

Grade 12
Essential Mathematics
Achievement Test

Student Booklet

January 2019

Manitoba 

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Student Booklet. January 2019

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**Grade 12 Essential Mathematics Achievement Test
Student Booklet (January 2019)**

DESCRIPTION

Total Possible Marks: 79

Maximum Time: 120 minutes

This test consists of six parts:

Learning Unit	Suggested Time to Complete	Marks
Home Finance	15–20 minutes	16
Probability	10–15 minutes	11
Vehicle Finance	15–20 minutes	17
Geometry and Trigonometry	15–20 minutes	15
Precision Measurement	10–15 minutes	9
Statistics	10–15 minutes	11

**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 calculator. Graphing calculators are not permitted.
- ◆ 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.
- ◆ Express answers in decimal and percentage form to at least **two decimal places** when rounding, unless otherwise indicated.

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

Remember

- ◆ Include units in your final answer.
- ◆ 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.

The word	The question is asking for...
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 clearly shows or explains an idea, concept, or method
calculate	a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem
determine	a verification or confirmation by count, observation, formula, pattern, use of a table, etc.



PLEASE WAIT UNTIL INSTRUCTED TO TURN THE PAGE.

Home Finance

Question 1

4 marks 101
102

Jen and Joe are purchasing a house. Their monthly property taxes will be \$160, their monthly heating costs will be \$122, and their monthly mortgage payment will be \$1445. Their combined gross income per year is \$66 000.

A) Calculate their Gross Debt Service Ratio (GDSR) as a percent. (3 marks)

B) Justify why Jen and Joe might consider purchasing a less expensive house. (1 mark)

Question 2

2 marks 103

Chris is purchasing a parcel of land valued at \$87 500 to build a house. The land transfer tax is calculated as follows:

Land Transfer Tax Table	
Value of Property	Rate
On the first \$30 000	0%
On the next \$60 000 (i.e., \$30 001 to \$90 000)	0.5%
On the next \$60 000 (i.e., \$90 001 to \$150 000)	1.0%
On the next \$50 000 (i.e., \$150 001 to \$200 000)	1.5%
On amounts in excess of \$200 000	2.0%

Calculate the total land transfer tax due. (2 marks)

Question 3

1 mark 104

Describe one regular home maintenance task that could prevent an expensive emergency repair cost.

Question 4

1 mark 105

Choose the letter that best completes the statement below.

One benefit of owning a house instead of renting an identical house is that:

- A) the initial costs are lower
- B) the property is an investment
- C) the insurance cost is lower
- D) you are not responsible for repair and maintenance costs

Answer: _____

Question 5

3 marks

106
107
108

The Leon family purchased a new energy efficient washing machine. It uses 125 L less water per load than their old machine.

A) The Leon family does 12 loads of laundry per week with their new machine.

Calculate how many litres of water they will save per year. (1 mark)

B) Calculate how much money the Leon family will save per year with their new washing machine if they pay \$2.85 per 1000 L of water. (1 mark)

C) The Leon family paid \$889.20 for their new washing machine.

Calculate how many years it will take for the amount of money saved to equal the value of the new washing machine. (1 mark)

Question 6

1 mark 109

Choose the letter that best completes the statement below.

Two ongoing expenses of owning a home are:

- A) heating costs and home insurance
- B) heating costs and property tax adjustment
- C) home insurance and land transfer tax
- D) property tax and land transfer tax

Answer: _____

Question 7

4 marks

110
111

Adele is buying a house for \$275 000. She makes a \$55 000 down payment. She obtains a mortgage for the remaining amount. The amortization rate is \$6.44 per thousand dollars borrowed (based on an interest rate of 4.75% for 20 years).

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

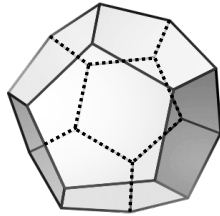
B) Calculate the total amount paid for the house after the 20 years, including the down payment. (2 marks)

Probability

Question 8

1 mark 112

Taryn rolls a fair dodecahedron (12-sided die). Its sides are numbered 1 through 12.



State the probability, as a decimal, of rolling a number less than 6.

Question 9

2 marks

113
114

At a hockey game, one person is randomly selected to win a prize. There are 1000 people in attendance. Of those in attendance, 175 are children.

