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FURTHER YOUR PASSION

ACADEMIC UPGRADING

AUGUST/2009

MATH PLACEMENT TEST

STUDY GUIDE

IMPORTANT INFORMATION ABOUT THIS GUIDE AND THE PLACEMENT TEST

This study guide is designed to prepare students for the Academic Upgrading Math Placement test. An answer key is included at the end of this guide. The test is available on a drop-in basis in the Testing Centre (MC 221; see www.sait.ca/testing for hours and location). It is designed for upgrading placement purposes only. **No section of these exams may be used for admission to any other SAIT program other than Upgrading; that is, these are not SAIT admission exams. In addition, the results cannot be used at any other educational institution.**

The fee is $50.

There are two parts to the test.

Part 1 is the NO CALCULATOR Grade 9 portion. It consists of questions #1 – 30 and covers material up to and at the Grade 9 level. A mark of 21/30 = 70% on this part of the exam can be accepted in lieu of the math admission requirement to Academic Upgrading and allows entrance into Math 180 (SAIT's version of Pure Math 10).

Part 2 is the Calculator/Grade 10 & 11 portion. You only need to complete this portion if you are trying to gain entrance directly into Math 181 or Math 182 without beginning with Math 180. Otherwise, you do not have to write Part 2.

- The grade 10 section is #31-40. A score of 7/10 on this section of the exam allows entrance into Math 181 (SAIT's Pure Math 20 equivalent course).
- The grade 11 section is #41-50. A score of 7/10 on this section allows entrance into Math 182 (SAIT's Pure Math 30 equivalent).

You have **3 hours** to complete the **entire** exam (includes Parts 1 and 2).

Note: Math 180 is SAIT's version of Pure Math 10, but is not transferable outside of SAIT. Math 181 is equivalent to Pure Math 20, and Math 182 is equivalent to Pure Math 30. Both Math 181 and Math 182 are accepted as admission requirements at other post-secondary institutions in Alberta, but you should always check with the post-secondary institution you are interested in attending (if it is not SAIT) to confirm it will accept the courses.

Introduction: Math Study Guide

- Review the mathematics topics required by examining the list of learning objectives for each section.

- Complete the practice exercises. You may use the formulas provided in the formula sheet at the end of the guide (this formula sheet is included for you when you write the test). The grade 9 exercises should be completed without the use of a calculator. The grade 10 and 11 exercises require the use of a scientific calculator (graphing calculators are not permitted).

- Check your answers with the answer key provided at the end of this guide.

NOTE: If you are interested in taking an exam that can be used in lieu of the Pure Math 30 admission requirement for entrance into SAIT programs, this study guide is not sufficient for your preparation, though it is an excellent review. Graphing calculators are permitted for that exam. You may work on previously released Pure Math 30 diploma exams by going to the following website:

www.sait.ca/testing – click on Pure Math 30 Admissions Exam and it will link you to the appropriate Alberta Education website.

There is also an exam that can be taken in lieu of the Applied Math 30 Admissions Exam, as well as a Pure Math 20 Admissions Exam. See the Testing website for more information.

Grade 9

Grade 9 Objectives:

- Add, subtract, multiply, and divide fractions in both improper and mixed formats.
- Convert between decimals & percents, decimals & fractions, and fractions & percents.
- Calculate the tax and total final price on an object.
- Calculate successive percent increases or decreases (e.g. in population, price, etc.).
- Order a set of rational numbers on a number line.
- Represent and solve word problems using algebraic expressions.
- Use the order of operations to evaluate an expression.
- Solve basic equations by using distribution where necessary.
- Solve inequalities and plot their solutions on a number line.
- Collect like terms.
- Use the exponent rules to simplify expressions involving integral exponents.
- Use the Pythagorean Theroem to solve word problems.
- Find the area of shapes including circles and rectangles.
- Find expressions to represent the volume of shapes and composite shapes composed of cones, spheres, cylinders, and rectangular prisms.
- Solve word problems involving similar triangles.
- Plot points in (x,y) form on a coordinate plane.
- Draw a line based on a table of values generated from a particular relation.
- Interpret a histogram to answer questions about the data including the mean (average).
- Find the probability of an event happening or not happening (e.g. using dice, spinners, etc.).

