Grade 12
Essential Mathematics
Achievement Test

Student Booklet

June 2017

Manitoba

After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Learning Resource Centre. Order online at www.mtbb.mb.ca.

This resource will also be available on the Manitoba Education and Training website at www.edu.gov.mb.ca/k12/assess/archives/index.html.

Websites are subject to change without notice.

Disponible en français.

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 (June 2017)

DESCRIPTION

Total Possible Marks: 75   **Maximum Time: 120 minutes**

This test consists of six parts:

Learning Unit	Suggested Time to Complete	Marks
Home Finance	15–20 minutes	13
Probability	10–15 minutes	10
Vehicle Finance	15–20 minutes	19
Geometry and Trigonometry	15–20 minutes	13
Precision Measurement	10–15 minutes	9
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.

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At this point, please turn off your cell
phone and all other such devices.
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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.
- ◆ Express answers in decimal and percentage form to **two decimal places** when rounding, unless otherwise indicated.

  Example: $\dfrac{15}{29} = 0.52$ 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 shows or explains an idea, concept, or method
calculate/determine	a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem
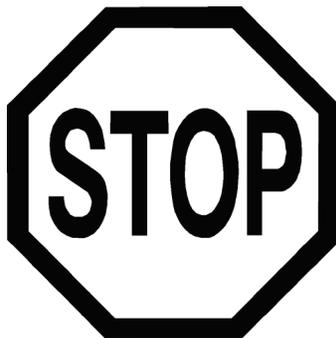
PLEASE WAIT UNTIL INSTRUCTED TO TURN THE PAGE.

Home Finance

Alain's total portioned assessment for his property is $83 750. His municipality uses the following tax rates:

General Municipal: 21.01 mills

Provincial Education: 8.113 mills

Local School: 18.264 mills

Local Improvements: none

Calculate the total property tax that Alain will pay if he receives a provincial tax credit of $700.

Manitoba recently recorded one of the coldest winters on record.

State one energy-efficient improvement a homeowner could make to their home to reduce their heating bill.

Question 3

2 marks Bahari has $40 000 worth of contents he would like to insure. He purchases a comprehensive tenant's insurance policy with a $200 deductible.

Calculate his annual premium.

Annual Premium Table Tenant Package Policy ($500 deductible)		
All Areas		
Coverage Amount	Standard Form	Comprehensive Form
$25,000	$158.00	$200.00
$30,000	$174.00	$226.00
$35,000	$199.00	$252.00
$40,000	$212.00	$269.00
$45,000	$235.00	$298.00
$50,000	$254.00	$324.00
$55,000	$272.00	$346.00
$60,000	$293.00	$373.00
$65,000	$315.00	$400.00
$70,000	$337.00	$427.00
$75,000	$359.00	$454.00
Each additional $1,000	$4.50	$5.50
$200 deductible: increase premium by 10%		

Question 4

State 2 initial (one-time) costs when purchasing a house.

Place one response per line.

1. _____

2. _____

Choose the letter that best completes the statement below.

When calculating property taxes, the cost of local improvements is based on:

A) the area of the city
B) the frontage
C) the square footage of the house
D) the distance from the fire hydrant

Answer: _____

Question 6

Paco earns $3100 monthly and would like to purchase a new house. The monthly mortgage payment will be $797, the monthly heating costs will be $150 and the annual property taxes are $2400.

Calculate Paco's Gross Debt Service Ratio (GDSR).

Question 7

2 marks

Andy is buying a house and needs a mortgage.

State 2 ways he can lower the total interest paid on the mortgage of the house.

Place one response per line.

1. _____

2. _____

Probability

The probability of Jen winning a swimming race is 1 out of 7.

State the probability of winning as a decimal and a percent.

Decimal: _____

Percent: _____

Question 9

2 marks

The following spinner is divided into 4 colours.
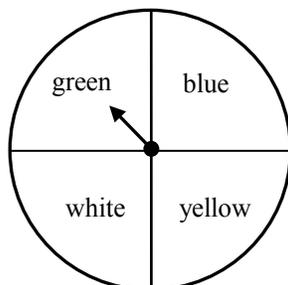
The spinner was spun 40 times and the results are shown in the table below.

