

Resource: Released Questions



Grade 9 Assessment of Mathematics

November 2023

Mathematics



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This resource is provided to support educators with the EQAO Grade 9 Assessment of Mathematics. Each question on the assessment is mapped to a category of knowledge and skills and an overall and a specific expectation in *The Ontario Curriculum, Grade 9: Mathematics (2021)*. This resource includes the definitions of the categories of knowledge and skills as well as examples of adapted assessment questions. Detailed information about each question, including the overall expectation and category of knowledge and skills to which the question is mapped, and the correct answer, are provided. For more information about the assessment design, refer to the *Framework* at www.eqao.com.

DETAILS OF THE ASSESSMENT

The EQAO Grade 9 Assessment of Mathematics is an online assessment completed by students at the end of the Grade 9 mathematics course. The assessment uses a multi-stage computer adaptive testing model that adapts to the individual student's performance as the student progresses through the stages of the assessment (e.g., based on a student's performance in Stage 1, the student will be routed to a set of questions that is overall easier or more difficult in Stage 2). Though students are routed to different question sets, outcomes are put on the same scale, and overall levels of achievement are comparable.

The EQAO Grade 9 Assessment of Mathematics assesses the knowledge and skills that are defined in the expectations found in *The Ontario Curriculum, Grade 9: Mathematics* (2021). The questions assess students' knowledge and skills in the strands:

- Number
- Algebra
- Data
- Geometry and Measurement
- Financial Literacy

Although the assessment does not measure the content in the Mathematical Thinking and Making Connections strand, students will be required to apply mathematical processes while completing the assessment. The assessment does not measure the content in the Social-Emotional Learning (SEL) Skills in Mathematics strand.

Each question on the assessment is mapped to an overall and a specific curriculum expectation. Each question is also mapped to one of these categories of knowledge and skills:

- Knowledge and Understanding (**KU**)
- Application (**AP**)
- Thinking (**TH**)

Questions in the mathematics assessment do not assess the Communication category of knowledge and skills.

During each stage of the assessment, students complete questions mapped to each category of knowledge and skills assessed. The category assigned to each question assumes that students have been taught the knowledge and skills outlined in the Grade 9 mathematics curriculum, as the EQAO assessment is completed near the end of the Grade 9 mathematics course.

Regardless of how students are routed as they progress through the stages of the assessment, students complete the same number of questions from each of the various strands assessed, as the assessment follows a blueprint. The blueprint, which can be found in the *Framework*, defines how many questions a student will complete from each strand. This makes the assessment comparable from year to year. (For more information, see www.eqao.com.)

RESULTS REPORTED

The EQAO Grade 9 Assessment of Mathematics is a standards-referenced large-scale assessment based on the expectations and standards (levels of achievement) for student proficiency in *The Ontario Curriculum*. EQAO reports an overall level of achievement in mathematics for each student. EQAO does not provide scores by strand or by category of knowledge and skills at the student level, as each student does not complete enough questions mapped to each strand or skill to report on each accurately. However, through the EQAO secure reporting tool, the agency provides reports by strand and skill at the school, board and provincial levels for schools and boards to use for improvement planning.

DEFINITIONS OF THE CATEGORIES OF KNOWLEDGE AND SKILLS

EQAO has adapted the definitions of the three categories below from the achievement chart for mathematics found in the Ontario mathematics curriculum. This section outlines the definitions EQAO uses to determine the category for each question on the assessment. An example is provided for each category.

Knowledge and Understanding

A question is mapped to Knowledge and Understanding if in order to answer the question students must demonstrate only

- subject-specific content (knowledge) and/or
- comprehension of its meaning and significance (understanding).

These questions assess basic knowledge and/or understanding of concepts.

Example

This table of values shows information about the linear relationship between the cost of an activity and the number of people participating.

Number of people	Cost of activity (\$)
0	50
1	70
2	90

Which statement about this table of values is true?

- A** The initial cost is \$50.
- B** The initial cost is \$70.
- C** The cost per person is \$50.
- D** The cost per person is \$70.

Correct answer: **A**

To answer this question, students need to select the correct statement. They can identify the initial cost directly from the table of values and do not need to select a tool to determine the answer.

Application

A question is mapped to Application if in order to answer the question students must either

- select the appropriate tool or
- get the necessary information and “fit” it to the problem.

