Grade 12
Essential Mathematics
Achievement Test

Student Booklet

January 2020

Manitoba

Grade 12 essential mathematics achievement test.
Student Booklet. January 2020

This resource is available in print and electronic formats.

ISBN: 978-0-7711-6362-3 (print)
ISBN: 978-0-7711-6364-7 (pdf)

Manitoba Education
Winnipeg, Manitoba, Canada

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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 as this time.

Available in alternate formats upon request.

Grade 12 Essential Mathematics Achievement Test
Student Booklet (January 2020)

DESCRIPTION

Time Required to Complete the Test: 2 hours

Additional Time Allowed: 30 minutes

This test consists of six parts:

Home Finance	16
Probability	11
Vehicle Finance	17
Geometry and Trigonometry	14
Precision Measurement	9
Statistics	10
Total Possible Marks:	**77**

DIRECTIONS

- Show all your work and clearly indicate your final answer.
- Use your *Formula Sheet* and your study sheet.
- Use a well-organized method to communicate your answer.
- Let the mark values for each question guide you in answering the question.
- Include units in your final answer.
- Make sure your calculator is set to degree mode.
- Express answers in decimal and percentage form to at least **two decimal places** when rounding.

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

  Note: Do not round answers in the Precision Measurement unit.
- 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.
- Note that all scenarios described in test questions take place in Manitoba.

Electronic communication between students through phones, email, or file sharing during the test is strictly prohibited. Please turn off your cell phone and all other such devices.

Terminology Sheet

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	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 PROCEED.

Home Finance

Question 1

3 marks 101 102

The average monthly heating cost for Rhong's house is $265.

A) Calculate his total expected heating cost for 4 years. (1 mark)

B) The heating cost will be reduced by 35% if Rhong installs heated floors.

Calculate his total expected heating cost for 4 years with heated floors. (2 marks)

Question 2

4 marks 103 104

Stella purchases a house in Winnipeg valued at $215 000. She buys a comprehensive homeowner's insurance policy with a $500 deductible.

A) Calculate her annual premium, before taxes. Refer to the table on the following page. (3 marks)

B) Describe one way Stella could reduce her annual insurance premium for this property. (1 mark)

Manitoba Homeowner's Insurance Rates

Manitoba Homeowner's Insurance Rates ($500 deductible)								
	Winnipeg		Area 2		Area 3		Area 4	
Amount	Standard	Comprehensive	Standard	Comprehensive	Standard	Comprehensive	Standard	Comprehensive
$ 50 000	195	214	147	161	196	216	261	287
$ 55 000	216	238	160	176	217	239	289	318
$ 60 000	237	260	173	190	237	261	315	347
$ 65 000	252	277	187	205	255	281	339	373
$ 70 000	266	303	200	220	270	297	359	395
$ 75 000	294	314	210	231	285	314	379	417
$ 80 000	310	323	221	243	302	332	402	462
$ 85 000	318	333	226	249	313	344	416	458
$ 90 000	324	349	231	254	324	356	431	474
$ 95 000	348	370	244	268	345	380	459	505
$100 000	364	393	260	286	361	397	480	528
$105 000	390	417	278	306	378	416	503	553
$110 000	402	441	293	322	393	432	523	575
$115 000	418	464	299	329	409	450	544	598
$120 000	436	487	309	340	424	466	564	620
$125 000	451	510	319	351	444	488	591	650
$130 000	472	543	339	373	466	513	620	682
$135 000	498	557	345	380	477	525	634	697
$140 000	523	580	358	394	496	546	660	726
$145 000	538	596	375	413	508	559	676	744
$150 000	550	604	385	424	520	572	692	761
$155 000	557	613	398	438	551	606	733	806
$160 000	565	622	413	454	569	626	757	833
$165 000	572	629	425	468	589	648	783	861
$170 000	590	647	441	485	609	670	810	891
$175 000	607	668	451	496	624	686	830	913
$180 000	620	686	466	513	648	713	862	948
$185 000	636	702	478	526	667	734	887	976
$190 000	652	717	492	541	705	776	938	1032
$195 000	678	742	504	554	720	792	958	1054
$200 000	692	771	519	571	726	799	966	1063
Additional Amounts per $1000 Coverage	Add: $3.15	Add: $3.50	Add: $2.75	Add: $3.03	Add: $3.55	Add: $3.91	Add: $4.72	Add: $5.19

