Grade 12
Essential Mathematics
Achievement Test

Student Booklet

June 2024

Manitoba

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Available in alternate formats upon request.

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

DESCRIPTION

Time Required to Complete the Test: 2 hours

Additional Time Allowed: 30 minutes

This test consists of six parts:

Home Finance	16
Precision Measurement	9
Vehicle Finance	18
Probability	11
Geometry and Trigonometry	14
Statistics	10

Total Possible Marks: **78**

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: $\dfrac{15}{29} = 0.52$ 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.

STOP

PLEASE WAIT UNTIL INSTRUCTED TO PROCEED.

Home Finance

Choose the letter that best completes the following statement.

An ongoing cost associated with home ownership is the

A)   land survey

B)   property tax adjustment

C)   home insurance premium

D)   land transfer tax

Answer: _____

Calculate the annual home insurance premium, before taxes, for the following situation:

- Value of home: $185 000
- Area 3
- Comprehensive policy
- $200 deductible

Use the *Manitoba Homeowner's Insurance Rates* table on the following page.

Show your work.

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	438
$ 85 000	318	333	226	249	313	344	416	462
$ 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%

Manitoba no longer charges sales tax on home insurance premiums.

Describe one energy efficient option that will reduce a homeowner's energy bill.

Michael is purchasing a property valued at $245 000. The table below shows the land transfer tax to be paid for the first $200 000.

Land Transfer Tax Table		
Value of Property	**Rate**	**Tax Amount**
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%	$750
On amounts in excess of $200 000	2.0%	
Total Land Transfer Tax Due		

Calculate the total land transfer tax due for this property.

Show your work.

Choose the letter that best completes the following statement.

One advantage of purchasing a house rather than renting a similar house is that

A)   homeowners need a smaller down payment than tenants

B)   homeowners pay less for home insurance than tenants

C)   homeowners have more freedom to relocate than tenants

D)   homeowners have more freedom to renovate than tenants

Answer: _____

A couple is buying a house for $297 000. They make a $30 000 down payment and obtain a mortgage for the remaining amount. The monthly amortization rate is $10.11 per thousand dollars borrowed.

Calculate their monthly mortgage payment.

Show your work.

Describe one way to reduce the amount of interest paid over the life of a mortgage.

The monthly mortgage payment for a house is $1846, the annual property taxes are $2800, the monthly heating cost is $180, and the gross monthly income of the purchasers is $6000.

Calculate the Gross Debt Service Ratio.

Show your work.

Calculate the total amount of property tax to be paid for the following situation:

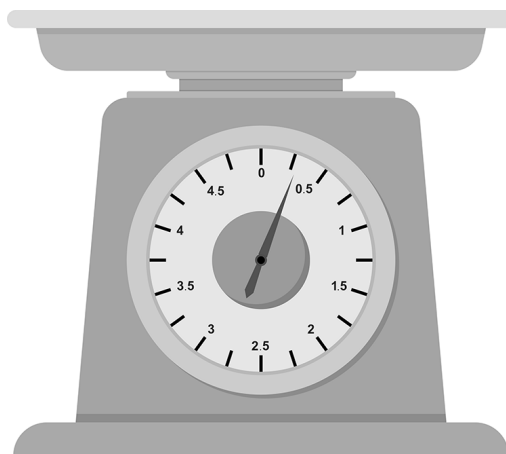| Portioned assessment	$182 000
Municipal mill rate	13.2 mills
Education taxes	$2145
Frontage	110 ft.
Local improvement cost	$4.05/ft.
Property tax credit	$700

Show your work.

Precision Measurement

Note: Do not round answers in this unit.

Janalee is baking a cake. Before measuring the ingredients, she notices that her scale is not correctly calibrated.

Choose the letter that best completes the statement below.

The aspect of measurement most affected is

A) accuracy

B) precision

C) tolerance

D) uncertainty

Answer: _____

State the precision of the clock shown below.

Question 12

2 marks

The thermometer of Genevieve's oven has a precision of 5°F.

A) State the uncertainty of the thermometer. (1 mark)

B) Genevieve needs to preheat her oven to 375°F.

State the maximum possible temperature of the oven at this setting. (1 mark)

Question 13

A) State the minimum value of 8 ft. $\pm\, 0.5$ ft. (1 mark)

minimum value: _____

B) State the maximum value of 30 cm $^{+0\ \text{cm}}_{-1\ \text{cm}}$. (1 mark)

maximum value: _____

C) State the nominal value as a midpoint of $\begin{array}{c} 19.5 \text{ in.} \\ 17.5 \text{ in.} \end{array}$. (1 mark)

nominal value as a midpoint: _____

State the range of acceptable measurements for the following form of tolerance.

$$2.6 \text{ mm} \; {}^{+0.3 \text{ mm}}_{-0.2 \text{ mm}}$$

Choose the letter that best completes the statement below.