The category that a question is mapped to may change from Knowledge and Understanding to Application if a context is added or if a tool required to answer the question is not provided.

Example

This table of values shows information about the linear relationship between the cost of an activity and the number of people participating.

Number of people	Cost of activity (\$)
0	50
10	250
20	450

What is the cost per person for this activity?

- A** \$20
- B** \$50
- C** \$200
- D** \$250

Correct answer: **A**

Students must select the tool they will use as they need to determine the rate of change. This could be done through a variety of strategies using the information in the table of values.

Thinking

A question is mapped to Thinking if in order to answer the question students must either

- select and sequence a variety of tools or
- demonstrate a critical thinking process (e.g., reasoning).

Students may need to make a plan to answer these questions.

Example

This table of values shows information about the linear relationship between the cost of an activity and the number of people participating.

Number of people	Cost of activity (\$)
10	250
20	450
40	850

If the total cost for the activity is \$750, how many people participate?

- A** 25 people
- B** 30 people
- C** 35 people
- D** 37 people

Correct answer: **C**

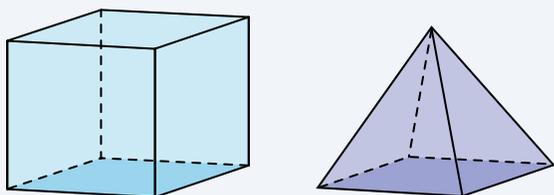
Students need to make a plan to answer this question. They may first determine the rate of change and the initial value using the information in the table of values and then use those two values to determine the answer. There are multiple ways to solve this question.

IMPACT OF ANSWER OPTIONS

When two questions are similar in content, the answer options can affect the category of knowledge and skills to which the question is mapped. Consider these two versions.

Version 1

This cube and pyramid have the same height and base area.



Complete the following statement.

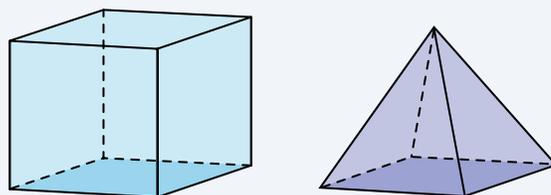
The volume of the cube is _____ [the same as, two times larger than, three times larger than, three times smaller than] the volume of the pyramid.

Correct answer: **three times larger than**

This question is mapped to the **Knowledge and Understanding** category. In the curriculum students learn about the relationships between the volume of prisms and pyramids with the same height and base area. Students state the relationship between the volume of these two objects.

Version 2

This cube and pyramid have the same height and base area.



The volume of the pyramid is 12 cm^3 .

What is the volume of the cube?

- A 4 cm^3
- B 6 cm^3
- C 24 cm^3
- D 36 cm^3

Correct answer: **D**

In the curriculum students learn about the relationships between the volume of prisms and pyramids with the same height and base area. Students must use the relationship between the volume of these two objects to determine the volume of the cube given the volume of the pyramid. Therefore, this question is mapped to **Application**, as the tool is not given.

SUGGESTED USES FOR THIS RESOURCE

Here is a suggested list of how the example questions can be used in the classroom:



Use questions without including the answer options. Students can answer the question and then discuss the steps required and other possible answers, including those arrived at through common errors or misconceptions. Discuss whether there are multiple methods that can be used to answer the question. Students can then compare their answer to the given options.



Use technology in the classroom to have students record answers instantly, which will allow for discussion of correct answers and the common errors or misconceptions associated with the incorrect options. The discussion can lead to a deeper understanding of concepts and assist students in correcting their own misconceptions.



Use questions as part of a pre- and post-assessment on a topic to show students their improved understanding within a unit.



Use questions when spiralling as a method to revisit topics.



Encourage students to use manipulatives, and model how to use them effectively. For example, graphing applications can be used with questions mapped to expectations in the Algebra strand as well as those mapped to other strands, such as Data, or Geometry and Measurement.

QUESTIONS

These questions were adapted from the EQAO Grade 9 Assessment of Mathematics for use in the classroom. This section provides the overall expectation and the category of knowledge and skills for each question.

B. NUMBER

B1. Development of Numbers and Number Sets

demonstrate an understanding of the development and use of numbers, and make connections between sets of numbers

1 How many real numbers are between 0 and 10?

KU

A an infinite number

B 9

C 10

D 100

2 Which statement about rational numbers is correct?

AP

A A rational number is always positive.

