Principles of Mathematics, Grade 10 (MPM2D)
Course Description

Course Title: Principles of Mathematics
Course Code: MPM2D
Grade: 10

Course Type: Academic
Credit Value: 1.0
Prerequisite: MPM1D or MPM1H (after MFM1P)

- **This course builds on** your knowledge from grade 9 Academic mathematics
- **It leads you to** MCR3U, MCF3M
- **You will also have the option to take** MBF3C, MEL3E

Official Ontario Ministry of Education secondary curriculum available here:
http://www.edu.gov.on.ca/eng/curriculum/secondary/math.html

This course focuses on three main strands:

Quadratic relations of the form $y = ax^2 + bx + c$:

Analytic geometry

Trigonometry

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Quadratic relations of the form $y = ax^2 + bx + c$:

Students will explore non-linear relations in algebraic and graphical representations. They will also multiply and factor polynomial expressions to solve problems such as the break-even points for a business' profit and determine the maximum height of a ball that is thrown in the air.

Problem: Explain how you would graph the following equation, $y = x^2 + 2x - 8$, by determining the zeros and vertex.

Solution:

$y = x^2 + 2x - 8$

Factor

$y = (x + 4)(x - 2)$

Find zeros

$x + 4 = 0$ $\qquad$ $x - 2 = 0$

$x = -4$ $\qquad$ $x = 2$

Find axis of symmetry

$$= \frac{-4 + 2}{2}$$

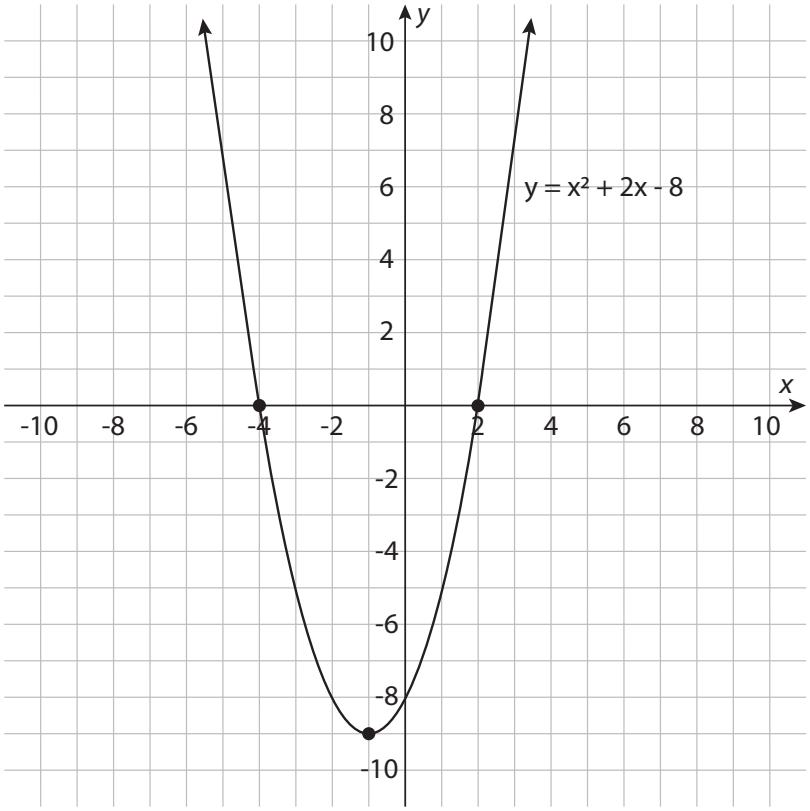
$= -1$

Sub into original to find y-value of vertex

$y = (-1)^2 + 2(-1) - 8$

$= -9$

vertex = (-1, -9)



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Problem: The profit formula for a company is given by the equation $P = -1.1x^2 + 15.3x - 10.3$, where P is the profit in thousands and x is the number of items sold in thousands. Determine the breakeven points for this company and how many items they must sell to maximize profit.

