Grade 12
Essential Mathematics
Achievement Test

Student Booklet

January 2024

Manitoba

Grade 12 Essential Mathematics Achievement Test
Student Booklet (January 2024)

DESCRIPTION

Time Required to Complete the Test: 2 hours

Additional Time Allowed: 30 minutes

This test consists of six parts:

Home Finance	15
Probability	11
Vehicle Finance	18
Geometry and Trigonometry	15
Precision Measurement	8
Statistics	9

Total Possible Marks: **76**

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.

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

  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.

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	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.

STOP

PLEASE WAIT UNTIL INSTRUCTED TO PROCEED.

Home Finance

Question 1

Gary wants to purchase a house. The annual property taxes will be $3405, the monthly heating costs will be $175, and the monthly mortgage payment will be $1160. His gross pay is $4620 per month.

A) Calculate Gary's Gross Debt Service Ratio. (3 marks)

  Show your work.

B) Justify whether Gary's bank will approve his mortgage. (1 mark)

Benoît takes possession of his new house on October 1st. The previous owner paid $2610 in property tax for the entire year.

Calculate Benoît's property tax adjustment for his 3-month portion of the year.

Mary's annual home insurance premium is $823. She adds sewer backup coverage to the policy at a cost of $6.50 per month.

Calculate her total annual insurance cost.

Sheila has been approved for a $200 000 mortgage. The bank offers her a 4% loan for 20 years with a monthly rate of $6.04 per $1000 borrowed.

A)   Calculate Sheila's monthly mortgage payment if she accepts this offer. (1 mark)

B)   Describe two ways that Sheila could reduce her monthly mortgage payment. (2 marks)

Place one response per line.

1._____

2. _____

Describe one benefit of owning a house rather than renting a similar house.

A)   Lars spends $30 per month to light his warehouse with incandescent bulbs. He will save 75% on his electricity bill if he switches to LED bulbs.

Calculate his monthly savings. (1 mark)

B)   The new LED bulbs will cost him $562.50, after taxes.

Calculate how many months it will take for the savings to pay for the bulbs. (1 mark)

Question 7

3 marks

Kari's property has a market value assessment of $250 000.

A) Calculate the portioned assessment for the property if the portion percentage is 45%.
(1 mark)

B) Kari's municipal mill rate is 12.7 mills on the portioned assessment. The education taxes are
$1850 and there is a provincial property tax credit of $700.

Calculate the total amount of property tax Kari must pay. (2 marks)

Show your work.

Probability

Students in a homeroom class must choose one optional course. The following table shows how many students chose each course.

Optional Course	Number of Students
Art	18
Drama	4
Drafting	6

The principal randomly selects one student from the class.

Calculate the experimental probability, as a percent, that this student chose drafting.

A community centre regularly hosts basketball tournaments. The probability that a team wins the tournament is 20%. The tournament entry fee is $150. There is a prize valued at $1200 for the winning team.

Calculate the expected value of participating in the tournament.

Show your work.

The odds **against** purchasing a dress with a defective zipper are $49 : 1$.

State the odds in favour of purchasing a dress with a defective zipper.

Question 11

Randy plays a game using two regular six-sided dice each numbered 1 to 6. The two dice must be rolled at the same time. To win the game, Randy must roll doubles.
(Example: 1 and 1, 2 and 2, ...)

A)   State the theoretical probability, as a fraction, of rolling doubles. (1 mark)

B)   Randy rolls the two dice 5 times. The results are shown below:

	Dice A	Dice B
Roll 1	5	3
Roll 2	6	4
Roll 3	4	4
Roll 4	3	1
Roll 5	2	6

State the experimental probability, as a decimal, of rolling doubles. (1 mark)

Odds represents a comparison between the number of favourable outcomes and the number of unfavourable outcomes.

Explain what probability represents.

A survey of 400 high school students showed that 200 of them have a cell phone.

Identify which of the following answers represents the odds **against** a student having a cell phone.

A) 1 : 1

B) 4 : 2

C) 1 : 2

D) 50%

Answer: _____

In a package of 500 beads, Crystal found 5 broken ones.

A)   State the probability of randomly picking a broken bead from this package. (1 mark)

B)   Calculate how many broken beads Crystal would expect to find in a package of 780 beads based on your answer in Part A. (1 mark)

Vehicle Finance

Explain why the fuel economy of a vehicle is usually better driving on the highway compared to driving in the city.

Martina leases a car. The conditions of the lease are shown below.

Conditions of Lease	
Monthly lease payment (after taxes)	$325
Term	3 years
Sticker price	$20 000
Residual value	60%

A) Calculate the total cost to lease the car for the 3-year term. (1 mark)

B) At the end of the term, Martina decides to buy out the car.