B A rational number can be written as a fraction.

C The square root of any number is a rational number.

D A rational number in its decimal form is a non-ending, non-repeating decimal.

3 Set C and Set D are given.

TH

Set C = {3, 6, 9, 12,...}

Set D is the set of integers that are multiples of 5.

Select the statement that correctly describes the numbers that are common to **both** Set C and Set D.

A The common numbers are always divisible by 9.

B The common numbers are always multiples of 15.

C The common numbers are always odd numbers.

D There are no common numbers between Set C and Set D.

B2. Powers

represent numbers in various ways, evaluate powers, and simplify expressions by using the relationships between powers and their exponents

4 Which value is equivalent to 3.5×10^5 ?

KU

A 350

B 35 000

C 350 000

D 3 500 000

5 An equation is shown.

AP

$$\frac{(x^6y^3)(x^{\square}y^8)}{x^3y^4} = x^{12}y^{\triangle}$$

Select the values that make this equation true:

$\square =$ _____ [6, 7, 9] and $\triangle =$ _____ [6, 7, 9].

6 Select the expression that has the value that is the least.

TH

A $\frac{1}{4} \left(\frac{4^3}{4^4} \right)^2$

B $\frac{1}{2} \left(\frac{4^3}{4^4} \right)^2$

C $\frac{1}{2} \left(\frac{4^3}{4^4} \right)$

D $\frac{1}{4} \left(\frac{4^3}{4^4} \right)^2$

B3. Number Sense and Operations

apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems

- 7** Which rational number is equivalent to $-\frac{5}{6}$?
KU

A

B

C

D

- 8** The temperature is measured five times.
AP

The first temperature measured is 7°C .
The temperature goes down by 13°C , up by 4°C , down by 9°C , and then up by 1°C .

What is the final temperature measured?

A

B

C

D

- 9** There are 42 students:

- TH
- $\frac{6}{7}$ of the students are members of a school club;
 - $\frac{1}{4}$ of the students who are members of a school club are members of the school environmental club.

How many of these students are members of a school club but are **not** members of the school environmental club?

A

B

C

D

C. ALGEBRA

C1. Algebraic Expressions and Equations

demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations

10 What is a simplified form of this expression?

KU $-3x(4x^2 - 5)$

A $-12x^2 - 15x$

B $-12x^3 - 5$

C $-12x^2 + 15$

D $-12x^3 + 15x$

11 For each expression, select the appropriate choice.

AP

	Equivalent to $4n - 2$	Equivalent to $4n - 8$
$(3n - 4) + (n + 2)$	<input type="checkbox"/>	<input type="checkbox"/>
$4(n - 2)$	<input type="checkbox"/>	<input type="checkbox"/>
$(5n + 6) - (n + 8)$	<input type="checkbox"/>	<input type="checkbox"/>

12 There are a total of 90 red and yellow tiles.

TH There are 5 times as many red tiles as yellow tiles.

How many red tiles are there?

A 15 tiles

B 18 tiles

C 72 tiles

D 75 tiles

C2. Coding

apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands

- 13** When creating pseudocode, Suchen uses this expression.
KU

distance > (8 * **minutes** + 15)

What is **distance** an example of in this pseudocode?

A a variable

B an equation

C a constant

D an inequality

- 14** This pseudocode is used to determine the value of a variable in an equation.
AP

variableB = 0

variableC = 0

output "Enter the value of variable B."

store input as **variableB**

output "Enter the value of variable C."

store input as **variableC**

variableA = ((5 * **variableC**) – **variableB**)/4

output "The value of variable A is ", **variableA**, "."

What is the value of **variableA** if the program is run and 2 is entered for **variableB** and 6 is entered for **variableC**?

