Mathematics Diagnostic Examination Guidance

Examination Overview

- The mathematics examination will be 50 minutes long and will be worth 100 points. There will be three sections on the examination:
  - Section A - Expanding & Factoring:

    This section will have eight - 2 point questions and two - 4 point questions (24%)
  - Section B - Linear Functions:

    This section will have five - 4 point questions and two - 8 point question (36%)
  - Section C - Miscellaneous questions:

    This section will have ten - 4 point questions (40%)

Section A - Expanding and Factoring

- Expanding
  - Distributive law $a(b+c)=ab+ac$
  - Multiplying binomials $(a+b)(c+d)=ac+ad+bc+bd$
  - Multiplying conjugates $(a+b)(a-b)=a^2-b^2$
  - Binomials squared $(a\pm b)^2=a^2\pm 2ab+b^2$
- Factoring
  - Greatest common factor
  - Product / sum factoring; expressions of the form x^2+bx+c
  - Factoring trinomials where the leading coefficient is not 1 $(ax^2+bx+c, a\neq 1)$
  - Difference of squares and perfect square trinomials
  - Some questions will involve two types of factoring - for example, first factoring out a greatest common factor and then factoring using product / sum techniques. Below are a few examples of questions that would require multiple steps of factoring:

$$2x^2-4x-30$$
$$=2(x^2-2x-15)$$
$$=2(x-5)(x+3)$$

$$x^4-x^2-12$$
$$=(x^2-4)(x^2+3)$$
$$=(x+2)(x-2)(x^2+3)$$

$$6x^2y+27xy+30y$$
$$=3y(2x^2+9x+10)$$
$$=3y(2x+5)(x+2)$$

Section B - Linear Functions

- Slope, y-intercept form $\left(y = mx + b\right)$
- General form $\left(Ax + By + C = 0\right)$
  - $A > 0$
  - No fractions
  - Right side of the equation must be 0
- Knowledge about slope: slope formula, parallel lines have equal slope and perpendicular lines have slopes that are negative reciprocals of one another.
- Graphing linear functions and writing the equation of a linear function from a graph.
- Determining the equation of a linear function from various pieces of information given.
- Applications of linear functions (word problems).

Section C - Miscellaneous Questions

- This section of the examination is not designed to be studied for. In this section the Ritsumeikan Uji IB Mathematics Department would like to assess how well students are able to answer questions that require critical thinking and problem solving skills. For some of these questions, new information will be explained and then questions pertaining to this information will be posed.

Sample Examination

- On pages 3 to 5 of this booklet is sample set of questions for section A and B. Solutions to the sample questions can be found on page 6.
- This document is designed as a preparation guide for the IB Course Mathematics diagnostic examination. The actual examination questions will differ from those in this guide, and applicants should not expect that understanding of the questions in this guide will guarantee success on the diagnostic examination.

Section A

Each question in question #1 is worth 2 marks and each question in #2 is worth 4 marks. This section is worth a total of 24 marks. No partial marks will be awarded. Write your answers in the appropriate box on the answer sheet provided. Any answers or writing in this booklet will not be marked.