Grade 9 Mathematics Exercises (to be completed without using a calculator)

1. Solve the following and express your answer in both improper and mixed fraction formats.

   $3+\frac{4}{5}$

2. Solve the following and express your answer in reduced form.

   $\frac{4}{3}-\frac{5}{8}$

3. Solve the following and put into reduced (simplest) form:

   $\frac{2}{7}\times\frac{3}{8}$

4. Solve the following and put into reduced (simplest) form: $\frac{3}{10}\div\frac{2}{3}$

5. Express $\frac{3}{8}$ as a decimal.

6. What is 30% of 45?

7. Beth buys a cake with a price tag of $15. If the GST (federal sales tax) is 5%, what is the total price of the cake?

8. Joe is waiting for a DVD player to go on sale. The original price of the stereo was $100. After one month, Joe noticed the price dropped by 5%. After another month, Joe saw the price drop another 10%. What is the new price of the stereo?

9. Place the following numbers in correct order from greatest to least:

   2/3, -3/4, 0.6, -0.7777, 1/5

10. The cost of a regular-sized pasta dish is $1 less than twice the cost of a lunch (smaller-sized) pasta dish. If "s" represents the cost of the smaller-sized pasta dish, represent the cost of the regular-sized pasta dish "r" in terms of "s".

11. Marnie has 15 coins in her pocket. All of the coins are either nickels (worth $0.05 each) or dimes (worth $0.10 each). The total value of the coins is $1.15. How many nickels and how many dimes does Marnie have?

12. Evaluate the following: $50-2(10+4\div 2)\times 2$

13. Solve the following equation: $4x - 2 = 18$

14. Solve the following equation: $3(x - 4) = 2(x + 3)$

15. Solve the following inequality: $4(x + 3) \geq 20$

16. Solve the following inequality and graph the solution on a number line: $2(x - 4) \geq -6x$

17. Simplify: $5x^2 - 4x - 3 - (3x^2 - 2x - 3)$

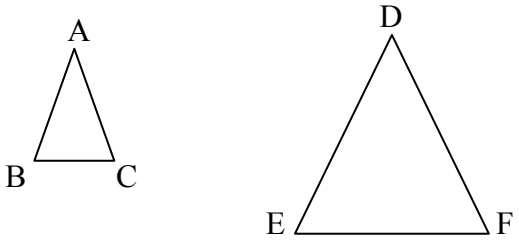
18. Simplify the following: $\dfrac{k^{12} \times k^4}{k^2}$

19. A 5 metre-long ladder is leaned up against a wall. If the ladder reaches 4 m up the wall, how many metres is the base of the ladder from the wall?

20. A desk is 100 cm long and 50 cm wide. A piece of square note paper is 10 cm long and 10 cm wide. How many pieces of note paper (side-by-side) can fit on the desk?

21. A soup can has a diameter of 6 cm and a height of 10 cm. Write an expression in terms of π that could be used to find the volume of the can.

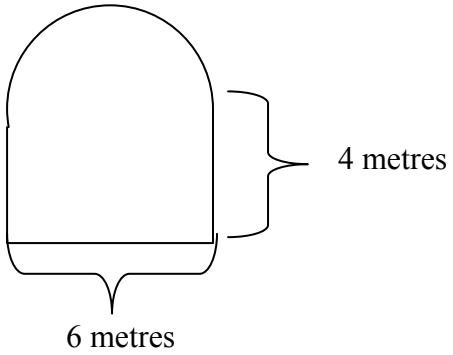
22. Use the following diagram of **similar** triangles to answer #22 below. Note that the diagrams below are not drawn to scale.



AC is 2 cm and DF is 8 cm. If DE is 10 cm, how long is AB?

