

Grade 12  
Essential Mathematics  
Achievement Test

# **Student Booklet**

January 2017

Manitoba Education and Training Cataloguing in Publication Data

Grade 12 essential mathematics achievement test.  
Student Booklet. January 2017

This resource is available in print and electronic formats.

ISBN: 978-0-7711-7394-3 (print)

ISBN: 978-0-7711-7395-0 (pdf)

1. Educational tests and measurements—Manitoba.
  2. Mathematical ability—Testing.
  3. Mathematics—Examinations, questions, etc.
  4. Mathematics—Study and teaching (Secondary)—Manitoba.
- I. Manitoba. Manitoba Education and Advanced Learning.  
510.76

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While the department is committed to making its publications as accessible as possible, some parts of this document are not fully accessible at this time.

Available in alternate formats upon request.

## Grade 12 Essential Mathematics Achievement Test Student Booklet (January 2017)

### DESCRIPTION

**Total Possible Marks: 78**

**Maximum Time: 120 minutes**

**This test consists of six parts:**

<b>Learning Unit</b>	<b>Suggested Time to Complete</b>	<b>Marks</b>
Home Finance	15–20 minutes	16
Probability	10–15 minutes	11
Vehicle Finance	15–20 minutes	16
Geometry and Trigonometry	15–20 minutes	14
Precision Measurement	10–15 minutes	10
Statistics	10–15 minutes	11

### GENERAL DIRECTIONS

- ◆ You may use the *Formula Sheet: Essential Mathematics* found at the end of this booklet and your study sheet.
- ◆ Use of a scientific calculator may be necessary. Graphing calculators are not permitted.
- ◆ Read all instructions on the test carefully.
- ◆ If you need more space to answer a question, extra pages may be provided by your teacher. Write your booklet ID number and question number on any extra page(s) used and staple the additional page(s) into the booklet where your answer begins.

**At this point, please turn off your cell  
phone and all other such devices.**

## DIRECTIONS

- ◆ Show all your work.
- ◆ Use your *Formula Sheet* and your study sheet.
- ◆ Use a scientific (non-graphing) calculator.
- ◆ Show **complete answers** in the space(s) provided in this booklet.
- ◆ Provide explanations and justifications.
- ◆ Use a well-organized method to communicate your answer.
- ◆ Let the mark values for each question guide you in answering the question.

### Remember

- ◆ Include units in your final answer.
- ◆ Express answers in decimal and percentage form to **two decimal places** when rounding, unless otherwise indicated.

Example:  $\frac{15}{29} = 0.52$  or  $51.72\%$

- ◆ Some answers are to be given as decimal values. Rounding too early in your solution may result in an inaccurate final answer for which full marks will not be given.

## Directing Words

Some questions may include directing words such as *explain*, *state*, and *calculate*. These words are explained below.

<b>The word</b>	<b>The question is asking for...</b>
identify/choose	the appropriate answer(s) from a given list of choices
state	a word, sentence, or number, without an explanation
describe/explain	words or symbols, diagrams, charts or graphs, or other methods that clearly show what you are thinking
justify/support	an explanation, information, or evidence that shows why your method, idea, or answer is correct
sketch/illustrate	a reasonably neat picture or diagram (not necessarily to scale) that shows or explains an idea, concept, or method
calculate/determine	a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem



**PLEASE WAIT UNTIL INSTRUCTED TO TURN THE PAGE.**



# Home Finance

## Question 1

3 marks

101  
102

Mika's monthly mortgage payment is \$1100. His annual heating bill is \$2160, his annual property tax bill is \$3600, and his annual income is \$66 000. The bank calculated his Gross Debt Service Ratio (GDSR) as follows:

$$GDSR = \frac{\left( \begin{array}{ccc} \text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{mortgage} & \text{property} & \text{heating} \\ \text{payment} & \text{taxes} & \text{costs} \end{array} \right)}{\text{Gross monthly income}} \times 100$$

$$\begin{aligned} GDSR &= \frac{(\$1100 + \$300 + \$2160)}{\$5500} \times 100 \\ &= \frac{\$3560}{\$5500} \times 100 \\ &= 64.73\% \end{aligned}$$

A) State the error made by the bank. (1 mark)

