa

E3 create isometric drawings from mat plans

E4 identify isometric drawings from a combination of composite isometric drawings

E5 identify and draw hidden and missing lines on a 3-view orthographic drawing

E6 create isometric drawings from 3-view orthographic drawings and vice versa

E7 calculate the perimeter of polygons and circles

E8 calculate the surface areas of polygons, circles and right prisms

E9 calculate the volumes of right prisms

E10 identify and describe patterns between surface area and volume of right prisms.

E11 construct right prisms from component polygons/circles and nets

GCO F: Students will solve problems involving the collection, display, and analysis of data.

F1 organize and compile data in appropriate formats to facilitate data treatment

Course Overview

Unit 1: Mathematics Essentials (19 classes)

Overview

This unit provides students with an opportunity to obtain foundational concepts primarily related to number sense and operational sense. Students will continue to build upon concepts from this unit as the mathematics introduce herein will be drawn upon in a variety of contexts in future units. Student will be introduced to imperial measurement in this unit. For many, this will be their first experience with imperial measurement. By providing students with "bench-marks", such as a yard being roughly the distance between a floor and a door handle, and how they interrelate (one yard equals three feet) students will have the opportunity to obtain a concrete understanding of the magnitude of these units of measure.

As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

A1 demonstrate an understanding of simple fractional parts

A2 identify and describe factions and mixed numbers concretely, pictorially, and symbolically

A3 rename fractions

A4 compare and order fractions

B1 use mental math and estimation strategies for operations involving integers and decimal fractions

B2 apply mental math and estimation strategies in problem situations when appropriate

B3 perform operations involving integers and decimal fractions in practice and problem situations using the most appropriate method

B4 add and subtract fractions concretely, pictorially, and symbolically

B5 add and subtract fractions in problem situations using the most appropriate method

B6 convert common fractions to decimal fractions

B7 convert decimal fractions to a common 16th fraction

B8 add and subtract denominate numbers

B9 multiply and divide denominate numbers by whole numbers

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

D1 select and use appropriate measuring devices involving metric measurement

Course Overview *continued...*

Unit 2: Construction/Housing (28 classes)

Overview

This unit uses a practical context related to construction/housing to help students learn mathematical content and processes. This context should also prove to be very valuable as the activities found herein are relevant to students as they may be presently engaged in similar projects with their parents/guardians or through part-time employment.

This unit emphasizes that mathematics is much more that a collection of computational tasks, but rather that mathematics involves data collection, operations, data uses, and communication. As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

B12 apply the concept of ratio in problem situations related to rafter: span, height, line, and pitch

B13 estimate material quantities and cost in problem situations

B14 apply percent in problem situations

B15 calculate lumber quantities using lineal feet and board feet

C1 apply the Pythagorean Theorem in problem situations related to identifying right angles

C2 analyse, explain, and construct developments in problem situations pertaining to real number operations and the concept of scale

C3 apply the Pythagorean Theorem in problem situations related to rafter: span, height, and line

C4 solve for single variables in problem situations using the Pythagorean Theorem

D2 select and use appropriate measuring devices involving imperial measurement

D3 construct and use appropriate measuring devices related to the concept of scale

F1 organize and compile data in appropriate formats to facilitate data treatment

Course Overview *continued...*

Unit 3: Electrical (15 classes)

Overview

This unit uses an electrical context to deliver the mathematical content and processes. This unit further supports the concept that mathematics involves data collection, operations, data use, and communication. Unique to this unit is the emphasis on the necessity for interdisciplinary connections as mathematics can only be performed on electrical quantities once the circuitry is understood (science) and resulting decisions made, such as the use of alternative electrical devices, are often based on individual and societal values.

As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

B16 calculate total voltage for dry cells connected in series and parallel

C5 calculate the total (equivalent) resistance for resistors when connected in series and parallel

C6 solve for single variables in problem situations using Ohm's Law

C7 analyse series and parallel ciruits to determine the voltage, current, and resistance at any devise (resistor) using the most appropriate method

C8 solve for single variables in problem situations involving electrical power

C9 solve for single variables in problem situations involving electrical energy

D4 select and use appropriate measuring devices involving electrical quantitites

Course Overview *continued...*

Unit 4: Spatial sense (12 classes)

Overview

This unit provides students with an opportunity to visualize three-dimensional objects through combinations of physical constructions and two dimensional representations of these constructions. Developmentally, this unit progresses from simple two-dimensional representations to more complex representations which provide the illusion of three-dimensionality.

This unit emphasizes that spatial sense is an important component of mathematics and is equally important for the spatial demands in the trades, particularly fabrication.

Specific Curriculum Outcomes (SCOs)

E1 construct shapes from mat plans and 3 - view orthographic projections

E2 create 3-view orthographic projections from mat plans and vice versa

E3 create isometric drawings from mat plans

E4 identify isometric drawings from a combination of composite isometric drawings

E5 identify and draw hidden view lines and missing object lines on a 3-view orthographic projection

E6 create isometric drawings from 3-view orthographic projections and vice versa

Unit 5: Fabrication (8 classes)

Overview

This unit builds upon the spatial shills developed in unit four. Students will be provided with the oportunity to extend two-dimensional constructions (circle, triangle, rectangle) into right prisms (cone, right-triangular prism, right-rectangular prism). In addition, students will also be afforded the opportunity to calculate surface area and volumes for these constructions and to think critically about the relationship that exist between them.

Specific Curriculum Outcomes (SCOs)

C10 identify and describe patterns between perimeter and surface area

E7 calculate the perimeter of polygons and circles

E8 calculate the surface areas of polygons, circles and right prisms

E9 calculate the volumes of right prisms

E10 identify and describe patterns between surface area and volume of right prisms.

E11 construct right prisms from component polygons/cicles and nets

Unit 1: Mathematics Essentials

(Suggested Time: 19 Classes)

Overview

This unit provides students with an opportunity to obtain foundational concepts primarily related to number sense and operational sense. Students will continue to build upon concepts from this unit as the mathematics introduce herein will be drawn upon in a variety of contexts in future units. Student will be introduced to imperial measurement in this unit. For many, this will be their first experience with imperial measurement. By providing students with "bench-marks", such as a yard being roughly the distance between a floor and a door handle, and how they interrelate (one yard equals three feet) students will have the opportunity to obtain a concrete understanding of the magnitude of these units of measure.

As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

A1 demonstrate an understanding of simple fractional parts

A2 identify and describe factions and mixed numbers concretely, pictorially, and symbolically

A3 rename fractions

A4 compare and order fractions

B1 use mental math and estimation strategies for operations involving integers and decimal fractions

B2 apply mental math and estimation strategies in problem situations when appropriate

B3 perform operations involving integers and decimal fractions in practice and problem situations using the most appropriate method

B4 add and subtract fractions concretely, pictorially, and symbolically

B5 add and subtract fractions in problem situations using the most appropriate method

B6 convert common fractions to decimal fractions

B7 convert decimal fractions to a common 16th fraction

B8 add and subtract denominate numbers

B9 multiply and divide denominate numbers by whole numbers

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

D1 select and use appropriate measuring devices involving metric measurement

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

B1 use mental math and estimation strategies for operations involving integers and decimal fractions

B2 apply mental math and estimation strategies in problem situations when appropriate

Elaborations–Strategies for Learning and Teaching

Mental Math involves the use of strategies to get exact answers by performing the mathematics in one's head. By contrast, **Estimation** involves the use of strategies to get approximate answers by performing the mathematics in one's head.

Although the intent of mental mathematics and estimation is to have the math performed in one's head, paper and pencil should be used when a strategy is first introduced and continued until there is a familiarity with how, and why, the strategy works. Mastery of these mental mathematics and estimation strategies is evident when an operation can be performed in one's head in approximately 10 seconds or less. Mental math and estimation should be performed in small increments all year in addition to the first treatment at the beginning of this course.

The mental math strategies provided in this section are common, however, many others exist. Each strategiy identified below is modeled in the student resource, *Applied Mathematics 801A*. Student should be encouraged to identify, or invent a strategy that works for them in particular situations. The following strategies and depth of strategy should be considered:

Front-End Addition and ***Make 1, 10s, 100s... Addition*** involving 3-digit addends.
Front-End Subtraction, ***Make 1, 10s, 100s... Subtraction*** and ***Subtraction by Counting Up*** involving 3 digit subtrahends and minuends.
Front-End Multiplication involving single-digit by 4-digit factors.
Front-End Division involving 3-digit dividends, single-digit divisors, and integral quotients.

Students should be provided with problem situations which contain numbers/measurements that are conducive to operations that can be perform mentally. Operations will become more meaningful to students when they are provided with a context that is not distracted by the complexities of large numbers.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Paper & Pencil

- Find the following sums using mental math.

  A. 47 + 35 B. 125 + 34 C. $\begin{array}{r} 67 \\ +53 \\ \hline \end{array}$

- Find the following differences using mental math.

  A. 99 - 42 B. 183 - 57 C. $\begin{array}{r} 62 \\ -19 \\ \hline \end{array}$

- Find the following products using mental math.
  A. 5 x 25 B. 3 x 228 C. 3 x 2.6 D. 3 x 3.25

- Find the following quotients using mental math
  A. 90 ÷ 3 B. 363 ÷ 3 C. 864 ÷ 8 D. 15.6 ÷ 6

Use Mental Math to solve the following problems:

- Susan purchased a pair of pants for $45 and a shirt for $17. What was the total cost of her purchase before tax?
- Jill has a credit of $256 at the hardware store. If she purchased $126 worth of painting supplies and $118 in hardware, how much credit remains?
- A square swimming pool contains 6.4 m side lengths. What is the perimeter of the pool?
- A water tank holds 75 liters of water. If you must fill the tank using a 5 liter container, how many times would the container have to be filled?

Journal

- When would you use the *Front End Addition Strategy*? The *Make 1, 10s, 100s... Addition Strategy*? Provide an example for each.
- Which mental math strategies for subtraction do you prefer? Explain.
- Invent another strategy for multiplication and provide an example to demonstrate its use.

Resources/Notes

Applied Mathematics
pp. 1-3 to 1-13

Please Note:

The *Applied Mathematics* reference in the fourth column in this curriculum guide always refers to the student text *Applied Mathematics 801A* (Prince Edward Island Department of Education, English Programs, September 2007)

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

D1 select and use appropriate measuring devices involving metric measurement

B3 perform operations involving integers and decimal fractions in practice and problem situations using the most appropriate method

Elaborations–Strategies for Learning and Teaching

Students should be provided with opportunities to collect data through measurement activities that require them to further perform opperations on the resulting integer and decimal fraction measurements.