23. A 20 m tall building casts a shadow 50 m long. At the same time, a pole casts a shadow that is 10 m long. How tall is the pole?

24. A grain storage unit has the shape of a cylinder with a hemisphere on top as seen in the diagram below. The length of the base is 6 metres, and the height of the cylindrical part is 4 metres.



Write an expression in terms of π that could be used to find the volume of the grain storage unit.

25. Draw an x-y coordinate plane and plot the following four points:

A: (2, 5)
B: (-1, 3)
C: (-4, -2)
D: (3, -4)

26. Fatima is given a relation by her teacher and uses it to create the table of values below:

x	*y*
-2	3
0	2
2	1
4	0

Draw a line that represents the relation given in the table.

Use the following information to answer #27 and #28.

A math quiz is out of 10 marks. The scores of the students are below:

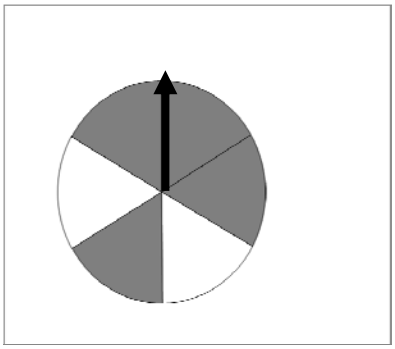
Mary:	6/10
Joe:	6/10
Sam:	7/10
Harry:	7/10
Henry:	7/10
Roy:	7/10
Katie:	8/10
Ray:	8/10
Michael:	8/10
Karen:	9/10
Alfie:	9/10
Sue:	10/10

27. Draw a histogram to represent this information.

28. What was the class average (mean) to the nearest tenth?

Use the following information to answer #29 below.

A spinner is shown below. It consists of a circular area with four gray sectors and twowhite sectors. An arrow, which can be spun, is shown in the middle.



29. When the arrow is spun, what is the probability that it will stop in a grey sector? Express your answer as a fraction in reduced form.

30. A drawer contains 4 black socks, 3 brown socks, and 2 red socks. You reach into the drawer and, without looking, pull out one sock. What is the probability of NOT selecting a red sock? Express your answer as a fraction in reduced form.

Grade 10

Pure Math 10 (Grade 10) Objectives:

- Factor quadratic equations where the answer is rational.
- Add, subtract, multiply, and divide rational expresssions.
- Simplify exponential expressions, including fractional exponents, using the exponent laws.
- Rationalize the denominator of expressions involving square roots.
- Use the sine and cosine laws to solve word problems involving non-right angle triangles.
- State the domain and range of a given function or shape.
- Given the equation of a line, find the slope and y-intercept (and vice versa).
- Find the slopes and equations of lines parallel and perpendicular to an original given line.
- Use function notation to substitute values into a given function.

Grade 10 Mathematics Exercises (may use a scientific calculator)

31. Determine the slope and the y-intercept of the following line:

$$-3x - 4y + 4 = 0$$

32. Find the equation of the line passes through the point (-3, 4) and is perpendicular to the following line: $3x - y + 1 = 0$

33. Factor the following: $10x^2 - 11x - 6$

34. Perform the following operation and simplify:

$$\frac{b^2 - b - 6}{b^2 + 4b + 4} \times \frac{3b + 6}{b^2 - 9}$$

35. Simplify the following exponential expression completely. Express the answer with positive exponents only.

$$\left(\frac{3a^{-2}b^{\frac{3}{4}}}{2a^{-\frac{3}{2}}b^{-\frac{1}{4}}} \right)^{-2}$$

