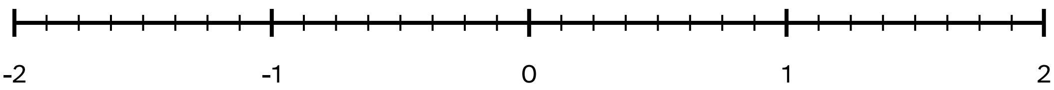
MATH 9 · RATIONAL NUMBERS

Meaning, Order, and Distance (Key)

Name Block Date

QUESTION 1

The number line below is divided into eighths.



Draw a copy of the line and place these four numbers on it.

$\frac{5}{8}$	1.75	$-1\frac{3}{8}$	-0.25

Then state which of the four sits closest to zero and which sits farthest from zero.

$\frac{5}{8}$ is 5 eighths right of 0. 1.75 is 6 eighths right of 1. -1$\frac{3}{8}$ is 3 eighths left of -1. -0.25 is 2 eighths left of 0.

Taking the four in that order, their distances from zero are 0.625, 1.75, 1.375 and 0.25.

Closest to zero **-0.25**, farthest from zero **1.75**

QUESTION 2

Put these numbers in order from least to greatest.

$-\frac{1}{2}$	-0.6	0	$-\frac{5}{8}$

Two of them sit close together. Explain how you decided which of those two comes first.

Written as decimals, -$\frac{5}{8}$ = -0.625 and -$\frac{1}{2}$ = -0.5.

-0.625 and -0.6 are the close pair. Both are negative, and 0.625 is the greater distance from zero, so -$\frac{5}{8}$ sits farther left and comes first.

-$\frac{5}{8}$, -0.6, -$\frac{1}{2}$, 0

QUESTION 3

Being greater and being farther from zero are not the same thing.

a) Which is greater, $-\frac{7}{10}$ or $\frac{3}{5}$?

b) Which of the two is farther from zero?

c) Sam says, "If *a* is greater than *b*, then *a* is farther from zero." Give an example showing Sam is wrong, and name what Sam has confused.

a) $\frac{3}{5}$ = 0.6 is positive and $-\frac{7}{10}$ = -0.7 is negative, so $\mathbf{\frac{3}{5}}$ is greater.

b) The distances from zero are 0.7 and 0.6, so $\mathbf{-\frac{7}{10}}$ is farther from zero.

c) Take a = -1 and b = -2. Then a is greater, but a is 1 from zero and b is 2 from zero, so a is the closer one. Sam has confused **position on the line with distance from zero**.

QUESTION 4

Find two rational numbers between $\frac{1}{3}$ and $\frac{1}{2}$.

Priya says there are exactly three numbers between them. Explain why she is wrong.

Rewrite both over 24: $\frac{1}{3} = \frac{8}{24}$ and $\frac{1}{2} = \frac{12}{24}$, so $\mathbf{\frac{3}{8}}$ **and** $\mathbf{\frac{5}{12}}$ both lie between them.

Halfway between any two of them is another one, and that step can be repeated without ever stopping, so there are **infinitely many**.

QUESTION 5

Between which two consecutive integers does $-\frac{17}{5}$ lie? Explain how the number line tells you.

$-\frac{17}{5}$ = -3.4, so it sits 4 tenths to the left of -3.

That places it **between -4 and -3**, and nearer to -3.

QUESTION 6

The table shows three temperature readings taken on one day.

Time	6:00 a.m.	Noon	9:00 p.m.
Temperature	-3.5°C	$2\frac{1}{4}$°C	-1.75°C

a) Order the three readings from coldest to warmest.

b) How much warmer was noon than 6:00 a.m.?

c) A fourth reading at 3:00 p.m. was halfway between the noon and 9:00 p.m. readings. Find it.

a) **-3.5, -1.75, 2.25**, which is 6:00 a.m., then 9:00 p.m., then noon.

b) $2.25 - (-3.5) = 2.25 + 3.5 = 5.75$, so **5.75°C** warmer.

c) Halfway is half of the sum.

$\frac{1}{2}(2.25 + (-1.75)) = \frac{1}{2}(0.5) = 0.25$, so **0.25°C**

QUESTION 7

A number sits 2.5 units from zero. Give every value it could have, and say how the line makes that clear.

Distance is counted in both directions, so there is one such number on each side of zero. They are **2.5 and -2.5**.

QUESTION 8

Marek says the number halfway between two numbers is always closer to zero than both of them.

a) Find the number halfway between -$\frac{3}{4}$ and $\frac{1}{4}$.

b) Decide whether Marek is right. Use your answer to part a, then test his claim again with a pair of numbers that are both positive.

a) The halfway value is half of the sum.

$$\frac{1}{2}\left(-\frac{3}{4} + \frac{1}{4}\right) = \frac{1}{2}\left(-\frac{1}{2}\right) = -\frac{1}{4}$$

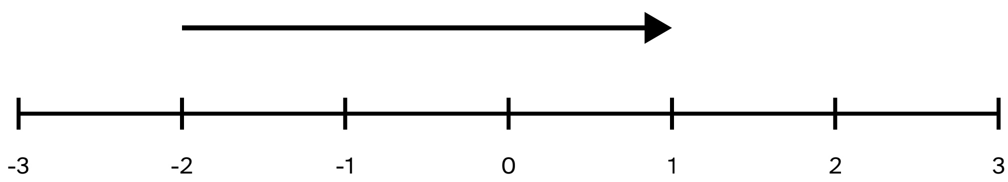
b) Both -$\frac{1}{4}$ and $\frac{1}{4}$ are 0.25 from zero, so it is not closer than both. Halfway between 2 and 4 is 3, farther from zero than 2. Marek is **wrong**.

Adding and Subtracting Rational Numbers (Key)

Name Block Date

QUESTION 1

The arrow represents $-2+3$. It starts at -2 and moves 3 units right to 1.



On the same number line, draw a straight arrow to represent $-1+4$. Write the equation with its result.

The printed arrow shows $-2+3=$ **1**.

The student's arrow starts at -1, runs straight to the right, and ends at 3.

$-1+4=$ **3**

QUESTION 2

$2-(-3)=5$. Use a number line or words to explain why subtracting a negative number can make the result greater.

Subtracting -3 reverses a change of 3 units left. Reversing that change moves 3 units right, which is the same as adding 3.

$2-(-3)=2+3=5$

The result is greater because subtracting -3 has the same effect as **adding 3**.

QUESTION 3

Calculate $-3.6+5.25$. Use the signs to check whether your result should be positive or negative.

The positive amount has the greater size, so the result is positive.

$5.25-3.6=1.65$

$-3.6+5.25=$ **1.65**

QUESTION 4

Calculate $-\frac{5}{12} + \frac{7}{18}$. Use the smallest common denominator you can find.

The smallest common denominator is 36.

$$-\frac{5}{12} + \frac{7}{18} = -\frac{15}{36} + \frac{14}{36} = -\frac{1}{36}$$

The result is $\mathbf{-\frac{1}{36}}$.

QUESTION 5

Compare the two methods for $-2.75 + 1.8$.

Method A	Method B
$-(2.75 - 1.8)$	$-2.75 + 2 - 0.2$

Complete both methods and check that they agree. Which method makes the signs clearer to you, and why?

Method A:

$$-(2.75 - 1.8) = -(0.95) = -0.95$$

Method B:

$$-2.75 + 2 - 0.2 = -0.75 - 0.2 = -0.95$$

Both methods give **-0.95**. Method A makes the sign clear because 2.75 has the greater size, so the negative sign stays outside the difference.

QUESTION 6

Calculate $\frac{7}{8} - 1\frac{1}{4}$.

$$1\frac{1}{4} = \frac{5}{4} = \frac{10}{8}$$

$$\frac{7}{8} - \frac{10}{8} = -\frac{3}{8}$$

The result is $\mathbf{-\frac{3}{8}}$.

QUESTION 7

Arjun wrote:

$$-\frac{2}{3}-\frac{5}{8}=-\frac{2}{3}+\frac{5}{8}=-\frac{1}{24}$$

Identify Arjun's first mistake. Explain why that step is wrong, then repair the calculation.

Arjun changed subtraction to addition but did not replace $\frac{5}{8}$ with its opposite. Subtracting a positive amount must add a negative amount.

$$-\frac{2}{3}-\frac{5}{8}=-\frac{2}{3}+\left(-\frac{5}{8}\right)$$

$$=-\frac{16}{24}-\frac{15}{24}=-\frac{31}{24}=-1\frac{7}{24}$$

The repaired result is **$-1\frac{7}{24}$**.

QUESTION 8

A hiker starts 125m above a trail marker and then changes elevation three times.

Stage	Start	First change	Second change	Third change
Signed amount	+125m	-187.5m	$+42\frac{3}{4}$m	-16.25m

a) Write one expression for the hiker's final position.

b) Calculate the final position and state whether the hiker is above or below the marker.

c) Explain how the sign of your result checks your conclusion.

a) $125-187.5+42.75-16.25$

b) $125-187.5+42.75-16.25=-36$

The final position is **36m below the marker**.

c) Positions above the marker are positive and positions below it are negative. The result -36 therefore confirms that the hiker is **below** the marker.

QUESTION 9

Rina says, “If the sum of two rational numbers is negative, both numbers must be negative.”

a) Give a counterexample using one positive number and one negative number.

b) When two numbers have opposite signs, what must be true for their sum to be negative?

a) For example, $-5+2=$ **-3**. One number is positive, so Rina's claim is wrong.

b) The negative number must be **farther from zero than the positive number**.

Multiplying and Dividing Rational Numbers (Key)

Name Block Date

QUESTION 1

Predict the sign of $-8\left(-1\frac{1}{2}\right)$. Then calculate it.

Both factors are negative, so the product is positive.

$-8\left(-1\frac{1}{2}\right) =$ **12**

QUESTION 2

Complete the last two products in the pattern.

Expression	$3(-2)$	$2(-2)$	$1(-2)$	$0(-2)$	$-1(-2)$	$-2(-2)$
Product	-6	-4	-2	0		

Each time the first factor decreases by 1, the product increases by 2.

The missing products are **2 and 4**.

QUESTION 3

Calculate $(-4.2)(-0.5)$.

$(-4.2)(-0.5) =$ **2.1**

QUESTION 4

Calculate $-\frac{7}{12}\left(\frac{18}{35}\right)$. Simplify before multiplying.

$$-\frac{7}{12}\left(\frac{18}{35}\right) = -\frac{1}{2}\left(\frac{3}{5}\right) = -\frac{3}{10}$$

The product is $\mathbf{-\frac{3}{10}}$.

QUESTION 5

Calculate $\dfrac{\frac{5}{6}}{-\frac{10}{9}}$.

$$\frac{\frac{5}{6}}{-\frac{10}{9}} = \frac{5}{6}\left(-\frac{9}{10}\right) = -\frac{3}{4}$$

The quotient is $\mathbf{-\frac{3}{4}}$.

QUESTION 6

Sofia wrote:

> $$\frac{-\frac{3}{5}}{\frac{6}{7}} = -\frac{3}{5}\left(\frac{6}{7}\right) = -\frac{18}{35}$$

Find Sofia's first mistake and fix the calculation.

Sofia multiplied by $\frac{6}{7}$ instead of its reciprocal.

$$\frac{-\frac{3}{5}}{\frac{6}{7}} = -\frac{3}{5}\left(\frac{7}{6}\right) = -\frac{7}{10}$$

The corrected quotient is $\mathbf{-\frac{7}{10}}$.

QUESTION 7

Solve $-\frac{3}{5}x = \frac{9}{10}$.

$$x = \frac{\frac{9}{10}}{-\frac{3}{5}} = \frac{9}{10}\left(-\frac{5}{3}\right) = -\frac{3}{2}$$

***x* = -1$\frac{1}{2}$**

QUESTION 8

A chamber cools by 2.5°C every $\frac{3}{4}$ hour. It starts at 18°C. What is its temperature after 2.25 hours?

$\frac{2.25}{0.75} = 3$, so there are 3 cooling intervals.

$18 - 3(2.5) = 18 - 7.5 = 10.5$

The temperature is **10.5°C**.

QUESTION 9

Mateo says, “Dividing by a positive number between 0 and 1 always makes the result greater.”

$$\frac{-6}{\frac{1}{2}}$$

a) Calculate the quotient.

b) Decide whether Mateo is right. Replace his claim with one that works for both positive and negative starting values.

a) $\frac{-6}{\frac{1}{2}} = -6(2) =$ **-12**

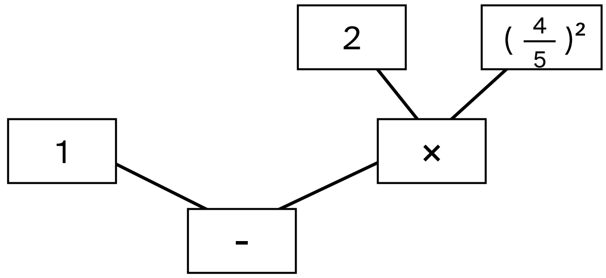
b) -12 is less than -6, so Mateo is wrong. Dividing a nonzero number by a positive number between 0 and 1 makes it **farther from zero**.