A) Calculate the probability, as a percent, of a child winning the prize. (1 mark)

B) State the odds **against** a child winning the prize. (1 mark)

Question 10

3 marks 115

A graduation committee wants to fundraise by raffling off a \$400 hot-air balloon ride. There are 500 tickets being sold for \$5 each.

Calculate the expected value if you buy 7 tickets. (3 marks)

Question 11

1 mark 116

The odds in favour of being struck by lightning this year are 1 : 960 000.

State the probability, as a fraction, of being struck by lightning this year.

Question 12

2 marks 117

Connor is a goalie. The opposing team took 32 shots on him. He saved 93.75% of these shots.

Calculate how many shots Connor did **not** save. (2 marks)

Question 13

2 marks

118
119

Five cards numbered 1 to 5 are placed in a bag.

David randomly picks one card from the bag. He records the number and then puts the card back in the bag. He does this a total of 10 times.

Here are the results:



A) State the experimental probability of David picking a 4. (1 mark)

B) David thinks the theoretical probability of picking a 5 is 50%.

Explain why David is incorrect. (1 mark)

Vehicle Finance

Question 14

2 marks 120

A new truck is worth \$30 000. The truck's value depreciates at a rate of 25% per year.

Calculate the value of the truck at the end of the first year. (2 marks)

Question 15

1 mark 121

Choose the letter that best completes the statement below.

In Manitoba, the cost of car insurance is **not** affected by the:

- A) age of the driver
- B) amount of the deductible
- C) driving record
- D) location the car is driven

Answer: _____

Question 16

1 mark 122

A car's trip meter shows that it has travelled 636 km. The car used 60 L of fuel for this trip.

Calculate the fuel economy in L/100 km.

Question 17

1 mark 123

Choose the letter that best completes the statement below.

Alia will either finance the purchase of a vehicle or lease the vehicle long term.

She decides to lease because:

- A) the insurance is less expensive
- B) there is no cost for additional kilometers
- C) the leased vehicle can be used as equity for additional financing
- D) the monthly payments are lower

Answer: _____

Question 18

3 marks 124

Da-eun takes her motorcycle to the repair shop to have the oil changed and suspension repaired. The repair shop charges \$125 per hour for labour. The service details are shown in the table below:

Service	Cost of Parts/Supplies	Hours of Labour Required
Oil change	\$18	0.5
Suspension repair	\$227	1.75

Calculate the total amount Da-eun will pay, after taxes. (3 marks)

Question 19

3 marks 125
126

Valentina wants to buy a used vehicle through a private sale. The vehicle is priced at \$23 200 and has a book value of \$21 900.

A) Calculate the total amount Valentina will pay for her vehicle, after taxes. (2 marks)

B) Valentina will need to get a safety inspection for \$55.

Calculate the cost of the safety inspection, after taxes. (1 mark)

Question 20

3 marks

127
128

Gwen wants to borrow \$23 000 to purchase a car. A bank offers her an interest rate of 5.25% over 5 years.

A) Calculate the amount of interest Gwen would pay on her first month's payment. (2 marks)

B) Explain how Gwen can reduce the total interest paid over the life of this loan if she is unable to make a larger down payment. (1 mark)

Question 21

2 marks 129

Darvin is buying a new BMW in Manitoba. The base price is \$36 500 and he adds a performance package worth \$3500. The freight is \$650 and the dealership gives him \$13 000 as a trade-in value on his old vehicle.

Calculate the total cost of the new vehicle, after taxes. (2 marks)

Question 22

1 mark 130

Obed is leasing a truck worth \$39 000, before taxes. He decides to purchase the truck at the end of his 3-year lease. The truck has a residual value of 60%.

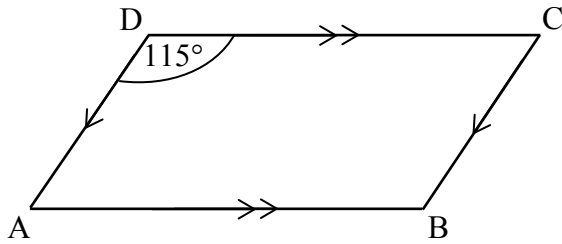
Calculate how much Obed must pay to purchase the truck at the end of his lease, before taxes.