B) Determine the correct GDSR. (2 marks)

**Question 2**

2 marks 103

Wilhelm is purchasing a property valued at \$192 000. The land transfer tax is calculated as follows:

<b>Land Transfer Tax Table</b>		
<b>Value of Property</b>	<b>Rate (%)</b>	<b>Tax Amount (\$)</b>
On the first \$30 000	0%	\$0
On the next \$60 000 (i.e., \$30 001 to \$90 000)	0.5%	\$300
On the next \$60 000 (i.e., \$90 001 to \$150 000)	1.0%	\$600
On the next \$50 000 (i.e., \$150 001 to \$200 000)	1.5%	
On amounts in excess of \$200 000	2.0%	
Total Land Transfer Tax Due:		

Calculate the total land transfer tax due.

### Question 3

3 marks 104

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When purchasing a home a homeowner must consider one-time costs as well as on-going expenses.

State whether the following are one-time or on-going expenses.

i) Mortgage payment: \_\_\_\_\_

ii) Hiring movers: \_\_\_\_\_

iii) Land survey: \_\_\_\_\_

## Question 4

2 marks 105

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Josh has recently graduated from college and is looking for work in a new town.

Explain 2 reasons why Josh should rent rather than buy a place to live while searching for work.

Place one response per line.

1. \_\_\_\_\_

2. \_\_\_\_\_

## Question 5

3 marks 106  
107

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Bilal purchased a home for \$350 000 and made a minimum down payment of 5%. He obtained a mortgage at an interest rate of 4% over 25 years. The amortization rate is \$5.26 per thousand dollars borrowed.

A) Calculate the monthly mortgage payment. (2 marks)

B) Calculate the total interest paid over 25 years. (1 mark)

## Question 6

3 marks

108  
109

Jaiyi is purchasing a new high efficiency furnace. Her two options are as follows:

	<b>Initial Cost</b>	<b>Monthly Heating Cost</b>
Option A	\$5000	\$100
Option B	\$2000	\$140

- A) Calculate the difference in cost between Option A and Option B at the end of 5 years.  
(2 marks)

- B) Justify whether Jaiyi should choose Option A or Option B. (1 mark)

# Probability

## Question 7

2 marks 110

---

State the probability of 43% as a fraction and a decimal.

Fraction: \_\_\_\_\_

Decimal: \_\_\_\_\_

## Question 8

2 marks <sup>111</sup>  
<sub>112</sub>

---

A sports store sells lacrosse sticks. Out of 500 sold, 55 are defective. The manufacturer says that 5 out of 100 is the expected number of defective sticks.

A) State the theoretical probability of a stick being defective. (1 mark)

B) State the experimental probability of a stick being defective. (1 mark)

## Question 9

3 marks 113

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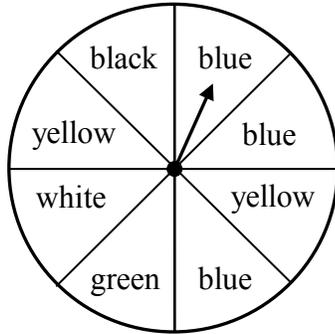
The probability of winning a computer programming contract is 28%. The contract is worth \$12 000 but it costs \$2300 to prepare the contract.

Calculate the expected value (EV) of the contract.

## Question 10

2 marks 114  
115

Given the following spinner:



A) State the probability of the arrow landing on yellow. (1 mark)

B) State the odds in favour of the arrow landing on blue. (1 mark)

## Question 11

1 mark 116

---

During a hockey season, 75 of the 400 games went into overtime.

State the odds **against** a game going into overtime.

## Question 12

1 mark 117

---

Choose the letter that best completes the statement below.

Probability compares the number of favourable outcomes to the

- a) odds for the event
- b) odds against the event
- c) total number of outcomes
- d) theoretical probability

**Answer:** \_\_\_\_\_

# Vehicle Finance

## Question 13

2 marks 118

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State 2 costs of operating a vehicle, other than car payments and car insurance.

Place one response per line.

1. \_\_\_\_\_

2. \_\_\_\_\_

## Question 14

3 marks <sup>119</sup>  
120

Izzy wants to buy a new car with a base price of \$22 500 before taxes. She wants the following options worth \$2450 before taxes: leather seats, sunroof, and chrome wheels.

