TIPS4RM

Leading MATH Success

TIPS4RM

Targeted Implementation and Planning Supports for Revised Mathematics

Summative Tasks

Grade 10 Applied

Ontario

Grade	10 Applied
Total time	150 minutes (2 75-minute periods)
Materials	large grid/chart paper; a board or flat surface at least the size of the chart paper that can be inclined; a small pan of water; tennis; ping pong or other balls; markers
Description	Students: • simulate the motion of a ball used in a sport of their choice. (The motion of the ball on the ramp will be quadratic in nature, and students will analyse the resulting graph.) • create a model of the motion by rolling a wet ball/object on an inclined surface covered with large grid/chart paper. (The water leaves a parabolic trail on the paper.) • apply a scale appropriate for their sport and analyse the resulting graph.
Expectations Assessed	**Mathematical Process Expectations** **MPS.01 • Problem Solving •** develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding; **MPS.02 • Reasoning and Proving •** develop and apply reasoning skills to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments; **MPS.03 • 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; **MPS.05 • Connecting •** make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts; **MPS.07 • Communicating •** communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions. **Quadratic Relations of the Form** $y = ax^2 + bx + c$ **QRV.02 •** identify characteristics of quadratic relations; **QRV.03 •** solve problems by interpreting graphs of quadratic relations.
Prior Knowledge/ Skills	Students should be able to: • identify key features of a parabola; • draw conclusions from a graph of a parabola; • compare graphical and algebraic representations of quadratic relations.
Assessment Tools	Rubric (teacher created) Observation

Description

- Simulate the motion of a ball used in a sport of their choice.
- Analyse the resulting quadratic graph.

Materials

- BLM 1.1
- large grid/chart paper, (1 per group)
- several sets of:
  - pan of water
  - balls: tennis, golf, ping pong
  - markers

Assessment Opportunities

Minds On…

Whole Class → Guided Discussion

Students consider a sport that has a ball whose motion might be parabolic. Lead a discussion about the students' findings.

Students choose a sport.

Students consider sports such as baseball, soccer, golf.

Small Groups → Discussion

Students who chose the same sport/activity work in small groups to hypothesize the maximum height and time for a complete path of the ball.

Action!

Small Groups (2 or 3) → Investigation

Students write their names on the back of the grid/chart paper and their sport on the front. Tape the paper to a board and elevate one end about 10 cm, creating a slope. Model the motion of the ball on the paper by gently rolling it starting at the bottom on one side. Students practise rolling the ball so it goes different heights and different lengths, yet stays on the board.

They consider their particular choice and try to roll the ball to model a path that would match a motion in their sport. After their practice rolls, they wet the ball and roll it on the chart paper (taped to the board) and trace the resulting path with a marker. Several tries on the same piece of graph paper may be necessary. Trace each roll with a marker.

This activity should be combined with a paper-and-pencil assessment. In turn, each group will leave their desk and "make" their "path" using the graph paper and ball.

Students display their graphs. Number each group's graph for reference. Analysis of the graphs takes place on Day 2.

Students may change the incline of the board to make a more appropriate curve.

Consolidate Debrief

Individual → Journal Entry

Students complete BLM 1.1 individually and hand it in.

Home Activity or Further Classroom Consolidation

On Day 2 you will be placing a pair of axes and a scale on your graph to represent the motion of the ball that you have chosen. Consider what these axes refer to, e.g., distance, time, height, and what range of numbers would be most appropriate to represent your choice. Determine the time it takes for one complete path of the ball and what its maximum height is.

1.1: The Sporty Parabolas

Name: _____

Consider the display of graphs of “parabolas” and the motion of the balls they represent.

1. Describe how to roll the ball to create “tall, skinny” or “short, wide” parabolas.

2. Choose a graph that you think is a particularly good model of the sport they’re used in (refer to the graph by number).
   Explain why you think it is a good model.

3. There are no axes on the graphs.
   What do you think the vertical axis should represent? Explain.

   What do you think the horizontal axis should represent? Explain.

4. Why do all the graphs display a vertex that is a maximum point and not a minimum point?

Description
- Students analyse the graph(s) from Day 1 and answer questions using the graph.

Materials
- student graphs from Day 1
- BLM 2.1
- beach ball

Assessment Opportunities

Minds On…

Whole Class → Guided Discussion

Toss a beach ball to a student, who then tosses to another and then another.