A 1

B 2.25

C 7

D 7.5

C2. Coding (continued)

15 Pseudocode is written to determine if a given point is **above** the line $y = -4x + 12$.
TH

Select the correct parts of the code to complete this pseudocode.

```
rateOfChange = -4
initialValue = 12
output "Enter the x-coordinate of the point."
store user input as xInput
output "Enter the y-coordinate of the point."
store user input as yInput
yValue = _____ * xInput + _____
if _____
    output "The point is above the line."
else
    output "The point is not above the line."
```

A initialValue

B rateOfChange

C yInput

D yInput = yValue

E yInput < yValue

F yInput > yValue

C3. Application of Relations

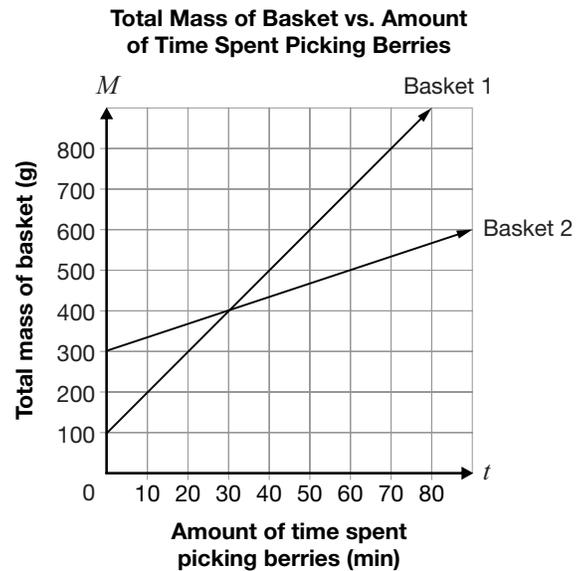
represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions

- 16** **KU** The equation $H = 5 + 1.5t$ represents the relationship between the height of a plant, H , in centimetres, and time, t , in days.

Which statement is true?

- A The initial height of the plant is 1.5 cm.
- B The initial height of the plant is 5 cm.
- C The height of the plant increases 5 cm each day.
- D The height of the plant increases 6.5 cm each day.

- 17** **AP** This graph shows the relationship between the total mass of a basket, in grams, and the amount of time spent picking berries, in minutes, for two baskets.

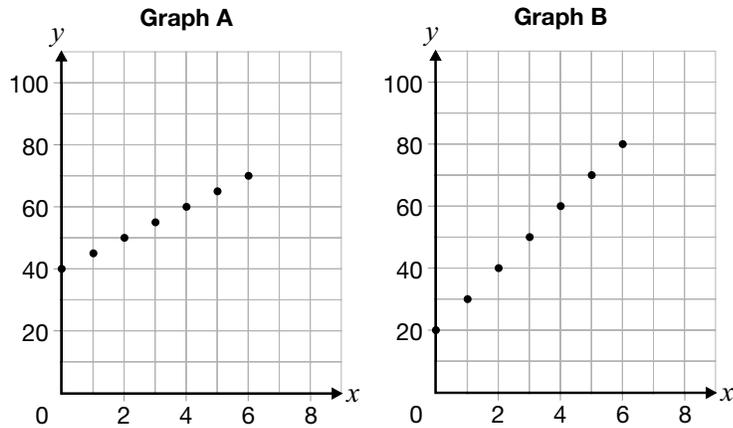


Which statement is true about the graph?

- A The initial mass of Basket 1 is 200 g more than the initial mass of Basket 2.
- B At 30 minutes, the total mass of Basket 1 and that of Basket 2 are the same.
- C The total mass of Basket 1 will always be greater than the total mass of Basket 2.
- D At 30 minutes, the difference between the total mass of Basket 1 and that of Basket 2 is 200 g.

C3. Application of Relations (continued)

18 Information about two linear relationships is shown on these graphs.



Select the options that correctly complete these statements.

The rate of change of Graph A is _____ [greater than, less than, the same as] the rate of change of Graph B.

The initial value for Graph A is _____ [greater than, less than, the same as] the initial value for Graph B.

At $x = 10$, Graph A has a y -value that is _____ [greater than, less than, the same as] the y -value in Graph B.

C4. Characteristics of Relations

demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate

- 19** This table of values shows the relationship between the total rental cost of a bicycle, C , in dollars, and time, t , in hours.

KU

Time, t (h)	Total rental cost, C (\$)
0	30.00
1	37.50
2	45.00
3	52.50

Which equation represents this relationship?