Geometry and Trigonometry

Question 23

1 mark 131

The following shape is a parallelogram.



State the measure of $\angle A$.

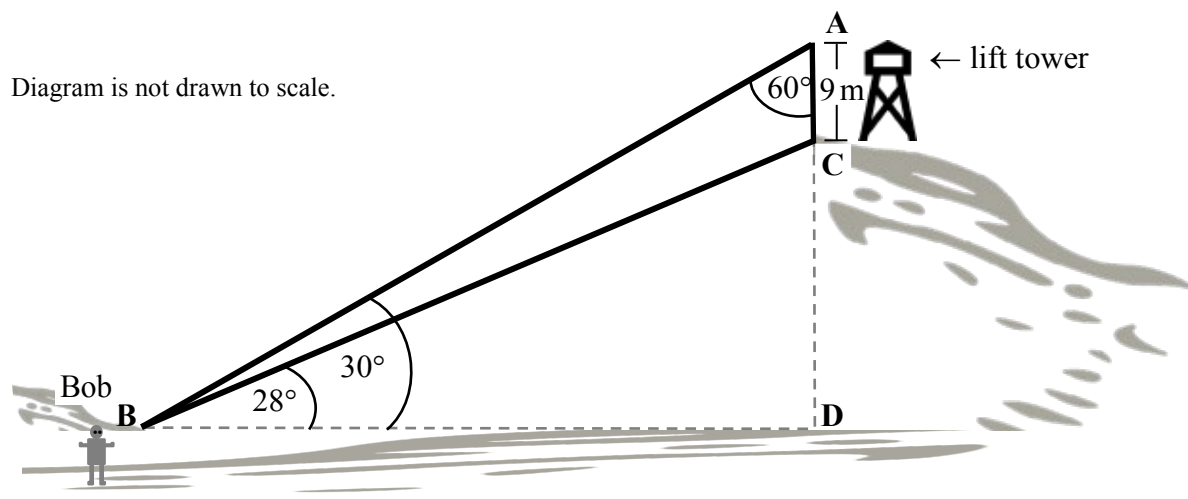
Question 24

4 marks

132
133

Bob is standing at the base of a mountain. The angle of elevation to the bottom of the lift tower is 28° . The angle of elevation to the top of the lift tower is 30° . The lift tower is 9 m tall.

Diagram is not drawn to scale.



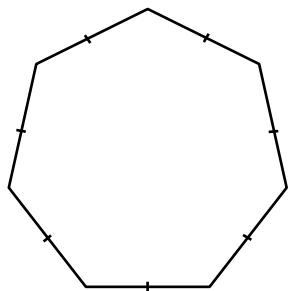
A) State the measure of $\angle ABC$. (1 mark)

B) Calculate the distance from Bob to the bottom of the lift tower (\overline{BC}). (3 marks)

Question 25

2 marks 134

Given the following regular heptagon:



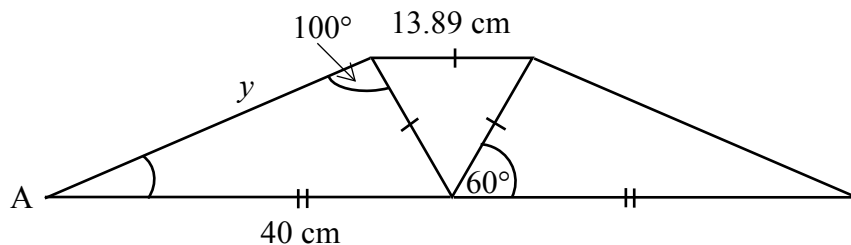
Calculate or illustrate the total number of diagonals that can be drawn.
If illustrating, clearly state the total number of diagonals. (2 marks)

Question 26

2 marks

135
136

Leslie is designing a new quilt whose pattern consists of one equilateral triangle and two congruent obtuse triangles.