Order of Operations and Strategy (Key)

Name Block Date

QUESTION 1

The tree shows the order for $1 - 2(\frac{4}{5})^2$.



Use the tree to calculate the exact value.

$$1 - 2\left(\frac{4}{5}\right)^2 = 1 - 2\left(\frac{16}{25}\right) = 1 - \frac{32}{25} = -\frac{7}{25}$$

The exact value is $\mathbf{-\frac{7}{25}}$.

QUESTION 2

Calculate $\dfrac{-\frac{3}{4}}{\frac{1}{5}} + \left(-\frac{1}{3}\right)\left(-\frac{5}{2}\right)$.

$$\frac{-\frac{3}{4}}{\frac{1}{5}} = -\frac{3}{4}(5) = -\frac{15}{4}$$

$$\left(-\frac{1}{3}\right)\left(-\frac{5}{2}\right) = \frac{5}{6}$$

$$-\frac{15}{4} + \frac{5}{6} = -\frac{45}{12} + \frac{10}{12} = -\frac{35}{12}$$

The value is $\mathbf{-2\frac{11}{12}}$.

QUESTION 3

Calculate $(-3)^2$ and -3^2. Why are the answers different?

$(-3)^2 =$ **9** and $-3^2 = -(3^2) =$ **-9**.

The brackets make -3 the base in the first expression. Without brackets, the exponent applies to 3 before the negative sign is used.

QUESTION 4

Calculate $2 - 3(-4)$.

$2 - 3(-4) = 2 - (-12) =$ **14**

QUESTION 5

Calculate $\frac{3}{4} - \left[\frac{1}{2} - \left(-\frac{1}{8}\right)\right]$.

$$\frac{3}{4} - \left(\frac{1}{2} + \frac{1}{8}\right) = \frac{3}{4} - \frac{5}{8}$$

$$= \frac{6}{8} - \frac{5}{8} = \frac{1}{8}$$

The value is $\mathbf{\frac{1}{8}}$.

QUESTION 6

Leo wrote:

> $-2^2 + 3(-2) = 4 - 6 = -2$

Find Leo's first mistake and give the correct value.

Leo treated -2 as the base, but there are no brackets around it.

$-2^2 + 3(-2) = -(2^2) - 6 = -4 - 6 =$ **-10**

QUESTION 7

Calculate $\dfrac{\left[\frac{1}{2}-\left(-\frac{3}{4}\right)\right]}{\frac{5}{8}}$.

$\frac{1}{2}-\left(-\frac{3}{4}\right)=\frac{5}{4}$

$\dfrac{\frac{5}{4}}{\frac{5}{8}}=\frac{5}{4}\left(\frac{8}{5}\right)=$ **2**

QUESTION 8

A marker is 12.5m above zero. A worker moves down 4.75m three times, then up $1\frac{1}{8}$m twice.

Find the final position.

$12.5-3(4.75)+2(1.125)=12.5-14.25+2.25=0.5$

The final position is **0.5m above zero**.

QUESTION 9

A room starts at 12°C and cools by 3°C each hour for 5 hours.

Ava writes $12-3(5)$. Ben writes $(12-3)5$.

a) Choose the expression that models the situation and find the final temperature.

b) Explain what Ben's brackets make his expression do.

a) Ava's expression subtracts five changes of 3°C.

$12-3(5)=12-15=$ **-3°C**

b) Ben's brackets subtract 3 first, then multiply the entire remaining temperature by 5. That does not represent five equal drops.

What Exponents Represent (Key)

Name Block Date

QUESTION 1

One student says 5^4 means 5×4. Another says it means four factors of 5. Who is correct? Write the repeated multiplication.

The second student is correct.

$5^4 = 5 \times 5 \times 5 \times 5 =$ **625**

QUESTION 2

In 7^3, name the base and exponent. What does the exponent tell you to do?

The **base is 7** and the **exponent is 3**. The exponent says to use 7 as a factor three times.

QUESTION 3

Without a calculator, decide whether 3^4 or 4^3 is greater. Explain how you know.

$3^4 = 81$ and $4^3 = 64$, so **3^4 is greater**.

QUESTION 4

Calculate 6^3.

$6^3 = 6 \times 6 \times 6 =$ **216**

QUESTION 5

Complete the table.

n	1	2	3	4	5
n^2					
n^3					

n^2 : **1, 4, 9, 16, 25**

n^3 : **1, 8, 27, 64, 125**

QUESTION 6

Show that 2^6 and 4^3 have the same value.

$2^6 = 64$ and $4^3 = 64$.

Both powers have the value **64**.

QUESTION 7

Jules wrote $2^5 = 2 \times 5 = 10$. Find the mistake and give the correct value.

Jules multiplied the base by the exponent instead of using five factors of 2.

$2^5 = 2 \times 2 \times 2 \times 2 \times 2 =$ **32**

QUESTION 8

A display has 2^4 lights in each row and 2^4 rows. How many lights are there?

$2^4 = 16$, so there are 16 rows of 16 lights.

$16(16) =$ **256 lights**

QUESTION 9

Amir says, “Doubling the base only doubles the value of a power.”

a) Compare 6^4 with twice 3^4.

b) Explain why doubling the base has a larger effect when the exponent is 4.

a) $6^4 = 1296$, while $2(3^4) = 2(81) = 162$. Amir is **wrong**.

b) Each of the four factors is doubled, so the product is multiplied by $2^4 =$ **16**, not by 2.

Product and Quotient Laws (Key)

Name Block Date

QUESTION 1

Follow the repeated factors, then compress each product into one power.

Expression	Repeated factors	One power
a^3a^4	$(aaa)(aaaa)$	
m^2m^5		
$7^4 \cdot 7^2$		

$a^3a^4 = a^7$, $m^2m^5 = m^7$, and $7^4 \cdot 7^2 = 7^6$.

For the same base, add the exponents: $x^m x^n = x^{m+n}$.

QUESTION 2

Simplify b^6b^3 as one power. State when the product law does not apply.

$b^6b^3 = \mathbf{b^9}$.

The product law does not apply when the powers have different bases.

QUESTION 3

Cancel common factors, then write each quotient as one power.

Expression	After common factors cancel	One power
$\frac{k^7}{k^3}$	$\frac{kkkkkkk}{kkk}$	
$\frac{n^9}{n^4}$		
$\frac{10^6}{10^2}$		

$\frac{k^7}{k^3} = k^4$, $\frac{n^9}{n^4} = n^5$, and $\frac{10^6}{10^2} = 10^4$.

For the same nonzero base, subtract the exponents: $\frac{x^m}{x^n} = x^{m-n}$.

QUESTION 4

Simplify $\frac{p^{11}}{p^5}$.

$\frac{p^{11}}{p^5} = \mathbf{p^6}$, where $p \neq 0$.

QUESTION 5

Write c^4c^6 as one power.

$c^4c^6 = \mathbf{c^{10}}$.

QUESTION 6

Write $\frac{r^{12}}{r^5}$ as one power.

$\frac{r^{12}}{r^5} = \mathbf{r^7}$, where $r \neq 0$.

QUESTION 7

Nora wrote $5^2 \cdot 5^3 = 10^5$. Explain her mistake and give the correct answer.

Nora multiplied equal bases. Keep the base and add the exponents: $5^2 \cdot 5^3 = 5^{2+3} = \mathbf{5^5}$.

QUESTION 8

One file contains 2^7 blocks. Another contains 2^5 blocks. Write the number of possible pairs as one power.

$2^7 \cdot 2^5 = 2^{7+5} = \mathbf{2^{12}}$ **pairs**.

QUESTION 9

For positive whole-number exponents, Ava claims that $x^a x^b = x^c x^d$ whenever $a + b = c + d$.

a) Is Ava's claim always true?

b) Use the exponent laws to justify your decision.

Yes. Both sides reduce to the same power: $x^{a+b} = x^{c+d}$.

Powers of Products, Quotients, and Powers (Key)

Name Block Date

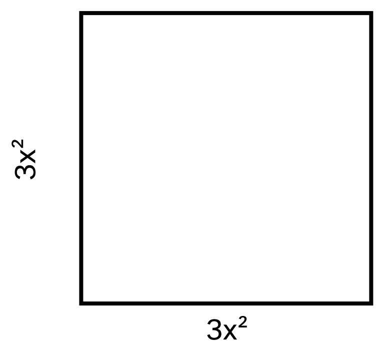
QUESTION 1

Two students simplify $(2x)^3$. One gets $2x^3$. The other gets $8x^3$. Expand the power to decide who is correct.

$(2x)^3 = (2x)(2x)(2x) = 2^3x^3 =$ **8x³**. The second student is correct.

QUESTION 2

The square has side length $3x^2$.



Write the area as a product of the side lengths, then simplify.

$(3x^2)(3x^2) = (3x^2)^2 =$ **$9x^4$**.

QUESTION 3

Simplify $(y^4)^3$.

$(y^4)^3 = y^{4 \cdot 3} =$ **y^{12}**.

QUESTION 4

Simplify $\left(\frac{a}{b}\right)^3$. State the restriction on b.

$\left(\frac{a}{b}\right)^3 = \frac{a^3}{b^3}$, where $b \neq 0$.

QUESTION 5

Simplify $(3a)^2$.

$(3a)^2 = 3^2a^2 =$ **$9a^2$**.

QUESTION 6

Simplify $(x^3)^4$.

$(x^3)^4 = x^{3\cdot 4} =$ **x^{12}**.

QUESTION 7

A cube has edge length $2k^3$ centimetres. Write its volume as a power of the edge length, then simplify.

$V = (2k^3)^3 = 2^3k^9 =$ **$8k^9$ cm^3**.

QUESTION 8

Harper wrote $(4r^3)^2 = 4r^6$. Find the mistake and fix the answer.

Harper squared r^3 but did not square 4.

$(4r^3)^2 = 4^2r^6 =$ **$16r^6$**.

QUESTION 9

Mia says, "A power distributes over every operation, so $(a+b)^2 = a^2 + b^2$."

a) Test Mia's claim using $a = 1$ and $b = 1$.

b) Explain why the power-of-a-product law cannot justify her claim.

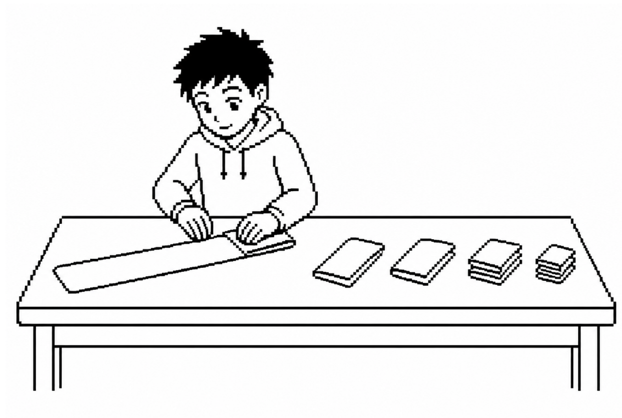
a) $(1+1)^2 = 4$, but $1^2 + 1^2 = 2$, so the claim is **false**.

b) The law applies to factors joined by multiplication. In $a + b$, the terms are joined by addition.

Zero Exponents, Signs, and Mixed Laws (Key)

Name Block Date

QUESTION 1



Continue the exponent pattern by dividing each value by 5.

Power	5^4	5^3	5^2	5^1	5^0
Value	625				

The values are **625, 125, 25, 5, 1**, so $5^0 = 1$.

QUESTION 2

Find 12^0. Then complete the rule.

$x^0 =$ is valid when $x \neq$.

$12^0 =$ **1**. The rule is $x^0 = 1$ when $x \neq 0$.

QUESTION 3

Evaluate $(-4)^2$. Then describe exactly what is included in the base.

$(-4)^2 = (-4)(-4) =$ **16**. The base is -4, including the negative sign.

QUESTION 4

Simplify $\frac{x^5x^3}{x^8}$. Identify the exponent law used at each change and state any restriction.

$\frac{x^5x^3}{x^8} = \frac{x^8}{x^8}$ by the product law.

$\frac{x^8}{x^8} = x^{8-8} = x^0 =$ **1** by the quotient and zero-exponent laws, where $x \neq 0$.

QUESTION 5

Riley wrote $6^0 = 0$. Use $\frac{6^3}{6^3}$ to show Riley why the answer is 1.

$\frac{6^3}{6^3} = 1$ because a nonzero number divided by itself is 1.

By the quotient law, $\frac{6^3}{6^3} = 6^{3-3} = 6^0$. Therefore, $6^0 = 1$.