When reading and communicating metric measurement it is important that students pay attention to the fine details of significant figures. Significant figures in measurement include all figures that can be read from a scale plus an additional figure that is estimated.

Students could be asked to measure the length and width of various objects in the classroom. From the length and width measurements, students should find the resulting perimenter (addition), area (multiplication), difference between length and width (subtraction), and length as a multiple of width (division). Through this activity, units should be discussed. Students should recognize that calculations involving measured values may result in solutions in which the unit is maintained (adding dimensions; subtracting dimensions, multiplication of a measurment by a scalar), altered (mutiplication of dimensions), or eliminated (division of dimensions).

Mental mathematics may be used to perform these calculations; however, several of the values/measurements may not be conducive to mental mathematics. As a result, students may use pencil and paper along with traditional algorithm techniques.

Students should be presented with relevant context to perform operations in problem situations. In both practice and problem situations, quotients should only be provided when integer divisors are present.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Performance

- Locate five rectangular objects in your classroom (desk, text, calculator, etc.). Measure the length and width of each object to the nearest centimeter and record your measurements in a chart. For each object, calculate:
  - the area;
  - the perimeter;
  - the difference between the length and width;
  - the length as a multiple of width.

Paper & Pencil

- How many square feet (ft^2) of flooring is required to cover a bathroom floor bathroom with dimension 8 ft by 12ft?
- The total length of one wall containing a 3 ft wide door measures 21 ft. Assuming that the door is centered between the two end walls, how far is the door from each end wall? Draw a sketch to assist in solving this problem.
- If the four shelves of a bookcase have a total surface area of 1850.5 cm^2, what is the surface area of each individual shelf?
- How many square meters (m^2) of curtain material is required to cover all four front livingroom windows, the kitchen window, and the bathroom window. The material required for one livingroom window is 3 m^2, the kitchen window is 2 m^2, and the bathroom window is 1 m^2.
- Perform the following operations

A. $\begin{array}{r} 764.25 \\ \underline{-273.17} \end{array}$ B. $\begin{array}{r} 367.05 \\ 558.455 \\ \underline{+278.3} \end{array}$ C. $\begin{array}{r} 3221 \\ \underline{\times\ 332} \end{array}$ D. $41\overline{)1025}$

Resources/Notes

Applied Mathematics
pp 1-14 to 1-20

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

A1 demonstrate an understanding of simple fractional parts

A2 identify and describe factions and mixed numbers concretely, pictorially, and symbolically

A3 rename fractions

A4 compare and order fractions

Elaborations–Strategies for Learning and Teaching

Students could be introduced to the concept of "fair shares". If a "whole" is divided into a number of shares, each share must be fair or all shares equal in size.

Students could be provided with a series of activities based on the concept that the more shares a whole is split into, the smaller each share. The use of the following models should be used to reinforce this concept: 'area' models such as pattern blocks; "length" models such as cube-a-links or colour tiles; and 'set' models such as counters. Students could be challenged to invent a model to describe fractions using everyday materials.

Students should be afforded opportunities to examine equivalent fractions using models. When fractions are provided in a variety of forms, students should be able to convert the fractions to other forms (mixed numbers, improper fractions, equivalent fractions). Students should be able write the lowest equivalent fraction possible when given a fraction in any form.

Given a variety of fractions in multiple forms, students should be able to compare and order these fractions. Students should use conceptual methods to compare fractions. These methods include:

- comparing each to a reference $(0, \frac{1}{2}, or\, 1)$
- comparing two numerators when the fractions have the same denominator
- comparing the two denominators when the fractions have the same numerator

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Performance

- Cut a circle out of a piece of paper. Fold the paper so that it is split into:
  a) two fair shares
  b) four fair shares
  c) eight fair shares

Interview

- What happens to the size of each piece of paper as the number of shares increase?

Journal

- Two people each have one-fourth of a chocolate bar. Explain in writing how one of these people could have more bar than the other person.

Performance

- Fold this long piece of paper to make a ruler showing halves, fourths, eighths, and sixteenths. Measure the dimensions of a book using your ruler.

- Using counters, model the following fractions.
  $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{6}, \frac{2}{4}, \frac{3}{4}, \frac{2}{3}$

- Using pattern blocks, demonstrate that $\frac{3}{6}$ is equivalent to $\frac{1}{2}$.

- Model the following numbers using pattern blocks.
  a) $3\frac{1}{2}$ b) $1\frac{5}{6}$ c) $2\frac{1}{3}$

Resources/Notes

Applied Mathematics
pp. 1-21 to 1-32

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

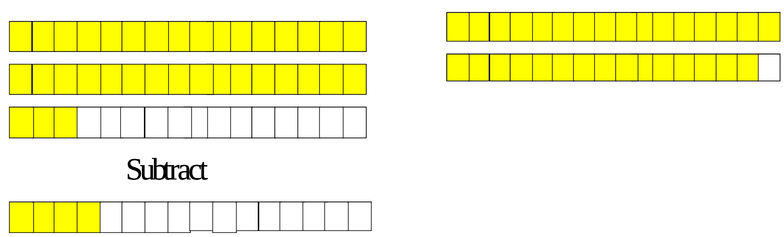
B4 add and subtract fractions concretely, pictorially, and symbolically

Elaborations–Strategies for Learning and Teaching

Students should be provided with opportunities to model addition and subtraction of fractions concretely and pictorially using cube-a-links, paper models, or any appropriate manipulative. The intent of modelling is to emphasis the rationale for obtaining a common denominator, and maintaining the denominator value when performing the addition/subtraction operation with the numerator. Having modelled the addition and subtraction of fractions, students can demonstrate their ability to communicate these operations pictorially and symbolically as follows:

ex. $\frac{1}{16} + \frac{1}{4} = \frac{5}{16}$

ex. $2\frac{3}{16} - \frac{1}{4} = 1\frac{15}{16}$



Students could be asked to construct a cube-a-link measuring tool composed of four yellow, four red, four blue, and four green cubes. The measuring tool would be one unit in length with each cube representing $\frac{1}{16}$ of the total length. Students could then be invited to estimate lengths and widths of various objects and check their estimates using the cube-a-link tool. Examples could be the length and width of a textbook, the dimensions of the surface of a student desk, or the dimensions of a door. Students could then be asked to add the dimensions to find perimeter or to subtract the dimensions to determine how much longer than wide a particular object is.

B5 add and subtract fractions in problem situations using the most appropriate method

Students should be provided with relevent context in problem situations which require the addition and subtraction of fractions or combinations of both operations.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Performance

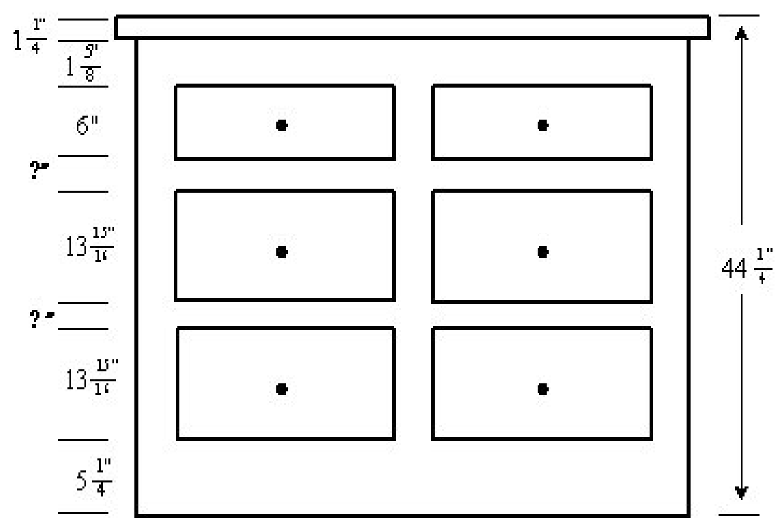
- Estimate the lengths of various objects in your classroom (in cube-a-link units) and check your estimates using the cube-a-link measuring tool.

Journal

- Describe, in words and pictorially, how to add two fractions containing different denominators.

Pencil & Paper

- What is the measurement of the space between the drawers below? Assume both spacings are equal (drawing is not to scale).



- Perform the following operations concetely, pictorially, and symbolically.

A. $\frac{3}{8} + \frac{3}{16}$ B. $\frac{3}{4} - \frac{3}{8}$ C $\frac{5}{16} - \frac{1}{4}$

D. $\frac{1}{2} - \frac{3}{16}$ E. $5\frac{3}{8} - 3\frac{3}{8}$ F. $3\frac{5}{16} + 2\frac{9}{16}$

Resources/Notes

Applied Mathematics
pp 1-33 to 1-40

Applied Mathematics
pp 1-33, 1-39, 1-40

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

B6 convert common fractions to decimal fractions

B7 convert decimal fractions to a common 16th fraction

Elaborations–Strategies for Learning and Teaching

Converting a common fraction to a decimal fraction is appropriate when mathematical operations are required to be performed on the fraction. For example, in constructing a 14-step stairway between two floors that measure 109 $\frac{3}{4}$ " apart, it would be a practical exercise to divide 109.75" ($\frac{3}{4}$ " = 0.75") by 14 to obtain the step rise.

Students will require rounding information in order to perform these conversions, particularly if the decimal fraction is non-terminating. Therefore, in addition to performing the conversion, students must have an understanding of place value in order to round the decimal fractions appropriately.

Most imperial tape measures divide each inch of measure into sixteen equal parts (sixteenths). As a result, it is impractical to measure a fraction of an inch when given the decimal approximation. Therefore, it is important that students are able to convert the decimal part of a measurement into a common sixteenth fraction.

Students could be challenged, using a tape measure, to draw a line that is 3.625" long. Once they experience the difficultly in performing this task, they can be challenged with designing a method of converting the decimal part of 3.625" to a common 16^{th} fraction. All common sixteenth fractions should be written as a simplest equivalent fraction when possible (e.g. $\frac{10}{16}$ = $\frac{5}{8}$).
The process of coverting the decimal part of a number to a common sixteenth fraction can be performed by multipling the decimal part by 16, followed by rounding. However, it is important for students to understand why this process works. Students would better understand why 0.625 is equal to $\frac{10}{16}$ if a ratio was created as follows:

$$\frac{625}{1000} = \frac{x}{16}$$

$$0.625 = \frac{x}{16}$$

$$x = 0.625 \times 16$$

$$x = 10$$

Therefore, 0.625 is equal to $\frac{10}{16}$.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Paper & Pencil

- Convert the following common fractions to decimal fractions:

$\frac{1}{16}$ =	$\frac{5}{16}$ =	$\frac{9}{16}$ =	$\frac{13}{16}$ =
$\frac{1}{8}$ =	$\frac{3}{8}$ =	$\frac{5}{8}$ =	$\frac{7}{8}$ =
$\frac{3}{16}$ =	$\frac{7}{16}$ =	$\frac{11}{16}$ =	$\frac{15}{16}$ =
$\frac{1}{4}$ =	$\frac{1}{2}$ =	$\frac{3}{4}$ =	$\frac{16}{16}$ =

- Given the number below written in decimal form, identify the digit located in the following positions:

652.14892

A. Tens
B. Tenths
C. Ten Thousandths
D. Ones
E. Hundredths
F. Thousandths

- Convert the following numbers to a common 16th fraction. Round all answers and write lowest equivalent fraction when possible.