A) State the measure of angle A. (1 mark)

B) Choose the equation that allows you to solve for y . (1 mark)

A) $y^2 = 13.89^2 + 40^2 - 2(13.89)(40)\cos 60^\circ$

B) $y^2 = 40^2 + 13.89^2 - 2(40)(13.89)\cos 100^\circ$

C) $\frac{\sin 13.89}{y} = \frac{\sin 100^\circ}{40}$

D) $\frac{\sin 40}{100} = \frac{\sin y}{13.89}$

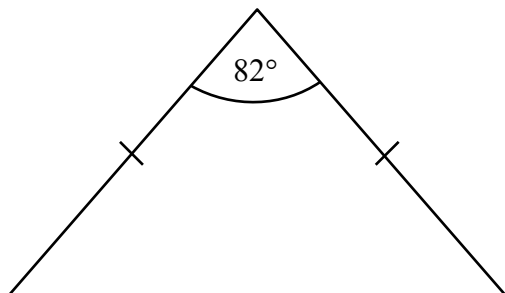
Answer: _____

Question 27

1 mark 137

The angle at the top of the following isosceles triangle is 82° .

Calculate the measure of one of the base angles.



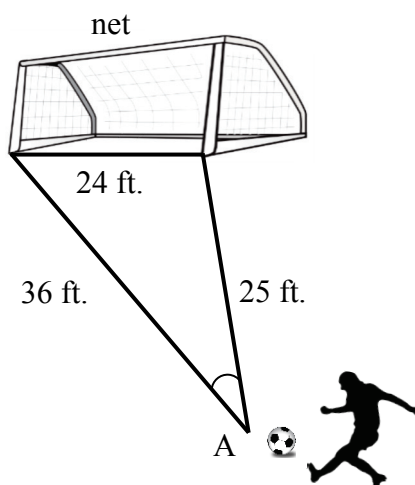
Question 28

3 marks 138

The posts of a soccer net are 24 ft. apart. A player attempts to score a goal by kicking the ball from a point 25 ft. from one post and 36 ft. from the other.

Calculate the measure of angle A. (3 marks)

Diagram is not drawn to scale.



Question 29

2 marks 139

A kite is a type of quadrilateral.

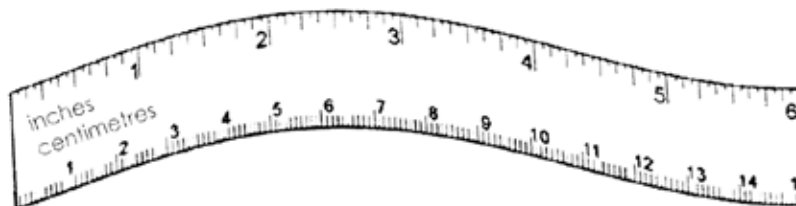
Sketch a kite and identify all congruent interior angles and sides. (2 marks)

Precision Measurement

Question 30

1 mark 140

Paul continually bends and unbends his flexible plastic ruler. It now looks like this:



Choose the letter that best completes the statement below.

The aspect of measurement that is affected is:

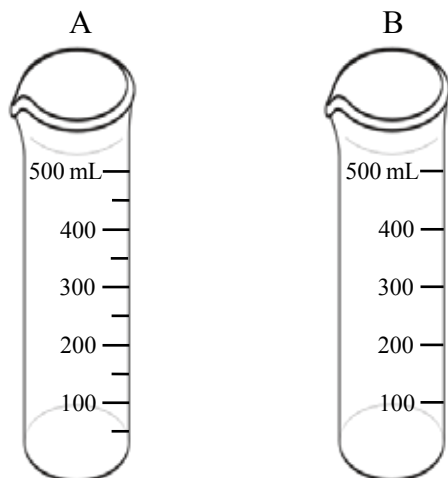
- A) precision
- B) uncertainty
- C) tolerance
- D) accuracy

Answer: _____

Question 31

2 marks 141
142

Rick is measuring the volume of a liquid using the cylinders below:



A) State the precision of cylinder A. (1 mark)

B) Justify which cylinder is more precise. (1 mark)

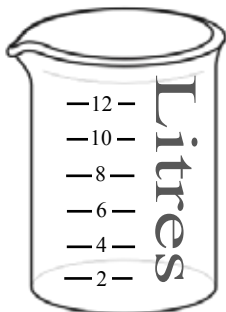
Question 32

3 marks 143
144

Marco needs to mix water with his eco-friendly herbicide concentrate for his garden. If too little water is added to the herbicide, it will kill his vegetables. However, if too much water is added, the herbicide will not be effective.

