GENERAL COMMENTS

Grade 12 Applied Mathematics Achievement Test (January 2019)

Student Performance—Observations

The following observations are based on local marking results and on comments made by markers during the sample marking session. These comments refer to common errors made by students at the provincial level and are not specific to school jurisdictions.

Information regarding how to interpret the provincial test and assessment results is provided in the document *Interpreting and Using Results from Provincial Tests and Assessments* available at www.edu.gov.mb.ca/k12/assess/support/results/index.html.

Various factors impact changes in performance over time: classroom-based, school-based, and home-based contexts, changes to demographics, and student choice of mathematics course. In addition, Grade 12 provincial tests may vary slightly in overall difficulty although every effort is made to minimize variation throughout the test development and pilot testing processes.

When considering performance relative to specific areas of course content, the level of difficulty of the content and its representation on the provincial test vary over time according to the type of test questions and learning outcomes addressed. Information regarding learning outcomes is provided in the document *Grades 9 to 12 Mathematics: Manitoba Curriculum Framework of Outcomes* (2014).

Relations and Functions (provincial mean: 66.9%)

Conceptual knowledge

Many students wrongly believed that the initial value of an exponential regression equation started at time $t = 1$ rather than $t = 0$. Some students used division and subtraction when creating their exponential functions. Some students struggled to find the reduced rate of change (the "b" value). Others incorrectly used models like linear, quadratic, cubic, etc., when asked to determine an exponential regression equation. Many students did not know that an initial value in an exponential function could change without affecting the rate of change (the "b" value).

Procedural skill

Many students did not know how to use the space on their graphs appropriately when given a blank coordinate grid. The graphs they drew were too small in the space provided. They also had difficulty determining appropriate and consistent scales on the axes. Students struggled to find the correct data points from the graph provided when determining a sinusoidal regression equation. Students who used Desmos could not find the "b" value for the sinusoidal regression. They did not seem to know how to restrict the "b" value based on a known period using braces notation in the software, e.g., $\{0 < b < 0.3\}$.

Communication

Students missed many units, rounded incorrectly, and forgot "$y =$" when writing equations. They could not correctly state an amount of time and often wrote it as an interval. Students struggled with scientific notation and had difficulty interpreting what it represented. For example, 3×10^{-18} is essentially zero but was often interpreted as a number close to 3. Some students used parentheses incorrectly when providing sinusoidal regression equations, e.g., $y = a\sin\left(b\left(x - c\right)\right) + d$.

Probability (provincial mean: 62.0%)

Conceptual knowledge

When asked to give an answer in odds, students often expressed answers in probabilities. When asked to count two different groups of objects, they counted only one. Some students did not use the fundamental counting principle properly. Sometimes, they considered repetition incorrectly. When asked to solve a combination question including "at least", many students gave answers for only the exact case. Sometimes, students forgot to include the number of items in either set in the Venn diagram.

Procedural skill

When asked to calculate the number of elements in two sets in a Venn diagram, students did not subtract elements in all three sets. When solving a counting problem involving cases, they did not multiply within the cases. Some students performed permutations on questions that required combinations and vice versa. They often misinterpreted when order matters.

Communication

In a Venn diagram, students often forgot to indicate the value that does not belong to any set. When converting probability from decimal to percent, many students did not express the percent to two decimal places.

Financial Mathematics (provincial mean: 60.5%)

Conceptual knowledge

Students had difficulty correctly applying the down payment based on the context of the question. In many cases, students did not consider the influence of down payment on equity. Students were not familiar with the term *biweekly*. They had difficulty justifying their choices effectively when asked if the bank would lend money to a borrower. They lacked understanding of mortgage and debts when looking at the principal and balance remaining. Students often believed that the entire mortgage payment went toward the balance without considering the interest. Students found it hard to determine appreciation, equity, and principal paid. Some students did not include all liabilities when determining total liabilities.