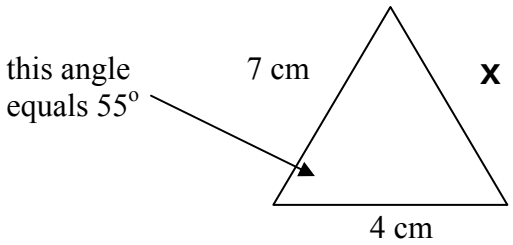
36. Perform the following operation and simplify:

$$\frac{4}{x-2} - \frac{2x-3}{x^2-4} = \frac{5}{x+2}$$

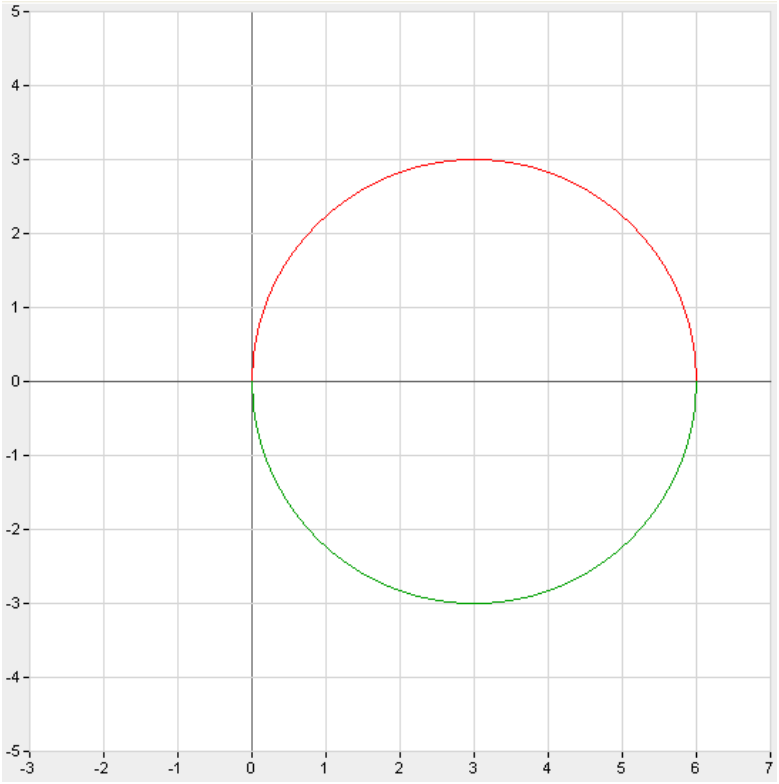
37. Simplify the following expression completely. Rationalize the denominator.

$$\frac{3}{4 - \sqrt{27}}$$

38. In the diagram below, what is the length of side "x" to the nearest tenth of a centimetre? (Note that the diagram is not drawn to scale.)



39. State the domain and range of the graph below:

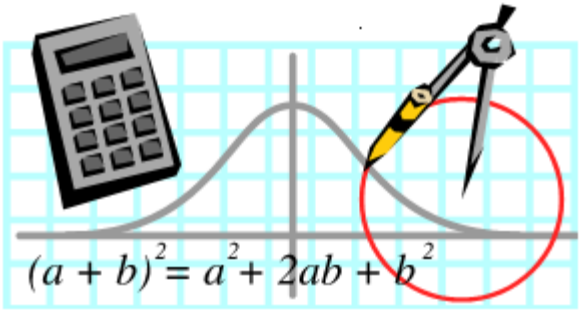


40. If $f(x) = x^3 - 2x + 4$, what is $f(-2)$?

Grade 11

Pure Math 20 (Grade 11) Objectives:

- Find the solution to a system of equations in two variables.
- Find the solution to a system of inequalities and graph the solution on a coordinate plane.
- Find the intersection points of a circle and a line.
- Find the shortest distance between a point and a line.
- Determine the x-intercepts, y-intercepts, and vertex of a given parabola.
- Solve quadratic equations with rational and non-rational roots.
- Determine the nature of the roots of quadratic equations as rational, irrational, or imaginary.
- Perform composition of functions using function notation.
- Determine the factors of a polynomial function.
- Solve an equation where one side contains an absolute value symbol.