Colour	Number of Times
green	16
yellow	11
white	8
blue	5

A) State the experimental probability of spinning white. (1 mark)

B) State the theoretical probability of spinning white. (1 mark)

The probability of a baseball team winning a tournament is 15%.The entry fee is $200. If they win the tournament, the team will receive a cash prize of $1000.

Calculate the expected value (EV).

Question 11

Akuna is the manager of an assembly line that makes compact fluorescent light bulbs. Workers on the assembly line randomly chose 250 light bulbs to test and found 1 defective light bulb.

A) State the experimental probability, in fraction form, of a light bulb being defective. (1 mark)

B) State the number of defective light bulbs that are expected in a shipment of 5000 light bulbs. (1 mark)

The odds **against** hitting a deer on the highway each year are $49 : 1$.

State the probability of hitting a deer this year.

Vehicle Finance

A car has a value of $23 000. It depreciates at a rate of 20% per year.

Calculate the value of the car at the end of 2 years.

Saar wants to buy a new car for $23 500 after taxes. He gets a 4-year loan at an annual interest rate of 6.75%.

A) Calculate the amount of interest paid for the first month. (2 marks)

B) Saar's monthly car payment is $560.01.

Calculate the amount of interest paid over the life of the loan. (2 marks)

Question 15

Jersey wants to buy a used car from her friend, Jack. The price of the car is $7000. She needs to fix a few things on the car.

Repairs	Total Cost
New Tires	$500
Engine Tune-Up	$110

The book value of the car is $5000. She needs to get a lien search worth $18 and a $40 safety inspection before taxes.

Calculate the **total tax** she will pay for this car.

A retired couple drives 500 km each month to go to the dog park, the grocery store, and the mall.

State the type of car insurance policy their agent would recommend.

Question 17

2 marks

Mabon was told by a dealership that his new car would use 5.5 L of fuel for every 100 km driven. In reality, the car is using 8 L of fuel for every 100 km he drives.

Calculate how much more fuel is used than expected if he drives 1500 km.

Choose the letter that best completes the statement below.

Your car insurance premium is **not** affected by:

A) moving to the city from the country
B) changing the amount of deductible
C) being in a demerit position on the Driver Safety Rating scale (DSR)
D) changing the type of insurance

Answer: _____

Question 19

Jonas is purchasing a car. The following table shows the various details of his purchase.

Value of Car	$23 000	Number of Payments	48
Tax	$2990	Amount Borrowed	$22 990
Down Payment	$3000	Cost of Financing	$1840

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

B) Jonas paid a total of $24 830 in monthly car payments.

State the amount he paid each month. (1 mark)

Wilma needs to get one of her car's headlights replaced. The headlight will cost $200. It will take 1.5 hours of labour to replace the headlight at a rate of $90 an hour.

Calculate the total cost, after taxes, of replacing the headlight.

Geometry and Trigonometry

Question 21   2 marks

A community group is building bird houses.
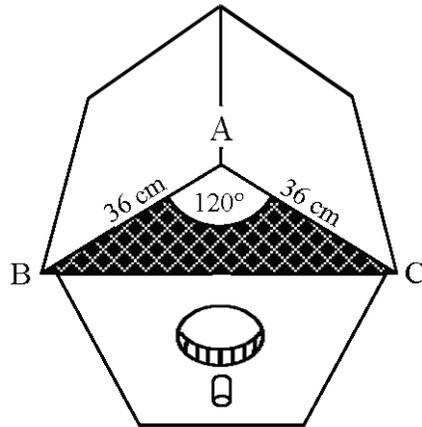
A)   State the type of triangle that is shaded in the diagram. (1 mark)

B)   State the measure of $\angle C$ in triangle ABC. (1 mark)