1. Factor fully each of the following.

a.) $x^2 - x - 20$

b.) $6x^2 + x - 2$

c.) $4x^2 - 9$

d.) $4x^3y + 10x^2y - 6xy$

e.) $9x^2 - 12x + 4$

f.) $3x^2 - 2x - 8$

g.) $4x^2 + 32x + 60$

h.) $15x^2 + 7x - 2$

2. Fully expand and simplify each of the following.

a.) $(x-3)(5x+4) - (2x+1)^2$

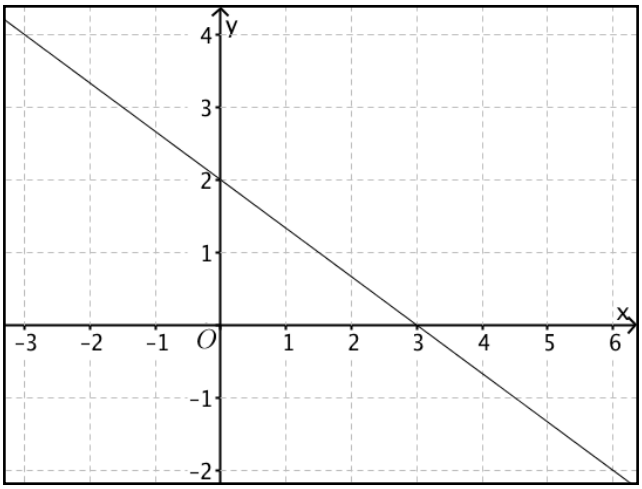
b.) $(2x-1)(2x+1) + (3x-1)(2x+7)$

Section B

Questions 3 to 7 are each worth 4 marks, questions 8 and 9 are worth 8 marks. This section is worth a total of 36 marks. No partial marks will be awarded. Write your answers in the appropriate box on the answer sheet provided. Any answers or writing in this booklet will not be marked.

3. The cost, C, of renting a bicycle is \$20 plus an additional fee of \$3 per hour, h. An expression , in terms of h, to represent the cost is:

4. Write the equation of the linear function displayed on the graph below in the form $y = mx + b$:

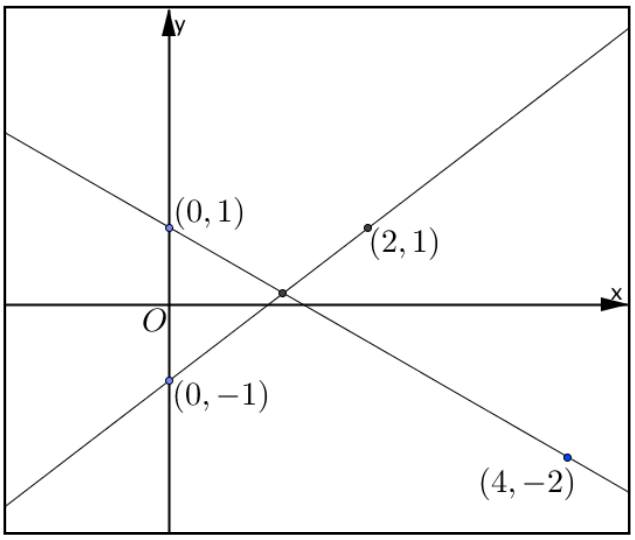


5. Determine the equation of the linear function $\frac{2}{3}x - \frac{1}{4}y = 2$ in general form.

6. Determine the equation of the linear function $3x + 2y - 12 = 0$ in slope, y-intercept form.

7. The equation of a linear function is $x + 3y - 6 = 0$. Determine the slope of a linear function perpendicular to the given line.

8. The intersection point of the two functions in the graph below is of the form $\left(\frac{a}{b},\frac{c}{b}\right)$. Determine the point of intersection.



9. Determine the equation of the linear function, written in general form, that passes through points $(3,2)$ and $(-1,0)$.

Sample Sections A and B Answer Key

Section A:

2 point questions

1a	$(x-5)(x+4)$
1d	$2xy(2x-1)(x+3)$
1g	$4(x+3)(x+5)$

1b	$(3x+2)(2x-1)$
1e	$(3x-2)^2$
1h	$(5x-1)(3x+2)$

1c	$(2x+3)(2x-3)$
1f	$(3x+4)(x-2)$

4 point questions

2a	$x^2-15x-13$

2b	$10x^2+19x-8$

Please Note:

- If the answer is noted as $(x+3)(x-4)$, the reverse order of the factors $(x-4)(x+3)$ is also correct.
- For an answer containing a greatest common factor; it is expected that the greatest common factor is first. The order of the two other factors is not important. If the answer was $2y(x+3)(x-4)$ then $2y(x-4)(x+3)$ is also accepted, but something such as $(x+3)2y(x-4)$ or $(x-4)(x+3)2y$ would not be.
- The answer for $2a$ is $x^2-15x-13$. The terms are expected to be given in decreasing powers of x, and so something such as $-15x+x^2-13$ or any other order would not be accepted.

Section B:

4 point questions

3	$C=3h+20$
6	$y=-\frac{3}{2}x+6$

4	$y=-\frac{2}{3}x+2$
7	3

5	$8x-3y-24=0$

8 point questions

8	$\left(\frac{8}{7},\frac{1}{7}\right)$

9	$x-2y+1=0$