GENERAL COMMENTS

Grade 12 Applied Mathematics Achievement Test (June 2017)

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).

Summary of Test Results (Province)

June 2017	January 2017	June 2016	January 2016	June 2015	January 2015
56.7%	55.2%	55.3%	58.6%	54.9%	58.2%

Relations and Functions (provincial mean: 57.3%)

Conceptual knowledge

Students had difficulty with a polynomial equation given in factored form. They were unsure of how to use the factored equation to find the local maximum. Some students unsuccessfully multiplied out the factors, while others substituted values for x into the equation. Many students struggled to identify the appropriate type of regression to use when given data points that resembled an increasing logarithmic function. Some students confused domain with range. Many had difficulty writing a domain that matched the context of the question.

Procedural skill

When graphing data points, some students reversed the independent and dependent variables. Some students had difficulty applying formulas; reversing addition/subtraction and not following order of operations.

Communication

Some students made bracket errors with their domain. Students forgot to include or included incorrect units of measure with their final answer. Some students did not show their work fully even when asked (such as just writing "Desmos"). Some students answered questions with an explanation rather than an answer.

Probability (provincial mean: 49.8%)

Conceptual knowledge

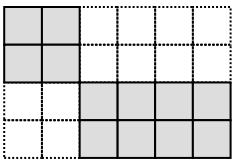
When asked to use the percentage of people to find the number of people, students left their answer as a percentage which resulted in an incomplete answer.

When given the probability of success of two independent outcomes, students struggled to understand that neither outcome was dependent upon the other. Students experienced much difficulty with creating a graphic organizer which affected the rest of the question. Students were unable to identify all necessary outcomes in the sample space. Alternatively, some students considered all outcomes but not their individual probabilities.

Students occasionally used permutations to solve a grouping question that had no order. Additionally, students ignored combinations; they reported that the number of ways to choose a group of r objects of Type A and s objects of Type B from a group of m Type A objects and n Type B objects as $\frac{r}{m}$; ignoring combinatorics and the influence of Type B objects altogether.

When working with probabilities, students often ignored the distinguishable objects. Students had great difficulty with determining the number of ways an arrangement could be made with restrictions. Although the question identified which letters of the alphabet were vowels, students misinterpreted the instructions and used extra letters in their arrangements.

Within a pathway problem with multiple parts, students treated the area as one big grid (see diagram below). This over-simplified the problem and resulted in an incorrect approach.



Procedural skill

When solving a problem using a Venn diagram, many students did not calculate the overlap. This oversight led them to calculate a negative number which they often reported as a positive. When solving the pathway problem, some students made addition errors within the diagram. Other students counted correctly within parts of the diagram, but instead of multiplying their answers, they added. When determining the total number of arrangements using permutations, students added the results instead of multiplying.

Communication

When stating a probability, some students correctly wrote the probability as a decimal to the nearest hundredth, but then wrote the probability as a percent rounded to the nearest whole number (e.g., 0.38 = 38%).

Financial Mathematics (provincial mean: 65.3%)

Conceptual knowledge

When determining the maximum affordable amount of a mortgage, many students treated the scenario as an investment by calculating the future value rather than calculating the present value of a loan. Students had difficulty representing different investment plans using a financial calculator. They struggled to understand that the same sum of money could be invested in different ways. Hence, many students mixed up the present value with the payment amount and vice versa. A few students tried to calculate both the mortgage amount and the value of an investment, with payments, using the compound interest formula. Alternately, some students tried using a financial calculator to determine the total loan amount paid rather than solving by hand.

When asked to determine the amount of a monthly mortgage payment, some students used the down payment amount as the present value and the total amount of the mortgage as the future value. The addition of monthly condo fees to the monthly mortgage payments, along with a down payment, caused confusion for students. Common errors included forgetting to add the down payment, treating the monthly condo fee as annual, and dividing the mortgage payment by 12 even though it was already given as monthly.

Procedural skill

Some students had difficulty entering values into a financial calculator. Common mortgage errors included representing the TVM solver's N-value as time only, incorrect compounding periods, and incorrect number of payments. Common investment errors included incorrect number of payments per year and inconsistent P/Y (payments per year) and N-values. There were some students who entered the correct number of payments per year, but forgot to update the compounding period.

Communication

When asked to give one reason why someone would purchase a less expensive house, many students just restated the question by answering with "because it is cheaper."

Design and Measurement (provincial mean: 52.2%)

Conceptual knowledge

When asked to find the diameter of a sphere whose surface area had increased by a given amount, students used the increased amount to determine the diameter rather than calculating the original surface area first. Some students struggled with correctly identifying all faces of a three-dimensional object when given a diagram. Other students did not understand the importance of efficiently using the space on the sheet of plywood provided when planning their design project.

Procedural skill

When calculating the diameter of a sphere given its surface area, some students correctly isolated r, but incorrectly calculated the value of r due to not using brackets when dividing by 4π.

Communication

Many students forgot to include units with their final answer.

Logical Reasoning (provincial mean: 62.8%)

Conceptual knowledge

Students often wrote the inverse of the given conditional statement rather than the converse. Many students did not know how to write a biconditional statement. When using a 3-set Venn diagram to solve a problem, some students had difficulty determining the correct number of elements in the regions where 2 sets intersected, while others had difficulty with the non-intersected regions. When asked to determine the number of elements where at least 2 sets intersected, students forgot to also include the intersection of all 3 sets.

Procedural skill

When writing the converse of the given conditional statement, students forgot to include the word "then." Some students correctly explained why the given conditional statement was biconditional, but did not know how to write it as such. Other students incorrectly placed the "if and only if" portion at the beginning of the biconditional statement, thus having difficulty finishing the statement.

Communication

When asked to explain whether a prediction was correct or incorrect, students explained their thinking but did not clearly identify whether the prediction was correct or not. Some students did not include a box when using a Venn diagram.

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	Notation	15.2%
E2	Units	31.5%
E3	Transcription/Transposition	14.5%
E4	Final Answer	21.4%
E5	Rounding	29.6%
E6	Whole Units	15.2%

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 include a chart comparing the local marking results to the results from the departmental re-marking of sample test booklets. Provincially, 42.5% of the test booklets sampled were given nearly identical total scores. In 43.4% of the cases, local marking resulted in a higher score than those given at the department; in 14.2% of the cases, local marking resulted in a lower score. On average, the difference was approximately 1.9% with local marking resulting in the slightly higher average score.

Survey Results

Teachers who supervised the Grade 12 Applied Mathematics Achievement Test in June 2017 were invited to complete a feedback form regarding the test and its administration. A total of 137 forms were received. A summary of their comments is provided below.

After adjusting for non-responses:

- 94.0% of teachers indicated that all of the topics in the test were taught by the time the test was written.
- 99.2% of teachers thought that the test content was consistent with the learning outcomes outlined in the curriculum documents and 94.6% thought that the difficulty of the test was appropriate.
- 92.5% of teachers indicated that their students used a study sheet on classroom assessments and 82.2% of teachers indicated that all of their students used a study sheet during the test. 66.7% of teachers indicated that the study sheets were made during class.
- 67.2% of teachers indicated that their students used the *Formula Sheet* on classroom assessments and 79.5% of teachers indicated that all of their students used the *Formula Sheet* during the test.
- During the test, 81.1% of teachers indicated that all of their students used a graphing calculator, 20.3% indicated that at least some of their students used computer software, 23.4% indicated that at least some of their students used Internet applets, and 13.6% indicated that at least some of their students used apps on a mobile device.
- 94.4% of teachers indicated that students were able to complete the test in the time allowed.