Mathematics for Work and Everyday Life, Grade 12

Workplace Preparation MEL4E

This course enables students to broaden their understanding of mathematics as it is applied in the workplace and daily life. Students will investigate questions involving the use of statistics; apply the concept of probability to solve problems involving familiar situations; investigate accommodation costs, create household budgets, and prepare a personal income tax return; use proportional reasoning; estimate and measure; and apply geometric concepts to create designs. Students will consolidate their mathematical skills as they solve problems and communicate their thinking.

Prerequisite: Mathematics for Work and Everyday Life, Grade 11, Workplace Preparation

MATHEMATICAL PROCESS EXPECTATIONS

The mathematical processes are to be integrated into student learning in all areas of this course.

Throughout this course, students will:

Problem Solving	• develop, select, apply, compare, and adapt a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
Reasoning and Proving	• develop and apply reasoning skills (e.g., use of inductive reasoning, deductive reasoning, and counter-examples; construction of proofs) to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;
Reflecting	• demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);
Selecting Tools and Computational Strategies	• select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;
Connecting	• make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);
Representing	• create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;
Communicating	• communicate mathematical thinking orally, visually, and in writing, using precise mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

A. REASONING WITH DATA

OVERALL EXPECTATIONS

By the end of this course, students will:

1. collect, organize, represent, and make inferences from data using a variety of tools and strategies, and describe related applications;
2. determine and represent probability, and identify and interpret its applications.

SPECIFIC EXPECTATIONS

1. Interpreting and Displaying Data

By the end of this course, students will:

1.1 read and interpret graphs (e.g., bar graph, broken-line graph, histogram) obtained from various sources (e.g., newspapers, magazines, Statistics Canada website)

1.2 explain the distinction between the terms *population* and *sample*, describe the characteristics of a good sample, and explain why sampling is necessary (e.g., time, cost, or physical constraints)

Sample problem: What are some factors that a manufacturer should consider when determining whether to test a sample or the entire population to ensure the quality of a product?

1.3 collect categorical data from primary sources, through experimentation involving observation (e.g., by tracking food orders in restaurants offering healthy food options) or measurement, or from secondary sources (e.g., Internet databases, newspapers, magazines), and organize and store the data using a variety of tools (e.g., spreadsheets, dynamic statistical software)

Sample problem: Observe cars that pass through a nearby intersection. Collect data on seatbelt usage or the number of passengers per car.

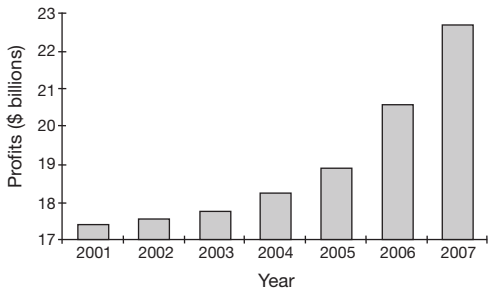
1.4 represent categorical data by constructing graphs (e.g., bar graph, broken-line graph, circle graph) using a variety of tools (e.g., dynamic statistical software, graphing calculator, spreadsheet)

1.5 make inferences based on the graphical representation of data (e.g., an inference about a sample from the graphical representation of a population), and justify conclusions orally or in writing using convincing arguments (e.g., by showing that it is reasonable to assume that a sample is representative of a population)

1.6 make and justify conclusions about a topic of personal interest by collecting, organizing (e.g., using spreadsheets), representing (e.g., using graphs), and making inferences from categorical data from primary sources (i.e., collected through measurement or observation) or secondary sources (e.g., electronic data from databases such as E-STAT, data from newspapers or magazines)

1.7 explain how the media, the advertising industry, and others (e.g., marketers, pollsters) use and misuse statistics (e.g., as represented in graphs) to promote a certain point of view (e.g., by making general statements based on small samples; by making statements using general population statistics without reference to data specific to minority groups)

Sample problem: The headline that accompanies the following graph says "Big Increase in Profits". Suggest reasons why this headline may or may not be true.



1.8 gather, interpret, and describe information about applications of data management in the workplace and in everyday life

2. Investigating Probability

By the end of this course, students will:

2.1 determine the theoretical probability of an event (i.e., the ratio of the number of favourable outcomes to the total number of possible outcomes, where all outcomes are equally likely), and represent the probability in a variety of ways (e.g., as a fraction, as a percent, as a decimal in the range 0 to 1)

2.2 identify examples of the use of probability in the media (e.g., the probability of rain, of winning a lottery, of wait times for a service exceeding specified amounts) and various ways in which probability is represented (e.g., as a fraction, as a percent, as a decimal in the range 0 to 1)

2.3 perform simple probability experiments (e.g., rolling number cubes, spinning spinners, flipping coins, playing Aboriginal stick-and-stone games), record the results, and determine the experimental probability of an event

2.4 compare, through investigation, the theoretical probability of an event with the experimental probability, and describe how uncertainty explains why they might differ (e.g., "I know that the theoretical probability of getting tails is 0.5, but that does not mean that I will always obtain 3 tails when I toss the coin 6 times"; "If a lottery has a 1 in 9 chance of winning, am I certain to win if I buy 9 tickets?")