A $C = 30t$

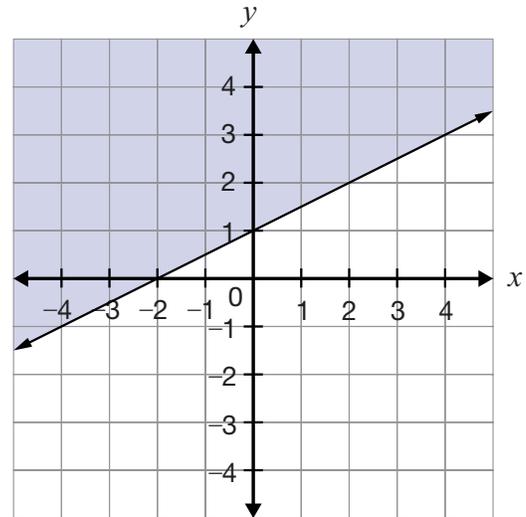
B $C = 30t + 7.5$

C $C = 7.5t$

D $C = 7.5t + 30$

- 20** Which inequality corresponds to this graph?

AP



A $2x - y \leq -2$

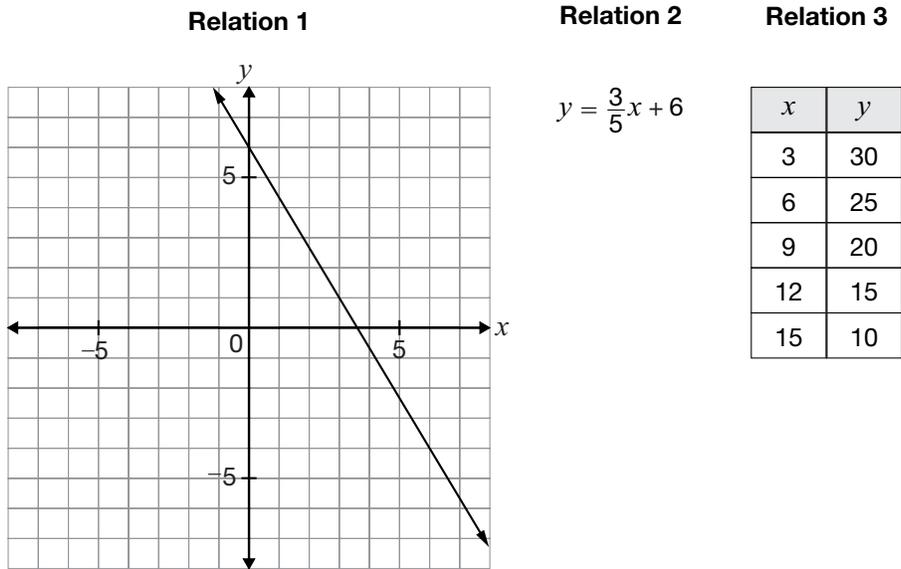
B $2x + y \leq -2$

C $x - 2y \leq -2$

D $x + 2y \leq -2$

C4. Characteristics of Relations (continued)

21 Information about three different linear relations is given.
TH



Which statement about the relations is true?

- A

Relation 1 and Relation 3 have the same slope, while Relation 2 and Relation 3 have different y -intercepts.
- B

Relation 1 and Relation 2 have the same y -intercept, while Relation 1 and Relation 3 have different slopes.
- C

Relation 2 and Relation 3 have the same slope, while Relation 1 and Relation 2 have different slopes.
- D

Relation 1 and Relation 2 have the same y -intercept, while Relation 1 and Relation 3 have the same y -intercept.

D. DATA

D1. Collection, Representation, and Analysis of Data

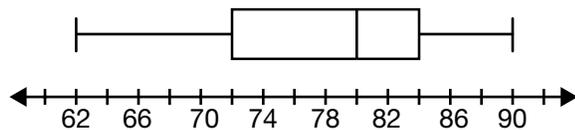
describe the collection and use of data, and represent and analyse data involving one and two variables

- 22** **KU** A correlation coefficient, r , represents the strength of a linear relationship between two variables.

Which option represents the strongest negative linear correlation?

- A $r = -0.95$
- B $r = 1.0$
- C $r = -0.05$
- D $r = 0$

- 23** **AP** This box plot represents the score out of 90 received by students on a driver's education exam.



Driver's education exam score (out of 90)

75% of students pass the exam.

What is the minimum score needed to pass the exam?

- A 62
- B 72
- C 80
- D 84

- 24** **TH** A bag contains 5 tomatoes that each have a different mass. The mean and median masses of the tomatoes are determined.

The tomato with the smallest mass is replaced with a tomato that has a larger mass than the other tomatoes.

How will the new mean and new median masses of the 5 tomatoes be different after the tomato is replaced?