Ask:
- What is the maximum height that this ball reached?
- How long do you think it took to get to this height?
- What was the vertical distance it travelled?
- From what height did the ball leave my hand?
- How would a graph of this motion differ if it hit the floor rather than if it were caught by a student?

Action!

Small Groups (2 or 3) → Investigation

Students who worked together to generate the graphs, share their thinking about placing and labelling the axes to make their graph represent the motion of the ball they chose, with respect to the sport it represents.

Students choose the graph that is the best model. They highlight this graph with a different coloured marker. They place vertical and horizontal axes with an appropriate scale on their graph. They label the vertex and draw the axis of symmetry for their parabola.

Ask specific questions about the sport and determine the depth of the students' understanding.

Individual → Investigation

Students work individually to answer the questions (BLM 2.1). Each member of the group refers to their group's graph to answer the questions.

Conference with the students individually about the questions on BLM 2.1.

Consolidate Debrief

Whole Class → Guided Discussion

To set a context for the Home Activity, students use their knowledge of quadratic relationships to respond to the question:
- For a given quadratic relation, how do its graph, its numeric table of values, and the equation representing the relation connect?

Home Activity or Further Classroom Consolidation

Using the graph of $y = -(x + 1)(x - 4) = -x^2 + 3x + 4$ and the algebraic equations shown, write as many connections as you can see between the equations and the graph.

2.1: Our Sporty Parabola

Name: _____

1. Name the coordinates of the vertex of your parabola.

2. a) Is this point a maximum point or a minimum point?

   Explain how you know.

   b) What do the coordinates of the vertex mean with respect to the motion of the ball it models?

3. State the equation of the axis of symmetry.

   How can you show that this is the axis of symmetry?

4. If the entire parabola was shifted to the right one unit, what would be the coordinates of its new vertex?

5. What does the vertical axis represent?

   What is its scale? 1 unit =

   Explain your reasoning for choosing this scale.

6. What does the horizontal axis represent?

   What is its scale? 1 unit =

   Explain your reasoning for choosing this scale.

2.1: Our Sporty Parabola (continued)

7. At what point does the parabola meet the vertical axis?

   What does this mean in terms of the sport your ball represents?

8. At what point(s) does the parabola meet the horizontal axis?

   What does this mean in terms of the sport your ball represents?

9. Suppose someone much smaller or much bigger or much weaker or much stronger than you are to participate in the sport your ball represents. How would your graph change? Explain your reasoning.

Grade	10 Applied
Total Time	1 period (75 minutes)
Materials	graph paper, graphing calculator, linking cubes or The Geometer's Sketchpad®4
Description	Students use two different models to represent and solve a problem involving two unknowns. Possible models: • two equations in two unknowns that are solved algebraically • a graph of two linear relations, identification and interpretation of the point of intersection as the solution to the problem • a numerical table of values with identification of the values that represent the solution • another model, e.g., using manipulatives • justify their models and compare their results
Expectations Assessed	**Mathematical Process Expectations** **MPS.01 • Problem Solving •** develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding; **MPS.02 • Reasoning and Proving •** develop and apply reasoning skills to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments; **MPS.03 • 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; **MPS.05 • Connecting •** make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts; **MPS.06 • Representing •** create a variety of representations of mathematical ideas, connect and compare them, and select and apply the appropriate representations to solve problems; **MPS.07 • Communicating •** communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions. **Modelling Linear Relations** **MLV.01 •** manipulate and solve algebraic equations, as needed to solve problems; **MLV.02 •** graph a line and write the equation of a line from given information; **MLV.03 •** solve systems of two linear equations, and solve related problems that arise from realistic situations.
Prior Knowledge/ Skills	Students should be able to: • represent, solve, and interpret a linear system in context using a variety of methods.
Assessment Tools	Problem-solving rubric (teacher-created)

Math Learning Goals

- Students use at least two models to solve a linear system.