Grade 11 Mathematics Exercises (may use a scientific calculator)

41. Determine the point of intersection of the following pair of lines. (Solve the system of equations.) Express the solutions as an ordered pair.

$$4x - 6y - 3 = 0$$
$$6x - 4y + 3 = 0$$

42. Graph the solution to the following system of inequalities on a coordinate plane:

$$2x - y + 3 \geq 0$$
$$\frac{1}{2}x - y + 4 \geq 0$$

43. Solve for the points of intersection of the circle and line given below:

Circle: $x^2 + (y+2)^2 = 4$
Line: $x + y + 4 = 0$

44. Find the shortest distance between the line $y = -2x - 3$ and the point (0,0). Express your answer to the nearest tenth.

45. Determine the vertex and the x- and y-intercepts of the following parabola:

$$y = -x^2 - 4x + 5$$

46. Solve the following quadratic equations for x. Express the answers in simplest radical form where necessary.

a.) $4x^2 + 8x + 3 = 0$
b.) $x^2 - 6x + 4 = 0$

47. For each of the quadratic equations below, state whether the roots are rational, irrational, or imaginary. (Hint: you do not have to fully solve the equations – use the discriminant.)

a.) $x^2 + 2x - 3 = 0$
b.) $x^2 + 3x - 2 = 0$
c.) $x^2 + 2x + 3 = 0$

48. Given that $f(x) = x^3$ and $g(x) = x - 2$, find $g(f(-1))$.

49. Fully factor the following polynomial:

$$f(x) = 2x^3 + 7x^2 - 7x - 12$$

50. Solve the following equation:

$$-3|2 - x| + 5 = -16$$

Academic Upgrading
Mathematics Placement Exam
Formula Sheet

Triangle: $A = \frac{1}{2}bh$

Pythagorean Theorem: $c^2 = b^2 + c^2$

Square: $A = s^2$

Rectangle: $A = lw$

Parallelogram: $A = bh$

Circle:

$C = 2\pi r$

$A = \pi r^2$

Rectangular solid:

$V = lwh$

$A = 2lw + 2lh + 2wh$

Right circular cylinder:

$V = \pi r^2 h$

$A = 2\pi r^2 + 2\pi rh$

Right prism:

$V = Bh$ (B = area of the base)

Right circular cone:

$V = \frac{1}{3}\pi r^2 h$

$A = \pi r^2 + \pi rs$ (s = slant height)

Sphere:

$$V = \frac{4}{3}\pi r^3$$

$$A = 4\pi r^2$$

Straight line: $Ax + By + C = 0$ (general form)

Linear equation (slope-intercept form):
$y = mx + b$

Definition of slope:
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Distance formula:
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Quadratic equation: $ax^2 + bx + c = 0$

Quadratic Formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Law of Sines:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Law of Cosines:

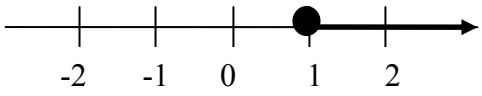
$$c^2 = a^2 + b^2 - 2ab\cos C$$

Academic Upgrading Math Placement
Answer Key

Note: *If you would like to view the worked solutions manual for the answers below, please e-mail upgrading@sait.ca.*