A. 36.312 E. 5.675

B. 1.25 F. 14.7

C. 3.75 G. 5.435

Resources/Notes

Applied Mathematics
pp 1-41, 1-42

Applied Mathematics
pp 1-43 to 1-45

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

B8 add and subtract denominate numbers

Elaborations–Strategies for Learning and Teaching

Treatment of denominate numbers should be related to systems of measurement with which the student is familiar, or will likely use in the future, such as imperial measurements of length (yard, feet, inch).

As a beginning activity, students can be given the definition of denominate numbers (numbers written in association with a unit of measure) and then asked to measure all walls in the classroom in yard - feet - inch format (e.g. 2 yards, 2 feet, 7 inches). Once this task is completed, a discussion could occur related to how to determine when to move from yards to feet to inches when performing measurements involving denominate numbers.

Students can then be challenged to calculate the perimeter of the classroom and report the perimeter using the yard - feet - inch format. Upon completion of this task, each student could be asked to write a rule for the addition (and subtraction) of denominate numbers. Classmates could then exchange and test these rules.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Performance

- Estimate the perimeter of the classroom in yards. Record your estimated value in a chart as shown below.

1 yard = 3 feet
OR
1 yard = approximate distance travelled in one step

Perimeter(P) = Sum of all sides of a polygon

	Length (estimate)	Width (estimate)	Perimeter (estimate)
Classroom	6 yds	5 yds	22 yds

- With a partner measure each side of the classroom in yards, feet and inches (ex. 3yd 2' 7"). Find the sum of the measurements to determine the perimeter of the room. Record the data and calculations in yards, feet and inches in a table as shown below.

Conversion factors: 1 yard = 3 feet
1 foot = 12 inches

Perimeter(P) = Sum of all sides

	Length yards feet inches	Width yards feet inches	Perimeter yards feet inches
Classroom	6 yds	5 yds	22 yds

Paper & Pencil

- Find the difference between the following measurements.

A. 10' 7"
- 7' 3"

B. 6' 3"
- 4' 8"

C. 30 yds 1' 10"
- 28 yds 0' 11"

Resources/Notes

Applied Mathematics
pp 1-46 to 1-49

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

B9 multiply and divide denominate numbers by whole numbers

Elaborations–Strategies for Learning and Teaching

Students could be provided with situations which require denominate numbers to be multiplied or divided. For example, a square cottage foundation contains side dimensions of 5 yards, 2 feet, 7 inches. Students could be asked to determine the perimeter of the foundation using multiplication. Having completed this task, students could be asked to write a rule for a classmate to be able to solve problems involving this operation.

Similarly, students could be asked to write a rule which would allow classmates to divide a denominate number by a whole number after having completed a task such a finding the center of a wall with dimensions 5 yards, 2 feet, 4 inches.

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Journal

- Write a rule(s) that will allow members of your class to multiply measurements (denominate number) by a whole number. Have a classmate test the rule(s) you created.
- Can you find another method to multiply denominate numbers? Explain.

Pencil and Paper

- Calculate the product of the following:

A.	B.	C.
3' 2"	5' 7"	3 yds 2' 7"
x 3	x 2	x 2

- Calculate the quotient of the following:

A. 4' 2" ÷ 2 B. 3' 8" ÷ 2 C. 3 yds 2' 6" ÷ 3

Resources/Notes

Applied Mathematics
pp 1-50 to 1-52

Unit 1: Mathematics Essentials

Outcomes

Students will be expected to

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

Elaborations–Strategies for Learning and Teaching

Students are expected to know the meaning of the following metric prefixes: milli, centi, and kilo. They should be able to use all metric prefixes, given a table of prefixes, to convert between units of measurement mentally. These conversions would involve restating a metric measurement with a new prefix and altering the numeric component of the measurement by shifting the decimal. Students should understand that restating a measurement with a prefix of larger magnitude requires an adjustment to reduce the numeric component of the measurement by the same factor.

Students can perform these conversions mentally if appropriate. However, converting between systems of measurements is often too difficult to perform mentally. Students may wish to create an equation involving rates as follows:

? ft = 5 yards (rate: 3 ft = 1 yard)

$$\frac{X \text{ ft}}{5\ \not{\text{yards}}} = \frac{3 \text{ ft}}{1\ \not{\text{yard}}}$$

X = 15 ft

Alternatively, students may wish to perform unit analysis by making the unknown equal to the known and then multiply by the necessary conversion factor:

$$? \text{ ft} = 5\ \not{\text{yards}} \times \frac{3 \text{ ft}}{1\ \not{\text{yard}}}$$

= 15 ft

Note: Caution should be considered when using this method as students may become experts in using this method to obtain the correct answer without knowing why or how the answer is obtained. Students should be aware that multiplying by a reciprocal is equivalent to dividing. It is suggested that students be first introduced to conversions that are easily performed mentally such that they can not only observe how unit analysis works but also why it works. For example, students could be asked how many kilometres is 5000 metres.

Mental Math: Divide 5000 by 1000: the answer is 5 km.

Unit Analysis $$? \text{ km} = 5000\ \not{\text{m}} \times \frac{1 \text{ km}}{1000\ \not{\text{m}}}$$

answer = 5 km

Unit 1: Mathematics Essentials

Tasks for Instruction and/or Assessment

Performance

- Using a metric tape measure, measure the length of three objects in your classroom in millimeters (nearest millimeter), centimeters (nearest tenth of centimeter), and meters (nearest hundredth of meter). Using the data, complete the following:
  A. Explain how the units of measurement "**m**", "**cm**", and "**mm**" interrelate.
  B. Describe a method of converting from the millimeter **(mm)** to the meter **(m)**.

Paper & Pencil

- Convert the following measurement to the indicated unit mentally. Confirm your answers using another method of computation (unit analysis or rate equations).

  A.20 mg = ? g B. 4 cm = ? m C. 15 dL = ? L

  D.16 km = ? m E. 60 mV = ? V F. 3 mg = ? g

  G. 3425 cm = ? km H. 3.5 kL = ? mL

- Convert the following measurement to the indicated unit using the most appropriate method.

  A.2.5 yd = ? m B. 195 lb = ? kg C. 15 ga = ? L

  D. 16 m^3 = ? L E. 300 mi= ? km F. 65 kg = ? lb

Presentation

- Create a system of measurement for a quantity of your choice. Identify the "base" unit and explain how the units within you system interrelate. Present your system to your classmates and describe the advantages and disadvantages of your system of measurement with respect to unit conversion.

Resources/Notes

Applied Mathematics
pp. 1-53 to 1-58

Unit 2: Construction/Housing

(Suggested Time: 28 Classes)

Overview

This unit uses a practical context related to construction/housing to help students learn mathematical content and processes. This context should also prove to be very valuable as the activities found herein are relevant to students as they may be presently engaged in similar projects with their parents/guardians or through part-time employment.

This unit emphasizes that mathematics is much more that a collection of computational tasks, but rather that mathematics involves data collection, operations, data uses, and communication. As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

B12 apply the concept of ratio in problem situations related to rafter: span, height, line, and pitch

B13 estimate material quantities and cost in problem situations

B14 apply percent in problem situations

B15 calculate lumber quantities using lineal feet and board feet

C1 apply the Pythagorean Theorem in problem situations related to identifying right angles

C2 analyse, explain, and construct developments in problem situations pertaining to real number operations and the concept of scale

C3 apply the Pythagorean Theorem in problem situations related to rafter: span, height, and line

C4 solve for single variables in problem situations using the Pythagorean Theorem

D2 select and use appropriate measuring devices involving imperial measurement

D3 construct and use appropriate measuring devices related to the concept of scale

F1 organize and compile data in appropriate formats to facilitate data treatment

Unit 2: Construction/Housing

Outcomes

Students will be expected to

D2 select and use appropriate measuring devices involving imperial measurement

Elaborations–Strategies for Learning and Teaching

Students should be able to meaure to the nearest 16th of an inch using an imperial tape measure and a carpenter's square. This outcome builds upon outcomes in the previous unit, *Mathematics Essentials.* Mearsurements should be recorded as simplest equivalent fractions. Students should be comfortable in identifying the denominator of the simplest equivalent fraction from its location from a whole number increment line on a measuring tape and from the increment line length.

C1 apply the Pythagorean Theorem in problem situations related to identifying right angles

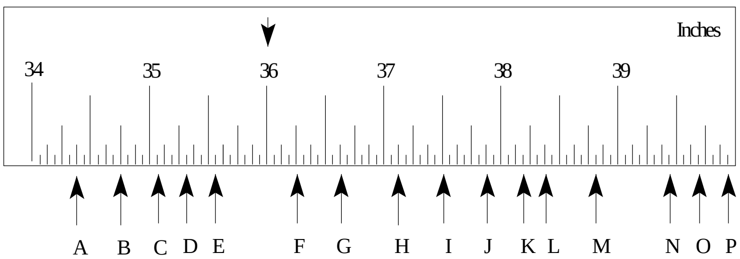
Using a carpenter's square, like any measuring devise, lends itself to potential errors in measurement. A 90^o angle can be verified by using the Pythagorean Theorem and the reference 3-4-5 right-angle triangle. The Pythagorean Theorem states that for any right-angled triangle the sum of the square of the length of the two shortest sides is equal to the square of the length of the longest side (hypotenuse). This theorem can be represented using the formula $A^2 + B^2 = C^2$. If a triangle has side lengths of 3 units, 4 units, and 5 units, the Pythagorean Theorem will confirm that this triangle is a right triangle (one angle is 90^o). Students are expected to check vertices for 90^oangles (squareness) using the Pythagorean Theorem when given side lengths. When given drawings or constructions students are expected to use the 3-4-5 triangle to confirm "squareness" by measuring 3 units along one side of a vertex, 4 units along the other side of the same vertex and then confirm that the hypotenuse is 5 units in length.

Unit 2: Construction Housing

Tasks for Instruction and/or Assessment

Pencil & Pencil

- Look at the following section of a tape measure. An arrow points at the 36" increment because 36" can also be expressed as 3'. Record the measurements (A-P) to the nearest 16th of an inch by displaying the measurements in inches and fraction of an inch (ex. $39\frac{1}{16}$").



