GRADE 12 APPLIED MATHEMATICS (40S)

Midterm Practice Examination
Instructions
The midterm examination is based on Modules 1 to 4 of the Grade 12 Applied Mathematics course. It is worth 20% of your final mark in this course.

Time
You will have a maximum of 3.0 hours to complete the midterm examination.

Notes
You are allowed to bring the following to the examination: pens/pencils (2 or 3 of each), metric and imperial rulers, a graphing and/or scientific calculator, and your Midterm Exam Resource Sheet. Your Midterm Exam Resource Sheet must be handed in with the examination. Graphing technology (either computer software or a graphing calculator) is required to complete this examination.

Show all calculations and formulas used. Use all decimal places in your calculations and round the final answers to the correct number of decimal places. Include units where appropriate. Clearly state your final answer. Final answers without supporting calculations or explanations will not be awarded full marks. Indicate equations and/or keystrokes used in calculations.

When using graphing technology, include a screenshot or printout of graphs or sketch the image and indicate the window settings (maximum and minimum x- and y-values), increments, and axis labels, including units.
1. Given the function graphed below, complete the table with the required information. 

(8 marks)

<table>
<thead>
<tr>
<th>Type of Function</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
<td></td>
</tr>
<tr>
<td>Coordinates of (x)-intercept(s)</td>
<td></td>
</tr>
<tr>
<td>Coordinates of (y)-intercept(s)</td>
<td></td>
</tr>
<tr>
<td>End behaviour</td>
<td></td>
</tr>
<tr>
<td>Absolute or relative maximum and/or minimum—state (y)-value</td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
</tr>
</tbody>
</table>

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Name: ________________________________

Answer all questions to the best of your ability. Show all your work.

1. Given the function graphed below, complete the table with the required information. 

(8 marks)
2. The loudness of a sound, $L$, measured in decibels (dB), is defined by the formula

$$L = 10 \log \left( \frac{I}{I_o} \right),$$

where $\left( \frac{I}{I_o} \right)$ is the intensity of a sound, $I$, in W/cm$^2$, compared to the minimum sound intensity, $I_o$, your ear can detect. (5 marks)

a) The volume at a concert is measured to be 115 dB. Calculate the ratio, $\left( \frac{I}{I_o} \right)$, for this sound in W/cm$^2$. (3 marks)
b) The value of $\left(\frac{I}{I_o}\right)$ for a jet engine is approximately $3.16227766 \times 10^{12}$ W/cm².

How many decibels is the loudness of a jet engine? (2 marks)

3. When an object is projected vertically upward, its height, $h$, in metres, after $t$ seconds, is given by the equation $h = -4.9t^2 + vt + s$, where $v$ is the initial velocity of the object and $s$ is the initial height (if any) above the ground. (9 marks)

a) From your location at the top of a cliff, 55 m above a lake, you throw a rock straight up into the air with a velocity of 15 m/sec. It lands in the water directly below you. Write an equation that models this situation. (1 mark)
b) Sketch a graph of this equation, showing the height of the rock as a function of time. Label the axes of the graph. (3 marks)
c) Determine the maximum height the rock attains and the number of seconds it takes to attain the maximum height. Show your work or explain your strategy. Round your final answers to the nearest tenth. (3 marks)

d) How long is the rock in the air? Show your work or explain your strategy. Round your final answer to the nearest tenth. (2 marks)
4. The village of Winkler was first established in 1906 and was recognized as a city in 2002. The city population recorded during various years between 1911 and 2011 is reported below. *(11 marks)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Year #</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1911</td>
<td>5</td>
<td>458</td>
</tr>
<tr>
<td>1921</td>
<td>15</td>
<td>812</td>
</tr>
<tr>
<td>1931</td>
<td>25</td>
<td>1,005</td>
</tr>
<tr>
<td>1941</td>
<td>35</td>
<td>957</td>
</tr>
<tr>
<td>1951</td>
<td>45</td>
<td>1,331</td>
</tr>
<tr>
<td>1961</td>
<td>55</td>
<td>2,529</td>
</tr>
<tr>
<td>1991</td>
<td>85</td>
<td>6,400</td>
</tr>
<tr>
<td>2001</td>
<td>95</td>
<td>7,999</td>
</tr>
<tr>
<td>2011</td>
<td>105</td>
<td>10,670</td>
</tr>
</tbody>
</table>


a) Plot the population data on a graph using the Year # as the independent variable. Sketch and label your graph below. *(4 marks)*

b) Using technology, find the exponential regression equation that best fits this data. *(2 marks)*
c) Winkler was officially incorporated as a town when the population was approximately 1835 inhabitants. According to this function model, during what year did this happen? (3 marks)

d) Using the exponential regression equation or technology, determine the approximate population of the city of Winkler during its centennial anniversary, in 2006. (2 marks)
5. Match each the following equations with its corresponding graph. Write the letter of the equation below the correct graph. (6 marks)

a) \( y = \log(x) + 5 \)
b) \( y = 5^x \)
c) \( y = \ln x \)
d) \( y = e^x \)
e) \( y = 0.5(x^2 + x - 6) \)
f) \( y = x^3 + 5x^2 + 4x - 5.1 \)

A  B  C

D  E  F
Name: ________________________________

6. List **five** things to consider when assessing the accuracy, reliability, and relevance of data and information. *(5 marks)*
7. Create a Venn diagram to represent the following information and answer the question below. (5 marks)

Students at a private dance studio may take ballet, hip hop, or tap dance classes.