- A The new mean mass and the new median mass are both greater.
- B The new mean mass and the new median mass are both less.
- C The new mean mass is greater, and the new median mass is less.
- D The new mean mass is less, and the new median mass is greater.

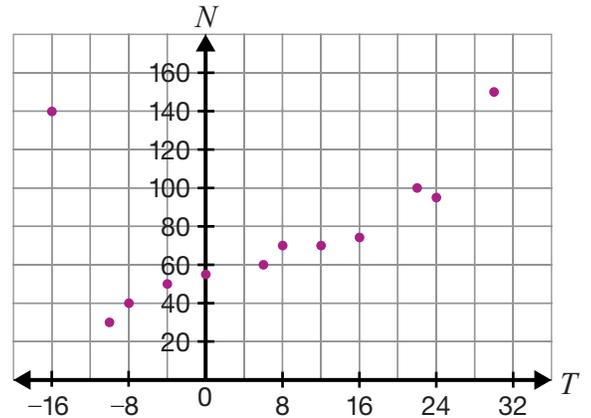
D2. Mathematical Modelling

apply the process of mathematical modelling, using data and mathematical concepts from other strands, to represent, analyse, make predictions, and provide insight into real-life situations

- 25** Select the option that does **not** require the use of mathematical modelling.
KU

- A analyzing real-life situations
- B representing real-life situations
- C predicting the outcome of real-life situations
- D giving solutions to real-life situations

- 26** This scatter plot represents the relationship between the number of drinks sold, N , in a store and the outdoor temperature, T , in degrees Celsius, at lunchtime.
AP



Select the **TWO** statements about this scatter plot that are true.

- A The data point $(-16, 140)$ is an outlier.
- B The number of drinks sold does not depend on the outdoor temperature at lunchtime.
- C There is a positive correlation between the outdoor temperature at lunchtime and the number of drinks sold.
- D There is a negative correlation between the outdoor temperature at lunchtime and the number of drinks sold.

D2. Mathematical Modelling (continued)

27 The results of a survey of 80 students are shown.

TH

	Students who like broccoli	Students who do not like broccoli
Students who like carrots	42	18
Students who do not like carrots	?	9

Which statement is correct based on the data?

- A 60% of students like carrots.
- B Most students who like carrots don't like broccoli.
- C 14% of students like broccoli but do not like carrots.
- D More students like broccoli than like carrots.

E. GEOMETRY AND MEASUREMENT

E1. Geometric and Measurement Relationships

demonstrate an understanding of the development and use of geometric and measurement relationships, and apply these relationships to solve problems, including problems involving real-life situations

28 A frame is in the shape of a rectangle.

KU

A second rectangular frame has triple the length and one third of the width of the first frame.

Complete this statement.

The area of the second frame is _____ the area of the first frame.

A the same as

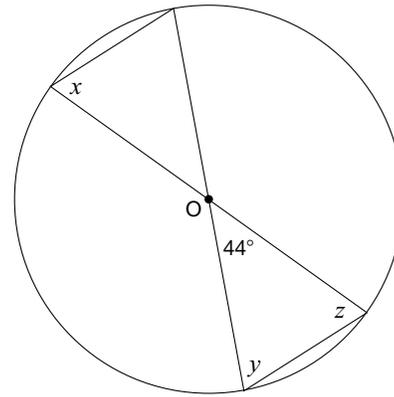
B half the size of

C three times the size of

D six times the size of

29 What are the values of x , y and z ?

AP



A $x = 44^\circ$, $y = 44^\circ$, $z = 44^\circ$

B $x = 44^\circ$, $y = 92^\circ$, $z = 44^\circ$

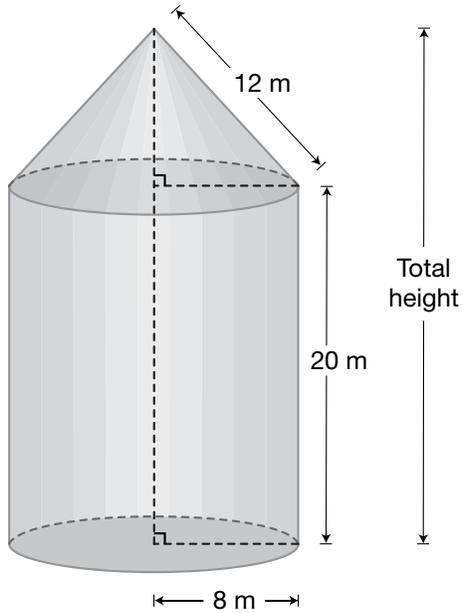
C $x = 68^\circ$, $y = 68^\circ$, $z = 68^\circ$

D $x = 44^\circ$, $y = 68^\circ$, $z = 68^\circ$

E1. Geometric and Measurement Relationships (continued)

30 The dimensions of a silo are given.

TH



Hint: Use the side-length relationship for right triangles, $a^2 + b^2 = c^2$.