- Using the Pythagorean Theorem, determine which of the following triangles are right-angle triangles (side lengths are provided).

  A. 12", 16", 20" B. 9', 12', 16'

  C. 3.5cm, 4.5 cm, 5.5 cm D. 4.30 m, 5.30 m, 6.82 m

Performance

- On a blank piece of paper place a mark located 1" up and 1" to the right of the bottom left corner. Using a carpenter's square, draw the following lines starting from the 1" mark:
  Note: Each line will begin where the previous line has ended.
  - Right $5\frac{7}{16}$
  - Up $3\frac{3}{8}$
  - Left $4\frac{3}{4}$
  - Up $3\frac{1}{8}$
  - Right $5\frac{1}{2}$
  - Down $6\frac{1}{2}$
  - Left $6\frac{3}{16}$

- For any angle that is square, any multiple of the 3-4-5 triangle (6-8-10 or 9-12-15) will confirm the squareness. Also, the 3-4-5 triangle works for any measurement (3 yd - 4yd - 5yd). Check the squareness of one corner of the following items:
  - student desk
  - teacher desk
  - text book
  - classroom

Journal

Why is it best to measure as far away from the vertex as possible when checking for squaremess?

Resources/Notes

Applied Mathematics
page 2-3 to 2-5

Applied Mathematics
pp 2-5, 2-6

Unit 2: Construction/Housing

Outcomes

Students will be expected to

C2 analyse, explain, and construct developments in problem situations pertaining to real number operations and the concept of scale

D2 select and use appropriate measuring devices involving imperial measurement

D3 construct and use appropriate measuring devices related to the concept of scale

Elaborations–Strategies for Learning and Teaching

Students could be asked to construct a stair stringer for a deck surface that is a specific distance above ground level. Students would be given all necessary dimensions such as stair tread and riser thickness and maximum allowable step rise ($7\frac{7}{8}$") along with all necessary construction materials (construction paper, scissors, measuring tape, and carpenter's square). It is also important that the students are made aware that the minimum thickness from the back edge of the stringer to the rise/run vertex is $3\frac{1}{2}$". Any thickness less than $3\frac{1}{2}$" may cause the stair system to become unstable and potentially fail. This activity requires that the student analyse the situation and perform mathematics based on their decisions. For example, the number of steps on the stringer will determine the measurement of the step rise. From this activity students may recognize that there is often many solutions to a mathematical problem.

Students could be asked to construct a scale where $\frac{3}{4}$" = 1'. The $\frac{3}{4}$ scale is ideal to construct because $\frac{3}{4}$" is easily divided into 12 equal sections using an imperial tape measure (recall: $\frac{3}{4}$" is equal to $\frac{12}{16}$"). Having students actually construct a scale of their own will facilitate their understanding of the section to the left, and the section to the right, of the zero reference. Students should construct their $\frac{3}{4}$" = 1' scale using card stock as they will use their scale for future measurements. For this reason it is particularly important that these measuring devices be constucted as accurately as possible If available, students may wish to have their scale laminated as they will be used for future measurements.

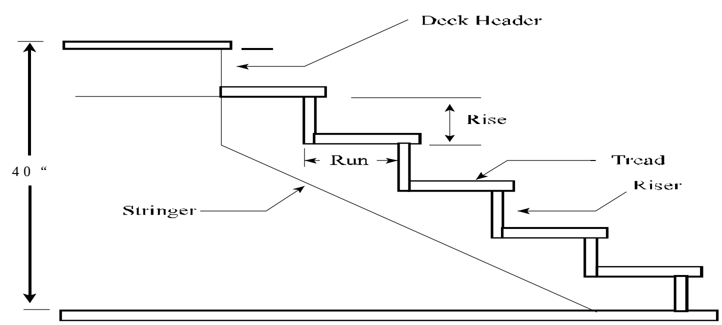
Unit 2: Construction Housing

Tasks for Instruction and/or Assessment

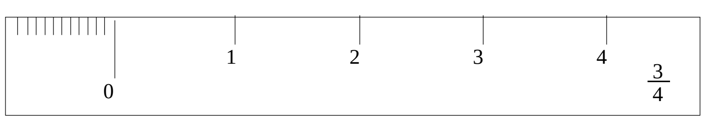
Performance

- Using a $9\frac{1}{2}$ " strip of construction paper and a carpenter's square construct a stair stringer for a deck which is $43\frac{1}{2}$ " above the ground. When constructing your stringer, you must consider that the stair tread being used will be 1" thick and that the risers being used will be $\frac{3}{4}$ " thick.

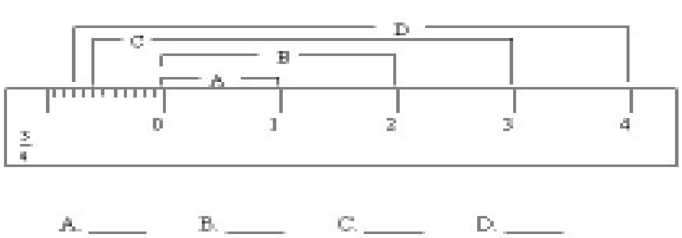
  The following diagram illustrates a stringer constructed for a deck surface that is 40 inches above the ground.



- Create a $\frac{3}{4}$ " = 1' scale.
  Cut a strip of card stock approximately two inches in width and 11" in length. Starting from the edge, place a $\frac{1}{2}$ " dash every $\frac{3}{4}$ " along the entire length. Using smaller dashes, divide the first section into 12 equal spaces (each will be $\frac{1}{16}$ " apart).
  Label your scale as shown below.



- Record the actual length of the measurements represented by letters A, B, C, D in the following diagram.



Resources/Notes

Applied Mathematics
page 2-7, 2-8, 2-9

Applied Mathematics
page 2-10, 2-11, 2-12

Various drawings and constructions within Unit 2.

Unit 2: Construction/Housing

Outcomes

Students will be expected to

C2 analyse, explain, and construct developments in problem situations pertaining to real number operations and the concept of scale

F1 organize and compile data in appropriate formats to facilitate data treatment

D2 select and use appropriae measuring devices involving imperial measurement

Elaborations–Strategies for Learning and Teaching

Students could be asked to create a scaled drawing and a scaled model of a baby barn (6' x 8'). They would use their $\frac{3}{4}$ " = 1' scales for the drawings and model construction along with necessary construction materials such as wooden popsicle sticks (at least 6" in length) for lumber, mitre box and saw for cutting, and a hot glue gun for assembly. Students would be expected to provide a scale drawing of the floor system, wall system, and a rafter that is appropriately labeled with student name, drawing name, scale, and date (see diagram page 2-14, 2-16 for format example) along with a material list and cutting instructions. Attention to measurement and squareness of cut is absolutely necessary to the assembly of the baby barn. All dimensions and "on centre" measures are provided in the related Construction/ Housing section of *Applied Mathematics*. When using the mitre box to cut the popsicle sticks it is suggested that the student stack the popsicle sticks on each other with one extra stick on the bottom that will later be discarded due to the splintering that can occur at the end of the cut. It is also suggested that the students cut only on the "back-stroke" with the stick held firmly against the side closest to them. Teachers must demonstrate the safe use of the miter box and monitor its use by students in an attempt to avoid injury.

Students who complete their constructions early could be asked to add windows (octagon or rectangular) or other components to their design. They may also be interested in designing a gabriel style roof.

Unit 2: Construction Housing

Tasks for Instruction and/or Assessment

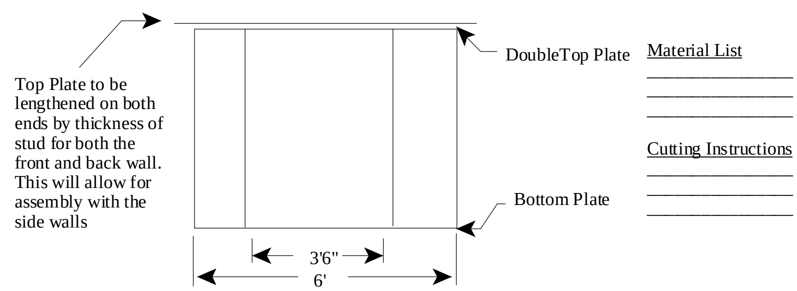
Performance

- Using a scale and graph paper, create a scaled ($\frac{3}{4}$ " = 1') drawing of the floor system for a baby barn with outside dimensions of 6' by 8'. Use 16" O.C. for the floor joists. Indicate all necessary dimensions, dimension lines and extension lines.

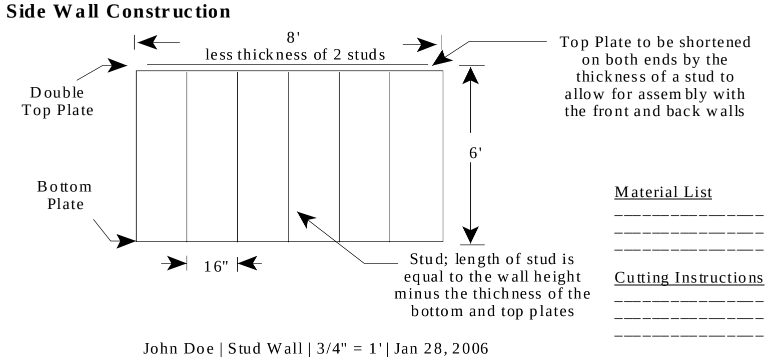
- Using a scale and graph paper, create a scaled ($\frac{3}{4}$ " = 1') drawing of the four walls for a baby barn with outside dimensions of 6' by 8'. Use 16" O.C. for the stud positions.

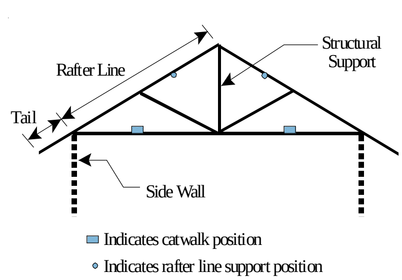
- Draw a scaled drawing of a rafter for your baby barn with a span of 6' and a 12:12 pitch. Use the scale $\frac{3}{4}$ " = 1' for your drawing. Include a 1' 6" tail in your rafter design.

Front Wall Construction



Side Wall Construction





Resources/Notes

Applied Mathematics
page 2-13 to 2-21

Unit 2: Construction/Housing

Outcomes

Students will be expected to

B12 apply the concept of ratio in problem situations related to rafter: span, height, line, and pitch

C3 apply the Pythagorean Theorem in problem situations related to rafter: span, height, and line

C4 solve for single variables in problem situations using the Pythagorean Theorem

B15 calculate lumber quantities using lineal feet and board feet

Elaborations–Strategies for Learning and Teaching

Students must first understand the meaning of the terms related to rafter design. These are pitch, span, height, and line. Using the rafter pitch ratio, students should be able to calculate the rafter height, $\frac{1}{2}$ span, and span by creating an equivalent ratio given one of these three variables.

