

UNIVERSITY OF MANITOBA

DATE: May 21, 2009

MIDTERM I

TITLE PAGE

COURSE: MATH 1210

TIME: 50 minutes

EXAMINATION: Classical and Linear Algebra

EXAMINER: M. Davidson

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FAMILY NAME: (Print in ink) \_\_\_\_\_

GIVEN NAME(S): (Print in ink) \_\_\_\_\_

STUDENT NUMBER: \_\_\_\_\_

SIGNATURE: (in ink) \_\_\_\_\_  
(I understand that cheating is a serious offense)

**INSTRUCTIONS TO STUDENTS:**

This is a 50 minute exam. **Please show your work clearly.**

No texts, notes, or other aids are permitted. There are no calculators, cellphones or electronic translators permitted.

This exam has a title page, 5 pages of questions and also 1 blank page for rough work. Please check that you have all the pages. You may remove the blank page if you want, but be careful not to loosen the staple.

The value of each question is indicated in the lefthand margin beside the statement of the question. The total value of all questions is 50 points.

| Question | Points | Score |
|----------|--------|-------|
| 1        | 3      |       |
| 2        | 5      |       |
| 3        | 4      |       |
| 4        | 6      |       |
| 5        | 10     |       |
| 6        | 10     |       |
| 7        | 12     |       |
| Total:   | 50     |       |

**Answer all questions on the exam paper** in the space provided beneath the question. If you need more room, you may continue your work on the reverse side of the page, but **CLEARLY INDICATE** that your work is continued.

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- [3] 1. Write the following in sigma notation:

$$3 + 7 + 11 + \dots + (16n + 11).$$

- [5] 2. Evaluate  $\sum_{j=1}^{12} (j - 3)(j + 2)$ .

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- [4] 3. For what value of  $k$  does the polynomial  $P(x) = 3x^4 + 5x^3 + kx^2 - x + 6$  have  $x + 2$  as a factor?

- [6] 4. Simplify  $\frac{8 - 2i}{5 + 3i}$ . Convert your answer into polar form.

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- [10] 5. Use induction to prove the following for all  $n \geq 1$ :

$$2 + 2 \cdot 3 + 2 \cdot 3^2 + 2 \cdot 3^3 + \cdots + 2 \cdot 3^{2n-1} = 3^{2n} - 1$$

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- [10] 6. Find all complex numbers  $z$  such that  $z^4 = -18\sqrt{2} - 18\sqrt{2}i$ . Express your answer(s) in exponential form, using principle value for arguments.

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7. Let  $P(x) = x^4 - 4x^3 + 8x^2 - 8x - 60$ .

[4] (a) Apply Descartes' rule of signs to  $P(x)$ .

[8] (b) Given that  $1 - 3i$  is a root of  $P(x)$ , express  $P(x)$  as a product of real linear and real irreducible quadratic terms.