$200 deductible—Increase premium by 10%

Question 3

3 marks 105

Calculate the missing values in the following amortization table. (3 marks)

Month	Monthly Mortgage Payment	Interest	Principal	Unpaid Balance
March	$1034.00	$711.68	$322.32	$189 423.00
April	$1034.00	$710.34		$189 099.34
May		$709.12	$324.88	

Question 4

1 mark 106

Albert comes home from his vacation and finds that his basement has flooded.

Describe one maintenance task Albert could have done to reduce the risk of his basement flooding.

Question 5

2 marks 107

Kelly's Statement and Demand for Taxes is shown in the table below.

Calculate the municipal taxes and the total taxes due. (2 marks)

Statement and Demand for Taxes			
	Total Portioned Assessment	**Mill Rate**	**Tax Amount**
Municipal Taxes	$128 250	19.842	
Education Taxes	$128 250	20.417	$2618.48
		Provincial Tax Credit	($700.00)
		Total Taxes Due	

Question 6

3 marks 108

Federico is calculating his Gross Debt Service Ratio (GDSR) using the information below.

Monthly mortgage payment	$975
Monthly property tax	$395
Monthly heating cost	$110
Gross annual income	$49 500

Calculate Federico's GDSR. (3 marks)

Probability

Question 7

1 mark 109

Sonya won a prize in a contest.

All of the prizes are listed below.

- 12 t-shirts
- 7 jerseys
- 6 gift cards

Calculate the probability, as a percent, that she won a t-shirt.

Question 8

1 mark 110

Choose the letter that best completes the statement below.

The number that does **not** represent a probability is:

A) 0.002

B) 1.2

C) 20%

D) $\frac{1}{2}$

Answer:_____

Question 9

1 mark 111

Mica is planning an outdoor activity for her club.

The weather forecast is as follows:

June 17	Probability of rain	30%
June 18	Odds for rain	3 : 8

Explain which day Mica should choose if she hopes to avoid rain.

Question 10

3 marks 112

Allison is bidding on a computer contract. The probability of winning the contract is 35%. The contract is worth $12 500. Allison spends $1600 to prepare her bid.

Calculate the expected value of the contract. (3 marks)

Question 11

2 marks 113

A survey company asked a random sample of 300 people to identify their favourite television program.

Of those surveyed:

- 30 people identified Program A
- 84 people identified Program B
- 74 people identified Program C
- 112 people identified Program D

Calculate how many people would be expected to identify Program D if 5000 people were surveyed. (2 marks)

Question 12

2 marks 114 115

Each year, a market gardener randomly grows either peas, beans, carrots, or onions.

The table below indicates which vegetable was grown each year for the past 10 years.

Year	Vegetable
2010	peas
2011	beans
2012	beans
2013	carrots
2014	onions
2015	peas
2016	carrots
2017	beans
2018	peas
2019	beans

A) State the experimental probability that the gardener will grow beans in 2020. (1 mark)

B) State the theoretical probability that the gardener will grow carrots in 2020. (1 mark)

Question 13

1 mark 116

The odds **against** Nico randomly selecting a country song from a playlist are $345:105$.

State the probability, as a fraction, of Nico **not** selecting a country song.

Vehicle Finance

Question 14

2 marks 117

A new sport utility vehicle is worth $34 000. The depreciation rate is 25% per year.

Calculate the value of the vehicle after 2 years. (2 marks)

Question 15

3 marks 118 119

A vehicle has a fuel economy of 12 L/100 km.

The driving distance from Cross Lake to Thompson is 258 km.

A) Calculate the number of litres of gas required to drive from Cross Lake to Thompson. (2 marks)

B) The cost of gas is $1.19/L.

Calculate the total cost of gas for this trip. (1 mark)

Question 16

1 mark 120

Justify why someone would finance the purchase of a vehicle instead of leasing an identical vehicle.