Students are expected to calculate either the rafter height, rafter line or $\frac{1}{2}$ span given any two of these variables using the Pythagoream Theorem ($A^2 + B^2 = C^2$)

Students should be able to calculate lineal feet given the number of pieces and length of lumber or given information in which these quantities can be determined. Similarly, students should be able to calculate board feet given the number of pieces of lumber and the rough (not plained) lumber dimensions or information in which these quantities can be determined.

Students should be provided with the explanation of a board foot as being the volume occupied by a one foot by one foot (1 ft^2) board that is one inch thick.

lineal feet = number of pieces x length (feet)
board feet = number of pieces x thickness (inches) x width (inches) x length (feet)

Students could be asked to calculate the amount of lineal feet and board feet required to construct a deck surface of a particular dimension.

Unit 2: Construction Housing

Tasks for Instruction and/or Assessment

Pencil & Paper

- Given a 6:12 pitch, calculate the height of a roof containing a rafter with a rafter span of:
  A. 24 ft B. 30 ft C. 6 m

- Given a 5:12 pitch, calculate the rafter span for a roof with the following height:
  A. 5 ft B. 10ft C. 7.5 ft

- A roof has a height of 6ft, calculate the roof pitch (rise:run) with the following span (express your roof pitch as " x : 12"):
  A. 12 ft B. 24 ft C. 48 ft

- Calculate the Rafter line length for a roof with a height of 6 feet and the following span: (Remember to convert the span to the ½ span before using the Pythagorean theorem.)
  A. 24 ft B. 28 ft C. 30 ft

- How many lineal feet are there in 10 pieces of 2" x 10" x 16' lumber?

- How many board feet are there in 10 pieces of 2" x 10" x 16' lumber ?

Resources/Notes

Applied Mathematics
page 2-18 to 2-20

Applied Mathematics
page 2-22 to 2-23

Unit 2: Construction/Housing

Outcomes

Students will be expected to

B13 estimate material quantities and cost in problem situations

F1 organise and compile data using appropriate formats to facilitate data treatment

B14 apply percent in problem situations

Elaborations–Strategies for Learning and Teaching

Students should be provided with a variety of situations in which they would be required to estimate material quantities. These situations could include material to paint the walls and/or ceiling in a room, ceramic tile flooring, carpet flooring, and concrete for a foundation. Each of these situations require the student to acquire product information and perform the estimation based on various decisions. For example, tile size may influence material quantity. The direction in which the carpet is installed may influence quantity of carpet purchased. In each case the data and calculations should be displayed in a format that is conducive to ease of calculation and communication.

Students are expected to apply the necessary provincial and federal tax rates when calculating their final estimated price.

Unit 2: Construction Housing

Tasks for Instruction and/or Assessment

Performance/Pencil & Paper

- Estimate the total cost (including taxes) of painting the classroom walls and ceiling from calculations of the surface area (Recall: Area = Length x Width) of all the walls in the classroom and the number of 4L cans of paint required to place two (2) coats of paint. You must contact a local paint supply store to determine the type and price of the paint. You must also obtain the average coverage of a 4L can from the paint supplier.

  Once all necessary data is collected, create and complete an estimation form containing: room information (all dimensions, area calculation); paint information (paint volume calculation, unit cost of 4L paint can); total cost of paint (before tax); amount of GST & PST; and total cost of paint (including taxes).

- Calculate the surface area of the floor in your classroom and determine the amount of ceramic tiles required to cover the floor, bags of adhesive, bags of grout, and cost (including taxes). You must contact a local flooring supply store to determine the type (name) and price of the tile.

  Once all necessary data is collected, create and complete an estimation form containing: room information (all dimensions, area calculation); flooring information (flooring quantity calculation, unit cost of flooring); total cost of flooring (before tax); amount of PST & GST; and total cost of flooring (including taxes).

- Measure the dimensions of the classroom and determine the length of carpet required to cover the floor and cost (including taxes). You must contact a local flooring supply store to determine the type (name) and price of the carpet.

  Once all necessary data is collected, create and complete an estimation form containing: room information (all dimensions, area calculation); flooring information (flooring quantity calculation, unit cost of flooring); total cost of flooring (before tax); amount of PST & GST; and total cost of flooring (including taxes).

Resources/Notes

Applied Mathematics
page 2-26 to 2-30

Unit 3: Electrical

(Suggested Time: 15 Classes)

Overview

This unit uses an electrical context to deliver the mathematical content and processes. This unit further supports the concept that mathematics involves data collection, operations, data use, and communication. Unique to this unit is the emphasis on the necessity for interdisciplinary connections as mathematics can only be performed on electrical quantities once the circuitry is understood (science) and resulting decisions made, such as the use of alternative electrical devices, are often based on individual and societal values.

As a general rule, students should attempt to perform all computations mentally; however, pencil and paper techniques may be required for those computation too complex to be performed mentally. Calculators should only be used as a last resort or when mental or paper and pencil techniques are too distracting to effectively problem solve.

Specific Curriculum Outcomes (SCOs)

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

B16 calculate total voltage for dry cells connected in series and parallel

C5 calculate the total (equivalent) resistance for resistors when connected in series and parallel

C6 solve for single variables in problem situations using Ohm's Law

C7 analyse series and parallel ciruits to determine the voltage, current, and resistance at any devise (resistor) using the most appropriate method

C8 solve for single variables in problem situations involving electrical power

C9 solve for single variables in problem situations involving electrical energy

D4 select and use appropriate measuring devices involving electrical quantitites

Unit 3: Electrical

Outcomes

Students will be expected to

B10 convert between measurements mentally when appropriate

B11 convert between measurements within, or between, systems of measurement using the concept of rate

Elaborations–Strategies for Learning and Teaching

Students are expected know the meaning of the following metric prefixes: milli, centi, kilo, and be able to use all metric prefixes, given a table of prefixes, to convert between units of measurement mentally. These conversions would involve restating a metric measurement with a new prefix and altering the numeric component of the measurement by shifting the decimal. Students should understand that restating a measurement with a prefix of larger magnitude requires an adjustment to reduce the numeric component of the measurement by the same factor.

Students can perform these conversions mentally if appropriate. However, converting between systems of measurements is often too difficult to perform mentally. Students may wish to create an equation involving rates as follows:

? mm = 0.26 km (rate: 1 kOhm = 1000 Ohms)

$$\frac{X \text{ Ohms}}{0.26 \text{ ~~kOhms~~}} = \frac{1000 \text{ Ohms}}{1 \text{ ~~kOhms~~}}$$

$X = 2.6 \times 10^2$ Ohms

Alternatively, students may wish to perform unit analysis by making the unknown equal to the know and then multiply by the necessary conversion factor:

$$? \text{ mm} = 0.26 \text{ ~~kOhms~~} \times \frac{1000 \text{ Ohms}}{1 \text{ ~~kOhm~~}}$$

$= 2.6 \times 10^2$ Ohms

Note: Caution should be considered when using this method as students may become experts in using this method to obtain the correct answer without knowing why or how the answer is obtained. Students should be aware that multiplying by a reciprocal is equivalent to dividing. It is suggested that students be first introduced to conversions that are easily performed mentally such that they can not only observe how unit analysis works, but also why it works. For example, students could be asked how many kilometres is 5000 metres.

Mental Math: Divide 5000 by 1000: the answer is 5 km.

Unit Analysis $? \text{ km} = 5000 \text{ ~~m~~} \times \frac{1 \text{ km}}{1000 \text{ ~~m~~}}$

answer = 5 km

Unit 3: Electrical

Tasks for Instruction and/or Assessment

Pencil & Paper

- Convert the following to the base unit:
  A. 300 mV = ? V
  B. 210 A = ? A
  C. 2.54 kOhms = ? Ohms

- Convert the following base units to the indicated unit:
  A. ? mV = 0.50 V
  B. ? mA = 0.0035 A
  C. ? kOhms = 2000 Ohms

- Use the Unit Analysis method to perform the following calculations:
  A. 350 mA = ? A
  B. ? GW = 450 000W
  C. 3.26 kOhms = ? Ohms
  D. ? mA = 0.432A
  E. ? kOhms = 4500 Ohms
  F. ? mA = 0.0024 kA

Resources/Notes

Applied Mathematics
page 3-4, 3-5

Applied Mathematics
page 3-6

Unit 3: Electrical

Outcomes

Students will be expected to

D4 select and use appropriate measuring devices involving electrical quantitites

Elaborations–Strategies for Learning and Teaching

Students should become familiar with how current, voltage, and resistance is measured with a digital or analog multimeter. Students should know that measurement of current requires that the electrical leads of the multimeter must be connected in series with the circuit whereas measurement of resistance and voltage require that the electrical leads be connected in parallel.

Students must be familiar with how to adjust the multimeter to obtain the most sensitive measurement and how to read the measurements using the appropriate unit of measurement.

B16 calculate total voltage for dry cells connected in series and parallel

Students should be given the opportunity to measure the experimental voltages obtained when dry cells are connected in series and parallel. Students should then compare the experimental value to the theoretical values. For series connections, the total voltage is equal to the sum of the individual voltages

$$(V_t = V_1 + V_2 + V_3...)$$

For parallel connections, the total voltage is equal to each individual voltages

$$(V_t = V_1 = V_2 = V_3...)$$

Students could be asked to reverse the direction of one of the dry cells in the series circuit and to explain the resulting experimental voltages using the formula $V_t = V_1 + V_2 + V_3...$

Unit 3: Electrical

Tasks for Instruction and/or Assessment

Pencil & Paper

- Three 1.5 V dry cells are connected in series. What is the expected total voltage?
- Two 6.0 V batteries are connected in parallel. What is the expected total voltage?
- How does the overall voltage change when an additional battery is added to equivalent batteries that are connected in series? Parallel?

Journal

- Why does the multimeter need to be connected in series when measuring circuit current?
- What would happen to the total voltage if one of the batteries in a series connection were inappropriately installed (reversed)?

Performance

- Measure your "personal resistance" by firmly holding the leads of a multimeter in both hands.
- Measure the voltage produced by connecting three batteries in series and in parallel. Compare experimental and theoretical values.

Resources/Notes

Applied Mathematics
page 3-8 to 3-12, 3-17, 3-20

Applied Mathematics
page 3-9 to 3-12

Unit 3: Electrical

Outcomes

Students will be expected to

C5 calculate the total (equivalent) resistance for resistors when connected in series and parallel

C6 solve for single variables in problem situations using Ohm's Law

Elaborations–Strategies for Learning and Teaching

Students should be able to calculate total resistance when given individual resistance values and information regarding the connection type (series or parallel). Similarly, students should be able to calculate the total resistance given a circuit diagram containing various resistors whose values are labelled.