Materials

- BLM 1.1
- graph paper/ graphing calculator
- linking cubes
- The Geometer's Sketchpad®4

		Assessment Opportunities
Minds On…	**Whole Class → Guided Discussion** Lead a discussion about activities that contribute to fitness, include topics such as mountain biking and reasonable biking speeds. Students read the problem (BLM 1.1) and ask clarifying questions.	Average biking speeds: 15–25 km/h
Action!	**Small Groups → Discussion** In groups of 3 or 4, students discuss various ways to model and solve this problem. They can refer to the posters. **Whole Class → Sharing** Discuss the models that can be used to solve this problem (numeric table of values, graphical representation, and algebraic representation). Discuss the teacher-created, assessment rubric. **Individual → Problem Solving** Students work individually to solve the problem using various models. For those students who may complete the task early, pose the following problem: If each pair of cyclists travelled at twice the given speeds, how far and for how many hours would they have travelled before they met?	Refer students to the posters found at LMS web library: • Representations: Make Our Thinking Visible • Understand the Problem • Mathematical Models and Actions
Consolidate Debrief	**Whole Class → Guided Discussion** Ask: • Were your answers the same regardless of the model that you used to solve the problem? • Should they be the same? Explain. • Why might your answers vary somewhat? • Which method provides the more accurate answer? Explain how you know. Demonstrate the connection between the methods.	Make available a variety of tools for student use.

1.1: The Bicycle Problem

Sam and Eronza are mountain bicycle riders. Sam set out riding on their favourite trail at 2:00 p.m. one afternoon. He travelled at an average speed of 15 km/h.

Eronza started riding on the trail at 2:30 p.m. She hoped that if she travelled fast enough, she would catch up to Sam. She travelled at an average speed of 25 km/h.

Use two different mathematical models to represent this situation.

Use the models to determine when Eronza was able to catch up to Sam.
What time did they meet and how far along the trail were they? Explain your solutions.

Compare the advantages and disadvantages of each of your models.

Grade	10 Applied
Total time	1 period (75 minutes)
Materials	student-made clinometers, graphing calculators, rulers, measuring tapes, graph paper
Description	Students use similar triangles and/or trigonometric ratios in context and find the solution to a problem, i.e., a length.
Expectations Assessed	**Mathematical Process Expectations** **MPS.01 • Problem Solving •** develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding; **MPS.02 • Reasoning and Proving •** develop and apply reasoning skills to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments; **MPS.03 • 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; **MPS.05 • Connecting •** make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts; **MPS.07 • Communicating •** communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions. **Measurement and Trigonometry** **MTV.01 •** use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity; **MTV.02 •** solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem.
Prior Knowledge/ Skills	Students should be able to: • use clinometers to find the angle of elevation; • use trigonometric ratios to find the height of an object; • find lengths in triangles using similar triangles.
Assessment Tools	Marking scheme for the numerical component of the task and a rubric for the problem-solving process.

Math Learning Goals

- Students use similar triangles and/or trigonometric ratios to solve a problem.

Materials

- BLM 3.1
- student-made clinometers
- scientific calculators,
- measuring tapes/rulers
- graph paper

Assessment Opportunities

Minds On…

Whole Class → Guided Discussion

Discuss different types of recreational activities that can be part of a camping trip. Lead the discussion to include swimming when the camp site is at a lake. Discuss the distance and speed at which people can swim and bike.

Students read the instructions and ask clarifying questions (BLM 3.1).

Average speeds:
- bike riding 15–25 km/h
- swimming 3 km/h

Action!

Small Groups → Placemat

In their section on the placemat, students roughly sketch diagrams they think will solve the problem. They briefly outline their procedure to find the distance across the river. In turn, each group member explains his/her diagram and procedure to the rest of the group. Groups discuss the merits of the different plans.

Individual → Problem Solving

Students solve the problem using the diagram, measurements, and procedure of their choice.

Standard telephone poles have an average height of 25 ft above ground (7.7 m).

Consolidate Debrief

Whole Class → Reflection

Students make notes then share their answers to the following questions:
- Which of the three assessment tasks was most interesting? Challenging? Why?
- Did the daily work in class during the course of the semester/year prepare you sufficiently for the tasks? Explain.
- How did you prepare for the assessment tasks?
- What could you do differently to improve your performance?

Students could also compare how quickly they swim versus how quickly they bike.

Students could determine if it would be faster to swim across the hypotenuse or bike the 2 sides of a right-angled triangle to get to the other side.