Which value is closest to the **total** height of the silo?

A 24 m

B 29 m

C 32 m

D 34 m

F. FINANCIAL LITERACY

F1. Financial Decisions

demonstrate the knowledge and skills needed to make informed financial decisions

- 31** A person creates a monthly budget and determines the monthly income will be \$2800.
KU

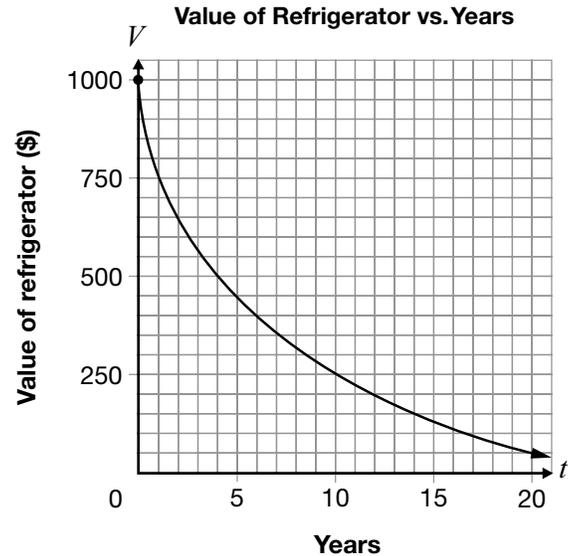
The person's expenses are shown in this table.

Monthly Expenses	Cost
Rent	\$1500
Utilities	\$350
Food	\$400
Other	\$345

Select the **TWO** statements that are true about the person's budget.

- A** The budget needs to be modified, because the monthly expenses are more than the monthly income.
- B** The budget does not need to be modified, because the monthly expenses are less than the monthly income.
- C** If the rent goes up by \$205, the monthly expenses will be the same amount as the monthly income.
- D** If the utilities go down by \$205, the monthly expenses will be the same amount as the monthly income.

- 32** This graph represents the relationship between the value of a refrigerator, in dollars, and the number of years since its purchase.
AP



Complete this statement.

After approximately 10 years, the value of the refrigerator will have _____ [appreciated, depreciated] by _____ [25%, 40%, 50%, 75%] of its initial purchase value.

F1. Financial Decisions (continued)

33 A person gets a loan to make a \$3000 purchase.
TH

Which borrowing situation will allow this person to pay the loan off in the **least** amount of time at 0% interest?

- A making a \$300 down payment and monthly payments of \$75
- B making a \$600 down payment and monthly payments of \$50
- C making a \$300 down payment and biweekly payments of \$50
- D making a \$600 down payment and biweekly payments of \$30

DETAILS OF THE QUESTIONS

QUESTION NUMBER	OVERALL EXPECTATION	COGNITIVE SKILL	KEY
1	B1	KU	A
2	B1	AP	B
3	B1	TH	B
4	B2	KU	C
5	B2	AP	*
6	B2	TH	D
7	B3	KU	A
8	B3	AP	B
9	B3	TH	C
10	C1	KU	D
11	C1	AP	*
12	C1	TH	D
13	C2	KU	A
14	C2	AP	C
15	C2	TH	*
16	C3	KU	B
17	C3	AP	B
18	C3	TH	*
19	C4	KU	D
20	C4	AP	C
21	C4	TH	A
22	D1	KU	A
23	D1	AP	B
24	D1	TH	A
25	D2	KU	D
26	D2	AP	A, C
27	D2	TH	C
28	E1	KU	A
29	E1	AP	C
30	E1	TH	B
31	F1	KU	B, C
32	F1	AP	*
33	F1	TH	C

LEGEND
Cognitive Skill
KU—Knowledge and Understanding
AP—Application
TH—Thinking

* See next page for solutions to questions 5, 11, 15, 18, 32.