Total resistance can be calculated using the following formulae:

Series $R_t = R_1 + R_2 + R_3 \ldots.$

Parallel $$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

The resistance of a devise can be calculated as the ratio of the voltage applied to the current passing through.

From Ohm's Law, the following formula can be used:

$$R = \frac{V}{I}$$

R (Ohms)
V (volts)
I (amperes)

Students should be given the opportunity to calculate any one of the variables in the Ohm's Law formula given the remaining two variables. Students should be required to appropriatley convert the units of resistance, voltage, and current prior to substituting them into the Ohm's Law formula.

Unit 3: Electrical

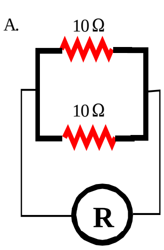
Tasks for Instruction and/or Assessment

Pencil & Paper

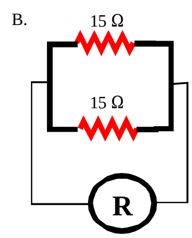
- Calculate the total (equivalent) resistance when 3Ohm, 5Ohm, and 15Ohm resistors are connected in series? Parallel?

- Calculate the total resistance of the following resistors connected in parallel.

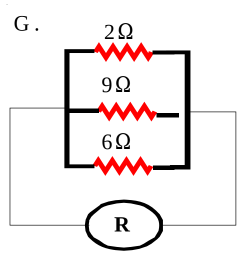
A.



B.



C.



- Using Ohm's law, calculate the resistance (in Ohm's) given the following voltage and current values:
  A. V = 12 volts, I = 5 amps
  B. V = 9 volts, I = 5 amps
  C. V = 1.2 volts, I = 0.88 amps
  D. V = 1.5 volts, I = 1.3 amps
  E. V = 300 millivolts, I = 2.4 amps

- What is the voltage if the current is 20 A and the resistance is 5 Ohm?

- What is the current if the voltage is 120 V and the resistance is 12 Ohm?

- What is the resistance if the current is 8.2 A and the voltage is 167 V?

Journal

- In consideration of Ohm's Law, describe two ways to increase the value of the circuit current.

Resources/Notes

Applied Mathematics
page 3-13, 3-14

Applied Mathematics
page 3-15 to 3-17, 3-20

Unit 3: Electrical

Outcomes

Students will be expected to

C7 analyse series and parallel circuits to determine the voltage, current, and resistance at any devise (resistor) using the most appropriate method

Elaborations–Strategies for Learning and Teaching

Students should be provided with opportunities to demonstate their knowledge of computations involving electrical quantities where both the characteristics of series or parallel circuits are required in association with Ohm's Law.

Students could be provided with partially completed data tables and asked to complete the table. This structure will better allow students to recognize the characteristics of the two circuit types as well as provide them with a method of displaying information that is conducive to data treatment. Similarly, students should also be provided with circuit diagrams providing a minimum sufficient quantity of data to allow computation of the remaining electrical quantities for all devices in the circuit.

Characteristics of a Parallel Circuit:

$V_t = V_1 = V_2 = V_3$; $I_t = I_1 + I_2 + I_3 ....$; $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Characteristics of a Series Circuits:

$V_t = V_1 + V_2 + V_3 ...$; $R_t = R_1 + R_2 + R_3$; $I_t = I_1 + I_2 + I_3 ...$

C8 solve for single variables in problem situations involving electrical power

Students should calculate the amount of power, current, or voltage consumed by any devise in a circuit given the other two quantities and the following formula:

$P = IV$; P (watts)
I (amperes)
V (volts)

Students should recognize that the total power consumed by the devises in an electrical circuit (series or parallel) is equal to the sum of the individual power consumption by each devise.

$P_t = P_1 + P_2 + P_3 ...$

Students should be provided with an opportunity to compare the power consumed by a series and a parallel circuit when the same devices are used in each.

Unit 3: Electrical

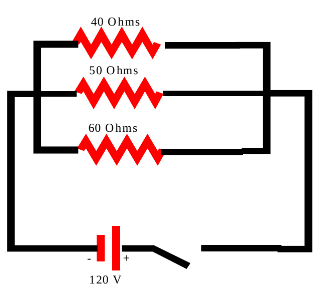
Tasks for Instruction and/or Assessment

Paper & Pencil

- Copy and complete the following table containing data taken from a series circuit.

Device #	Voltage	Current	Resistance
Device 1	0.75V		50
Device 2	1.5V	15mA	
Device 3			
Total	3 V		

- Given the parallel circuit on the below and accompanying data, create and complete a data table like the one above:



- Using the formula **P = I V,** solve for the missing quantity. You may wish to rearrange the formula prior to substituting in values.

  a. P = ?, I = 10 A, V = 120 V
  b. P = 1000 W, I = 15 A, V = ? V
  c. P = 50 W, I = ?, V = 12 V
  d. P = 2.4 kW, I = ? A, V = 120 V
  e. P = ? W, I = 300 mA, R = 40 Ohms
  f. P = ? W, V = 12 V, R = 24 Ohms

Journal

- How does the total voltage relate to the voltage drop at each device in the series circuit?
- How does the total current relate to the current passing through each device in the parallel circuit?
- Which circuit (series or parallel) would consume more power if both contained the same devices? Explain

Resources/Notes

Applied Mathematics
page 3-18, 3-19, 3-21, 3-22

Applied Mathematics
page 3-23 to 3-26

Unit 3: Electrical

Outcomes

Students will be expected to

C9 solve for single variables in problem situations involving electrical energy

Elaborations–Strategies for Learning and Teaching

Electrical energy is measured in kilowatt hours (kWh). The kilowatt hour is equivalent to the quantity of energy consumed by a 1000 watt devise that has operated for one hour.

The kWh can be calculated using the following formula:

$$\text{Energy} = \frac{\text{Power}}{1000} \times \text{Time}$$

Energy (kWh)
Power (Watts)
Time (hours)

Students could be provided with opportunities to compare electrical devices for efficiency. They could calculate cost saving by comparing alternative, low power, devices operating over the short and long term.

Students could obtain the cost of electricity from their parents electrical utility monthly statements. Cost can be calculated using the following formula:

$$\text{Cost (\$)} = \text{\#kWh} \times \text{Rate (\$/kWh)}$$

Students should be provided with various opportunities to calculate the cost of operating electrical devices and potential alternatives.

Unit 3: Electrical

Tasks for Instruction and/or Assessment

Paper & Pencil

- Calculate the amount of electrical power consumed if four exterior lights with a total power of 240 watts (60 W each) operated for:
  a. 10 minutes
  b. 2 hours
  c. 2 days
  d. 2 weeks

- Calculate the amount (kWh) of electrical energy consumed by four 100W light bulbs based on 4 hours of usage per day, for a period of:
  a. 1 day
  b. 1 week
  c. 1 month (assume 30 days)
  d. 1 year (365 days)

- Calculate the cost ($) of the electrical energy consumed by four 100W light bulbs based on 4 hours of usage per day, for a period of:
  a. 1 day
  b. 1 week
  c. 1 month (assume 30 days)
  d. 1 year (365 days)

- Calculate the savings in electrical energy cost by replacing four 100W bulbs with 13W bulbs based on 4 hours of usage per day, for a period of:
  a. 1 day
  b. 1 year (365 days)
  c. 5 year

Journal

- Is it a good idea to base your yearly energy cost on a one day consumption period? Explain.

Performance

- Calculate the amount of energy consumed in your home in a 24 hour period by taking two meter readings at exactly the same time of day, one day apart.
  Meter Reading (Day 1):________________ kWh
  Meter Reading (Day 2):________________ kWh
  Record the current cost of electricity (look on the internet or at a current electrical bill).
  1. Cost per kWh:________________ cents/kWh
  2. Calculate the cost of electrical energy for:
     a. 1 day
     b. 1 year (365 days)

Resources/Notes

Applied Mathematics
page 3-27 to 3-32

Unit 4: Spatial Sense

(Suggested Time: 12 Classes)

Overview

This unit provides students with an opportunity to visualize three-dimensional objects through combinations of physical constructions and two dimensional representations of these constructions. Developmentally, this unit progresses from simple two-dimensional representations to more complex representations which provide the illusion of three-dimensionality.

This unit emphasizes that spatial sense is an important component of mathematics and is equally important for the spatial demands in the trades, particularly fabrication.

Specific Curriculum Outcomes (SCOs)

E1 construct shapes from mat plans and 3-view orthographic projections

E2 create 3-view orthographic projections from mat plans and vice versa

E3 create isometric drawings from mat plans

E4 identify isometric drawings from a combination of composite isometric drawings

E5 identify and draw hidden view lines and missing object lines on a 3-view orthographic projection

E6 create isometric drawings from 3-view orthographic projections and vice versa

Unit 4: Spatial Sense

Outcomes

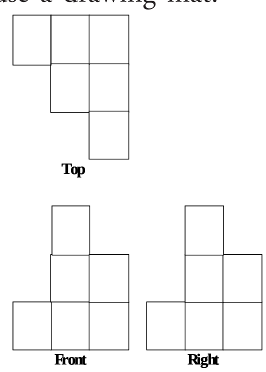
Students will be expected to

E1 construct shapes from mat plans and 3 - view orthographic projections

Elaborations–Strategies for Learning and Teaching

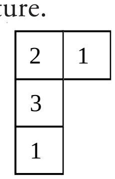
Given a mat plan or 3-view orthographic projections, students should be able to construct the representative shape.

The top, front, and right side views should be drawn for 3-view orthographic projections. The top view is always drawn above while the right view is always drawn to the right of the front view (see graphic below). To assist in maintaining proper orientation, students should always use a drawing mat.



Three-view orthographic projections may be more challenging for the student to initially understand; however, this method of representation is more comprehensive than mat plans as orthographic projections can be used to accurately represent voids in the 3-dimensional objects, particularly with the use of hidden lines which should only be introduced to the students after they begin to progress through this unit.

Mat plans are a very simplistic and limited method of representing a 3-dimensional shape on a 2-dimensional surface. When engaged in constructing shapes from the mat plan, students should be provided with the opportunity to discuss the limitations of using mat plans such as the inability to represent voids (hollow spaces) in the 3-dimensional structure.



Mat Plan

E2 create 3-view orthographic projections from mat plans and vice versa

It may be helpful for students to create the actual 3-dimensional model using available materials such as cube-a-links prior to creating the 3-view orthographic projections or mat plan.