3.1: Swimming Across the Lake

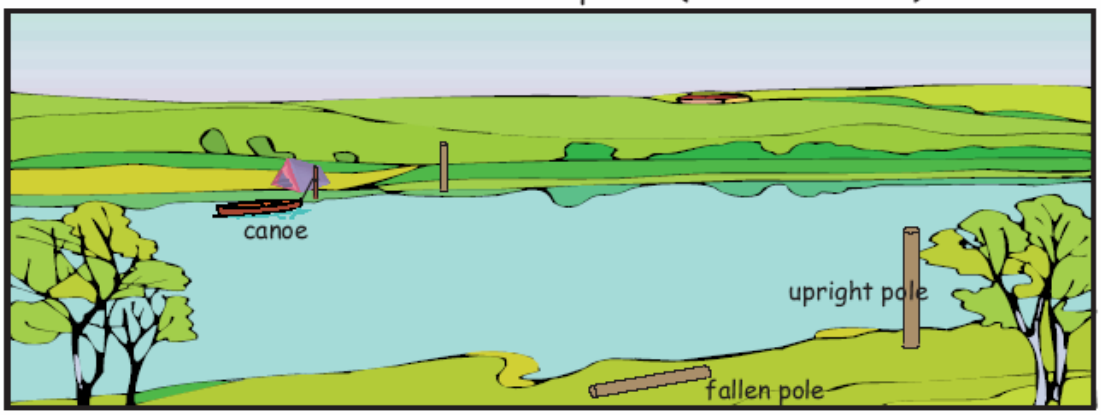
You want to swim across the lake. You can safely reach the other side if it is no more than 175 m across the lake. You have the following equipment to assist you if you need it:

- Clinometer
- Measuring tape
- Scientific/graphing calculator

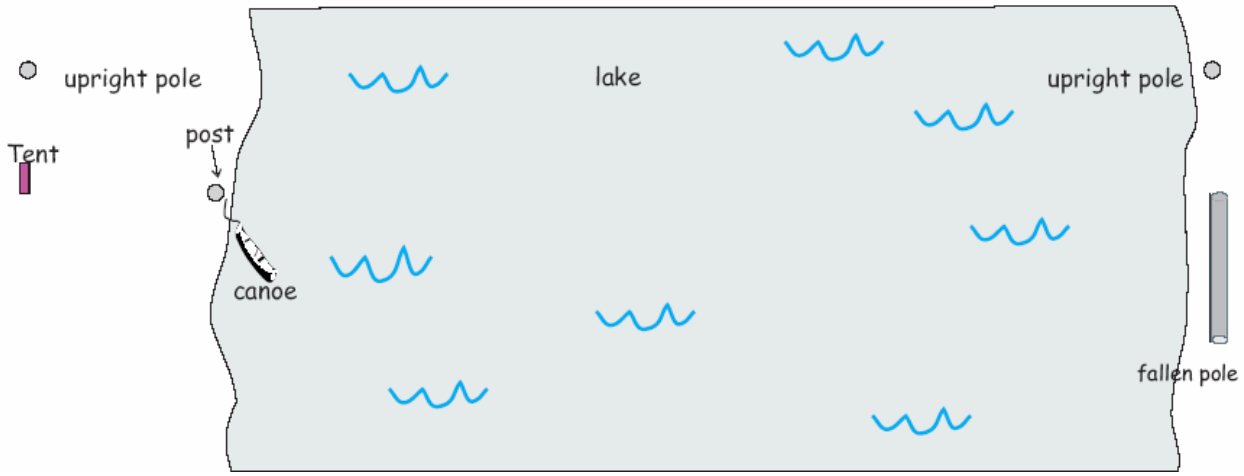
The upright pole is the same height as a standard telephone pole.

Use the diagram of the camping area and any necessary equipment to determine if you can safely swim across the lake, i.e., is it 175 m or less across the lake? Justify your answer.

Side view of the campsite (Not to Scale)



Aerial view of the campsite (Drawn to Scale)



Measurements have not been included on the diagram. Use the skills and knowledge you've gained in the course to determine these measurements.

You may need to make assumptions in order to solve the problem.
Make notes of any measurements you need, and the assumptions you make.

3.1: Swimming Across the Lake (continued)

1. Determine what measurements you need.

2. State any assumptions that you make.

3. Use the skills you have acquired (measuring, calculating, etc., …) to determine the measurements that you need. Show your work.

4. Determine if you are able to swim safely across the lake. Show your work and label your diagram.

5. Write a conclusion and justify your answer.