Question 17

3 marks 121

Ha-joon takes his truck to the repair shop because he needs a new radiator and a new headlight. The repair shop charges $85 per hour for labour.

The service details are shown in the table below.

Service	Cost of Parts	Hours of Labour Required
Radiator	$650	1.5
Headlight	$10	0.5

Calculate the total amount Ha-joon will need to pay, after taxes. (3 marks)

Question 18

3 marks 122

Matisse is purchasing a used car privately. The car is priced at $5000. The book value of the car is $5500. Matisse will need to pay $45 for a safety inspection.

Calculate the total amount he will pay for the car, after taxes. (3 marks)

Question 19

2 marks 123

Mary wants to buy a new car for $22 210. The dealership has agreed to accept Mary's old car with a trade-in value of $1340.

Calculate the total cost to purchase the new car, after taxes. (2 marks)

Question 20

1 mark 124

Choose the letter that best completes the statement below.

Carl drives his vehicle to school twice a month. His insurance agent should recommend

A) all-purpose insurance

B) pleasure insurance

C) lay-up insurance

D) no insurance

Answer:_____

Question 21

2 marks 125

Tia is leasing a new truck. Her monthly lease payment will be $349, after taxes, for 4 years. Her down payment is $2000.

Calculate the total leasing costs over 4 years. (2 marks)

Geometry and Trigonometry

Question 22

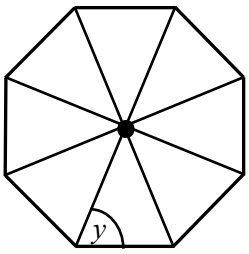
2 marks 126

Determine the number of diagonals in a regular dodecagon (12-sided shape). (2 marks)

Question 23

3 marks 127 128

Given the following regular octagon:



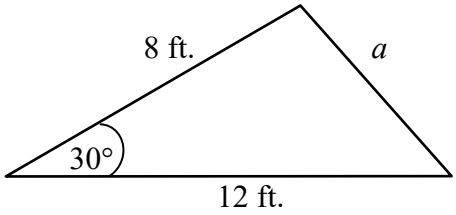
A) Calculate the measure of one of the central angles. (1 mark)

B) Calculate the measure of $\angle y$. (2 marks)

Question 24

3 marks 129

Calculate the length of side *a*, given the measurements below. (3 marks)



Question 25

1 mark 130

Vivianne states that an equilateral triangle is also an obtuse triangle.

Choose from the list below which statement is correct.

A) Vivianne is correct because obtuse triangles have three angles that are all less than 60^o.

B) Vivianne is correct because obtuse triangles have one angle greater than 90^o.

C) Vivianne is incorrect because equilateral triangles are also acute triangles.

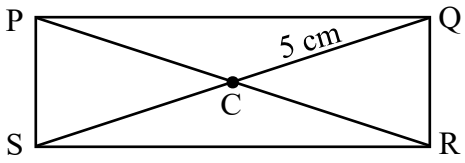
D) Vivianne is incorrect because equilateral triangles have a 90^o angle.

Answer:_____

Question 26

1 mark 131

Marcello draws rectangle PQRS with centre C and line segment $\overline{CQ}$ measuring 5 cm.

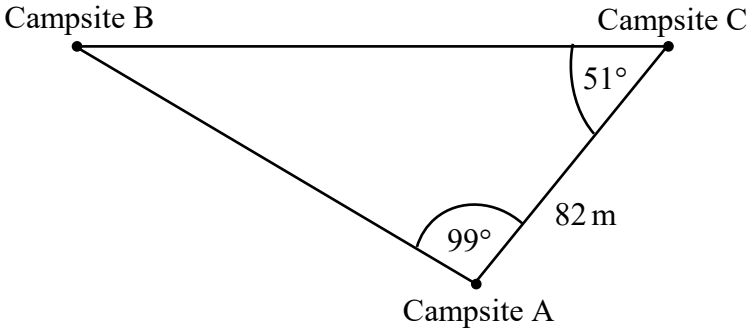


State the measure of diagonal $\overline{PR}$.