Bartholomew is solving a math problem involving a truss bridge. The 30 metre bridge is made of 5 equilateral triangles of the same size and has 2 braces as shown in the diagram.
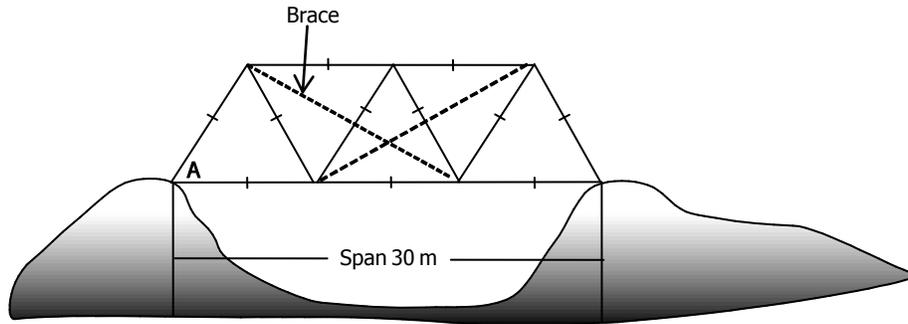
A) State the measure of angle A. (1 mark)

B) Calculate the length of the brace. (2 marks)

Identify which of the following is a property of a kite:

A) the lengths of the opposite sides are congruent

B) opposite angles are congruent

C) diagonals are congruent

D) diagonals intersect at 90°
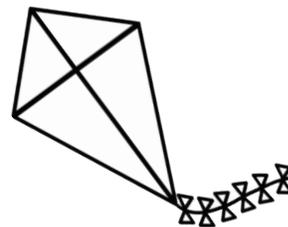
Answer: _____

Abia is measuring the distance a gondola travels between the base and the cabin at the top of the mountain. The angle of elevation from the base to the cabin is 46°. The angle of elevation from Abia to the cabin is 70°.
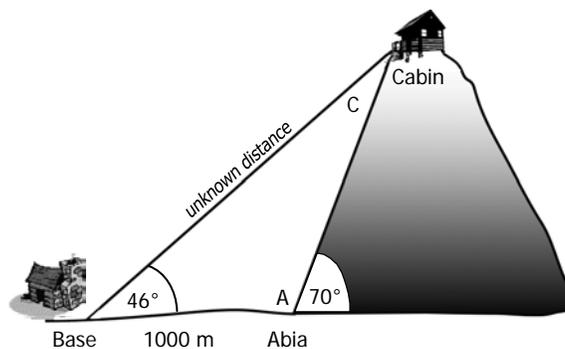
A) Calculate the measures of angle A and angle C. (2 marks)

B) Determine the distance between the base and the cabin if Abia is 1000 m from the base. (3 marks)

Question 25

Identify which of the following diagrams best illustrates an isosceles trapezoid.

A)

B)

C)

D)
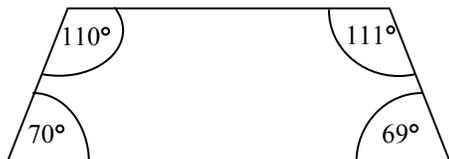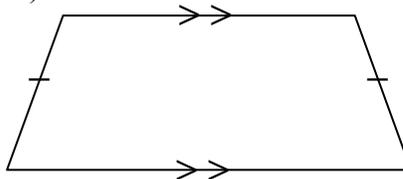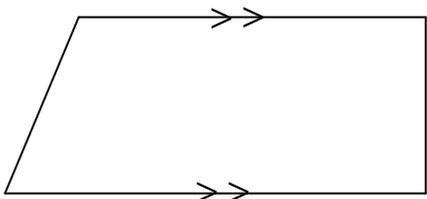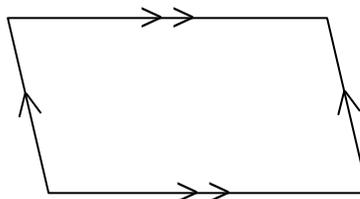
Answer: _____

An engineer is designing a building in the form of a regular polygon that has a central angle of 24°.
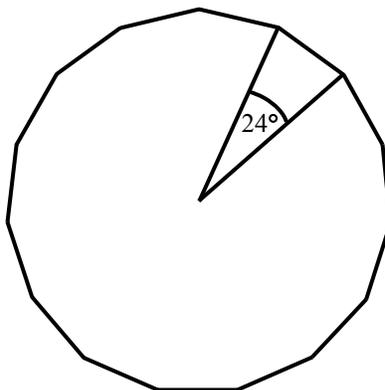
She is using the formula $S = \dfrac{64\,800}{C} - 360°$, where S is the sum of the interior angles of a polygon and C is the central angle of the regular polygon.