QUESTION 6

For $\frac{(x^a)^bx^c}{x^d}$, all exponents are whole numbers and $ab + c \geq d$. Simplify. State the law used at each step and any restriction.

$(x^a)^b = x^{ab}$ by the power-of-a-power law.

$x^{ab}x^c = x^{ab+c}$ by the product law.

$\frac{x^{ab+c}}{x^d} =$ $\mathbf{x^{ab+c-d}}$ by the quotient law, where $x \neq 0$.

QUESTION 7

Calculate $(-2)^4$ and -2^4.

$(-2)^4 =$ **16** and $-2^4 = -(2^4) =$ **-16**.

QUESTION 8

Simplify $\dfrac{m^3m^2}{m^5}$, where $m \neq 0$.

$\dfrac{m^3m^2}{m^5} = \dfrac{m^5}{m^5} = m^0 =$ **1**.

QUESTION 9

Dev says, "$\dfrac{(x-2)^3}{(x-2)^3} = (x-2)^0 = 1$ for every value of x."

a) Test the original quotient when $x = 2$.

b) Correct Dev's claim by stating the needed restriction.

a) When $x = 2$, the quotient is $\dfrac{0^3}{0^3} = \dfrac{0}{0}$, which is **undefined**.

b) The quotient equals 1 only when $x \neq 2$.

Polynomial Language and Models (Key)

Name Block Date

QUESTION 1

Look at $4x^2 - 7x + 3$. List its terms. Then name its coefficients, constant, and degree.

Terms: $4x^2, -7x, 3$. Coefficients: **4 and -7**. Constant: **3**. Degree: **2**.

QUESTION 2

Classify $9x^2$ as a monomial, binomial, or trinomial. State its degree.

It is a **monomial of degree 2**.

QUESTION 3

Which two terms are like terms?

$3x^2$	$-5x$	$7x^2$	4

$3x^2$ **and** $7x^2$ are like terms.

QUESTION 4

Write $5 + 2x^2 - 7x + 3x^2$ in descending order without combining. Then identify the like terms.

$2x^2 + 3x^2 - 7x + 5$. The like terms are $2x^2$ and $3x^2$.

QUESTION 5

Combine like terms: $6x + 4 - 2x + 7$.

$6x + 4 - 2x + 7 = 4x + 11$.

QUESTION 6

Decide whether $5x$ and $-2x$ are like terms. Justify your answer.

Yes. Both terms have the same variable raised to the same exponent.

QUESTION 7

Classify $5x^2 - 3x + 8$ and state its degree.

It is a **trinomial of degree 2**.

QUESTION 8

Combine like terms: $7y^2 + 3y - 2y^2 - 5$.

$7y^2 + 3y - 2y^2 - 5 = 5y^2 + 3y - 5$.

QUESTION 9

Two algebra-tile models each use six tiles.

	x^2 **tiles**	x **tiles**	**unit tiles**
Model A	2	1	3
Model B	1	3	2

Noah says the models represent the same polynomial because they use the same number of tiles. Test his claim by writing each polynomial.

Model A is $2x^2 + x + 3$. Model B is $x^2 + 3x + 2$.

Noah's claim is **false** because the types of tiles differ.

Adding and Subtracting Polynomials (Key)

Name Block Date

QUESTION 1

Two students add $(3x + 5) + (4x - 2)$. One gets $7x + 3$. The other gets $10x$. Use $x = 2$ to decide who is correct.

The original expression is $11 + 6 = 17$. Also, $7(2) + 3 = 17$, while $10(2) = 20$.

$7x + 3$ **is correct.**

QUESTION 2

Rewrite $(8x + 3) - (5x - 4)$ as addition of the opposite. Then simplify.

$(8x + 3) + (-5x + 4) = 3x + 7$.

QUESTION 3

Complete the missing polynomial.

$(2x^2 + 3x - 4) + \square = 7x^2 - x + 5$

$(7x^2 - x + 5) - (2x^2 + 3x - 4) = 5x^2 - 4x + 9$.

QUESTION 4

A rectangle has length $3x + 2$ metres and width $x - 1$ metres. Write and simplify its perimeter.

$P = 2(3x + 2) + 2(x - 1) = 6x + 4 + 2x - 2 = 8x + 2$ **m.**

QUESTION 5

A student wrote $(4x^2+3x)+(2x^2-5x)=6x^2+8x$. Locate the error and correct the result.

The student added 3 and 5 instead of 3 and -5. The correct result is $6x^2-2x$.

QUESTION 6

The table shows the amounts collected by three teams.

Team	First	Second	Third
Amount (kg)	$2x^2+4x-3$	x^2-6x+8	$3x^2+x+5$

Write a simplified expression for the total.

The total is $6x^2-x+10$ **kg.**

QUESTION 7

Simplify $(5x^2+2x-1)-(2x^2-3x+4)$.

$5x^2+2x-1-2x^2+3x-4=\ 3x^2+5x-5.$

QUESTION 8

Find the missing polynomial: $(x^2+4x)+=3x^2-x+6$.

$(3x^2-x+6)-(x^2+4x)=\ 2x^2-5x+6.$

QUESTION 9

Ravi claims, “Subtracting a polynomial makes every coefficient smaller.” Test his claim by simplifying

$(2x^2-5x+1)-(x^2-8x+4)$.

Use your result to explain whether Ravi is correct.

$2x^2-5x+1-x^2+8x-4=\ x^2+3x-3.$

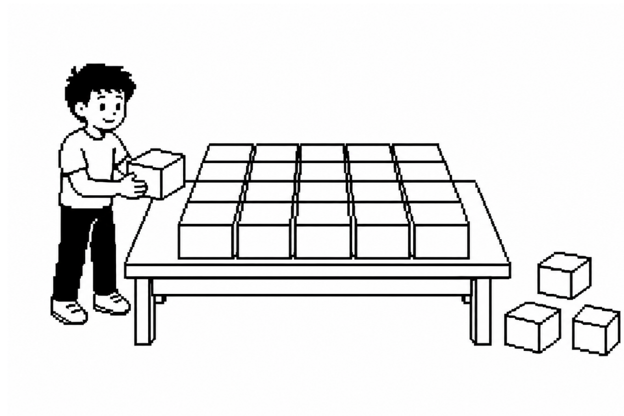
Ravi is incorrect. Subtracting $-8x$ adds $8x$, so the x-coefficient increases from -5 to 3.

MATH 9 · POLYNOMIAL OPERATIONS

Multiplying and Dividing by a Monomial (Key)

Name Block Date

QUESTION 1

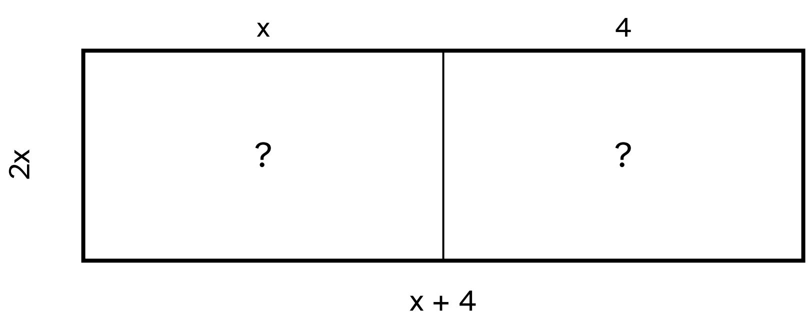


A rectangle has height $5x$ and width $x+3$. Is its area $5x^2+3$ or $5x^2+15x$? Explain your choice.

$5x(x+3)=5x^2+15x$, so the area is $5x^2+15x$.

QUESTION 2

The rectangle has width $2x$ and length $x+4$.



Label the area of each section.

The section areas are $2x^2$ and $8x$.

QUESTION 3

Simplify $\dfrac{12x+18}{6}$.

$\dfrac{12x}{6}+\dfrac{18}{6}=2x+3.$

QUESTION 4

Factor out the greatest common monomial from $8x + 20$.

$8x + 20 = 4(2x + 5)$.

QUESTION 5

A student wrote $4x(2x + 3) = 8x^2 + 3$. Identify the missed multiplication and correct the result.

The student did not multiply 3 by $4x$.

$4x(2x + 3) = 8x^2 + 12x$, so the result is $8x^2 + 12x$.

QUESTION 6

A rectangular banner has area $6x^2 + 15x$ square centimetres and height $3x$ centimetres. Find its length.

$\dfrac{6x^2 + 15x}{3x} = 2x + 5$. The length is $2x + 5$ **cm**, for $x > 0$.

QUESTION 7

Expand $-4x(2x-3)$.

$-4x(2x-3) = -8x^2 + 12x$.

QUESTION 8

Simplify $\dfrac{18x^2 - 12x}{6x}$.

$\dfrac{18x^2}{6x} - \dfrac{12x}{6x} = 3x - 2$, where $x \neq 0$.

QUESTION 9

Rectangle A has dimensions $3x$ by $2x+5$. Rectangle B has dimensions x by $6x+15$, where $x > 0$.

a) Show that the rectangles always have the same area.

b) A classmate claims they must also have the same perimeter. Test the claim.

a) Both areas are $6x^2 + 15x$.

b) $P_A = 2(3x) + 2(2x+5) = 10x + 10$, while $P_B = 2x + 2(6x+15) = 14x + 30$. The perimeter claim is **false**.

Combining Polynomial Operations (Key)

Name Block Date

QUESTION 1

Simplify $3(x+4)+2x$. Why must you remove the brackets before collecting like terms?

$3(x+4)+2x = 3x+12+2x = 5x+12$.

Removing the brackets shows all the terms that can be compared.

QUESTION 2

Simplify $(4x^2-3x+2)+(x^2+7x-5)-2x$.

$4x^2+x^2-3x+7x-2x+2-5 = 5x^2+2x-3$.

QUESTION 3

Evaluate $2(x+3)+x(x-1)$ at $x=4$ in two ways: before simplifying and after simplifying.

Before: $2(4+3)+4(4-1) = 14+12 = 26$.

After: $2x+6+x^2-x = x^2+x+6$, and $4^2+4+6 = 26$.

Both ways give **26**.

QUESTION 4

A square has side length $2x+1$. A rectangular strip with area $3x(2x+1)$ is attached along one side. Write the total area without expanding the square.

The total area is $(2x+1)^2+3x(2x+1)$.

QUESTION 5

A solution begins $2x(3x-4)+x^2=6x^2-4+x^2$. Identify the first error and correct the final result.

The term -4 must also be multiplied by $2x$.

$2x(3x-4)+x^2=6x^2-8x+x^2=\ 7x^2-8x.$

QUESTION 6

The outer rectangle has length $5x+2$ and width $2x$. A rectangle of area $3x^2-4x$ is removed. Write an expression for the remaining area.

$(5x+2)(2x)-(3x^2-4x)=10x^2+4x-3x^2+4x=\ 7x^2+8x.$

QUESTION 7

Simplify $2(3x-1)+x(x+4)$.

$2(3x-1)+x(x+4)=6x-2+x^2+4x=\ x^2+10x-2.$

QUESTION 8

Sam claims that $3(x^2-2x)+2x(x+1)$ and $5x^2-4x$ are equal for every value of x.

a) Expand and simplify the first expression.

b) Decide whether Sam's claim is true for every x.

a) $3x^2-6x+2x^2+2x=\ 5x^2-4x.$

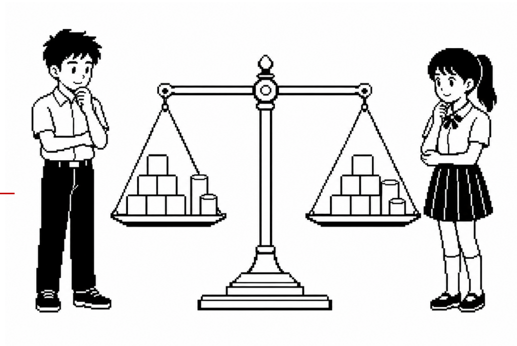
b) **Yes.** The expressions simplify to the same polynomial, so they are equal for every x.

One-Step and Two-Step Equations (Key)

Name Block Date

QUESTION 1

For $x + 9 = 23$, compare three moves: subtract 9 from both sides, subtract 9 from only the left side, or divide both sides by 9. Which moves preserve the equality? Which move also reveals x? Solve and check.



Subtracting 9 from both sides and dividing both sides by 9 preserve equality. Only subtracting 9 from both sides reveals x.

$x =$ **14**, and $14 + 9 = 23$.

QUESTION 2

Solve $3x + 5 = 20$. Keep the equation balanced at every step.

$3x = 15$, so $x =$ **5**.

Check: $3(5) + 5 = 20$.

QUESTION 3

Complete each missing value.

$4x - 7 = 21$, then $4x = \square$, so $x = \square$.