A) State the sticker price of the car. (1 mark)

B) Izzy has a car to trade-in worth \$12 250.

Calculate the total cost of the car after taxes. (2 marks)

## Question 15

3 marks 121  
122

---

Barry wants to lease a new car valued at \$23 275 before taxes. The payment for the car is \$340 per month plus taxes for a 4-year lease with a down payment of \$2000.

A) Calculate the total cost for leasing this car. (2 marks)

B) State the residual value of the car before taxes using a 40% residual rate. (1 mark)

**Question 16**

3 marks 123

Emily brought her vehicle into a service centre in Manitoba for a tune-up. The tune-up included the following items:

<b>Item</b>	<b>Details</b>	<b>Cost</b>
Replace windshield wipers	2 wipers	\$12 per wiper
Oil change	4 L oil	\$3 per litre
	1 filter	\$22 per filter
Labour	2.5 hours	\$110 per hour

Calculate the total cost of the tune-up after taxes.

## Question 17

2 marks 124

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Zoë's vehicle uses 7.6 L of fuel for every 100 km driven. The cost of fuel is \$1.05/litre, including taxes.

Calculate the cost of fuel for Zoë to drive her vehicle 2000 km.

## Question 18

1 mark 125

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Choose the letter that best completes the sentence below.

When purchasing car insurance, third party liability is the

- a) amount you pay every year for insurance
- b) amount you pay for extra coverage against damage to another person or their property
- c) one-time lump sum payment you pay to the insurance company when you first buy the car
- d) amount of the insurance claim you must pay when you are at fault for causing an accident

**Answer:** \_\_\_\_\_

## Question 19

2 marks 126  
127

---

A) A car worth \$29 000 depreciates 30% in the first year.

State the depreciation amount after the first year. (1 mark)

B) The same car depreciates 20% in the second year.

State the amount the car depreciated in the second year. (1 mark)

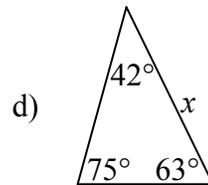
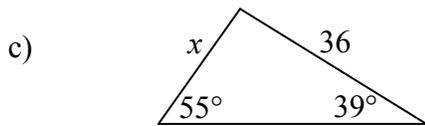
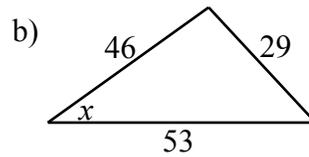
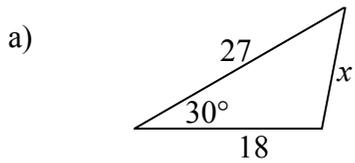
# Geometry and Trigonometry

## Question 20

1 mark 128

Choose the letter that best completes the statement below.

The triangle that would require only the Sine Law to solve for  $x$  is



Answer: \_\_\_\_\_

## Question 21

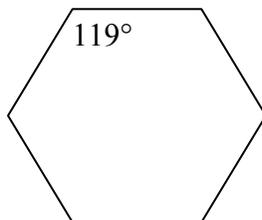
2 marks

129  
130

A standard soccer ball is made up of different shapes including hexagons sewn together to form a ball.

A) State the sum of the interior angles of a regular hexagon. (1 mark)

B) Paulo has the following piece of material that he is using to make a soccer ball.



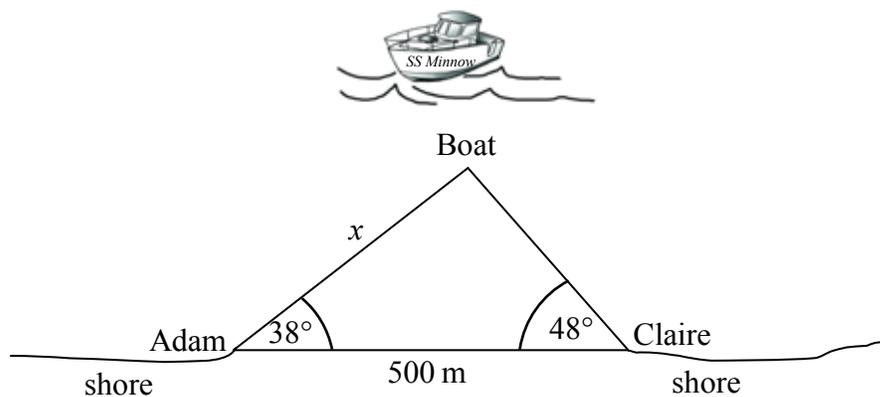
Justify whether the piece of material shown above is a regular polygon. (1 mark)