State the sum of the interior angles of the polygon.

Precision Measurement

Leanne measures her height to be 168 cm.

State the uncertainty of the measurement.

Do not round the final answer.

Uncertainty: _____

Explain why a pharmacist must use accurate dosages when preparing medications.

Question 29

Given the following measurement:

56.0 ± 0.3 mm

A) State the minimum value. Do not round your final answer. (1 mark)

B) State the tolerance of the measurement. Do not round your final answer. (1 mark)

Three of the four forms of tolerance listed below indicate the same measurement in megahertz.

Choose the form of tolerance that indicates a different measurement.

A) $16 \pm 0.3 \, \text{MHz}$

B) $^{16.3}_{15.7} \, \text{MHz}$

C) $15.7 \, ^{+0.3}_{-0.3} \, \text{MHz}$

D) $15.7 \, ^{+0.6}_{0} \, \text{MHz}$

Answer: _____

The recommended oil capacity of an engine has a maximum volume of 52.5 mL and a minimum volume of 47.5 mL.

State the measurement in the form: nominal value $\pm \dfrac{1}{2}$ (tolerance).

Explain why the tolerance of an oven's temperature needs to be considered when baking a cake for 30 minutes.

State the precision of the oven dial.
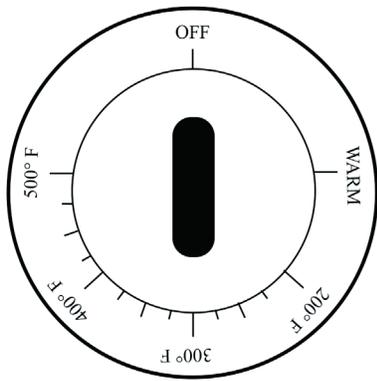
Statistics

Question 34

3 marks

Doug is a welder who is looking for employment. Hourly rates for available jobs are shown in the table below:

$22.50	$29.50	$18.50	$26.75	$26.75	$17.59	$26.75
$26.75	$28.25	$17.50	$24.25	$18.50	$24.00	$26.75

A) State the mean hourly rate. (1 mark)

B) State the mode of the hourly rate. (1 mark)

C) Explain why the mode may be a better indicator than the mean of the hourly rate Doug could expect. (1 mark)

The table below indicates the hours (per week) that each student in a band practices their instrument:

Practice	
Student	**Hours per Week**
Anna	0.25
Beth	2.5
Cassie	3.0
Dave	0.5
Ed	1.5
Fiona	1.25
Gordon	1.75
Hanna	2.0

Calculate Beth's percentile rank for the time she spends practising her instrument.

Choose the letter that best completes the statement below.

Removing a high outlier:

A) increases the mean

B) lowers the mean

C) has no effect on the mean

D) increases the median

Answer: _____

The test results from Jeremy's Statistics course are listed below.

| Test Results | 50% | 65% | 70% | 95% | 40% | 55% |

His final grade in the course will be calculated using a trimmed mean.

Calculate Jeremy's final grade after eliminating his highest and lowest test mark.

Question 38

Megan is taking a Psychology class at university. The table below shows her marks and their corresponding weights.

Category	Average Mark (%)	Weight (%)
Projects	75	10
Assignments	85	30
Tests	73	40
Exam	?	20

Calculate the mark Megan needs on her final exam to receive a final mark of 80%.

Formula Sheet: Essential Mathematics

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

Trigonometric Laws

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

Tax Rates

Federal	Goods and Services Tax (GST)	5%	Provincial	Provincial Sales Tax (PST)	8%

	Taxes on Vehicle Purchases	
	PST	**GST**
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