MATH 319 Winter 2021

MIDTERM EXAMINATION.

Deadline: Friday, March 12 at 11:59 PM.

ACADEMIC INTEGRITY

Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Members of our campus community are required to abide by our institutional code of conduct and promote academic integrity in upholding the University of Calgary's reputation of excellence.

EXAMINATION INSTRUCTIONS

1. The exam consists of four (4) written answer questions.

2. Complete the question directly on the exam pages (by printing the page, or by writing with a tablet/iPad). Alternatively, if you are unable to print and do not have access to a tablet, then you may complete the exam on four (4) single-sided page of blank 8.5" by 11" paper, with one question per page. **You may NOT type your solutions**.

3. Scan and/save your completed exam question as a single PDF file. Ensure that all pages have the correct orientation and are legible.

4. Do not scan this page. Scan only your solutions to the problems.

5. Upload the completed exam to the Midtern Dropbox Folder on D2L before the deadline.

6. Late submissions will NOT be accepted.

7. Write your work in a neat and organized format, and take the time to fully justify your steps. Your solutions will be evaluated based on both mathematical correctness and clarity of writing

8. To prove a statement is false, you must write out its negation and prove that.

EXAMINATION REGULATIONS

1. Aids allowed: All lecture notes. What you should look for are the definitions.

2. No other aids are allowed.

3. Students are strictly cautioned against: (a) communicating to other students during the exam period from Thursday, March 11 at 11:59 PM to Friday, March 12 at 11:59 PM inclusively; (b) using unauthorized aids such as online tutorial services.

4. During the examination, if a student becomes ill or receives word of domestic affliction, the student must contact the course instructor within 24 hours.

5. Failure to comply with these regulations will result in rejection of the examination paper.

SIGNATURE: Sign the top-right corner of your examination pages to indicate your acceptance of the Academic Integrity Statement and Examination Regulations.

Last Name:_____First Name:_____UCID:_____

1. This question is worth 12 marks.

Let $\alpha : \mathbb{R}^2 \to \mathbb{R}^2$ be the function defined by $\alpha(x, y) = (x + 2y, xy)$ for every $(x, y) \in \mathbb{R}^2$.

(a) Is α a transformation? Prove your answer.

(b) Is it true that for all lines l, $\alpha(l)$ is a line? Prove your answer.

(c) Is it true that there exists a line l so that $\alpha(l)$ is a line? Prove your answer.

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2. This question is worth 12 marks. Prove or disprove each of the following statements. **Please draw sketches in addition to your explanation.**

(a) For all points A, B and C in $\mathbb{R}^2$, there exists a point D so that $\sigma_C \sigma_B \sigma_A = \sigma_D$.

(b) For all points A and B in $\mathbb{R}^2$, $\sigma_B \sigma_A = \sigma_A \sigma_B$.

(c) For all points A, B and C in $\mathbb{R}^2$, $\sigma_C \sigma_B \sigma_A = \sigma_A \sigma_B \sigma_C$.

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3. This question is worth 12 marks. **Please draw sketches in addition to your explanation.**

Let G be a group of isometries so that $\rho_{A,60°}$ and $\rho_{B,120°}$ are elements of G, where $A \neq B$.

(a) Show that G has at least two halfturns.

(b) Show that G has a translation.

(c) Show that G has at least two rotations of $60°$.
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4. This question is worth 12 marks. For each of the following, determined whether the statement is true or false and give a brief explanation. **Please draw sketches in addition to your explanation.**

(a) The product of a translation and a rotation is a rotation.

(b) The product of a translation and a halfturn is a halturn.

(c) The product of 4 reflections in parallel lines is a translation.

(d) The product of 5 reflections in parallel lines is a translation.