When given a measurement in the form "nominal value $\pm\frac{1}{2}$ tolerance", the measurement must never be

A) less than the nominal value

B) greater than the nominal value

C) less than the maximum

D) greater than the maximum

Answer: _____

Vehicle Finance

Ricardo needs to get a new vehicle. He drives long distances for work and family activities.

Justify why Ricardo should buy rather than lease a vehicle based on this information.

Question 17

2 marks

Jen is buying a new vehicle from a dealership for $26 400. The dealership has agreed to accept Jen's old vehicle with a trade-in value of $7400.

Calculate the amount she will pay for the new vehicle, after taxes.

Show your work.

Question 18

Jacques is buying a used car privately for $16 500. The book value of the car is $15 400.

Calculate the amount Jacques will pay for the car, after taxes.

Show your work.

Paula states the following:

> "If you are involved in an accident, your car insurance premium and/or driver's license costs will increase."

Explain whether Paula is correct.

Suni takes his car to a garage for repairs. The details of the work done are shown below:

Parts: Labour:
    Fan belt $85   3.25 hours at $95 per hour
    Radiator $158

Calculate the total amount Suni will pay for these repairs, after taxes.

Show your work.

Question 21

3 marks

Nick owns a hybrid vehicle. The fuel economy of his vehicle is 4.6 L/100 km.

A) Calculate the amount of fuel Nick's vehicle will use if he plans to travel 2475 km during his summer vacation. (2 marks)

Show your work.

B) Nick spends $182.17 on fuel while on vacation.

Calculate the cost of fuel per litre. (1 mark)

Question 22

4 marks

Sadie is leasing a vehicle for $179 per month, after taxes. The term of the lease is for three years, and Sadie must pay $2100 at the time of signing the lease.

A) Calculate the total amount Sadie will have paid to lease the vehicle after three years. (2 marks)

Show your work.

B) Sadie decides to buy the vehicle at the end of her lease. The buyout price is $8000, after taxes.

State the total amount that Sadie paid to lease, and now buy this vehicle. (1 mark)

C) The original purchase price of the vehicle was $15 000, after taxes.

Justify whether Sadie made a good decision to lease, and then buy this vehicle. (1 mark)

A vehicle is worth $37 650. The vehicle's value depreciates at a rate of 20% per year.

Calculate the value of the vehicle at the end of the second year.

Show your work.

Probability

The odds of winning a race are $1:3$.

State the probability of winning this race.

Probability represents a comparison between the number of favourable outcomes and the total number of outcomes.

Explain what odds represents.

Question 26

"Pop the Balloon" is a carnival game that involves popping a balloon with a dart. There are 50 balloons taped to a wall, each with a coloured piece of paper inside. It costs $1 to play and the prizes are listed in the table below.

Pop the Balloon		
Colour of Paper Inside of the Balloon	Number of Balloons (Out of 50)	Prize Value per Balloon
Red	12	$5
Blue	18	$3
White	20	$0

A) Calculate the expected value of this game from a player's perspective. (3 marks)

Show your work.

B) Justify whether the carnival should continue to offer this game based on your answer in Part A. (1 mark)

Melissa is planning a trip to the beach.

This week's weather forecast is shown in the table below:

	Day 1	Day 2	Day 3	Day 4	Day 5
Probability of Rain	10%	35%	10%	90%	20%
Temperature	20ºC	18ºC	25ºC	25ºC	21ºC

Explain which day Melissa should plan to go to the beach, using the given probabilities.

Shawn says the probability of catching a fish is 60%.

Choose from the letters below the statement that is correct.

A)   The probability of not catching a fish is 3 out of 5.

B)   The odds for catching a fish are $3:2$.

C)   The odds for catching a fish are $2:3$.

D)   The odds against catching a fish are $3:2$.

Answer: _____

Darian says the probability of an event occurring is 150%.

Explain why Darian is incorrect.

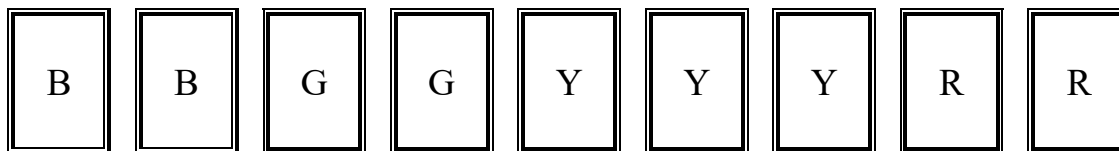# Question 30

2 marks

A set of 40 cards contains 10 red cards, 10 blue cards, 10 green cards, and 10 yellow cards.

Lindsay pulled 9 cards as shown below:

| B | B | G | G | Y | Y | Y | R | R |

A) State the theoretical probability of pulling a red card. (1 mark)

B) State the experimental probability of pulling a blue card. (1 mark)

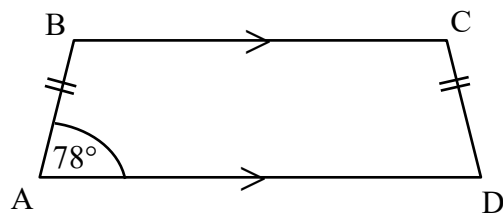# Geometry and Trigonometry

The diagram below shows an isosceles trapezoid.