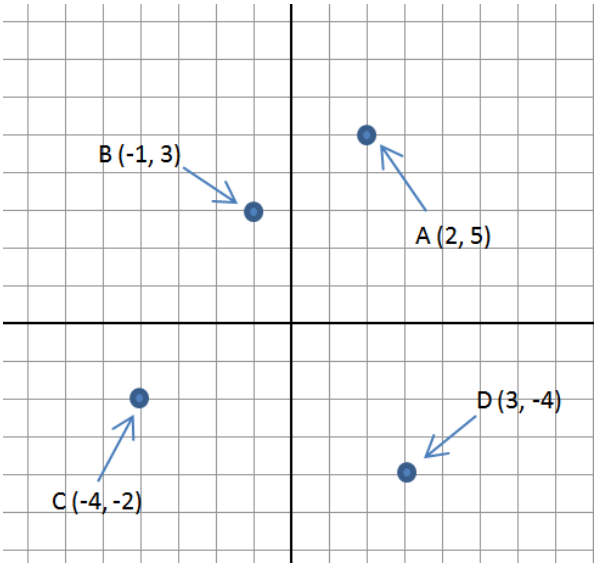
Section 1: Grade 9 Math

1. Improper form: $\frac{19}{5}$ Mixed form: $3\frac{4}{5}$
2. $\frac{17}{24}$
3. $\frac{3}{28}$
4. $\frac{9}{20}$
5. 0.375
6. 13.5
7. $15.75
8. $85.50
9. $\frac{2}{3}, 0.6, \frac{1}{5}, \frac{-3}{4}, -0.7777$
10. $r = 2s - 1$
11. 7 nickels and 8 dimes
12. 2
13. 5
14. 18
15. $x \geq 2$
16. $x \geq 1$

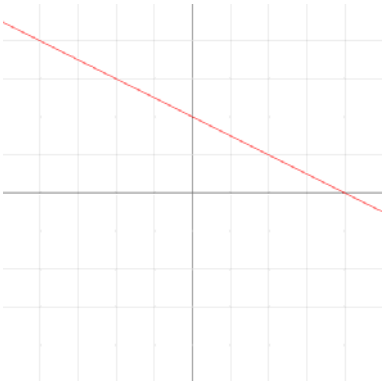


17. $2x^2 - 2x$
18. k^{14}
19. 3 m
20. 50
21. 90π
22. 2.5 cm
23. 4 m
24. 54π

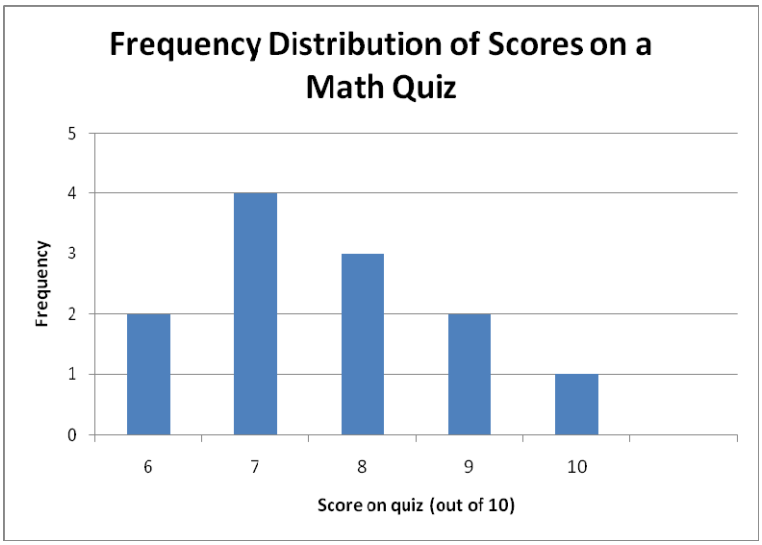
25.



26. Note: in graph below, each grid space is 1 unit apart.



27.