$4x =$ **28**, so $x =$ **7**.

QUESTION 4

Choose the solution to $5x + 4 = 19$.

-6	-2	3	8

$5x = 15$, so $x =$ **3**.

QUESTION 5

A solution begins $4x + 3 = 19$, so $4x = 22$. Identify the first error and correct the solution.

The solver added 3 instead of subtracting 3 from both sides.

$4x = 16$, so $x =$ **4**.

QUESTION 6

The perimeter of an equilateral triangle is 42 cm. Let s be the side length. Write an equation and solve it.

$3s = 42$, so $s =$ **14 cm**.

QUESTION 7

Solve $6x - 7 = 29$.

$6x = 36$, so $x =$ **6**.

QUESTION 8

Solve $5 - 3y = -16$.

$-3y = -21$, so $y =$ **7**.

QUESTION 9

Omar says, “Doing the same thing to both sides always preserves the exact solution.”

a) Start with $x = 4$ and multiply both sides by 0. What equation results?

b) Does the new equation still have only $x = 4$ as its solution? Correct Omar's claim.

a) The result is $0x = 0$.

b) Every value of x satisfies the new equation, so Omar is **incorrect**. To preserve the exact solution, the operation must be reversible; multiplying or dividing by 0 is not.

Multi-Step Equations and Distribution (Key)

Name Block Date

QUESTION 1

For $3x + 5x - 6 = 18$, explain why combining $3x$ and $5x$ first preserves the solutions. Then solve and check.

$3x$ and $5x$ are like terms, so together they are $8x$.

$8x - 6 = 18$, $8x = 24$, so $x =$ **3.**

Check: $3(3) + 5(3) - 6 = 18$.

QUESTION 2

Distribute, collect, solve, and check: $3(x + 4) = 27$.

$3x + 12 = 27$, $3x = 15$, so $x =$ **5.**

Check: $3(5 + 4) = 27$.

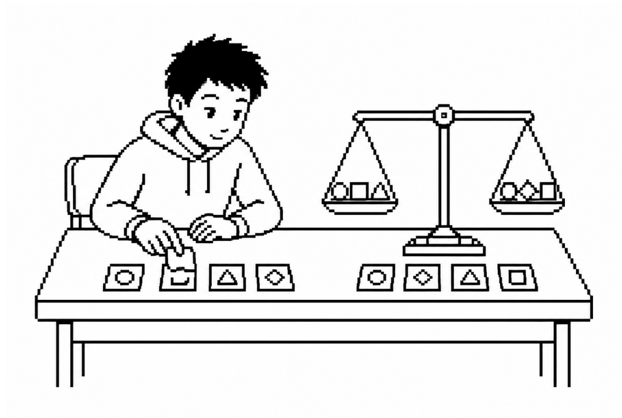
QUESTION 3

Solve $5x + 3 = 2x + 18$. Check your solution.

$3x + 3 = 18$, $3x = 15$, so $x =$ **5.**

Check: both sides equal 28 when $x = 5$.

QUESTION 4



Arrange these steps in a sensible order, then solve $2(3x-4)+5=x+17$: distribute, collect like terms, move variable terms, move constants, divide by the coefficient.

$6x-8+5=x+17$, $6x-3=x+17$, $5x=20$, so $x=$ **4**.

QUESTION 5

A student wrote $3(2x-5)=6x-5$. Identify the first error and correct the result.

The student did not multiply -5 by 3.

$3(2x-5)=\ 6x-15.$

QUESTION 6

Classify $3(x+2)=3x+6$ as having one solution, no solution, or infinitely many solutions.

Distributing gives $3x+6=3x+6$, which is true for every x. The equation has **infinitely many solutions**.

QUESTION 7

Solve $4(2x-3)=20$.

$8x-12=20$, $8x=32$, so $x=$ **4**.

QUESTION 8

Solve $7x+5=3x+21$.

$4x+5=21$, $4x=16$, so $x=$ **4**.

QUESTION 9

Maya says, “If the variable terms cancel, an equation always has infinitely many solutions.”
Compare these equations:

$2(x+3)=2x+6$

$2(x+3)=2x+7$

Classify each equation, then correct Maya's claim.

The first becomes $2x+6=2x+6$, so it has **infinitely many solutions**.

The second becomes $2x+6=2x+7$, or $6=7$, so it has **no solution**.

When variable terms cancel, compare the constants: equal constants give infinitely many solutions; unequal constants give no solution.

Equations with Rational Coefficients (Key)

Name Block Date

QUESTION 1

Compare $0.5x + 3 = 8$ with the equation formed by multiplying every term by 10. Explain why the equations have the same solution, then solve.

Multiplying every term by 10 gives $5x + 30 = 80$. Multiplying both sides by the same nonzero number preserves the solution.

$5x = 50$, so $x =$ **10**.

QUESTION 2

Solve $\frac{x}{3} + 2 = 7$. You may clear fractions first.

$\frac{x}{3} = 5$, so $x =$ **15**.

QUESTION 3

Multiply $\frac{x}{2} + \frac{x}{3} = 10$ by the least common denominator. Write the new equation, then solve.

Multiplying every term by 6 gives $3x + 2x = 60$.

$5x = 60$, so $x =$ **12**.

QUESTION 4

Choose whether fractions, decimals, or integers make $0.25x + 1.5 = 4$ easiest to solve. Explain your choice, then solve.

Integers are convenient. Multiplying every term by 4 gives $x + 6 = 16$, so $x =$ **10**.

QUESTION 5

A solution begins $\frac{x}{4} + 3 = 7$, so $x + 3 = 28$. Identify the first error and correct the solution.

Multiplying by 4 must apply to every term, so the new equation is $x + 12 = 28$.

Therefore, $x =$ **16**.

QUESTION 6

A recipe uses 0.75 kg of flour per batch. A bakery has used 6.3 kg from an 18.3 kg bag. Write an equation for the number of additional batches b, then solve it.

$6.3 + 0.75b = 18.3$. Then $0.75b = 12$, so $b =$ **16 batches**.

QUESTION 7

Solve $0.4x - 1.2 = 2.8$.

$0.4x = 4$, so $x =$ **10**.

QUESTION 8

Solve $\frac{x}{4} + \frac{x}{2} = 9$.

Multiplying by 4 gives $x + 2x = 36$, so $x =$ **12**.

QUESTION 9

Talia multiplies $\frac{x}{2} + \frac{3}{4} = 5$ by 4 and writes $2x + 3 = 5$.

a) Identify the term she did not multiply by 4.

b) Write the correct integer equation and solve it.

a) Talia did not multiply the right side by 4.

b) The correct equation is $2x + 3 = 20$. Then $2x = 17$, so $x = \frac{17}{2}$.

Modelling and Checking Linear Equations (Key)

Name Block Date

QUESTION 1

A student reads, “Seven more than three times a number is 34.” They write $3x+7=34$ and $3(x+7)=34$. Which equation matches the sentence? Explain.

$3x+7=34$ matches the sentence. Three times the number is found first, then 7 is added.

QUESTION 2

Solve the correct equation from Question 1. Check your answer in the sentence.

$3x+7=34$, $3x=27$, so $x=$ **9**.

Check: seven more than three times 9 is $27+7=34$.

QUESTION 3

The length of a rectangle is 5 cm more than twice its width. Its perimeter is 58 cm. Let w be the width. Write the length in terms of w, then write and solve an equation to find both dimensions.

The length is $2w+5$. The equation is $2w+2(2w+5)=58$.

$6w+10=58$, so $w=8$. The dimensions are **8 cm by 21 cm**.

QUESTION 4

A club rents a room for $120 and charges each participant $18. The total collected is $444. Write and solve an equation for the number of participants.

$120 + 18p = 444$. Then $18p = 324$, so $p =$ **18 participants**.

QUESTION 5

A student chooses $5x + 12 = 47$ for "Twelve less than five times a number is 47." Explain the translation error and write the correct equation.

"Twelve less than" means subtract 12, not add 12. The correct equation is $5x - 12 = 47$.

QUESTION 6

A 96 cm ribbon is cut into three pieces. The second piece is 8 cm longer than the first. The third is twice the first. Define a variable, write expressions for all three pieces, then write and solve an equation.

Let the first piece be x cm. The pieces are x, $x + 8$, and $2x$.

$x + (x + 8) + 2x = 96$, so $4x = 88$ and $x = 22$. The pieces are **22 cm, 30 cm, and 44 cm**.

QUESTION 7

Five movie tickets and a $3 fee cost $58. Write and solve an equation for the ticket price.

$5t + 3 = 58$, so $5t = 55$ and $t =$ **$11**.

QUESTION 8

Three consecutive whole numbers have a sum of 45. Find the numbers.

$n + (n+1) + (n+2) = 45$, so $3n + 3 = 45$ and $n = 14$.

The numbers are **14, 15, and 16**.

QUESTION 9

Plan A costs $25 plus $8 per visit. Plan B costs $13 plus $10 per visit. Jordan says Plan B must always cost less because its starting fee is lower.

a) Find the number of visits for which the plans cost the same.

b) Compare the plans at 4 visits and 8 visits. Use the results to assess Jordan's claim.

a) $25 + 8v = 13 + 10v$, so $v =$ **6 visits**.

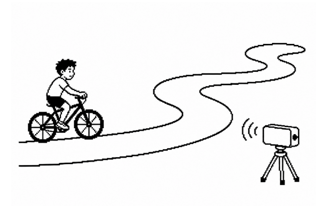
b) At 4 visits, Plan A costs $57 and Plan B costs $53. At 8 visits, Plan A costs $89 and Plan B costs $93. Jordan's claim is **false**.

Representing Continuous Linear Relations (Key)

Name Block Date

QUESTION 1

A sensor reports the readings in the table. A student draws a straight line through them. What assumption makes that line reasonable, and what would make it misleading?



Time t (min)	**0**	**1**	**2**	**3.5**	**6**
Volume V (L)	40	55	70		

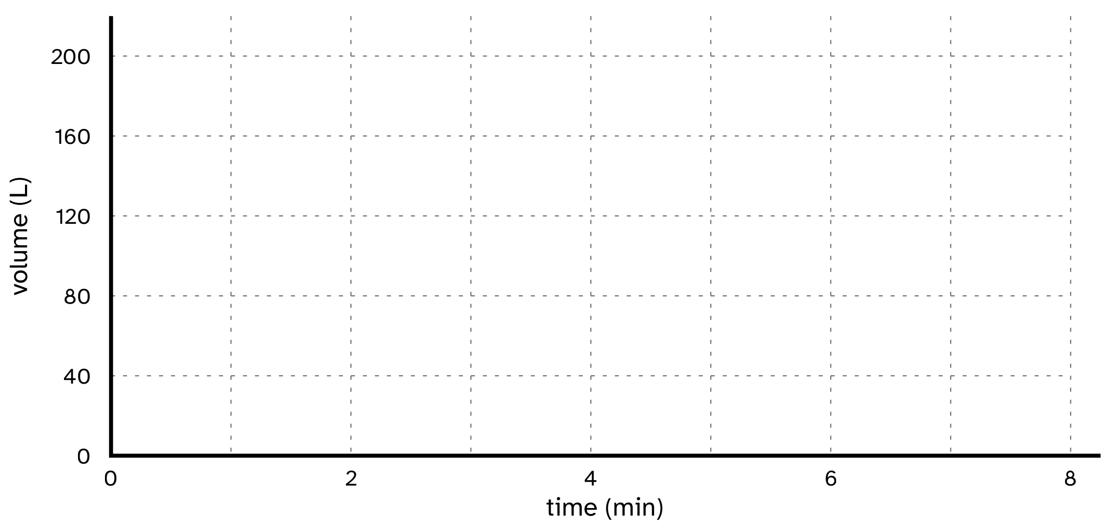
Use the constant-change assumption to complete the table.

The volume increases by 15 L each minute, so the missing values are **92.5 L and 130 L**.

A straight line assumes the rate stays constant. It is misleading if the rate changes.

QUESTION 2

Graph the relation from Question 1 for 0 to 8 minutes. Label both axes and use a sensible scale.



Plot $(0,40),(1,55),(2,70),(3.5,92.5),(6,130)$ and draw the line $V=40+15t$ to $(8,160)$.

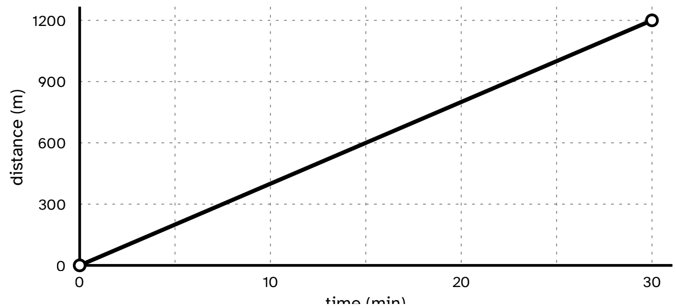
QUESTION 3

Decide whether a continuous graph is suitable for distance travelled while cycling over time. Explain.

