

UNIVERSITY OF MANITOBA

DATE: October 20, 2008

MIDTERM
TITLE PAGE

COURSE: MATH 1210

TIME: 60 minutes

EXAMINATION: Classical and Linear Algebra

EXAMINER: M. Davidson

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 60 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 pages 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 40 points.

Question	Points	Score
1	11	
2	8	
3	6	
4	7	
5	8	
Total:	40	

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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- [9] 1. (a) Prove the following, using induction, for all $n \geq 1$:

$$2 + 5 + 8 + \cdots + (3n - 1) = \frac{n(3n + 1)}{2}$$

- [2] (b) Write $2 + 5 + 8 + \cdots + (3n - 1)$ in sigma notation.

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- [8] 2. Find all complex numbers z such that $z^3 = -4 + 4\sqrt{3}i$. Express your answer(s) in exponential form.

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- [6] 3. Consider the polynomial $P(x) = 3x^6 + 12x^5 - 4x^3 + 17x^2 + 5$.
(DO NOT ATTEMPT TO FACTOR THIS POLYNOMIAL)
- (a) Apply Descartes rules of signs to $P(x)$. Be specific about what information it gives.
- (b) Apply the bound theorem to $P(x)$. Be specific about what information it gives.
- (c) What are the possible rational roots of $P(x)$? Include any information from part a and/or part b.

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- [7] 4. Given that $1 - i$ is a root of $P(x) = 3x^4 - 8x^3 + 12x^2 - 8x + 4$, express $P(x)$ as a product of linear terms.

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- [8] 5. Given $\vec{u} = [3, 4, -1]$ and $\vec{v} = [-2, 3, 7]$ and θ is the angle between them.
- (a) Find the value of $\cos \theta$. (do not simplify)

- (b) Find a non-zero vector that is orthogonal to both \vec{u} and \vec{v} .