28. 7.7
29. $\frac{2}{3}$
30. $\frac{7}{9}$

Section 2: Grade 10 Math

31. slope = $\frac{-3}{4}$
    y-intercept = 1

32. $y = \frac{-1}{3}x + 3$

33. $(2x-3)(5x+2)$

34. $\frac{3}{b+3}$

35. $\frac{4a}{9b^2}$

36. 7

37. $\frac{-12-9\sqrt{3}}{11}$

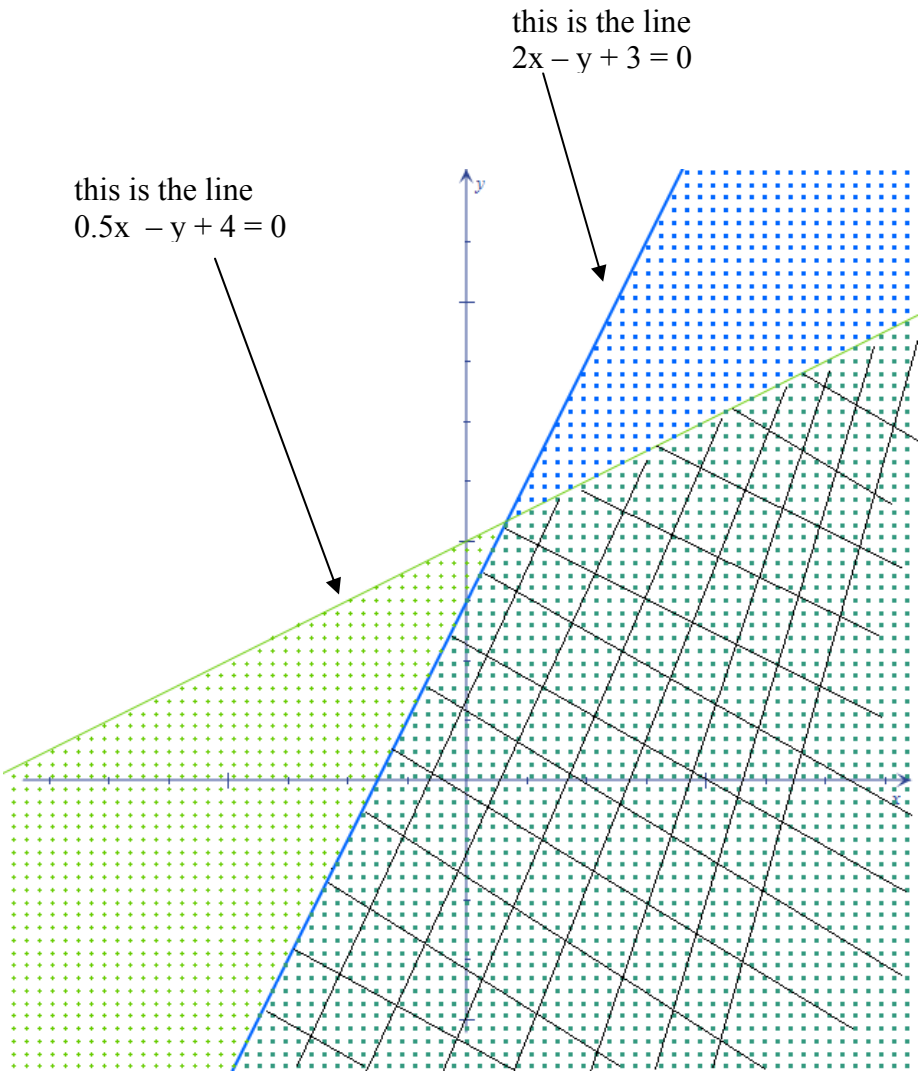
38. 5.7 cm

39. Domain: $0 \le x \le 6$
    Range: $-3 \le y \le 3$

40. 0

Section 3: Grade 11 Math

41. $\left(\frac{-3}{2}, \frac{-3}{2}\right)$
42. The answer is represented by the region with the black lines drawn across it. Note that the answer does include the blue and green lines themselves that border the region.



43. $(0,-4)$ and $(-2,-2)$
44. 1.3
45. x-intercepts: $x=-5,1$
    y-intercept: $y=5$
    vertex: $(-2,9)$
46.
    a. $x=\frac{-3}{2},\frac{-1}{2}$
    b. $x=3\pm\sqrt{5}$
47.
    a. The discriminant b^2-4ac is equal to 16. Because it is a perfect square, the roots are rational.
    b. The discriminant is equal to 17. Because it is not a perfect square, the roots are irrational.
    c. The discriminant is equal to -8. Because it is negative, the roots are imaginary.

48. -3
49. $(x+1)(x+4)(2x-3)$
50. $x=-5,9$

------End of Math Placement Answer Key------