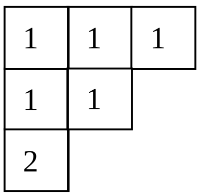
Teachers may want to engage their students in a discussion regarding commonalities between mat plans and 3-view orthographic projections, such as the top-view.

Unit 4: Spatial Sense

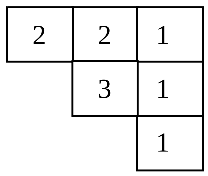
Tasks for Instruction and/or Assessment

Performance/Pencil & Paper

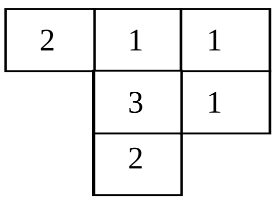
- Use the mat plans below to construct the buildings on a building mat. Draw the top, front, and right views (3-view orthographic) for each building.



Mat Plan

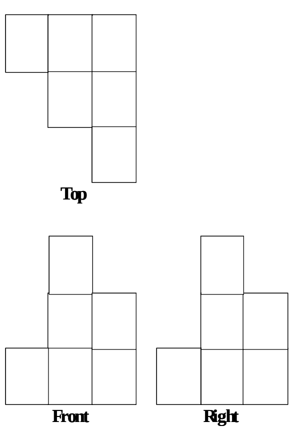


Mat Plan



Mat Plan

- Construct a 3-D model using the following views. Draw the corresponding mat plan.



Resources/Notes

Applied Mathematics
page 4-3 to 4-17

Applied Mathematics
page 4-4 to 4-17

Unit 4: Spatial Sense

Outcomes

Students will be expected to

E3 create isometric drawings from mat plans

Elaborations–Strategies for Learning and Teaching

Isometric drawings are unique because they present the illusion of depth of the 3-dimensional object. It may be helpful for students to create a 3-dimensional model from the Mat plan prior to creating the isometric drawing.

It is not the intention of this course to have students draft with t-squares and set squares; therefore, students should always have isometric paper provided. Students should select the corner of the object to be drawn which illustrates the most detail. It is also helpful to inform students to tilt the object such that the top-view is visible. The front-view of the object should be oriented to the left of the leading edge while the right-view should be to the right of the leading edge. Students can practice drawing isometric drawings or confirm the accuracy of their drawing using available software.

E4 identify isometric drawings from a combination of composite isometric drawings

Students should identify isometric drawings that can be created from given composite isometric drawings. Students may find it helpful to create the individual composite 3-dimensional models to assist in determining if the isometric drawing provided can be created from the composite figures.

E5 identify and draw hidden view lines and missing object lines on a 3-view orthographic projection

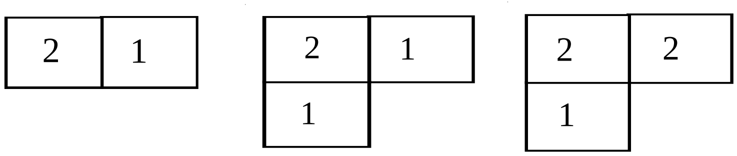
Students should be given the top, front, and right side views where one or more of these views require more object lines or hidden view lines. Hidden view lines, illustrated as dotted lines, indicate the edges of voids (hollow parts) that exist in the object not visible by the face that is being viewed. To avoid ambiguity, an isometric drawing may be required along with the 3-views to identify the missing object lines or hidden view lines.

Unit 4: Spatial Sense

Tasks for Instruction and/or Assessment

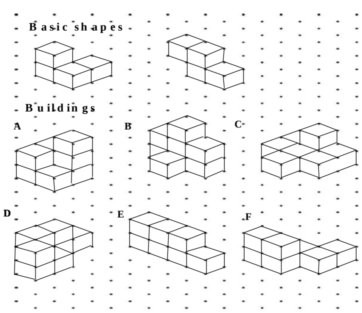
Performance/Paper & Pencil

- Using the isometric paper, draw an isometric drawing for each of the following mat plans:



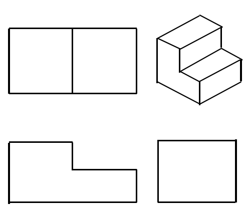
Mat Plan A   Mat Plan B   Mat Plan C

- How can the two basic shapes be put together to make each of the buildings shown below?



- Draw in the missing object lines or the hidden view lines of the following 3-view orthographic projection.

1



Performance

- Using available software, confirm the accuracy of corresponding mat plans, isometric drawings, and three-view orthographic projections.

Resources/Notes

Applied Mathematics
page 4-18 to 4-21

Isometric drawing tool (NCTM)
http://illuminations.nctm.org/ActivityDetail.aspx?ID=125

Applied Mathematics
page 4-22 to 4-23

Applied Mathematics
page 4-24 to 4-27

Enrichment:
Applied Mathematics
page 4-28 to 4-29

Unit 4: Spatial Sense

Outcomes

Students will be expected to

E6 create isometric drawings from 3-view orthographic projections and vice versa

Elaborations–Strategies for Learning and Teaching

Students should be engaged in a discussion regarding the commonalities between isometric and 3-view orthographic projections. Both drawing types illustrate three views that are common (top, front, right).

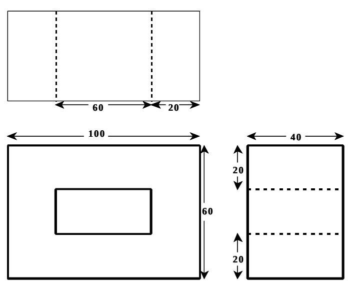
Students may wish to construct the 3-dimensional model from the drawing given prior to drawing the corresponding drawings. In addition to creating drawings, students could be provided with corresponding isometric and 3-view orthographic projections and asked to identify/match related surfaces on each drawing. Similarly, students could also be provided with a variety of 3-view orthographic projections along with the corresponding isometric drawings and asked to match the drawings, or components thereof, that relate.

Unit 4: Spatial Sense

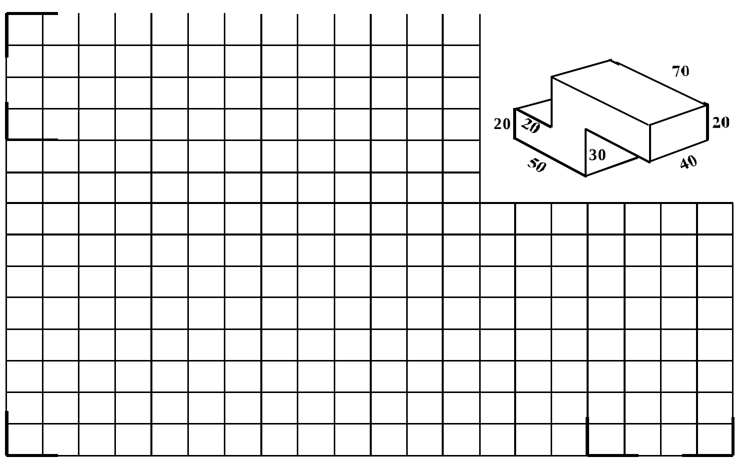
Tasks for Instruction and/or Assessment

Performance/Paper & Pencil

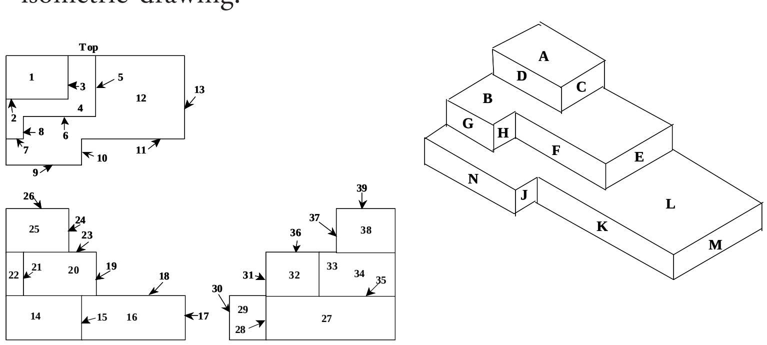
- Use the orthographic views of the machine component shown below to construct isometric views and to a build cube-a-link model.



- Draw three orthographic views of the object in the positions indicated by the short darkened line segments.



- Find the numbers in the top, front, and right side views that correspond to and represent the lettered surfaces in the isometric drawing.



Resources/Notes

Applied Mathematics
page 4-30 to 4-37

Unit 5: Fabrication

(Suggested Time: 8 Classes)

Overview

This unit builds upon the spatial shills developed in unit four. Students will be provided with the oportunity to extend two-dimensional constructions (circle, triangle, rectangle) into right prisms (cone, right-triangular prism, right-rectangular prism). In addition, students will also be afforded the opportunity to calculate surface area and volumes for these constructions and to think critically about the relationship that exist between them.

Specific Curriculum Outcomes (SCOs)

C10 identify and describe patterns between perimeter and surface area

E7 calculate the perimeter of polygons and circles

E8 calculate the surface areas of polygons, circles and right prisms

E9 calculate the volumes of right prisms

E10 identify and describe patterns between surface area and volume of right prisms.

E11 construct right prisms from component polygons/cicles and nets

Unit 5: Fabrication

Outcomes

Students will be expected to

E7 calculate the perimeter of polygons and circles

Elaborations–Strategies for Learning and Teaching

Polygons should be limited to treatments involving triangles and rectangles. Perimeter calculations of polygons are usually easily understood by students. However, perimeter calculations of the circle has the added complexity of involving the constant *pi*. Students could be engaged in discovering the value of pi by measuring the circumference and diameter of a variety of circular objects (bottle lids, etc.). From this activity the value of pi can be determined in the following two ways:

- dividing each circumference by the corresponding diameter;
- plotting the circumference versus the diameter and calculating the slope of the line of best fit.

Students could be asked to relate their calculations of pi to the following formula

$$c = \pi d$$

E8 calculate the surface areas of polygons, circles and right prisms

Polygons should be limited to treatments involving triangles and rectangles. Similarly, right prisms should be limited to the cylinder, right-triangular prism, and right-rectangular prism, which are logical extensions of the circles and polygons being studied.

To facilitate the learning the surface area of right prisms, students should be provide with the opportunity to construct the prisms from their component polygon/circle surfaces. For instance, a cylinder is composed of two face circles with a central section. When cut down the centre, the central section is rectangular in shape. The total surface area of the prism is the sum of these three components.