Solution:

$P = -1.1x^2 - 15.3x - 10.3$

Determine breakeven points

$0 = -1.1x^2 - 15.3x - 10.3$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-15.3 \pm \sqrt{(15.3)^2 - 4(-1.1)(-10.3)}}{2(-1.0)}$$

$$= \frac{-15.3 \pm \sqrt{188.77}}{-2.2}$$

$$= \frac{-15.3 + \sqrt{188.77}}{-2.2} \qquad = \frac{-15.3 - \sqrt{188.77}}{-2.2}$$

$= 0.709$ $\qquad = 13.2$

Determine number of items sold to maximize profit

$$= \frac{0.709 + 13.2}{2}$$

$= 6.9545$

∴ Since x represents items sold in thousands we multiply these numbers by 1000. 0.709 x 1000 = 709 and 13.2 x 1000 = 13,200.
The break even points are 709 units sold and 13,200 units sold.
Max profit occurs when 6,955 units are sold.

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Analytic geometry:

Students will use graphs of straight lines and plots of geometric shapes on grids to solve problems like this:

Problem: Bill is planning a dinner party for 240 guests. The guests have a choice of a steak or vegetarian dinner. The steak dinner costs $12 per person and the vegetarian dinner is $8 per person. If the total cost of the dinner was $2100, how many steak dinners were ordered and how many vegetarian dinners were ordered?

Solution:

Let s represent number of steak dinners

Let v represent number of vegetarian dinners

$s + v = 240$ (1)

$12s + 8v = 2100$ (2)

Solve by Substitution

Isolate v in (1)

$v = 240 - s$ (3)

Sub (3) into (2)

$12s + 8(240 - s) = 2100$

Solve for s

$12s + 1920 - 8s = 2100$

$4s = 180$

$s = 45$

Sub $s = 45$ into (1)

$45 + v = 240$

$v = 240 - 45$

$v = 195$

or

Elimination

$12 \times$ (1) $\quad 12s + 12v = 2880$ (4)

$12s + 8v = 2100$ (2)

(4) - (2) $\quad 4v = 780$

$v = \frac{780}{4}$

$v = 195$

Sub $v = 195$ into (1)