Procedural skill

Students made multiple errors when inputting time periods, interest, present value, and compounds per year into TVM solver. They did not refer to the debt-to-equity ratio of 50%. Some students had difficulty manipulating formulas.

Communication

Students had difficulty determining and explaining counterexamples of financial choices and differentiating between the specifics of leasing and buying. Many students were not able to provide sufficient information when asked to explain whether to rent or buy a vehicle. Many students missed dollar signs, rounded decimals to whole numbers, and failed to identify final answers clearly.

Design and Measurement (provincial mean: 71.5%)

Conceptual knowledge

When finding the total cost, students divided total cubic feet by cost per cubic feet instead of multiplying the two together. Some students were not able to identify the correct formula required to complete a surface area question.

Procedural skill

Students were able to calculate volumes of various objects, but did not calculate the correct volume for their design. Students had a lot of difficulty converting volume from cubic inches to cubic feet. When calculating the surface area of a sphere, some students used diameter rather than radius.

Communication

Many students rounded too soon or incorrectly. Some students had difficulty in writing units, for example, 81^3 instead of 81 in^3.

Logical Reasoning (provincial mean: 65.4%)

Conceptual knowledge

Students were unable to identify converse, inverse, and contrapositive correctly. Some students were able to identify multiples of numbers, but were unable to combine them to identify other possibilities. Many students were unable to use or understand set notation properly.

Procedural skill

When asked to provide an example of a disjoint subset, some students created their own sets instead of using the context of the question. They were unfamiliar with complement symbol in set notation, e.g., $n\left(A \cap B\right)'$.

Communication

When asked to describe the meaning of a specific set written in set notation, students did not relate their descriptions to the context of the question.

Communication Errors

Errors that are not related to the concepts within a question are called "Communication Errors" and these were indicated on the *Scoring Sheet* in a separate section. There was a maximum 0.5 mark deduction for each type of communication error committed, regardless of the number of errors committed for a certain type (i.e., committing a second error for any type did not further affect a student's mark).

The following table indicates the percentage of students who had at least one error for each type.

E1	Final Answer	27.1%
E2	Notation	17.4%
E3	Transcription/Transposition	14.4%
E4	Whole Units	3.3%
E5	Units	22.2%
E6	Rounding	47.9%

Marking Accuracy and Consistency

Information regarding how to interpret the marking accuracy and consistency reports is provided in the document *Interpreting and Using Results from Provincial Tests and Assessments* available at www.edu.gov.mb.ca/k12/assess/support/results/index.html.

These reports compare the local marking results to the results from the departmental re-marking of sample test booklets. Provincially, 42.4% of the test booklets sampled were given nearly identical total scores. In 50.9% of the cases, local marking resulted in a higher score than those given at the department; in 6.7% of the cases, local marking resulted in a lower score. On average, the difference was approximately 2.3% with local marking resulting in the slightly higher average score.

Survey Results

Teachers who supervised the Grade 12 Applied Mathematics Achievement Test in January 2019 were invited to complete a feedback form regarding the test and its administration. A total of 85 forms were received. A summary of their comments is provided below.

After adjusting for non-responses:

- 89.9% of teachers indicated that all of the topics in the test were taught by the time the test was written.
- 100% of teachers thought that the test content was consistent with the learning outcomes outlined in the curriculum documents and 95.2% thought that the difficulty of the test was appropriate.

- 91.0% of teachers indicated that their students used a study sheet on classroom assessments and 95.6% of teachers indicated that all of their students used a study sheet during the test. 66.3% of teachers indicated that students were given time to make their study sheets during class.

- 70.8% of teachers indicated that their students used the *Formula Sheet* on classroom assessments and 92.8% of teachers indicated that all of their students used the *Formula Sheet* during the test.

- During the test, 75.3% of teachers indicated that all of their students used a graphing calculator, 14.7% indicated that at least some of their students used computer software, 24.4% indicated that at least some of their students used Internet applets, and 17.1% indicated that at least some of their students used apps on a mobile device.

- 92.0% of teachers indicated that students were able to complete the test in the time allowed.