* Solutions for questions

5 An equation is shown.

AP

$$\frac{(x^6y^3)(x^{\square}y^8)}{x^3y^4} = x^{12}y^{\Delta}$$

Select the values that make this equation true:

$\square =$ 9 [6, 7, 9] and $\Delta =$ 7 [6, 7, 9].

11 For each expression, select the appropriate choice.

AP

	Equivalent to $4n - 2$	Equivalent to $4n - 8$
$(3n - 4) + (n + 2)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$4(n - 2)$	<input type="checkbox"/>	<input checked="" type="checkbox"/>
$(5n + 6) - (n + 8)$	<input checked="" type="checkbox"/>	<input type="checkbox"/>

15 Pseudocode is written to determine if a given point is **above** the line $y = -4x + 12$.

TH

Select the correct parts of the code to complete this pseudocode.

rateOfChange = -4

initialValue = 12

output "Enter the x-coordinate of the point."

store user input as **xInput**

output "Enter the y-coordinate of the point."

store user input as **yInput**

yValue = B * **xInput** + A

if F

 output "The point is above the line."

else

 output "The point is not above the line."

A **initialValue**

B **rateOfChange**

C **yInput**

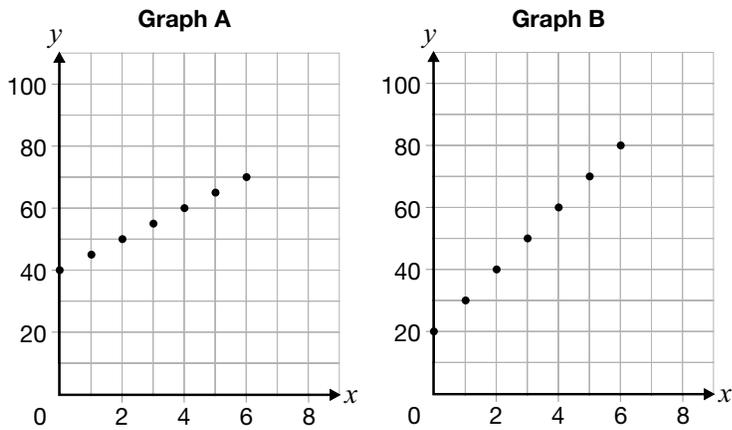
D **yInput = yValue**

E **yInput < yValue**

F **yInput > yValue**

* Solutions for questions (continued)

18 Information about two linear relationships is shown on these graphs.



Select the options that correctly complete these statements.

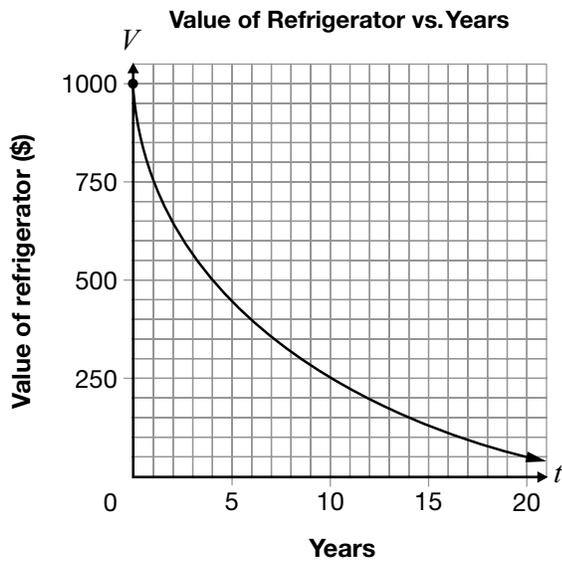
The rate of change of Graph A is less than [greater than, less than, the same as] the rate of change of Graph B.

The initial value for Graph A is greater than [greater than, less than, the same as] the initial value for Graph B.

At $x = 10$, Graph A has a y -value that is less than [greater than, less than, the same as] the y -value in Graph B.

* Solutions for questions (continued)

- 32** This graph represents the relationship between the value of a refrigerator, in dollars, and the number of years since its purchase.
AP



Complete this statement.

After approximately 10 years, the value of the refrigerator will have depreciated [appreciated, depreciated] by 75% [25%, 40%, 50%, 75%] of its initial purchase value.



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