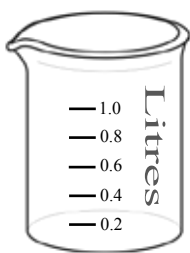
A) State the uncertainty of the measurement if Marco uses Container A. (1 mark)

Container A



B) Marco needs to add 12 L of water to the herbicide using Container B.

Container B

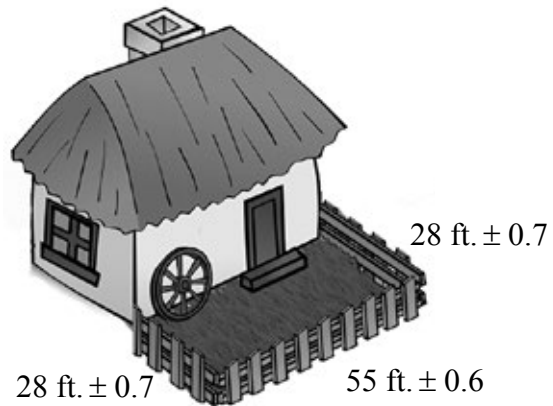


Calculate the total uncertainty of the measurements if Marco uses the container 12 times.
(2 marks)

Question 33

2 marks 145

A yard is being fenced on three sides as shown below.



Calculate the maximum length of fencing required given the measurements and the uncertainties above. (2 marks)

Question 34

1 mark 146

The tolerance of a measurement is 0.007 m. The nominal value, which is the maximum, is 15.084 m.

Choose an acceptable measured value from the list below:

- A) 15.091 m
- B) 15.078 m
- C) 15.098 m
- D) 15.070 m

Answer: _____

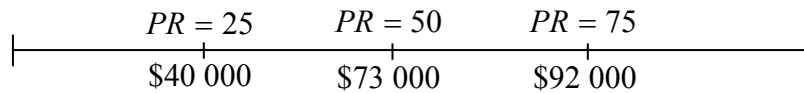
Statistics

Question 35

2 marks

147
148

Statistics for family income are available for the town of St. Lamont. The family incomes for the 25th, 50th, and 75th percentile ranks are shown below.



A) State the percent of families that earn more than \$92 000. (1 mark)

B) There are 1416 families in the town of St. Lamont.

Calculate how many families earn more than \$92 000. (1 mark)

Question 36

2 marks 149

The weights (kg) of fish caught in a fishing derby are:

1.91 2.25 2.84 2.90 3.71 4.18 4.49 4.82 5.02

Manuel caught the fish that weighed 2.90 kg.

Calculate the percentile rank of the weight of his fish. (2 marks)

Question 37

1 mark 150

A high school must report its absence rate. The table below shows the percent of students absent from September to January.

Month	September	October	November	December	January
Absence rate	3.3%	8.0%	8.3%	7.8%	7.6%

Justify whether the school should use the mean or median to promote its low absence rate.

Question 38

2 marks 151

The table below shows the number of text messages that Sajaad sent over the last few days.

Monday	Tuesday	Wednesday	Thursday	Friday
20	48	31	67	?

The mean number of text messages sent by Sajaad is 44.

Calculate the number of text messages he sent on Friday. (2 marks)

Question 39

2 marks 152

Three farms in Manitoba auctioned off their cattle. The table below shows the number of cows and the price per cow for each farm.

Farm	Number of Cows	Price per Cow
Newdale	300	\$1400
Parkview	500	\$1100
Hidden Valley	1000	\$950

Calculate the average price per cow using a weighted mean. (2 marks)

Question 402 marks 153
154

Given the following salaries:

\$100 000	\$45 000	\$35 000	\$40 000	\$33 000
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A) Calculate the mean. (1 mark)

B) Calculate the trimmed mean by removing the highest and lowest salaries. (1 mark)

Formula Sheet: Essential Mathematics

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

Additional formulas on next page. →

Tax Rates					
Provincial	Provincial Sales Tax (PST)	8%	Federal	Goods and Services Tax (GST)	5%
Taxes on Vehicle Purchases					
		PST		GST	
Buying New		PST		GST	
Buying Used from a Dealership		PST		GST	
Buying Used Privately		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	
Taxes on Home Insurance					
		PST		GST	
Homeowner's/Tenant's Insurance		PST		No GST	