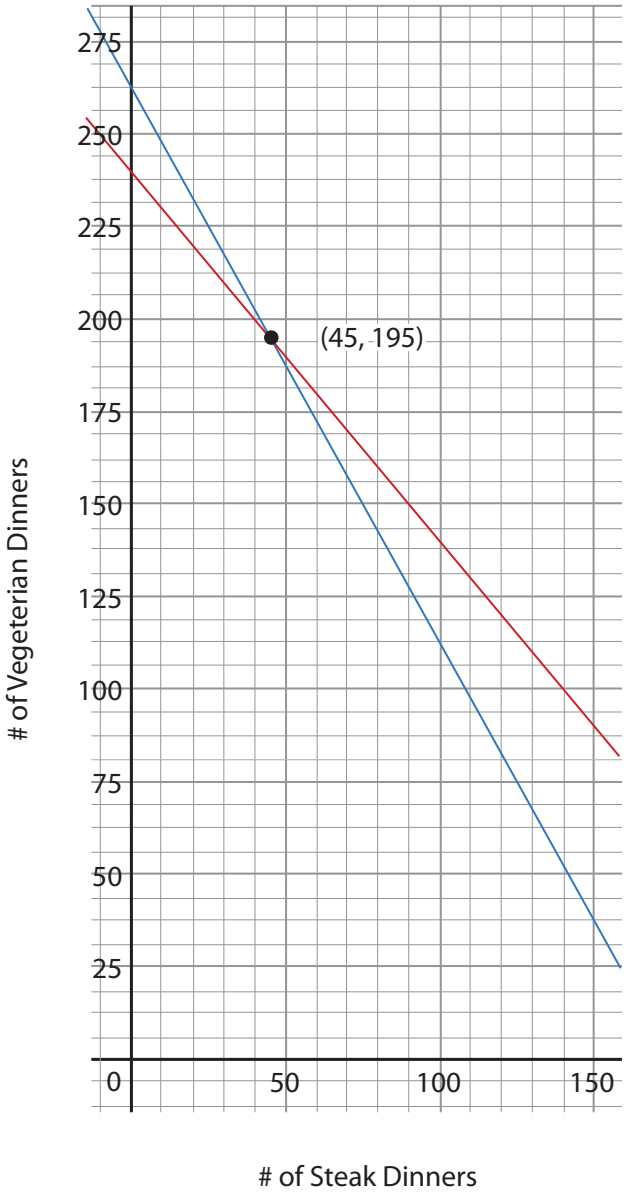
$s + 195 = 240$

$s = 240 - 195$

$s = 45$

$\therefore$ there were 45 steak dinners and 195 vegetarian dinners

This question can be verified by graphing.



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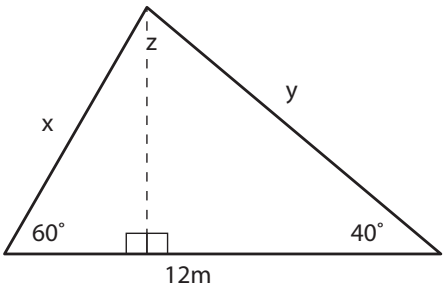
Trigonometry:

Students will solve problems related to similar triangles, right-angle triangles and scalene triangles. They will use ratios, formulas and rules to create scale models and calculate the height of inaccessible objects such as a cell phone tower or distances across rivers or canyons.

Problem: A cell phone tower is supported by two wires. The wires are attached to the ground 12 m apart so that they create angles of 40° and 60° with the ground. How long is each wire? How tall is the cell phone tower ?

Solution:



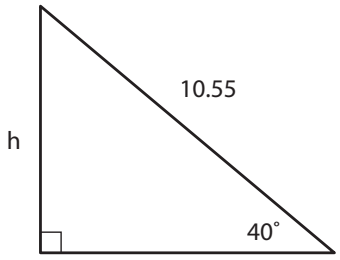
$\angle z = 180^\circ - 60^\circ - 40^\circ$

$= 80^\circ$

$$\frac{x}{\sin 40^\circ} = \frac{12}{\sin 80^\circ} \qquad \frac{y}{\sin 60^\circ} = \frac{12}{\sin 80^\circ}$$

$x = 7.83$ $\qquad$ $y = 10.55$

$\therefore$ the wire lengths are 7.83 m and 10.55 m.



Solve for the pole height

$$\sin 40^\circ = \frac{h}{10.55}$$

$10.55 \times \sin 40^\circ = h$

$10.55 \times 0.698 = h$

$7.36 = h$

$\therefore$ the pole is 7.36 m tall.

Trigonometric Table

Angle in degrees	Angle in Radians	Sine	Cosine	Tangent
36˚	0.628	0.588	0.809	0.727
37˚	0.646	0.602	0.799	0.754
38˚	0.663	0.616	0.788	0.781
39˚	0.681	0.629	0.777	0.810
40˚	0.698	0.643	0.766	0.839
41˚	0.716	0.656	0.755	0.869
42˚	0.733	0.669	0.743	0.900
43˚	0.750	0.682	0.731	0.933
44˚	0.768	0.695	0.719	0.966
45˚	0.785	0.707	0.707	1.000

Angle in degrees	Angle in Radians	Sine	Cosine	Tangent
81˚	1.414	0.988	0.156	6.314
82˚	1.431	0.990	0.139	7.115
83˚	1.449	0.993	0.122	8.144
84˚	1.466	0.995	0.105	9.514
85˚	1.484	0.996	0.087	11.43
86˚	1.501	0.998	0.070	14.301
87˚	1.518	0.999	0.052	19.081
88˚	1.536	0.999	0.035	28.636
89˚	1.553	1.000	0.017	57.290
90˚	1.571	1.000	0.000	∞