Yes. Time and distance can take values between recorded measurements.

QUESTION 4

The graph shows a steady walk away from a trailhead.



Read the distance at 15 minutes.

At 15 minutes, the line is at **600 m**.

QUESTION 5

Make a table with five points for $y = 60 - 8x$.

One table is $(0, 60), (1, 52), (2, 44), (3, 36), (4, 28)$.

QUESTION 6

A graph passes through the points in the table.

Point	1	2	3
x	0	2	5
y	25	55	100

Show that the relation is linear using two rates of change.

$\dfrac{55-25}{2-0} = 15$ and $\dfrac{100-55}{5-2} = 15$. The equal rates show a **linear relation**.

QUESTION 7

For $y = 12 + 4x$, find y when $x = 7$.

$y = 12 + 4(7) =$ **40**.

QUESTION 8

Should the number of buses that arrive over time be shown with a continuous graph? Explain.

No. The number of buses changes in whole-number jumps; part of a bus cannot arrive.

QUESTION 9

A cyclist's distance is recorded only at $(0, 4)$ and $(2, 10)$. Kai says, "Two points determine a line, so the cyclist must have travelled at a constant rate for the whole two minutes."

Explain what the two points do determine and what they do not prove about the cyclist's motion.

The points determine the straight line with average rate $\frac{10-4}{2-0} =$ **3 units per minute**.

They do not prove the cyclist moved at that same rate at every moment between the readings. More measurements or information about the motion would be needed.

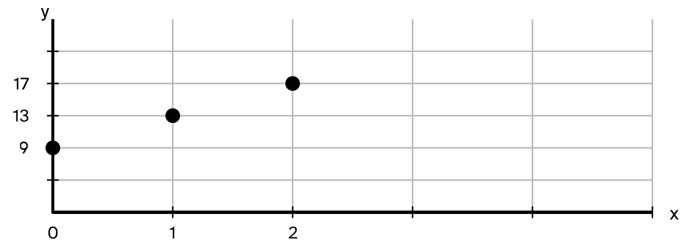
MATH 9 · LINEAR RELATIONS

Rate of Change and Initial Value (Key)

Name Block Date

QUESTION 1

For $y = 4x + 9$, set $x = 0$. Then increase x by 1. Which number is the initial value? Which is the rate of change?



The initial value is **9**, and the rate of change is **4**.

QUESTION 2

Determine the rate of change and initial value from each table. Write a rule.

A

x	0	2	5	8
y	7	17	32	47

B

t	1	3	6	10
V	94	82	64	40

A: rate 5, initial value 7, rule $y = 5x + 7$.

B: rate -6, initial value 100, rule $V = 100 - 6t$.

QUESTION 3

Find the rate of change between $(2, 11)$ and $(7, 31)$.

$\dfrac{31 - 11}{7 - 2} = \dfrac{20}{5} =$ **4**.

QUESTION 4

A line has rate of change -3 and passes through $(4, 10)$. Work backward to find the value at $x = 0$.

Moving from $x = 4$ back to $x = 0$ adds $4(3) = 12$ to the y-value.

The value at $x = 0$ is **22**.

QUESTION 5

The graph of a cooling liquid passes through $(0, 92)$ and $(12, 68)$, where time is in minutes and temperature is in degrees Celsius. Calculate the rate of change.

$\frac{68-92}{12-0} = \frac{-24}{12} =$ **-2°C per minute**.

QUESTION 6

A student claims that in $y = 12 - 5x$, the initial value is -5. Correct the claim.

The initial value is the value when $x = 0$, so it is **12**. The rate of change is **-5**.

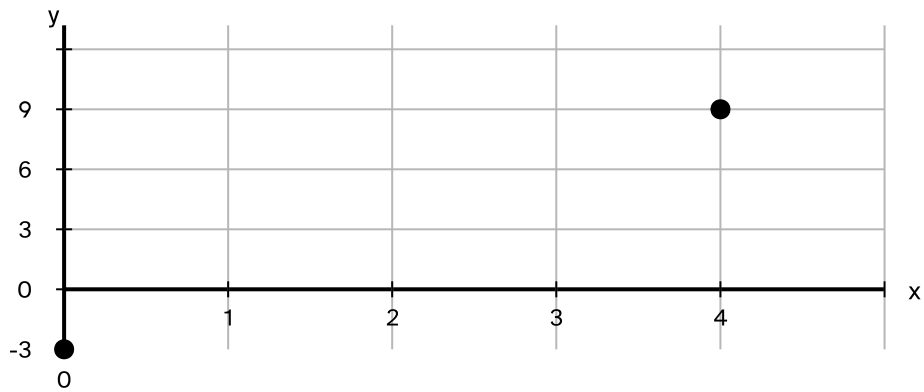
QUESTION 7

State the rate of change and initial value of $y = -2.5x + 14$.

Rate of change: **-2.5**. Initial value: **14**.

QUESTION 8

A line passes through $(0, -3)$ and $(4, 9)$. Write its rule.



The rate is $\dfrac{9-(-3)}{4-0} = 3$, and the initial value is -3. The rule is $y = 3x - 3$.

QUESTION 9

Mina says, “Two linear relations with the same rate of change must be the same line.” Compare $y = 3x + 2$ with the relation in this table.

x	0	2	5
y	-4	2	11

Find the rate and initial value of the table, then assess Mina's claim.

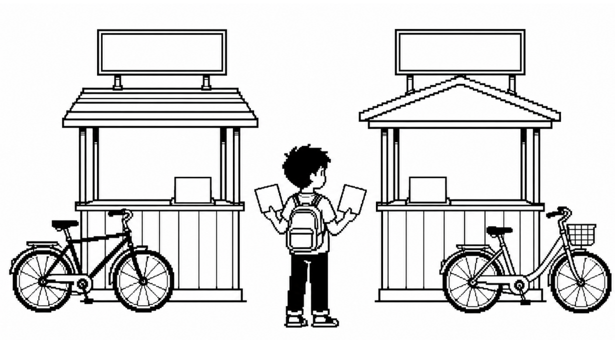
The table has rate 3 and initial value -4, so its rule is $y = 3x - 4$.

The rates match, but the initial values do not. The lines are parallel and distinct, so Mina's claim is **false**.

Comparing Linear Relations (Key)

Name Block Date

QUESTION 1



Two rental plans have costs $A = 18 + 2.4h$ and $B = 6 + 4h$. A student says, “Plan B starts cheaper, so it will always be cheaper.” Identify which plan starts lower and which increases faster.

Plan **B starts lower** at $6, but Plan **B also increases faster** at $4 per hour compared with $2.40 per hour.

QUESTION 2

The tables represent two continuous linear relations. Find the rate and initial value of each relation.

Relation P

x	0	2	5	8
y	15	23	35	47

Relation Q

x	1	4	8	11
y	23	32	44	53

P has rate **4** and initial value **15**.

Q has rate **3** and initial value **20**.

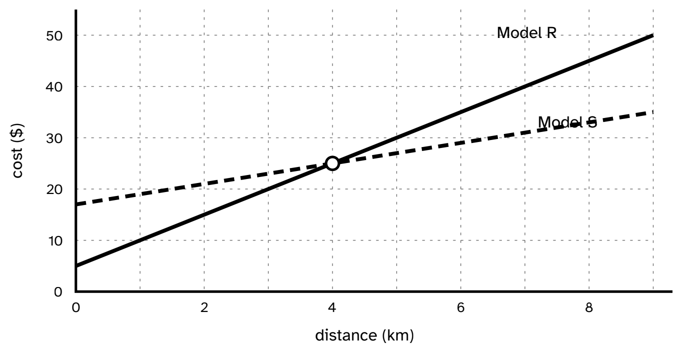
QUESTION 3

Explain why comparing only one table row, one graph point, or one initial value can give a misleading conclusion about two linear relations.

One value shows only which relation is greater at that input. Different rates can make the relations meet and reverse order. A sound comparison uses **both the initial values and the rates of change**.

QUESTION 4

The graph shows two delivery-cost models.



Which model has the lower initial cost? Which has the greater rate?

Model **R** has the lower initial cost and the greater rate of change.

QUESTION 5

A gym charges $45 to join and $12 per visit. Another gym has no joining fee and charges $17 per visit. Represent both costs with rules.

Joining-fee gym: $C = 45 + 12v$.

No-fee gym: $C = 17v$.

QUESTION 6

A student claims, "If one line is above another at $x = 0$, it must stay above because both lines are straight." Correct the claim using rates of change.

The claim is false. If the lower line has a greater rate, it can catch and pass the other line. Straight lines can **intersect when their rates differ**.

QUESTION 7

Find where $A = 20 + 3x$ and $B = 8 + 5x$ are equal.

$20 + 3x = 8 + 5x$, so $12 = 2x$ and $x =$ **6**.

QUESTION 8

At $x = 10$, which is lower: $A = 20 + 3x$ or $B = 8 + 5x$?

$A = 50$ and $B = 58$, so **A is lower**.

QUESTION 9

Return to the two gym plans in Question 5. Lee says, "The no-fee gym is the better choice for everyone."

a) Find the number of visits for which the costs are equal.

b) Compare the costs for 6 visits and 15 visits. Decide when Lee's claim is true and when it is false.

a) $45 + 12v = 17v$, so $v =$ **9 visits**.

b) At 6 visits, the costs are $117 and $102, so the no-fee gym is cheaper. At 15 visits, the costs are $225 and $255, so the joining-fee gym is cheaper. Lee's claim is **false after 9 visits**.

Extrapolation and Limits of Prediction (Key)

Name Block Date

QUESTION 1

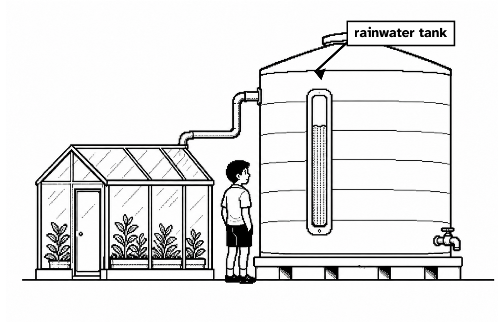
A wildlife team records the number of birds at a wetland each day from Monday through Saturday. It makes one estimate halfway between Wednesday and Thursday and another estimate two weeks later.

Which estimate requires the smaller assumption about the pattern continuing? Explain without calculating.

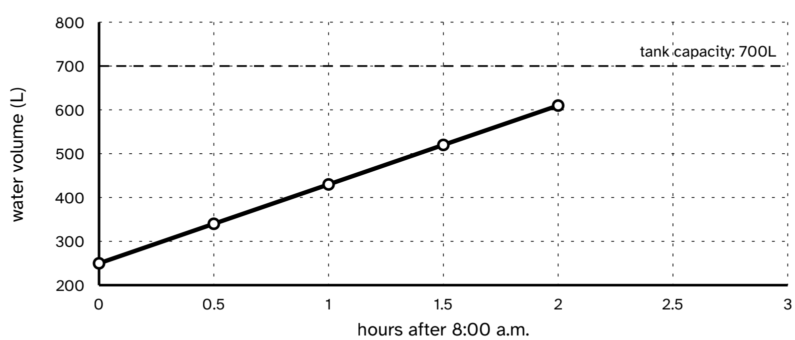
The halfway estimate requires the smaller assumption because it lies between recorded days. The estimate two weeks later assumes the pattern continues well beyond the data. The halfway estimate is **interpolation**.

QUESTION 2

A sensor records the volume of water in a school greenhouse tank. From 8:00 a.m. to 10:00 a.m., the pump fills the tank at a constant rate.



Time	8:00	8:30	9:00	9:30	10:00
Volume (L)	250	340	430	520	610



Determine the filling rate in litres per hour.

$\frac{610 - 250}{2}$ = **180 L per hour**.

QUESTION 3

School enrolment was 696 students in 2025. It had increased by 28 students each year from 2022 to 2025. Devon calculates $696 + 15(28) = 1116$ to predict the enrolment in 2040.

What part of Devon's calculation is correct? Why might the final prediction be wrong?

The arithmetic is correct: 2040 is 15 years after 2025, and $696 + 15(28) = 1116$.

The prediction assumes the recent increase continues unchanged for 15 more years. Enrolment may not follow that pattern, so **1116 is not guaranteed**.

QUESTION 4

A community room has the following rental costs. The relationship is linear for rentals from 1 to 6 hours.

Rental time (h)	1	3	5
Cost ($)	52	96	140

Determine a rule connecting rental time *h* and cost *C*.

The rate is $\frac{96-52}{3-1} = 22$. The initial cost is $52 - 22 = 30$, so $C = 30 + 22h$.