## Question 22

4 marks 131

A boat has drifted away from the shore. Adam and Claire are 500 m apart on the shore. The angle between the boat, Adam, and Claire is  $38^\circ$ , while the angle between the boat, Claire, and Adam is  $48^\circ$ .

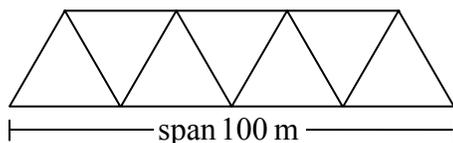
Calculate the distance ( $x$ ) Adam must swim to reach the boat.



## Question 23

2 marks 132

A student is solving a math question involving a 100 metre truss bridge. The bridge is made of 7 equilateral triangles as shown in the diagram below.



Sketch 1 of the bridge's triangles and state all side and angle measurements.

**Question 24**2 marks 133

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The sum of the interior angles of a regular polygon is  $2160^\circ$ .

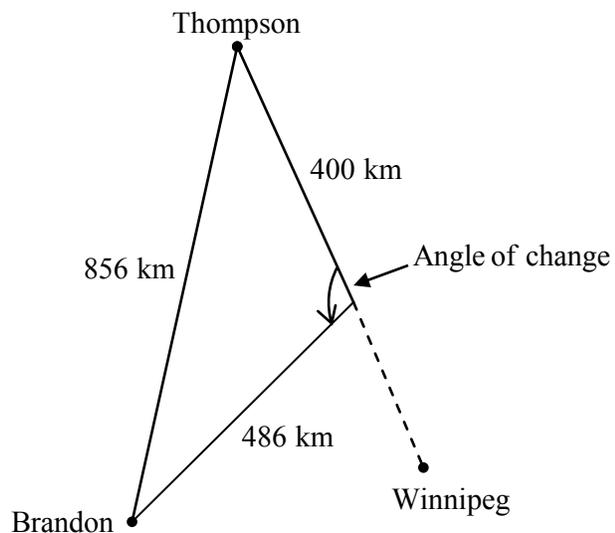
Calculate the number of sides of this regular polygon.

## Question 25

3 marks 134

An air ambulance is flying from Thompson to Winnipeg. After travelling 400 km, the plane is re-routed to Brandon.

Calculate the angle of change if the plane is 486 km from Brandon when it needs to change its direction.

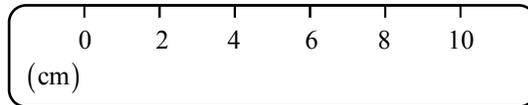


# Precision Measurement

## Question 26

1 mark 135

Given the measuring device below:



State the precision.

Precision: \_\_\_\_\_

## Question 27

3 marks

136  
137  
138

Given the following form of tolerance for a measurement:

$$5.3 \text{ cm } \begin{matrix} +0.4 \text{ cm} \\ -0.3 \text{ cm} \end{matrix}$$

A) State the maximum value. (1 mark)

B) State the minimum value. (1 mark)

C) State the tolerance. (1 mark)

## Question 28

2 marks

139  
140

Jen is a carpenter and needs to measure a piece of wood to 12 inches. She can use a yard stick with no incremental measurements or a tape measure with 1 inch increments.

A) State which device Jen should use. (1 mark)

B) State the uncertainty of the device you chose in Part A. (1 mark)

## Question 29

1 mark 141

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Explain why the concept of tolerance is important when installing closet doors.

## Question 30

2 marks 142

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A refrigerator has a maximum temperature of  $37.5^{\circ}\text{F}$  and a minimum temperature of  $32.7^{\circ}\text{F}$ .