2.5 determine, through investigation using class-generated data and technology-based simulation models (e.g., using a random-number generator on a spreadsheet or on a graphing calculator), the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases (e.g., "If I simulate tossing a coin 1000 times using technology, the experimental probability that I calculate for getting tails in any one toss is likely to be closer to the theoretical probability than if I simulate tossing the coin only 10 times")

Sample problem: Calculate the theoretical probability of rolling a 2 on a number cube. Simulate rolling a number cube, and use the simulation to calculate the experimental probability of rolling a 2 after 10, 20, 30, …, 200 trials. Graph the experimental probability versus the number of trials, and describe any trend.

2.6 interpret information involving the use of probability and statistics in the media, and describe how probability and statistics can help in making informed decisions in a variety of situations (e.g., weighing the risk of injury when considering different occupations; using a weather forecast to plan outdoor activities; using sales data to stock a clothing store with appropriate styles and sizes)

Sample problem: A recent study on youth gambling suggests that approximately 30% of adolescents gamble on a weekly basis. Investigate and describe the assumptions that people make about the probability of winning when they gamble. Describe other factors that encourage gambling and problems experienced by people with a gambling addiction.

B. PERSONAL FINANCE

OVERALL EXPECTATIONS

By the end of this course, students will:

1. gather, interpret, and compare information about owning or renting accommodation and about the associated costs;
2. interpret, design, and adjust budgets for individuals and families described in case studies;
3. demonstrate an understanding of the process of filing a personal income tax return, and describe applications of the mathematics of personal finance.

SPECIFIC EXPECTATIONS

1. Renting or Owning Accommodation

By the end of this course, students will:

1.1 identify the financial implications (e.g., responsibility for paying the cost of accommodation and furnishings; greater responsibility for financial decision making) and the non-financial implications (e.g., greater freedom to make decisions; the demands of time management or of adapting to a new environment; the possibility of loneliness or of the need to share responsibilities) associated with living independently

1.2 gather and compare, through investigation, information about the costs and the advantages and disadvantages of different types of rental accommodation in the local community (e.g., renting a room in someone's house; renting a hotel room; renting or leasing an apartment)

1.3 gather and compare, through investigation, information about purchase prices of different types of owned accommodation in the local community (e.g., trailer, condominium, townhouse, detached home)

1.4 gather, interpret, and compare information about the different types of ongoing living expenses associated with renting and owning accommodation (e.g., hydro, cable, telephone, Internet, heating, parking, laundry, groceries, cleaning supplies, transportation) and related costs

1.5 gather, interpret, and describe information about the rights and responsibilities of tenants and landlords

1.6 generate a checklist of necessary tasks associated with moving (e.g., change of address, set-up of utilities and services, truck rental), and estimate the total cost involved under various conditions (e.g., moving out of province; hiring a moving company)

2. Designing Budgets

By the end of this course, students will:

2.1 categorize personal expenses as non-discretionary (e.g., rent, groceries, utilities, loan payments) or discretionary (e.g., entertainment, vacations)

2.2 categorize personal non-discretionary expenses as fixed (e.g., rent, cable, car insurance) or variable (e.g., groceries, clothing, vehicle maintenance)

2.3 read and interpret prepared individual or family budgets, identify and describe the key components of a budget, and describe how budgets can reflect personal values (e.g., as they relate to shopping, saving for a long-term goal, recreational activities, family, community)

2.4 design, with technology (e.g., using spreadsheet templates, budgeting software, online tools) and without technology (e.g., using budget templates), explain, and justify a

monthly budget suitable for an individual or family described in a given case study that provides the specifics of the situation (e.g., income; personal responsibilities; expenses such as utilities, food, rent/mortgage, entertainment, transportation, charitable contributions; long-term savings goals)

2.5 identify and describe factors to be considered in determining the affordability of accommodation in the local community (e.g., income, long-term savings, number of dependants, non-discretionary expenses)

2.6 make adjustments to a budget to accommodate changes in circumstances (e.g., loss of hours at work, change of job, change in personal responsibilities, move to new accommodation, achievement of a long-term goal, major purchase), with technology (e.g., spreadsheet template, budgeting software)