Calculate the cost to buy out the car, after taxes. (2 marks)

Show your work.

Inara has just purchased a new car worth $24 500. She is told the value of the car will depreciate at a rate of 20% after the first year.

Calculate the value of her car after the first year.

Show your work.

Many dealerships require a security deposit when leasing a new car or truck.

Describe one reason why the entire security deposit may not be refunded when returning the leased vehicle.

Question 19

René goes to a garage to get the brake pads of his car replaced. The brake pads will cost a total of $70, before taxes. The garage charges $135 per hour for labour and it will take 1.5 hours to complete.

Calculate the total amount René will pay, after taxes.

Show your work.

Marshall is driving from Winnipeg to Saskatoon, a distance of 780 km. His vehicle uses 70 L of fuel for the trip.

A) Calculate the fuel economy of Marshall's vehicle in L/100 km. (1 mark)

B) Marshall continues on to Edmonton, a distance of 530 km from Saskatoon. The fuel economy of his vehicle remains the same.

Calculate how many litres of fuel his vehicle uses from Saskatoon to Edmonton. (2 marks)

Show your work.

Darius works full time. He uses his vehicle for driving to work, shopping, and going on vacation.

State the type of car insurance he must buy.

Maria buys a used vehicle privately for $14 000, before taxes. The book value of the vehicle is $12 300.

Calculate the total amount Maria will pay for this vehicle, after taxes.

Show your work.

Liane finances the purchase of a new car for $34 500, after taxes. Her monthly payment for the next 4 years will be $779.01.

Calculate the amount of interest Liane will have paid at the end of the 4 years.

Show your work.

Geometry and Trigonometry

The angle measures of a triangle are $30°$, $40°$, and $110°$.

Identify which option best describes this triangle.

A) isosceles and obtuse

B) equilateral

C) scalene and acute

D) scalene and obtuse

Answer: _____

Question 25

Margo stands a loonie (an 11-sided $1 coin) vertically on a table.

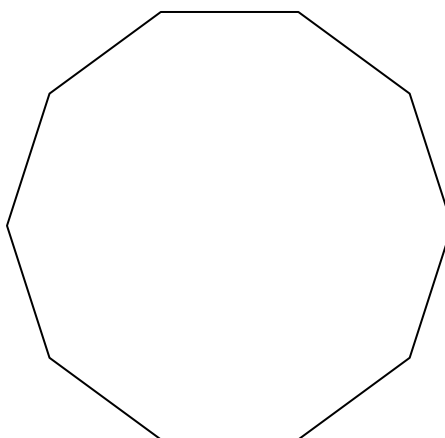Calculate the measure of the angle, *x*, that the coin makes with the table.

Pedro is designing a logo for his company. The logo will feature all diagonals of a regular decagon (10-sided polygon).

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

Show your work.

Identify which of the following quadrilaterals is **not** also a parallelogram.
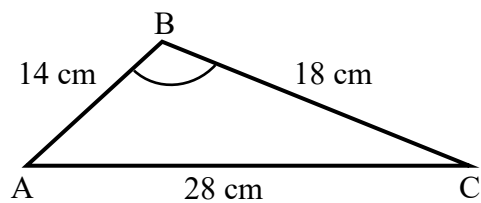
A) square

B) trapezoid

C) rhombus

D) rectangle

Answer: _____

Describe, using words or a labelled diagram, two properties of an isosceles trapezoid.

Jacynth bends a wire into a triangular frame. The triangle has sides that measure 14 cm, 18 cm, and 28 cm.
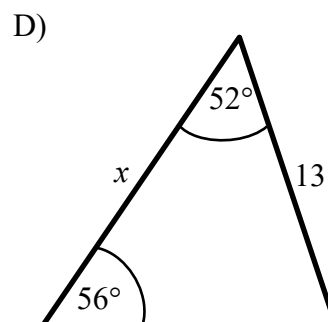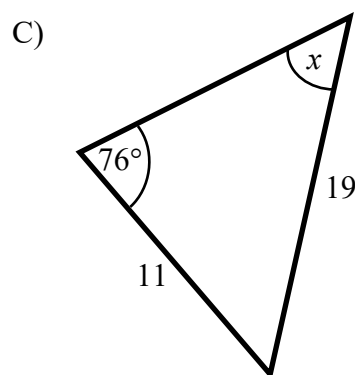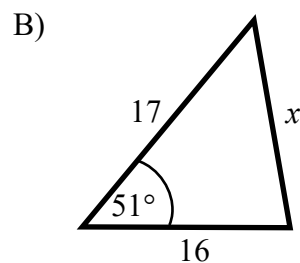
Calculate the measure of $\angle B$.