QUESTION 5

At 10:00 a.m., a phone battery is at 86%. During steady use, its charge decreases by 8 percentage points each hour. A linear model for *t* hours after 10:00 a.m. is

$$B = 86 - 8t$$

Predict the battery charge at 4:00 p.m.

4:00 p.m. is 6 hours after 10:00 a.m. $B = 86 - 8(6) =$ **38%**.

QUESTION 6

Two equipment-rental plans are modelled for *h* hours of use. The recorded rentals lasted between 0 and 5 hours.

$$A = 120 + 18h \qquad B = 60 + 25h$$

Before calculating, identify which plan starts lower and which plan increases faster.

Plan **B starts lower** at $60 and also **increases faster** at $25 per hour.

QUESTION 7

Data were collected for $1 \leq x \leq 5$. Is a prediction at $x = 3.5$ interpolation or extrapolation?

Because 3.5 lies inside the data interval, the prediction is **interpolation**.

QUESTION 8

The model $y = 80 - 6t$ reaches zero at what value of t?

$0 = 80 - 6t$, so $6t = 80$ and $t = \dfrac{40}{3} = 13\dfrac{1}{3}$.

QUESTION 9

Return to the rainwater tank in Question 2. Noor extends the constant-rate model to noon and predicts 970 L.

a) Verify Noor's calculation using the starting volume and filling rate.

b) Explain why 970 L is not a valid physical prediction.

c) Find the time when the model first reaches the tank's 700 L capacity.

a) Noon is 4 hours after 8:00 a.m., and $250 + 180(4) =$ **970 L**.

b) The tank can hold only 700 L, so the linear filling model must stop or change before noon.

c) $250 + 180t = 700$ gives $t = 2.5$ hours after 8:00 a.m., or **10:30 a.m.**

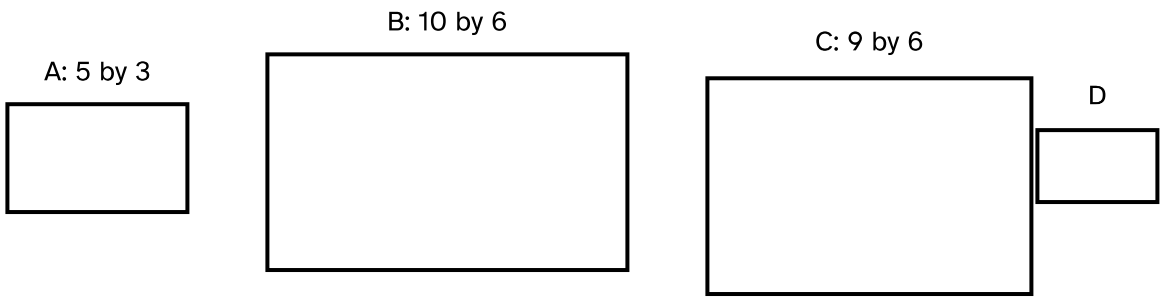
MATH 9 · SIMILARITY AND SCALE

What Similarity Preserves (Key)

Name Block Date

QUESTION 1

All four rectangles are larger or smaller versions of something, but which pairs keep the same shape? Decide before using the word *similar*.



Compare A with B and A with C using side-length ratios.

A to B: $\frac{10}{5} = \frac{6}{3} = \mathbf{2}$, so A and B are similar. A to C: $\frac{9}{5}$ is not equal to $\frac{6}{3}$, so A and C are **not similar**.

QUESTION 2

Corresponding position	1	2	3
Matching angle	40°	65°	75°
First side	4 cm	6 cm	8 cm
Corresponding side	6 cm	9 cm	12 cm

Show that one multiplier connects every pair of corresponding sides.

$\frac{6}{4} = \frac{9}{6} = \frac{12}{8} = \mathbf{1.5}$. Every corresponding side is multiplied by 1.5.

QUESTION 3

Two triangles have matching angles of 50°, 60°, and 70°. Are they similar?

Yes. All three pairs of corresponding angles are equal, so the triangles are similar.

QUESTION 4

Decide whether the claim is sufficient to prove that two figures are similar. Give a reason or counterexample.

They have the same area.

No. A 2 cm by 8 cm rectangle and a 4 cm by 4 cm square both have area 16 cm^2, but they are not similar.

QUESTION 5

Are these triangles similar? If they are, give the scale factor.

First triangle	Second triangle
Sides: 3, 4, 5	Sides: 9, 12, 15

$\frac{9}{3} = \frac{12}{4} = \frac{15}{5} = \mathbf{3}$, so the triangles are similar with scale factor **3**.

QUESTION 6

A student says, “Every pair of rectangles is similar because every rectangle has four right angles.”

What feature did the student identify correctly?

The student correctly identified that the **corresponding angles are equal**. The side lengths must also have one constant multiplier, so the full claim is false.

QUESTION 7

A photograph is 12 cm by 18 cm.

Can it be printed at 20 cm by 30 cm without changing the shape? Justify.

$\frac{20}{12} = \frac{30}{18} = \frac{5}{3}$. **Yes**, both dimensions use the same scale factor.

QUESTION 8

Lena says, “Two rectangles with the same perimeter must be similar.” She uses a 4 cm by 8 cm rectangle and a 5 cm by 7 cm rectangle.

Test Lena's claim. Use the dimensions to explain whether the rectangles are similar.

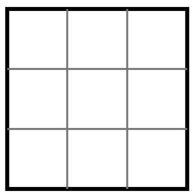
Both perimeters are **24 cm**, but the side ratios do not match: $\frac{5}{4}$ is not equal to $\frac{7}{8}$. The rectangles are **not similar**, so Lena's claim is false.

Scale Factors, Length, and Area (Key)

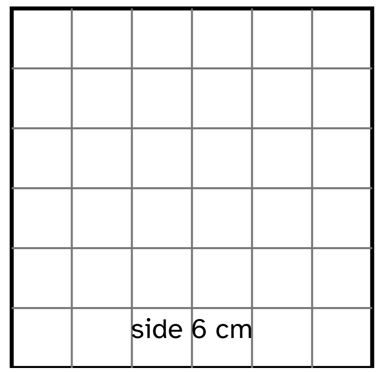
Name Block Date

QUESTION 1

A 3 cm square is enlarged to a 6 cm square. A student says, “The side doubled, so the area doubled.” Decide whether that must be true before using an area formula.



side 3 cm



side 6 cm

Count or calculate both areas.

The areas are 3^2 = **9 cm²** and 6^2 = **36 cm²**. The side factor is 2, but the area factor is **4.**

QUESTION 2

A triangle with the side lengths shown below is enlarged by a scale factor of 2.4.

5 cm	7 cm	9 cm

Find the new side lengths.

5(2.4) = **12 cm**, 7(2.4) = **16.8 cm**, and 9(2.4) = **21.6 cm**.

QUESTION 3

Find the missing length in the similar pair.

$$\frac{4}{10} = \frac{x}{25}$$

10x = 4(25), so x = **10**.

QUESTION 4

Complete the relationships.

Length factor	Perimeter factor	Area factor
0.5		
1.5		
3		
k		

Explain why perimeter and area do not respond in the same way.

Length factor	Perimeter factor	Area factor
0.5	0.5	0.25
1.5	1.5	2.25
3	3	9
k	k	k^2

Perimeter is a sum of lengths, so it uses k. Area has two length dimensions, so it uses k^2.

QUESTION 5

The area factor is 25. Find the positive length factor.

The positive length factor is $\sqrt{25}$ = **5**.

QUESTION 6

Two similar posters have areas 1800 cm^2 and 4050 cm^2.

Find the area factor from the first to the second.

$\frac{4050}{1800}$ = **2.25**.

QUESTION 7

Correct this claim.

A scale factor of 4 multiplies area by 8.

A length scale factor of 4 multiplies area by 4^2 = **16**, not 8.

QUESTION 8

Two similar posters have perimeters 48 cm and 72 cm. The smaller poster has area 80 cm^2.
Sami says, “The perimeter is multiplied by 1.5, so the area must also be multiplied by 1.5.”

Test Sami's claim and find the area of the larger poster.

The length factor is $\frac{72}{48}$ = 1.5, so the area factor is 1.5^2 = **2.25**. The larger area is 80(2.25) = **180 cm^2**. Sami's claim is false.

Scale Drawings and Maps (Key)

Name Block Date

QUESTION 1

A map shows two towns 6 cm apart. Without a scale, one student says the towns are 6 km apart and another says 60 km. Why can neither claim be justified? A scale of 1:250 000 is then provided.

Explain what the two numbers in the scale compare.

Without a scale, the map length cannot determine the actual distance. The scale compares **1 unit on the map with 250 000 of the same units in reality**.

QUESTION 2

Use the scale 1:50 000.

What actual distance is represented by 1 cm?

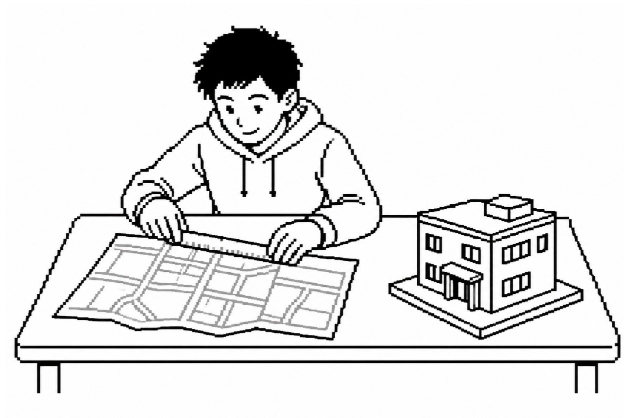
1 cm represents 50 000 cm = 500 m = **0.5 km**.

QUESTION 3

A classroom plan uses 1 cm to represent 0.8 m. The room is drawn 10.5 cm by 8 cm.

Find the actual dimensions.

10.5(0.8) = **8.4 m** and 8(0.8) = **6.4 m**.



QUESTION 4

Choose a useful scale for drawing a 12 m by 18 m community garden on letter-size paper. State the finished drawing dimensions and justify why the scale is practical.

One useful choice is **1 cm represents 2 m**. The drawing would be **6 cm by 9 cm**, which fits easily on letter-size paper and is large enough to label.

QUESTION 5

A model car is built at a scale of 1:24.

Real dimension	Length	Width	Height
Measurement	4.56 m	1.92 m	1.44 m

Find the model dimensions in centimetres.

The real dimensions are 456 cm, 192 cm, and 144 cm. Dividing each by 24 gives model dimensions **19 cm by 8 cm by 6 cm**.

QUESTION 6

Two floor plans show the same room. Plan A uses 1:100 and Plan B uses 1:50.

Which drawing is larger, and by what length factor?

Plan B uses twice as much drawing length for the same actual length, so **Plan B is larger by a length factor of 2**.

QUESTION 7

A map was drawn at a scale of 1:50 000 and then printed at 125% of its original size. Two locations are 10 cm apart on the enlarged print.

Maya uses 10 cm with the original scale and says the actual distance is 5 km.

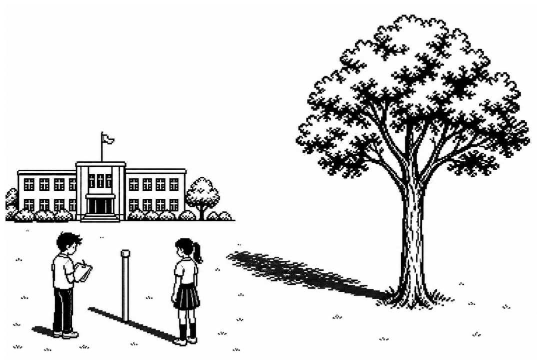
Test Maya's result. Find the actual distance and explain what she overlooked.

The original map distance was 10 cm at 125%, so at 100% it was $\frac{10}{1.25} = 8$ cm. At 0.5 km per centimetre, the actual distance is $8(0.5) =$ **4 km**. Maya overlooked the enlargement.

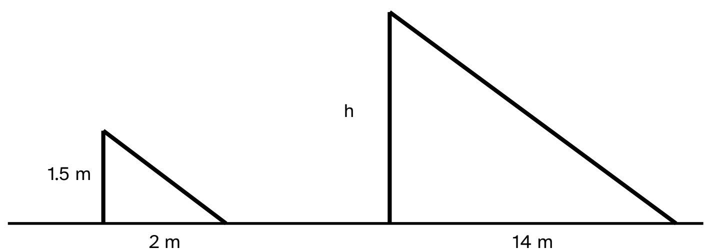
Indirect Measurement (Key)

Name Block Date

QUESTION 1



A tree is too tall to measure directly. At the same moment, a 1.5 m pole casts a 2 m shadow and the tree casts a 14 m shadow. Why should shadows reveal height at all?



Identify the matching angles that make the two right triangles similar.

Both triangles have a **right angle** where a vertical object meets level ground. The sunlight is parallel, so the **angles at the shadow tips are equal**.