A) State the measure of ∠D. (1 mark)

B) State the measure of ∠B. (1 mark)

A) Calculate the measure of one interior angle in a regular hexagon. (2 marks)

   Show your work.
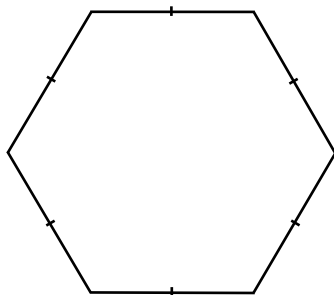
B) Calculate the measure of one central angle in a regular hexagon. (1 mark)
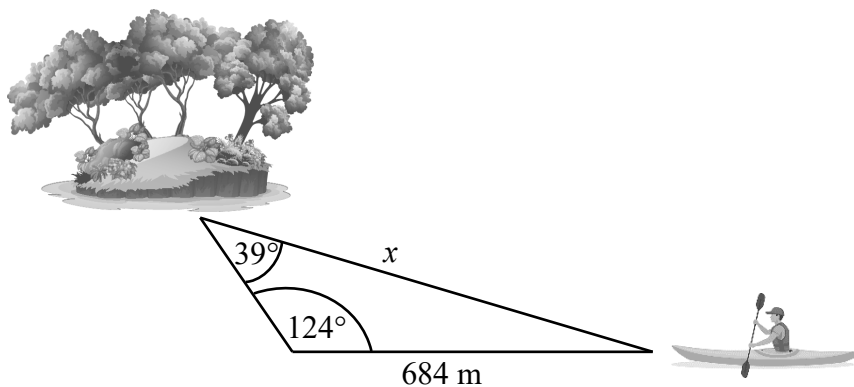
Question 33

2 marks

A) Describe one reason why all rectangles are parallelograms. (1 mark)

B) Describe one reason why not all parallelograms are rectangles. (1 mark)

James is kayaking to an island.

Calculate x, the distance James will travel if he kayaks to the island.

Show your work.

Choose the letter that best completes the following statement.

Isosceles triangles have

A)   all side lengths equal

B)   two equal side lengths

C)   no equal side lengths

D)   three equal angles

Answer: _____

Calculate the measure of $\angle A$.
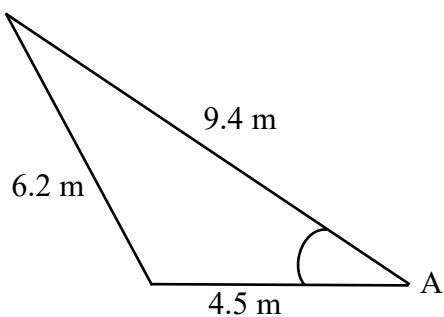
Show your work.

Statistics

A class of 10 students was surveyed. The students were asked how many hours per week they spend doing homework.

The survey results, in hours, are shown below:

2	6	3	4	3.5	2.5	8	4	5.5	1.5

State the median.

Question 38

3 marks

The table below shows the number of cars sold by a salesperson for the first six months of the year.

Month	Number of cars sold
January	4
February	10
March	18
April	20
May	32
June	12

A) Calculate the mean number of cars sold per month. (1 mark)

B) Calculate the trimmed mean by removing the highest and lowest number of cars sold. (2 marks)

Show your work.

Question 39

2 marks

Juan is 1.7 m tall. He is taller than 45 other students in his grade. Including Juan, there are 60 students in total.

A) Calculate Juan's percentile rank. (1 mark)

B) State the percentage of students in Juan's grade that are 1.7 m or taller. (1 mark)

Nina wants a mean score of 80% on her math quizzes. There are five quizzes in total and her marks, as a percent, for the first four quizzes are shown below:

Quiz	Percent (%)
1	73
2	90
3	95
4	70
5	x

Calculate the percent Nina needs on Quiz 5 to make sure her mean quiz score is 80%.

Show your work.

Question 41

Marisse took an art class. Her final mark is calculated according to the categories shown below:

Category	Weight	Mark (out of 100)
Paintings	30%	76
Photography	20%	92
3D Animations	10%	68
Drawings	40%	90

Calculate Marisse's final mark by using a weighted mean.

Show your work.

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

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

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 ($GDSR$)	$GDSR = \dfrac{\left(\begin{array}{ccc}\text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{mortgage} + \text{property} + & \text{heating} \\ \text{payment} & \text{taxes} & \text{costs}\end{array}\right)}{\text{Gross monthly income}}$	
Fuel Economy in L/100 km (FE)	$\dfrac{\text{L}}{100 \text{ km}} = \dfrac{\text{Fuel used in litres}}{\text{Distance travelled in km}}$	
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

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

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).