Question 27

4 marks 132

Geoff is going on a canoe trip with his school. The diagram below shows the 3 campsites they will use.



Calculate the distance between Campsite B and Campsite C. (4 marks)

Precision Measurement

Note: Do not round answers in this unit.

Question 28

1 mark 133

When cooking chicken, the internal temperature must reach a minimum of 165°F.

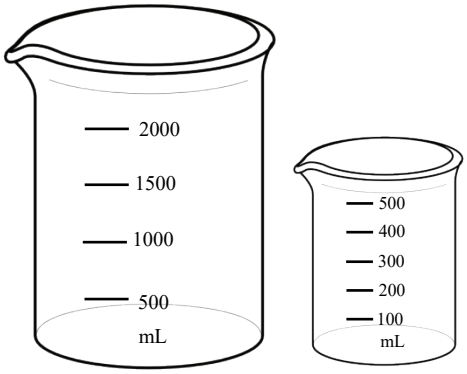
Explain why you need to use an accurate meat thermometer.

Question 29

2 marks

134
135

Ellen is preparing chain saw fuel by mixing oil with gas. She needs 600 mL of gas for the mixture.



Container 1 Container 2

A) Justify which container is more precise. (1 mark)

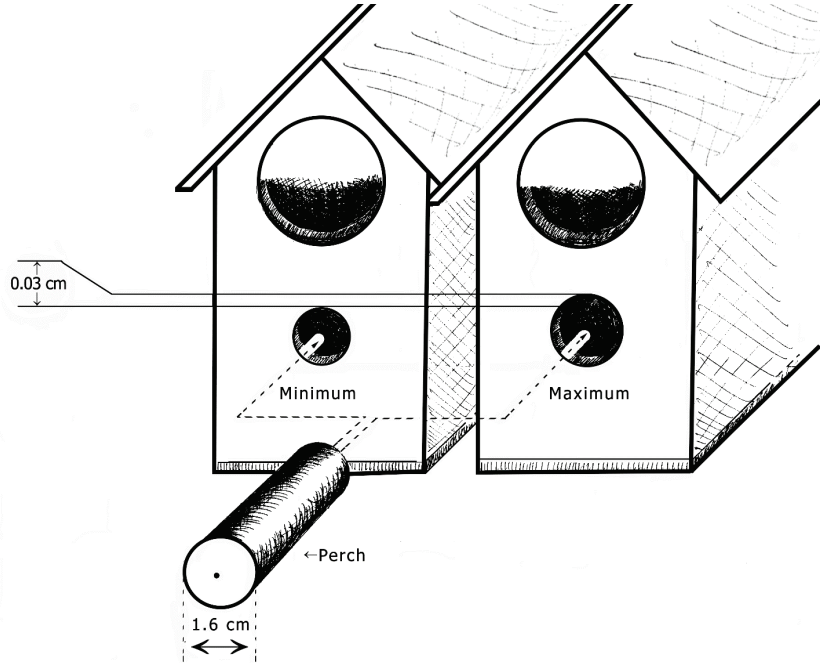
B) Ellen uses the container you chose in Part A to measure the 600 mL of gas.

Calculate the total uncertainty of the measurement. (1 mark)

Question 30

2 marks 136

Robert is building a bird house. The perch has a diameter of 1.6 cm which is the midpoint of the tolerance range. The tolerance is 0.03 cm.



State the range of acceptable measurements for the perch diameter in the form: $\begin{matrix}\text{maximum value} \\ \text{minimum value}\end{matrix}$

(2 marks)

Question 31

1 mark 137

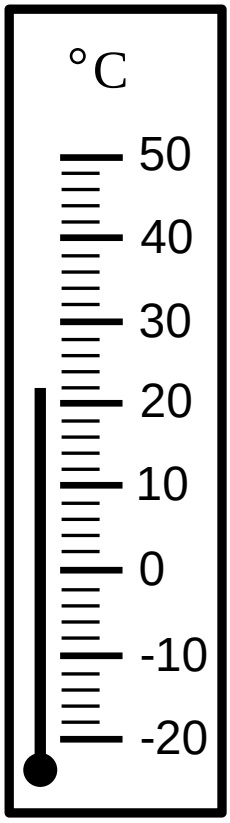
Last week, Phoenix collected 13.7 kg of berries.