State the tolerance in the form: nominal value  $\begin{matrix} +\text{tolerance} \\ -0 \end{matrix}$

## Question 31

1 mark 143

---

A lemonade bottling company fills 500 mL bottles.

Explain why the company should be accurate when measuring the amount of lemonade it puts in each bottle.

# Statistics

## Question 32

3 marks

144  
145  
146

---

Mackenzie weighs herself every week for 10 weeks. The following are her weights in pounds:

125 122 124 126 128 130 129 131 130 130

A) State the mean to one decimal place. (1 mark)

B) State the mode. (1 mark)

C) State the median to one decimal place. (1 mark)

**Question 33**

2 marks 147

Mathville has a population of 1 200 000 people and Megatropolis has a population of 3 108 000 people. The following table shows the percentage of people who speak English as their first language.

	<b>Population</b>	<b>% of people who speak English as a First Language</b>
Mathville	1 200 000	84.6%
Megatropolis	3 108 000	65.3%

Calculate the percentage of people who speak English as their first language in both cities combined using a weighted mean.

## Question 34

2 marks

148  
149

In a school, 236 students wrote a test. Jesse scored 60 out of 93 on the test and 127 students scored lower than him.

A) State Jesse's percentile rank. (1 mark)

B) State Jesse's mark as a percentage. (1 mark)

## Question 35

3 marks

150  
151  
152

Braedon is a Winnipeg real estate agent who has sold 6 houses in the last 5 weeks. The selling prices were as follows:

\$250 000	\$375 000	\$1 877 000	\$275 000	\$87 000	\$400 000
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- A) State the mean. (1 mark)
- B) State the trimmed mean by removing the highest and lowest values. (1 mark)
- C) Justify which mean would be a better indicator of the average selling price of a house in Winnipeg. (1 mark)

**Question 36**

1 mark 153

The following statistics are available on family income for a community:

Family income	\$62 000	\$70 000	\$80 000	\$90 000
Percentile rank	25th	50th	75th	85th

State the percentage of people who earn between \$62 000 and \$90 000.

## Formula Sheet: Essential Mathematics

Name of Formula	Details	Formula
Percentile Rank ( <i>PR</i> )	$b$ = number of raw scores below the given score $n$ = total number of raw scores	$PR = \frac{b}{n} \times 100$
Simple Interest ( <i>I</i> )	$P$ = principal $r$ = annual interest rate $t$ = time in years	$I = Prt$
Gross Debt Service Ratio ( <i>GDSR</i> )		$GDSR = \frac{\left( \begin{array}{l} \text{Monthly mortgage} \\ \text{payment} \end{array} + \begin{array}{l} \text{Monthly property} \\ \text{taxes} \end{array} + \begin{array}{l} \text{Monthly heating} \\ \text{costs} \end{array} \right)}{\text{Gross monthly income}} \times 100$
Fuel Economy in L/100 km ( <i>FE</i> )		$FE = \frac{\text{Fuel used in litres}}{\text{Distance in km}} \times 100$
Expected Value ( <i>EV</i> )	$P$ = probability	$EV = P(\text{win}) \times \$\text{gain} - P(\text{lose}) \times \$\text{loss}$
Sum of Interior Angles of Polygons ( <i>S</i> )	$n$ = number of sides	$S = 180^\circ(n - 2)$
Central Angle of Regular Polygons ( <i>C</i> )	$n$ = number of sides	$C = \frac{360^\circ}{n}$
Number of Diagonals in a Polygon ( <i>D</i> )	$n$ = number of sides	$D = \frac{n(n - 3)}{2}$
<b>Trigonometric Laws</b>		
Sine Law	$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$	Cosine Law $a^2 = b^2 + c^2 - (2bc \cos A)$ $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$
<b>Tax Rates</b>		
Federal	Goods and Services Tax (GST) 5%	Provincial Provincial Sales Tax (PST) 8%

	<b>Taxes on Vehicle Purchases</b>	
	<b>PST</b>	<b>GST</b>
Buying New	PST	GST
Buying Used from a Dealership	PST	GST
Buying Used (Private Sale)	PST calculated on greater of book value or purchase price	No GST
Safety	No PST	GST
Materials and Labour	PST	GST
Lien Search	No PST	No GST