QUESTION 2

A student measures the pole shadow at 9:00 a.m. and the tree shadow at noon. Explain why combining those measurements may fail even if both are accurate.

The Sun's angle changes between 9:00 a.m. and noon, so the two triangles may not have matching angles and may **not be similar**.

QUESTION 3

A mirror is placed on level ground 8 m from a building. A student stands 1.6 m from the mirror and can see the roof. The student's eye height is 1.7 m.

Explain why reflection creates equal angles. Then use similar triangles to calculate the building height.

The angle at which light reaches the mirror equals the angle at which it leaves. Therefore, $\frac{h}{8} = \frac{1.7}{1.6}$, so $h = 8\frac{1.7}{1.6}$ = **8.5 m**.

QUESTION 4

A photograph shows a person and a lighthouse standing on the same level ground. In the image, the 1.8 m person is 2.4 cm tall and the lighthouse is 38 cm tall.

Estimate the lighthouse height.

$\frac{1.8}{2.4} = \frac{h}{38}$, so $h = 38\frac{1.8}{2.4}$ = **28.5 m**.

QUESTION 5

A surveyor uses similar triangles to find the width of a river. A 4 m baseline corresponds to 10 m along the far bank, while a 7 m measurement corresponds to the unknown width *w*.

Write and solve a proportion.

$\frac{4}{10} = \frac{7}{w}$, so $4w = 70$ and w = **17.5 m**.

QUESTION 6

Correct this claim.

Any two shadows create similar triangles.

The claim is false. Shadow triangles are similar only when the light rays make the **same angle** and the objects meet comparable, usually level, ground.

QUESTION 7

At the same moment, a 1.5 m pole casts a 2 m shadow on level ground. A nearby tree casts a 12 m shadow down a sloping path. Erin uses the proportion from Question 1 and reports a tree height of 9 m.

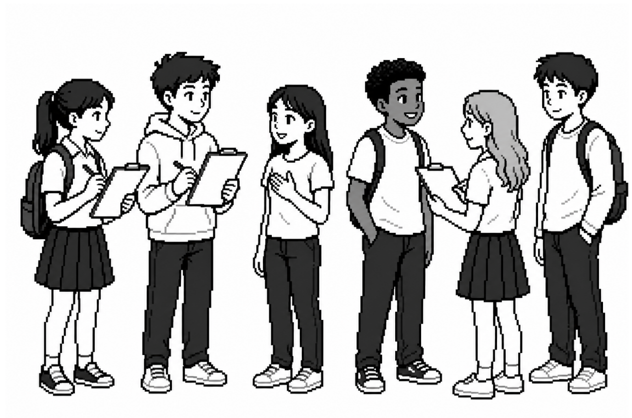
Decide whether Erin's result is justified. State what would need to be checked before using her proportion.

The arithmetic $1.5\frac{12}{2}$ = **9 m** is correct, but the result is **not justified**. The sloping path may change the triangle's ground angle. Erin must check that the pole and tree triangles have matching angles before using the proportion.

What Makes a Sample Trustworthy? (Key)

Name Block Date

QUESTION 1



A school wants to know whether students support a later start time. Two groups each ask 80 students.

Group	How students were chosen	Support later start
A	Students arriving before 8:00 a.m.	34%
B	Names chosen at random from the full student list	61%

Which sample better represents the whole school? Explain.

Group B better represents the school because every student on the full list had a chance to be selected. Group A excludes students who arrive later.

QUESTION 2

Why might a school use a sample instead of a census?

population	all 920 students at the school
sample	the 80 students who were asked
census	asking all 920 students

A sample takes **less time and fewer resources** than a census.

QUESTION 3

A recreation centre asks the first 50 people leaving the weight room about a new youth program. What group might this sample miss?

It may miss **young people who do not use the weight room**, including users of other facilities and youth who do not currently visit the centre.

QUESTION 4

Decide whether the question is neutral or leading. Rewrite it if it is leading.

How much do you enjoy our excellent new lunch menu?

It is **leading** because “excellent” pushes a positive response. A neutral version is: **“What is your opinion of the new lunch menu?”**

QUESTION 5

A music service asks only paying subscribers which features should remain free. It reports, “Users want fewer free features.”

Identify the population suggested by the word *users*.

The word *users* suggests the population is **everyone who uses the service**, including paying and free users.

QUESTION 6

A school has 400 Grade 9 students. Design a representative sample of 40 students.

Travel group	Bus	Walk	Driven
Students	220	120	60

How many students should come from each travel group?

The sample is one tenth of the population. Choose **22 bus students, 12 walkers, and 6 driven students**, using random selection within each group.

QUESTION 7

A student council posts a voluntary phone-policy poll to its social media followers. Of 600 responses, 78% oppose the policy. A separate random sample of 120 students finds that 46% oppose it.

Jae says, “The 600-person poll must be more trustworthy because it is larger.”

Test Jae's claim. Decide which result better represents the whole school and explain why.

The random sample is more trustworthy. The voluntary poll includes only followers who chose to respond, so it can overrepresent students with strong views. A larger biased sample does not become representative just because it is larger.

What Can an Average Hide? (Key)

Name Block Date

QUESTION 1

Two groups both have a mean score of 5.

Group A					Group B				
5	5	5	5	5	7	1	9	3	5

Verify that the means match. Compare the ranges and explain what the shared mean hides.

Both totals are 25, so both means are **5**. Group A has range **0**; Group B has range **8**. The mean hides how differently the scores are spread.

QUESTION 2

5	2	8	4	5	4	5

Calculate the mean, median, mode, and range.

In order: 2, 4, 4, 5, 5, 5, 8. Mean = $\frac{33}{7}$ = $\mathbf{4\frac{5}{7}}$; median = **5**; mode = **5**; range = **6**.

QUESTION 3

Five workers earn these hourly wages.

\$18	\$68	\$17	\$19	\$18

Find the mean and median. Which better describes a typical wage? Recalculate both without the \$68 wage.

Mean = $\frac{140}{5}$ = **\$28**; median = **\$18**. The median better describes a typical wage because \$68 pulls up the mean. Without \$68, both mean and median are **\$18**.

QUESTION 4

14	8	16	11	11

Find the mean, median, mode, and range.

In order: 8, 11, 11, 14, 16. Mean = **12**; median = **11**; mode = **11**; range = **8**.

QUESTION 5

A data set has a minimum of 3 and a range of 14. Find the maximum.

Maximum = 3 + 14 = **17**.

QUESTION 6

Two bus routes record travel times in minutes.

Route	Times				
C	20	19	21	20	20
D	25	10	30	20	15

Compare their means, medians, and ranges. Which route is more predictable?

Both means and medians are **20 minutes**. Route C has range **2 minutes**; Route D has range **20 minutes**. Route C is more predictable.

QUESTION 7

A headline says, “The average household has 2.4 children.” Explain what 2.4 means and give a possible data set for five households.

2.4 is the total number of children shared equally across the households; no household must have 2.4 children. One possible set is **1, 2, 2, 3, 4**.

QUESTION 8

Nora says, “Removing the greatest value from a data set always lowers the mean and median by the same amount.” Test her claim using this data.

6	4	21	5	4

Before removal, mean = **8** and median = **5**. Without 21, mean = **4.75** and median = **4.5**. The mean drops 3.25 while the median drops 0.5, so Nora's claim is false.

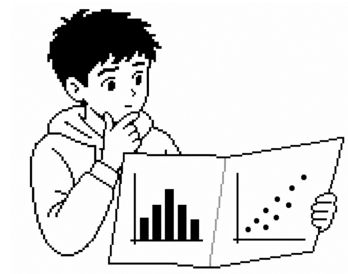
MATH 9 · STATISTICS IN SOCIETY

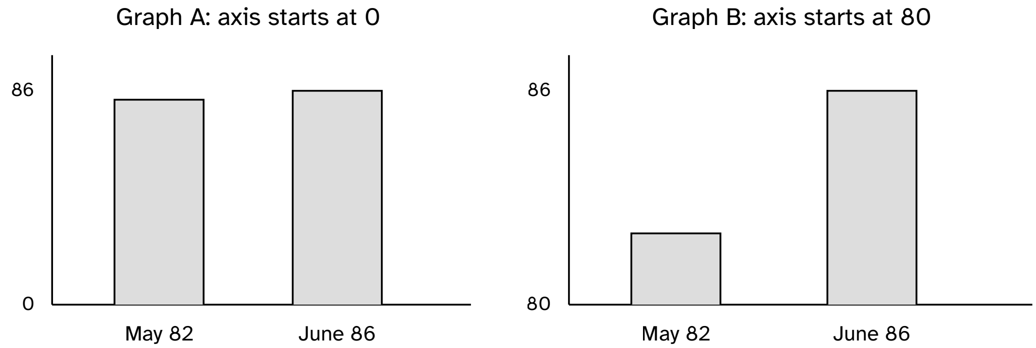
How Can a Graph Persuade You? (Key)

Name Block Date

QUESTION 1

A company's monthly rating rises from 82 to 86. Both graphs show the same data.





Which graph makes the change look larger?

Graph B makes the change look larger because its vertical axis begins at 80 and magnifies the 4-point difference.

QUESTION 2

A graph of school attendance has no title, no units, and categories labelled A, B, C, D.

List three questions that cannot be answered reliably.

What attendance measure is shown? What units or time period are used? Which groups do A, B, C, and D represent?

QUESTION 3

These are 12 students' commute times, in minutes.

14	8	20	10	26	13	9	18	12	19	10	11

Count how many times belong in each interval. Complete the table.

Time interval	5-9	10-14	15-19	20-24	25-29
Frequency					

Time interval	5-9	10-14	15-19	20-24	25-29
Frequency	2	6	2	1	1

QUESTION 4

A pictograph uses one full icon for 100 students. A category with 150 students is shown using two full icons.

Explain the error.

Two full icons represent 200 students. The category should use **1.5 icons** to represent 150 students.

QUESTION 5

A news graphic doubles both the height and width of a square icon to represent a value that doubled.

How does the icon's area change?

The area changes by 2^2 = **4 times**, so the graphic visually exaggerates the doubling.

QUESTION 6

Choose an effective display for each purpose and justify it.

Changes in temperature over 24 hours.

A **line graph** is effective because time is continuous and the connected points show how temperature changes through the day.

QUESTION 7

An infographic compares 40 participants in Program A with 60 participants in Program B. It uses a circle 4 cm in diameter for A and a circle 6 cm in diameter for B.

The designer says, “The diameter ratio matches the participant ratio, so the picture is fair.”

Test the designer's claim by comparing the data ratio with the circle-area ratio.

The data ratio is $\frac{60}{40}$ = **1.5**. The diameter factor is also 1.5, but the area factor is 1.5^2 = **2.25**. The Program B circle looks 2.25 times as large, so the picture exaggerates the difference.

Does the Evidence Support the Claim? (Key)

Name Block Date

QUESTION 1

A study finds that students who carry water bottles earn higher grades. A headline says, “Water bottles improve learning.”

What relationship did the study observe? Give another factor that could affect both variables, then write a fair headline.

The study found an **association**, not proof of cause. Attendance or organization could affect both. Fair headline: **“Students carrying water bottles had higher grades in this study.”**

QUESTION 2

A company tests a study app with 24 volunteers. Twelve use the app and twelve do not. The app group improves by 8 points; the other group improves by 5.

Find the difference in improvement. State information needed for a fair comparison, then write one supported conclusion and one conclusion that goes too far.

The improvement differs by **3 points**. Comparable starting scores and random assignment are needed. Supported: the app group improved more in this small study. Too far: the app guarantees an 8-point increase.

QUESTION 3

A survey reports 72% support for a park. The fine print says 50 of 300 invited residents responded.

How many respondents supported the park if the percentage was rounded to a whole number? Explain the response concern and write a more complete report.

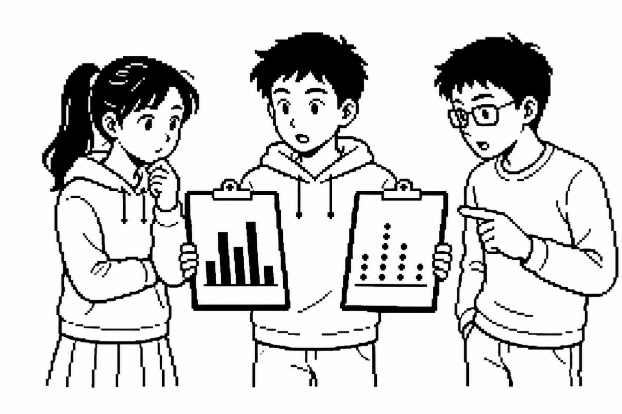
0.72(50) = **36 respondents**. The 250 non-respondents may hold different views. A fuller report says that 36 of the 50 respondents supported the park and only 50 of 300 invited residents replied.