Show your work.

Identify which of the following triangles will require the cosine law to solve for x.

A)

B)

C)

D)
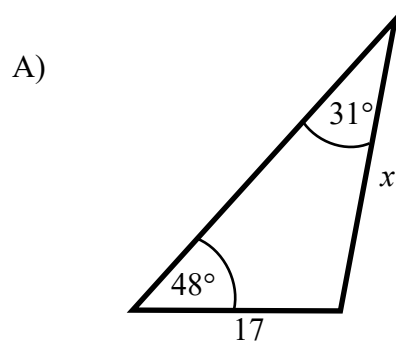
Answer: _____

Calculate the length of side c.

Show your work.

Precision Measurement

Note: Do not round answers in this unit.

Archie wants to buy a piece of fabric 120 inches long. The store uses a measuring device with a precision of 0.5 inches to measure the piece of fabric.

State the maximum length of the measured piece of fabric.

Agnes works in a jewellery store. She must weigh each gold ring very carefully. She weighs a gold ring on two different scales. The weights are shown below.
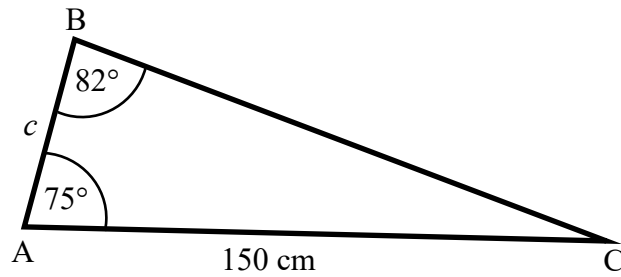
Scale A   Scale B

9.118 g   9.1 g
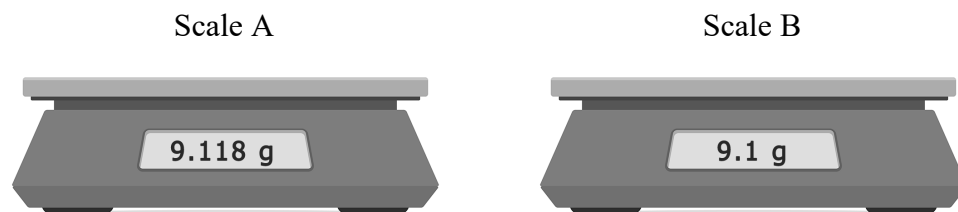
Identify, from the list below, why she should use Scale A.

A) Scale A has a greater tolerance.

B) Scale A has a greater uncertainty.

C) Scale A is more precise.

D) Scale A is more accurate.

Answer: _____

Question 34

2 marks

Given the following measurements: $\begin{array}{l}10.000\,\text{mm}\\9.964\,\text{mm}\end{array}$

A) Calculate the tolerance. (1 mark)

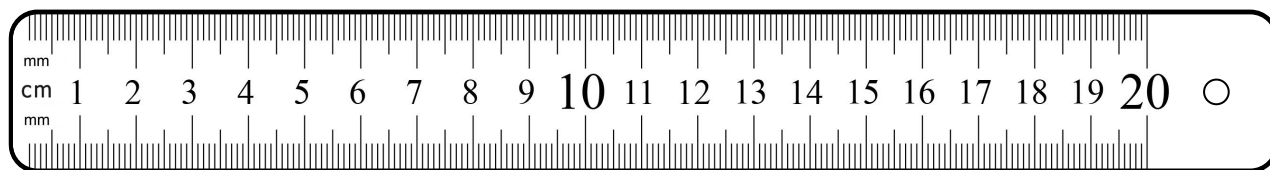B) Calculate the nominal value, if it is the midpoint between the maximum and minimum.
    (1 mark)

Question 35

Fannie is measuring floor tiles for her bathroom. She uses the ruler below:

State the precision of her ruler.

Identify from the list below the difference between accuracy and precision.

A) Accuracy is how close you are to the true value.
   Precision is the range of acceptable measurements.

B) Accuracy is the range of acceptable measurements.
   Precision is how close you are to the true value.

C) Accuracy is the smallest increment you can measure with a device.
   Precision is how close you are to the true value.

D) Accuracy is how close you are to the true value.
   Precision is the smallest increment you can measure with a device.