3. Filing Income Tax

By the end of this course, students will:

3.1 explain why most Canadians are expected to file a personal income tax return each year, and identify and describe the major parts of a personal income tax return (i.e., identification, total income, net income, taxable income, refund or balance owing)

3.2 gather, interpret, and describe the information and documents required for filing a personal income tax return (e.g., CRA guides, forms, and schedules; T4 slips; receipts for charitable donations), and explain why they are required

3.3 gather, interpret, and compare information about common tax credits (e.g., tuition fees, medical expenses, charitable donations) and tax deductions (e.g., moving expenses, child care expenses, union dues)

3.4 complete a simple personal income tax return (i.e., forms and schedules), with or without tax preparation software

3.5 gather, interpret, and describe some additional information that a self-employed individual should provide when filing a personal income tax return (e.g., a statement of business activities that includes business expenses such as insurance, advertising, and motor-vehicle expenses)

3.6 gather, interpret, and describe information about services that will complete a personal income tax return (e.g., tax preparation service, chartered accountant, voluntary service in the community) and resources that will help with completing a personal income tax return (e.g., forms and publications available on the Canada Revenue Agency website, tax preparation software for which rebates are available), and compare the services and resources on the basis of the assistance they provide and their cost

3.7 gather, interpret, and describe information about applications of the mathematics of personal finance in the workplace (e.g., selling real estate, bookkeeping, managing a restaurant)

C. APPLICATIONS OF MEASUREMENT

OVERALL EXPECTATIONS

By the end of this course, students will:

1. determine and estimate measurements using the metric and imperial systems, and convert measures within and between systems;
2. apply measurement concepts and skills to solve problems in measurement and design, to construct scale drawings and scale models, and to budget for a household improvement;
3. identify and describe situations that involve proportional relationships and the possible consequences of errors in proportional reasoning, and solve problems involving proportional reasoning, arising in applications from work and everyday life.

SPECIFIC EXPECTATIONS

1. Measuring and Estimating

By the end of this course, students will:

1.1 measure, using a variety of tools (e.g., measuring tape, metre or yard stick, measuring cups, graduated cylinders), the lengths of common objects and the capacities of common containers, using the metric system and the imperial system

1.2 estimate lengths, distances, and capacities in metric units and in imperial units by applying personal referents (e.g., the width of a finger is approximately 1 cm; the length of a piece of standard loose-leaf paper is about 1 ft; the capacity of a pop bottle is 2 L)

Sample problem: Based on an estimate of the length of your stride, estimate how far it is to the nearest fire exit from your math classroom, and compare your estimate with the measurement you get using a pedometer.

1.3 estimate quantities (e.g., bricks in a pile, time to complete a job, people in a crowd), and describe the strategies used

Sample problem: Look at digital photos that show large quantities of items, and estimate the numbers of items in the photos.

1.4 convert measures within systems (e.g., centimetres and metres, kilograms and grams, litres and millilitres, feet and inches, ounces and pounds), as required within applications that arise from familiar contexts

1.5 convert measures between systems (e.g., centimetres and inches, pounds and kilograms, square feet and square metres, litres and U.S. gallons, kilometres and miles, cups and millilitres, millilitres and teaspoons, degrees Celsius and degrees Fahrenheit), as required within applications that arise from familiar contexts

Sample problem: Compare the price of gasoline in your community with the price of gasoline in a community in the United States.

2. Applying Measurement and Design

By the end of this course, students will:

2.1 construct accurate right angles in practical contexts (e.g., by using the 3-4-5 triplet to construct a region with right-angled corners on a floor), and explain connections to the Pythagorean theorem

2.2 apply the concept of perimeter in familiar contexts (e.g., baseboard, fencing, door and window trim)

Sample problem: Which room in your home required the greatest, and which required the least, amount of baseboard? What is the difference in the two amounts?

2.3 estimate the areas and volumes of irregular shapes and figures, using a variety of strategies (e.g., counting grid squares; displacing water)

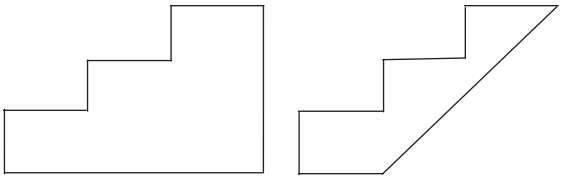
Sample problem: Draw an outline of your hand and estimate the area.