QUESTION 4

For each source, identify one reason to trust it and one question or concern.

Source	Reason to trust	Question or concern
A city report with methods and raw counts		
An advertisement with no sources		
A clearly worded class survey using a convenience sample		

The city report can be checked, but ask how the sample was chosen. The advertisement gives no source to check. The class survey uses clear wording, but convenience selection limits which population it represents.



QUESTION 5

A survey invites 300 people and receives 90 replies. Find the response rate.

$\frac{90}{300}(100\%) = \mathbf{30\%}$.

QUESTION 6

Study A follows 2,000 people for one month. Study B follows 200 people for five years.

Which study has the larger sample? What can each study reveal better? List two other features to compare before deciding which evidence is stronger.

Study A has the larger sample. Study B can reveal longer-term patterns. Also compare how people were selected, what was measured, dropouts, group differences, and the analysis.

QUESTION 7

A school compares last year's Grade 9 math mark of 68% with this year's mark of 74% and credits a new timetable.

Calculate the change in percentage points and the relative percent increase. Give another possible explanation and one way to strengthen the claim.

The change is **6 percentage points**. The relative increase is $\frac{6}{68}(100\%) \approx \mathbf{8.8\%}$. The students, course, assessment, or attendance may differ. Random or carefully matched comparison groups would strengthen the claim.

QUESTION 8

An energy-drink company compares 40 athletes who chose to use its drink with 40 athletes who did not. The drink group completes a fitness course 5 seconds faster on average.

The company claims, “Our drink makes athletes faster.”

State what the evidence actually shows. Give one other explanation for the difference and describe a fairer study that could test the company's claim.

The study shows that the athletes who chose the drink were **5 seconds faster on average**; it does not prove the drink caused the difference. The drink users may have started fitter or trained more. A fairer test would randomly assign similar athletes to drink and comparison groups, keep other conditions alike, and compare their changes.

Why Do Equal Percents Not Cancel? (Key)

Name Block Date

QUESTION 1

A \$100 jacket rises in price by 20%, then the new price falls by 20%.

Find the final price. Why do the two changes not cancel?

\$100(1.20) = \$120, then \$120(0.80) = **\$96**. The 20% increase uses \$100 as its base, but the decrease uses \$120.

QUESTION 2

A monthly fee rises from \$40 to \$46.

Find the percent increase.

$\frac{\$46 - \$40}{\$40}(100\%) = \mathbf{15\%}$.

QUESTION 3

Find the percent increase from \$80 to \$100.

$\frac{\$100 - \$80}{\$80}(100\%) = \mathbf{25\%}$.

QUESTION 4

Find the percent decrease from $100 to $80.

$\frac{\$100 - \$80}{\$100}(100\%) = \mathbf{20\%}$.

QUESTION 5

A store's return rate falls from 8% of purchases to 5%.

Find the decrease in percentage points.

8% - 5% = **3 percentage points**.

QUESTION 6

Calculate percent change. State whether it is an increase or decrease.

$75 to $90

$\frac{\$90 - \$75}{\$75}(100\%) = \mathbf{20\%\ increase}$.

QUESTION 7

A phone plan rises 12% one year and 8% the next.

Starting at \$50, find the price after both increases.

\$50(1.12)(1.08) = **\$60.48**.

QUESTION 8

Correct this claim.

A price that doubles has increased by 200%.

If the original price is P, the increase is $2P - P = P$. The price has increased by **100%**.

QUESTION 9

A store discounts an item by 25%. Imani says, “Increasing the sale price by 25% will return the item to its original price.”

Test Imani's claim. Find the percent increase from the sale price needed to restore the original price.

Using \$100 as an example, the sale price is \$75. The needed increase is $\frac{\$100 - \$75}{\$75}(100\%) =$ $\mathbf{33\frac{1}{3}\%}$. Imani's claim is false because the increase uses the smaller sale price as its base.

MATH 9 · FINANCIAL LITERACY

What Does a Sale Price Really Cost? (Key)

Name Block Date

QUESTION 1

A $200 bicycle is 25% off and then taxed 12%. Three students make the predictions shown below.

$150	$168	$174

Explain the reasoning that might produce each prediction.

$150 ignores tax. **$174** subtracts 25% and adds 12% using $200 as the base for both. Correct: discount $50, sale price $150, tax $18, and final price **$168**.

QUESTION 2

Store A takes 30% off, then another 20% off. Store B takes 50% off once.

Test both offers on a $100 item. Which store costs less?

Store A: $100(0.70)(0.80) = **$56**, an overall 44% discount. Store B costs **$50**, so Store B costs less. Each Store A discount uses a new base.

QUESTION 3

Two cereal boxes cost $5.40 for 450 g and $7.20 for 750 g.

Find each cost per 100 g. Which has the lower unit price? Give one non-price factor that could affect the choice.

$\frac{\$5.40}{450}(100) = \mathbf{\$1.20\ per\ 100\ g}$. $\frac{\$7.20}{750}(100) = \mathbf{\$0.96\ per\ 100\ g}$, so the 750 g box has the lower unit price. Waste, storage, or preference could affect the choice.

QUESTION 4

Find the final cost with 12% tax.

$48 with no discount

$48(1.12) = **$53.76**.

QUESTION 5

A $90 item has two offers: 20% off or $15 off.

Which offer saves more? Find the price where the savings are equal, then state which offer is better above that price.

20% of $90 is **$18**, so 20% off saves more. The savings are equal when $0.20P = \$15$, giving $P =$ **$75**. Above $75, 20% off is better.

QUESTION 6

A receipt lists the following amounts.

Entry	Subtotal	Discount	Tax	Total
Amount	\$63.50	\$9.53	\$6.48	\$60.45

Find the discount rate and tax rate to the nearest whole percent. Verify the discounted subtotal and total.

Discount rate: $\frac{\$9.53}{\$63.50}(100\%) \approx$ **15%**. Discounted subtotal: \$63.50 - \$9.53 = **\$53.97**. Tax rate: $\frac{\$6.48}{\$53.97}(100\%) \approx$ **12%**. Total: \$53.97 + \$6.48 = **\$60.45**.

QUESTION 7

Three identical games cost \$24 each. Store A offers “buy two, get one free.” Store B takes 35% off all three games.

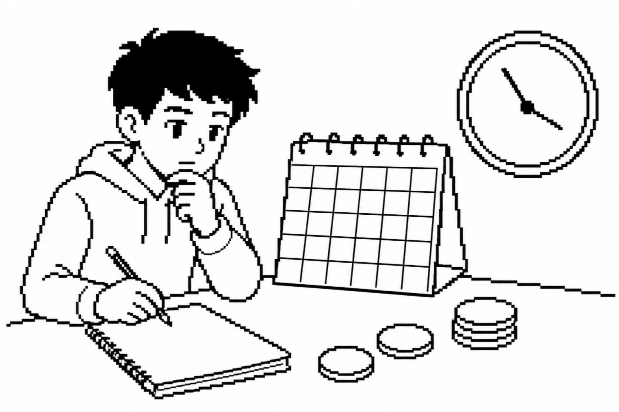
Which store has the lower total before tax? Explain why the larger-looking offer is not automatically the better one.

Store A costs 2(\$24) = **\$48**. Store B costs 3(\$24)(0.65) = **\$46.80**. **Store B** is cheaper. One free item out of three is a $33\frac{1}{3}\%$ discount, which is less than 35%.

Why Does Money Have a Cost Over Time? (Key)

Name Block Date

QUESTION 1



A lender charges \$5 each year for every \$100 borrowed. A student borrows \$600 for 3 years.

Find the yearly and total interest. State the yearly rate and describe how principal, rate, and time affect simple interest.

There are six \$100 groups, so the yearly interest is 6(\$5) = **\$30**. Total interest is 3(\$30) = **\$90**, at **5% per year**. More principal, a higher rate, or more time increases the interest.

QUESTION 2

Let P be the starting amount, r the yearly rate as a decimal, and t the time in years.

Explain why Pr gives one year's simple interest and why $I = Prt$ gives the interest after t years.

Multiplying P by r finds the stated fraction of the principal for one year. Simple interest uses the unchanged starting amount each year, so Pr is repeated t times: $I = Prt$.

QUESTION 3

Compare two $1,000 loans for 2 years.

Loan	Simple yearly rate	Fee
A	6%	$0
B	4.5%	$40

Find the interest, fees, and total repayment for each loan. Which loan costs less?

Loan A: $I = 1000(0.06)(2) = \$120$, so repayment is **$1,120**. Loan B: $I = 1000(0.045)(2) = \$90$; with the $40 fee, repayment is **$1,130**. Loan A costs less.

QUESTION 4

Find the simple interest on $1,200 at 4% per year for 2.5 years.

$I = 1200(0.04)(2.5) =$ **$120**.

QUESTION 5

Find the simple interest and final amount.

$800 at 5% per year for 4 years

$I = 800(0.05)(4) =$ **$160**. Final amount = $800 + $160 = **$960**.

QUESTION 6

Find the missing quantity.

$I = 90$, $P = 600$, and $t = 3$; find r.

$r = \frac{90}{600(3)} = 0.05 =$ **5%**.

QUESTION 7

For $I = 180$, $P = 1000$, and $r = 0.06$, find t.

$t = \frac{180}{1000(0.06)}$ = **3 years**.

QUESTION 8

A savings account uses simple interest of 4% per year on $1,500.

Make a table of total amount after 0, 1, 2, 3, and 4 years. Describe the pattern and identify the initial value.

Years	**0**	**1**	**2**	**3**	**4**
Amount	$1,500	$1,560	$1,620	$1,680	$1,740

The amount starts at **$1,500** and rises by a constant **$60 per year**.

QUESTION 9

Two simple-interest loans each lend $1,500. Loan X charges 4% per year with no fee. Loan Y charges 3% per year with a $60 fee.

Tariq says, “Loan Y is always cheaper because its rate is lower.”

Test Tariq's claim. Find when the total costs are equal and state which loan is cheaper before and after that time.

Loan X costs 60t$. Loan Y costs 45t$ + $60. Equal costs satisfy $60t = 45t + 60$, so t = **4 years**.
Loan X is cheaper before 4 years; Loan Y is cheaper after 4 years. Tariq's claim is false.

MATH 9 · FINANCIAL LITERACY

Can a Budget Make a Decision for You? (Key)

Name Block Date

QUESTION 1

Sam has $620 of monthly income and these planned costs.

Cost	Amount
Transit	$92
Phone	$55
Food	$180
Savings	$100
Entertainment	$145
Other	$70

Find the surplus or shortfall. Explain the purpose of the savings entry and propose one revision that balances the budget without reducing it.

Planned costs total **$642**, so the budget has a **$22 shortfall**. Savings protects a future goal or need. One revision is to reduce entertainment from $145 to **$123**.

QUESTION 2

Sam wants a $480 laptop. Compare three choices.

Choice	Terms
Save first	$80 per month
Borrow	8% simple interest for 1 year
Installments	12 payments of $43 plus a $25 fee

Find the time or total cost for each choice. Recommend one choice and state the tradeoff.

Saving takes **6 months**. Borrowing costs $38.40 interest, for **$518.40 total**. Installments cost 12($43) + $25 = **$541**. Saving costs least but delays the purchase; a recommendation may reasonably weigh cost against timing.

QUESTION 3

An emergency expense of $240 occurs.

If Sam has $600 saved, what percent of the savings is used?

$\frac{\$240}{\$600}(100\%) = \mathbf{40\%}$.

QUESTION 4

Classify the cost as fixed, variable, or occasional. Explain any answer that depends on the situation.

monthly transit pass

A monthly transit pass is usually a **fixed cost**. Paying separately for each trip would make transit a variable cost.

QUESTION 5

A credit offer advertises “Only $25 per month” for 24 months on a $500 purchase.

Find the total paid, the credit cost, and the percent extra paid compared with cash. What does the advertisement hide?

Total paid = 24($25) = **$600**. Credit cost = $600 - $500 = **$100**, which is **20% extra**. The advertisement hides the total cost and the 24-month commitment.

QUESTION 6

Correct this claim.

A balanced budget must spend every dollar.

A budget is balanced when planned uses do not exceed income. A surplus can be assigned to **savings or a future goal**; it does not have to be spent.

QUESTION 7

Lee has a $35 monthly budget surplus. A bicycle costs $500 cash, or 18 monthly payments of $32 plus a $24 fee.

Lee says, “The installment plan is affordable because $32 is less than my $35 surplus.”

Test Lee's claim. Compare the total costs and explain what the monthly surplus does and does not prove.

The installment total is 18($32) + $24 = **$600**, which is **$100 more** than cash. The payment fits the current surplus by only $3, so it leaves little room for changing costs or emergencies. The surplus shows the payment may fit now, but it does not prove the 18-month commitment is a sound choice.