C10 identify and describe patterns between perimeter and surface area

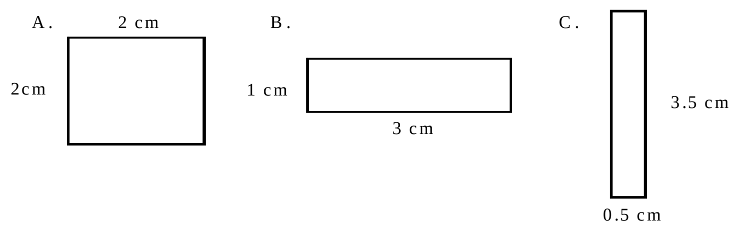
Students should be provided with the opportunity to recognize patterns between surface areas (SA) and perimeter (P) for polygons. By engaging students in calculating SA:P ratios they will be better able to compare the calculated ratio to the actual shape. From this activity, students should recognize that the more regular the shape the greater the SA:P ratio, particularly when using shapes of equal perimeter. Students can then be engaged in a discussion of how this knowledge can be applied in practical situations (ex. home construction: maximizing floor area with minimal wall length). Discussion should also include other factors that must be considered along with SA:P efficiency.

Unit 5: Fabrication

Tasks for Instruction and/or Assessment

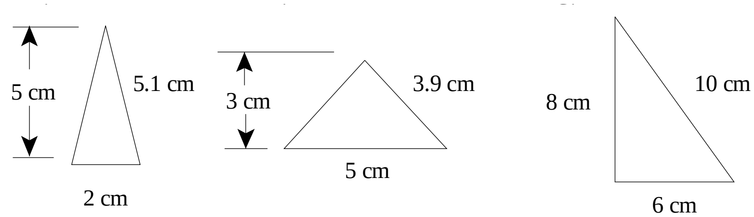
Paper & Pencil

- Calculate the surface area and perimeter given the following information:

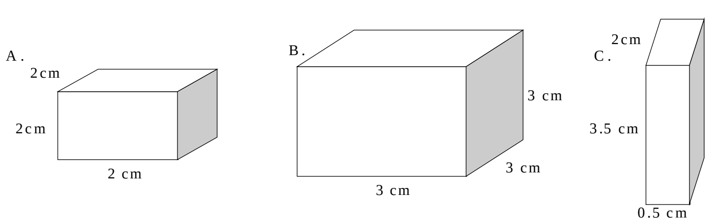


- Calculate the perimeter, surface area, and SA : P ratio given the following:
  a. l = 2cm, w = 15 cm
  b. l = 3cm, w = 10 cm
  c. l = 5cm, w = 6 cm

- Calculate the surface area and perimeter given the following information:



- Calculate the surface area of the following prisms:



Journal

- Can the surface area to perimeter ratio be increased by adjusting the length and width of the rectangular shape? Explain.

Resources/Notes

Applied Mathematics
p. 5-3 to 5-18

Unit 5: Fabrication

Outcomes

Students will be expected to

E9 calculate the volumes of right prisms

E10 identify and describe patterns between surface area and volume of right prisms.

Elaborations–Strategies for Learning and Teaching

Volumes of right prisms should be restricted to treatments involving cylinders, right-triangular prisms, and right-rectangular prisms which is consistent with the surface area calculations that were performed on these 3-dimensional objects.

By providing students with the opportunity to add a third dimension to a two-dimensional object they should recognize that volume is simply an extension of surface area. For example, the volume of a right-rectangular prism can be calculated using the following formula V=1x w x h. Alternatively, the volume can be calculated by simply multiplying the surface area of the face of the prism (1 x w) by the height.

$$V = SA\ (\text{face}) \bullet h$$

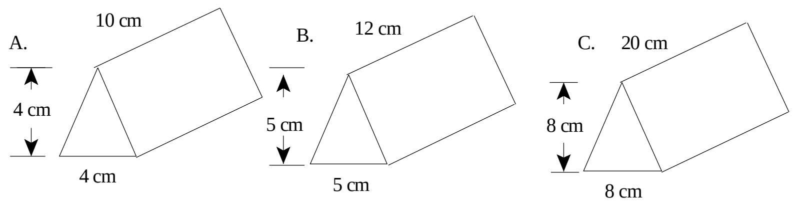
Students should be provided with opportiunities to calculate surface area (SA) to volume ratios for similar prisms of varying size. This activity will allow students to discover that the surface area to volume ratio should decrease as the size of the 3-dimensional object increases. This ratio is very important to many industries as well as living things. Heating/cooling systems require a large SA:V ratio to maximize surface area for heat transfer. Microprocessors may contain heat sinks with large SA:V ratios to allow heat to disperse at a greater rate. The living cell is incredibly small to increase cell SA:V ratio which allows nutrients and waste to be transferred through the cell membrane more rapidly. Northern animals tend to be larger (smaller SA:V ratio) than their southern cousins with larger SA:V which allows them to more easily maintain appropriate body temperature.

Unit 5: Fabrication

Tasks for Instruction and/or Assessment

Paper & Pencil

- Calculate the prism surface area and prism volume given the following information:



- Calculate the face-triangle height, prism surface area, and prism volume given the following information. Sketch the triangular right prism to assist in your calculations

  a. Face triangle is equilateral with 6 cm side lengths; 10 cm $\text{height}_{(\text{stretchout})}$

  b. Face triangle is equilateral with 7 cm side lengths; 12 cm $\text{height}_{(\text{stretchout})}$

  c. Face triangle is isosceles with 5cm, 7cm, 7cm side lengths; 10 cm $\text{height}_{(\text{stretchout})}$

  d. Face triangle is isosceles with 6cm, 9cm, 9 cm side lengths; 10 cm $\text{height}_{(\text{stretchout})}$

- Calculate the Surface Area, Volume, and SA:V Ratio, given the following:
  a. l = 3 cm, w = 4 cm, h= 3 cm
  b. l = 6 cm, w = 10 cm, h= 3 cm
  c. l = 5 cm, w = 6 cm, h= 3 cm

Journal

- Given two perfect cubes, one smaller than the other, which cube would have the greatest SA:V ratio? Explain.

- When would it be advantageous for an object to have a large SA:V ratio? A small SA:V ratio?

Resources/Notes

Applied Mathematics
page 5-5, 5-6, 5-10, 5-11, 5-15 to 5-18

Unit 5: Fabrication

Outcomes

Students will be expected to

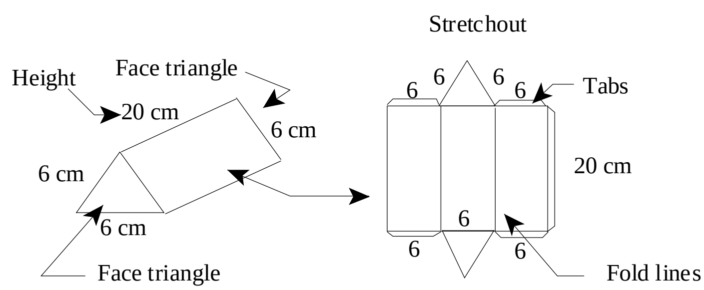
E11 construct right prisms from component polygons/circles and nets

Elaborations–Strategies for Learning and Teaching

Students will continue to build upon their knowledge of spatial sense by constructing right prisms from component polygons/ circles. Students should be provided with the opportunity to recognize that many complex structures that they encounter everyday, regardless of the level of apparent abstraction, are usually constructed by interesting combinations of polygons and circles.

Once students become familiar with creating prisms from polygons and circles they will be better prepared to create nets. In industry nets are often called stretchouts and are used to manufacture a variety of items from a variety of construction materials.

As a culminating task, students should be provided with the opportunity to construct a 3-dimensional object (e.g. oil tank) and asked to perform the resulting surface area and volume calculations on their construction. The concept of scale can also be included in this project.

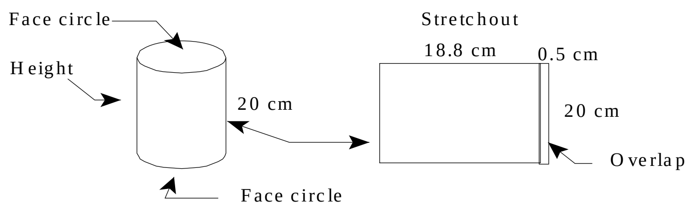


Unit 5: Fabrication

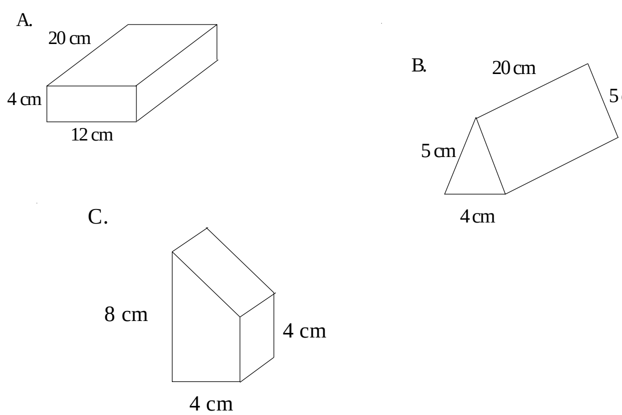
Tasks for Instruction and/or Assessment

Paper & Pencil

- Provided with two circles (radius: 3 cm) as end-faces, construct a cylinder with a height of 20 cm using Bristol board.



- Draw a stretchout for each of the following three dimensional shapes (polyhedra) using Bristol board and various measuring/ drawing tools. Add 0.5 cm tabs to select sides to allow for assembly. (General rule: for every side that must be attached (mended), there should exist one tab (not two) for assembly.)



Construct each of the above three dimensional shapes from their respective stretchout. Mend all seams with a hot glue gun.

- Calculate the total surface area (cm^2) and volume (cm^3) of each shape above.

Resources/Notes

Applied Mathematics
page 5-16 to 5-18

APPENDIX

Print/Electronic Resources:

Applied Mathematics 801A Student Text	1/p
Applied Mathematics 801A Teacher's Resource CD-ROM	1/t
Applied Mathematics 801 Curriculum Guide	1/t

Additional Resources:

Digital Multimeters	15/s
Jumper Test Leads	60/s
Light Sockets (miniture base)	48/s
Incandescent Lamps (miniture base)	100/s
Battery Holders (D-Cell)	15/s
D-Cell Batteries	30/s
9-V Batteries	15/s
Tape Measures	30/s
Metal Squares	15/s
Mitre Box/Mitre Saw	5/s
Glue Guns (miniature)	15/s
Glue (miniature)	24/s
Popsicle Sticks (minimum 6 inch)	10/s
Hex-a-Links (Caddy Stack)	1/s
Pattern Blocks (Caddy Stack)	1/s
Counters (Caddy Stack)	1/s
Plastic Totes	2/s

Distribution Ratio: 1/p (1 per pupil)
1/t (1 per teacher)
1/s (1 per school)

The additional resources listed above were provided to each high school by the Department of Education during the initial implementation of this program. Individual schools are responsible for maintaining and replenishing these resources as required.