2.4 solve problems involving the areas of rectangles, triangles, and circles, and of related composite shapes, in situations arising from real-world applications

Sample problem: A car manufacturer wants to display three of its compact models in a triangular arrangement on a rotating circular platform. Calculate a reasonable area for this platform, and explain your assumptions and reasoning.

2.5 solve problems involving the volumes and surface areas of rectangular prisms, triangular prisms, and cylinders, and of related composite figures, in situations arising from real-world applications

Sample problem: Compare the volumes of concrete needed to build three steps that are 4 ft wide and that have the cross-sections shown below. Explain your assumptions and reasoning.



2.6 construct a two-dimensional scale drawing of a familiar setting (e.g., classroom, flower bed, playground) on grid paper or using design or drawing software

Sample problem: Your family is moving to a new house with a living room that is 16 ft by 10 ft. Cut out and label simple geometric shapes, drawn to scale, to represent every piece of furniture in your present living room. Place all of your cut-outs on a scale drawing of the new living room to find out if the furniture will fit appropriately (e.g., allowing adequate space to move around).

2.7 construct, with reasonable accuracy, a three-dimensional scale model of an object or environment of personal interest (e.g., appliance, room, building, garden, bridge)

Sample problem: Design an innovative combination of two appliances or two other consumer products (e.g., a camera and a cellphone, a refrigerator and a television), and construct a three-dimensional scale model.

2.8 investigate, plan, design, and prepare a budget for a household improvement (e.g., landscaping a property; renovating a room), using appropriate technologies (e.g., design or decorating websites, design or drawing software, spreadsheet)

Sample problem: Plan, design, and prepare a budget for the renovation of a 12-ft by 12-ft bedroom for under $2000. The renovations could include repainting the walls, replacing the carpet with hardwood flooring, and refurnishing the room.

3. Solving Measurement Problems Using Proportional Reasoning

By the end of this course, students will:

3.1 identify and describe applications of ratio and rate, and recognize and represent equivalent ratios (e.g., show that 4:6 represents the same ratio as 2:3 by showing that a ramp with a height of 4 m and a base of 6 m and a ramp with a height of 2 m and a base of 3 m are equally steep) and equivalent rates (e.g., recognize that paying $1.25 for 250 mL of tomato sauce is equivalent to paying $3.75 for 750 mL of the same sauce), using a variety of tools (e.g., concrete materials, diagrams, dynamic geometry software)

3.2 identify situations in which it is useful to make comparisons using unit rates, and solve problems that involve comparisons of unit rates

Sample problem: If 500 mL of juice costs $2.29 and 750 mL of the same juice costs $3.59, which size is the better buy? Explain your reasoning.

3.3 identify and describe real-world applications of proportional reasoning (e.g., mixing concrete; calculating dosages; converting units; painting walls; calculating fuel consumption; calculating pay; enlarging patterns), distinguish between a situation involving a proportional relationship (e.g., recipes, where doubling the quantity of each ingredient doubles the number of servings; long-distance phone calls

billed at a fixed cost per minute, where talking for half as many minutes costs half as much) and a situation involving a non-proportional relationship (e.g., cellular phone packages, where doubling the minutes purchased does not double the cost of the package; food purchases, where it can be less expensive to buy the same quantity of a product in one large package than in two or more small packages; hydro bills, where doubling consumption does not double the cost) in a personal and/or workplace context, and explain their reasoning

3.4 identify and describe the possible consequences (e.g., overdoses of medication; seized engines; ruined clothing; cracked or crumbling concrete) of errors in proportional reasoning (e.g., not recognizing the importance of maintaining proportionality; not correctly calculating the amount of each component in a mixture)

Sample problem: Age, gender, body mass, body chemistry, and habits such as smoking are some factors that can influence the effectiveness of a medication. For which of these factors might doctors use proportional reasoning to adjust the dosage of medication? What are some possible consequences of making the adjustments incorrectly?

3.5 solve problems involving proportional reasoning in everyday life (e.g., applying fertilizers; mixing gasoline and oil for use in small engines; mixing cement; buying plants for flower beds; using pool or laundry chemicals; doubling recipes; estimating cooking time from the time needed per pound; determining the fibre content of different sizes of food servings)

Sample problem: Bring the label from a large can of stew to class. Use the information on the label to calculate how many calories and how much fat you would consume if you ate the whole can for dinner. Then search out information on a form of exercise you could choose for burning all those calories. For what length of time would you need to exercise?

3.6 solve problems involving proportional reasoning in work-related situations (e.g., calculating overtime pay; calculating pay for piecework; mixing concrete for small or large jobs)

Sample problem: Coiled pipe from the United States is delivered in 200-ft lengths. Your company needs pipe in 3.7-m sections. How many sections can you make from each 200-ft length?