Answer: _____

Question 37

2 marks

Walter needs to cut a rectangular hole in the wall to install a switch box. The height of the hole must be at least 83 mm and cannot be more than 97 mm. A switch plate is used to cover the hole.
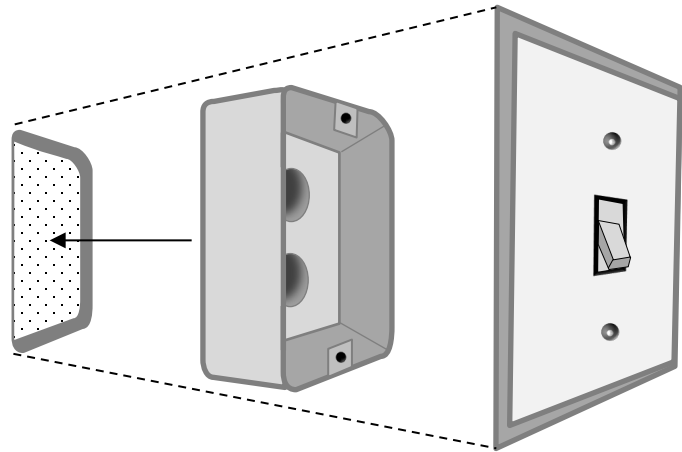
Rectangular Hole   Switch Box   Switch Plate
in Wall

A)   State the height of the rectangular hole in the form: $\text{minimum}\ ^{+\ \text{tolerance}}_{-\ 0}$ (1 mark)

B)   Explain one reason why it is important to stay within the tolerance range when cutting the hole. (1 mark)

Statistics

Explain how a set of data could have no mode.

The table below shows the number of students in a math class and their marks on a quiz.

Marks	50–59%	60–69%	70–79%	80–89%	90–100%
Number of Students	2	6	1	8	4

Jen, the only student who received a mark between 70% and 79%, calculated her percentile rank as follows:

$$PR = \frac{9}{21} \times 100 = 42.86$$

Describe two mistakes she made in her solution.

Question 40

The table below shows the weight, in kilograms, of suitcases on a flight from Flin Flon to Winnipeg.

Weights of Suitcases (kg)					
13	11	15	16	16	18
20	16	50	19	20	17

A) Calculate the median weight. (1 mark)

B) Identify the outlier in the data set. (1 mark)

C) Calculate the trimmed mean by removing the lightest and heaviest weights in the data set. (2 marks)

Show your work.

Question 41

Ms. Lee took a university math course. Her results are shown in the table below.

Results		
Category	**Mark** **(out of 100)**	**Weight**
Test 1	80	40%
Test 2	30	10%
Exam	40	50%

Calculate her final mark using a weighted mean.

Show your work.

No marks will be awarded for work done on this page.

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Formula Sheet: Essential Mathematics

Name of Formula	Formula	Details
Percentile Rank (*PR*)	$PR = \dfrac{b}{n} \times 100$	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	$\text{Tax} = \text{Portioned assessment} \times \dfrac{\text{mill rate}}{1000}$	
Gross Debt Service Ratio (*GDSR*)	$GDSR = \dfrac{\left(\begin{array}{l}\text{Monthly} + \text{Monthly} + \text{Monthly} \\ \text{mortgage} \quad \text{property} \quad \text{heating} \\ \text{payment} \quad\; \text{taxes} \qquad \text{costs}\end{array}\right)}{\text{Gross monthly income}}$	
Fuel Economy in L/100 km (*FE*)	$\dfrac{\text{L}}{100 \text{ km}} = \dfrac{\text{Fuel used in litres}}{\text{Distance travelled in km}}$	
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	$\text{Interior angle} = \dfrac{180°(n-2)}{n}$	n = number of sides
Measure of One Exterior Angle of a Regular Polygon	$\text{Exterior angle} = \dfrac{360°}{n}$	n = number of sides
Central Angle of Regular Polygons (*C*)	$C = \dfrac{360°}{n}$	n = number of sides
Number of Diagonals in a Polygon (*D*)	$D = \dfrac{n(n-3)}{2}$	n = number of sides

Additional formulas on next page. →

		Trigonometric Laws		

Trigonometric Laws

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

Tax Rates

Provincial	Provincial/Retail Sales Tax (PST/RST)	7%	Federal	Goods and Services Tax (GST)	5%

Taxes on Vehicle Purchases

	PST/RST	GST
Buying New	Yes	Yes
Buying Used from a Dealership	Yes	Yes
Buying Used Privately	Yes, calculated on greater of book value or purchase price	No
Safety	No	Yes
Materials and Labour	Yes	Yes
Lien Search	No	No

Note: As of July 1, 2020, PST is no longer added to home insurance.

Note: Provincial sales tax (PST) is also called retail sales tax (RST).