State the precision of the scale he used.

Question 32

2 marks 138

State the temperature shown on the thermometer below in the form: measurement ± uncertainty. (2 marks)



Question 33

1 mark 139

A drink contains $0.504 \text{ mg} \pm 0.002 \text{ mg}$ of caffeine.

State the minimum quantity of caffeine in this drink.

Statistics

Question 34

1 mark 140

Jorge is a soccer goalie. This year, he saved 92% of shots on net. This puts him in the 10th percentile of goalies in the league.

Justify, referring to percentile rank, whether Jorge was one of the best goalies in the league this year.

Question 35

2 marks 141

A train has 60 cars.

Calculate the average load of one train car using a weighted mean, based on the information in the table below. (2 marks)

Type of Car	Number of Cars on Train	Load Per Car (Tons)
Cargo	50	100
Grain	10	80

Question 36

1 mark 142

Choose the letter that best completes the statement below.

Trimming the highest and lowest values of a large data set will cause the median to:

A) increase

B) decrease

C) stay the same

D) change, but it is impossible to tell by how much

Answer: _____

Question 37

3 marks 143

Given the following information:

Median = 3
Mean = 4
Mode = 2

State 5 whole numbers that meet the criteria above, using the numbers 1 through 9. (3 marks)

____ ____ ____ ____ ____

Question 38

1 mark 144

The following data set represents the number of kids that visited Maggie's house on Halloween over the past seven years.

Year	Number of kids
2013	13
2014	11
2015	8
2016	19
2017	87
2018	21
2019	10

Explain why it would be better for Maggie to use the median rather than the mean to predict the number of kids next Halloween.

Question 39

2 marks 145

The Winnipeg Flyers hockey team keeps statistics on the number of goals scored by each player.

Player	Goals Scored
Buff, D.	13
Flowry, A.	15
Large, B.	21
Legica, J.	10
Lines, P.	36
Shuffler, M.	32
Steelers, N.	26
Wheely, B.	25

Calculate Steelers' percentile rank. (2 marks)

Formula Sheet: Essential Mathematics

Name of Formula	Formula	Details
Percentile Rank (PR)	$PR = \frac{b}{n} \times 100$	b = number of raw scores below the given score n = total number of raw scores
Simple Interest (I)	$I = Prt$	P = principal r = annual interest rate t = time in years
Education Tax or Municipal Tax	$\text{Tax} = \text{Portioned assessment} \times \frac{\text{mill rate}}{1000}$	
Gross Debt Service Ratio ($GDSR$)	$GDSR = \frac{\left(\begin{array}{ccc}\text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{mortgage} + & \text{property} + & \text{heating} \\ \text{payment} & \text{taxes} & \text{costs}\end{array}\right)}{\text{Gross monthly income}}$	
Fuel Economy in L/100 km (FE)	$FE = \frac{\text{Fuel used in litres}}{\text{Distance in km}} \times 100$	
Expected Value (EV)	$EV = P(\text{win}) \times \$\text{gain} - P(\text{lose}) \times \$\text{loss}$	P = probability
Sum of Interior Angles of Polygons (S)	$S = 180°(n-2)$	n = number of sides
Measure of One Interior Angle of a Regular Polygon	$\text{Interior angle} = \frac{180°(n-2)}{n}$	n = number of sides
Measure of One Exterior Angle of a Regular Polygon	$\text{Exterior angle} = \frac{360°}{n}$	n = number of sides
Central Angle of Regular Polygons (C)	$C = \frac{360°}{n}$	n = number of sides
Number of Diagonals in a Polygon (D)	$D = \frac{n(n-3)}{2}$	n = number of sides

Additional formulas on next page. →

Trigonometric Laws	
Sine Law $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$	Cosine Law $a^2 = b^2 + c^2 - (2bc \cos A)$ $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Tax Rates					
Provincial	Provincial Sales Tax (PST)	7%	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