- 3 students at the studio take all three.
- 7 students take tap and hip hop.
- 5 are in ballet and hip hop classes.
- All students who take tap also take either ballet or hip hop.
- 21 of the students take hip hop or tap.
- 14 are in ballet classes.
- 12 students take tap.

How many students attend the studio? _______________
8. Use graphing technology to sketch the graph of \( y = \log(x) \) and complete the table of information. (5 marks)

<table>
<thead>
<tr>
<th>Domain</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>x-intercept</td>
<td></td>
</tr>
<tr>
<td>Equation of asymptote</td>
<td></td>
</tr>
</tbody>
</table>

9. In a class of 25 students, 8 are on student council, 5 are on the volleyball team, and 2 students are on both the council and the team. How many students are neither on the council nor on the team? Justify your answer. (3 marks)
10. Sets A, B, and C are defined as:
   \[ A = \{x \mid x < 5, x \in \mathbb{R}\} \]
   \[ B = \{x \mid x \geq -2, x \in \mathbb{R}\} \]
   \[ C = \{x \mid -3 < x \leq 2, x \in \mathbb{R}\} \]

   a) Graph sets A, B, and C using the number line below. (3 marks)

   [Number line diagram]

   b) Using set notation, define the following: (3 marks)
      i) \[ A \cap B = \]
      ii) \[ B \cup C = \]
      iii) \[ A \cap B' = \]
11. Answer the following questions based on the conditional statement, “If a polygon is an octagon, then it has 8 sides.” (8 marks)
   a) State the hypothesis and the conclusion of this statement. (1 mark)

   b) Complete the following truth table for the conditional statement. Justify your results by describing the possible states of the hypothesis and conclusion for each of the four possible cases. (5 marks)

   Answer:

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Conclusion</th>
<th>Conditional Statement</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

   c) Write the converse of the given statement. (1 mark)

   d) Is the given statement biconditional? Explain. (1 mark)

12. An event consists of tossing three coins and noting if they land Heads, H, or Tails, T. Write the sample space, S, of this event. (1 mark)
13. Each of the letters in the words PRACTICE EXAM are written on individual cards and placed in a hat. (5 marks)
   a) One card is randomly drawn from the hat. Determine the probability of drawing a C. Write the final answer as a reduced fraction. (1 mark)

   b) One card is randomly drawn from the hat. Determine the probability of drawing a vowel. Write the final answer as a percentage. (1 mark)

   c) One card is drawn, the letter is noted, and the card is replaced. A second card is drawn. Determine the probability of drawing the P and then the M. Write the final answer as a fraction. (1 mark)

   d) One card is drawn, the letter is noted, and then a second card is drawn without replacing the first card. What is the probability of drawing two consonants? Write the final answer as a decimal to the nearest thousandth. (1 mark)

   e) One card is drawn at random from the hat. Determine the probability that it is not the X. (1 mark)
14. A dart is thrown randomly and lands on a square dartboard with three areas, as pictured below. Note that the sides of square A are 5 times as long as the sides of square C, and the sides of square B are 3 times as long as the sides of square C.

Calculate: (4 marks)

a) Probability that a dart lands in area A

b) Probability that a dart lands in area B

c) Odds in favour of a dart landing in area B

d) Odds against a dart landing in area C
15. An experiment consists of randomly drawing a card from a deck of 50 cards numbered from 1 to 50. What is the probability of drawing a card that is an even number or a multiple of 5? (4 marks)

16. Three bags contain marbles:

<table>
<thead>
<tr>
<th>Bag 1</th>
<th>Bag 2</th>
<th>Bag 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 green</td>
<td>2 green</td>
<td>4 green</td>
</tr>
<tr>
<td>2 red</td>
<td>1 red</td>
<td>3 white</td>
</tr>
<tr>
<td>1 white</td>
<td>5 black</td>
<td>2 black</td>
</tr>
</tbody>
</table>

Answer the following questions regarding one or more of the bags. (11 marks)

a) Using Bag 1, determine the probability of drawing a green marble. (1 mark)

b) Using Bag 2, determine the odds in favour of drawing a green marble. (1 mark)

c) Using Bag 3, determine the odds against drawing a black marble. (1 mark)
d) Create a tree diagram to represent the sample space for the event of drawing one marble from Bag 1 and then one marble from Bag 2. Include the probability of drawing each colour along each branch. (5 marks)
e) When choosing one marble from each of Bag 1 and Bag 2, what is the probability of choosing two marbles of the same colour? (2 marks)

f) When choosing one marble from each of Bag 1 and Bag 2, what is the probability of choosing two marbles of different colours? (1 mark)

17. A customer enters a restaurant. The probability that the customer orders at least one of either a steak or a salad is \( \frac{8}{11} \). The probability that the customer orders steak is \( \frac{2}{11} \), while the probability of ordering salad is \( \frac{7}{11} \). What is the probability that the customer orders both a steak and a salad? (4 marks)