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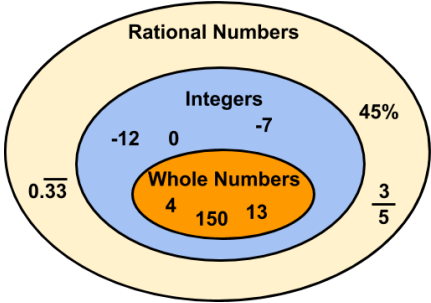
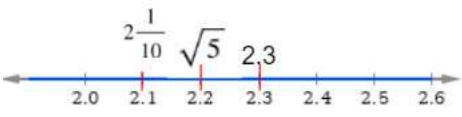
MATH

GRADE 8

Revision



Chapter 1: Real Numbers

<p>Rational and Irrational Numbers</p> <ul style="list-style-type: none"> Rational numbers are numbers that can be expressed as a fraction where the denominator is not equal to zero. <p>Examples: $2.1 = \frac{21}{10}$, $-2 = \frac{-2}{1}$, $4\frac{3}{8} = \frac{35}{8}$</p> <p>$45\% = \frac{45}{100} = \frac{9}{20}$</p>	
<ul style="list-style-type: none"> We use bar notation to write a repeating decimal 	<p>Examples: $0.41414141 \dots = 0.\overline{41}$, $0.333333 \dots = 0.\overline{3}$</p>
<ul style="list-style-type: none"> Write a fraction or mixed number as a decimal 	<p>Examples: $\frac{3}{8} = 3 \div 8 = 0.375$ $-2\frac{3}{10} = -\frac{23}{10} = -23 \div 10 = -2.3$</p>
<ul style="list-style-type: none"> Write a decimal as a fraction or mixed number 	<p>Example: <i>Write $3.\overline{24}$ as a mixed number:</i> $N = 3.242424 \dots$ $100N = 324.2424 \dots$ $100N - N = 324.2424 \dots = 3.242424 \dots$ $99N = 321$ $N = \frac{321}{99} = 3\frac{24}{99}$</p>
<ul style="list-style-type: none"> Irrational numbers are numbers that cannot be expressed as a ratio. 	<p>Examples: Decimals that do not terminate, but also do not have a repeating pattern, like $7.190233902\dots$, π, $\sqrt{11}$</p>
<ul style="list-style-type: none"> The set of real numbers is the set of rational numbers and irrational numbers. You can compare real numbers and show them on a number line. 	<p>Example: <i>Compare real numbers:</i> $\sqrt{5}$, $2\frac{1}{10}$, 2.3 Express all numbers as a decimal. $\sqrt{5} \approx 2.2$, $2\frac{1}{10} = 2.1$ $2.1 < 2.2 < 2.3$ So, $2\frac{1}{10} < \sqrt{5} < 2.3$ Here they are on a number line:</p> 

Powers and Exponents

<p>The base is 4</p> <p style="font-size: 2em; font-weight: bold;">4³</p> <p>The exponent is 3</p>	<p>Four to the third power</p> <p>The exponent tells you the number of times to multiply the base by itself.</p> <p style="font-size: 1.5em; font-weight: bold;">4³ = 4 · 4 · 4</p>
Write an expression using exponents →	$(-4) \cdot (-4) \cdot 5 \cdot 5 \cdot 5 = (-4)^2 \cdot 5^3$ $m \cdot n \cdot m \cdot n \cdot m \cdot m \cdot n = m^4 \cdot n^3$
Evaluate an expression that has an exponent →	$(-2)^3 = (-2) \cdot (-2) \cdot (-2) = -8$ $\left(\frac{1}{4}\right)^3 = \left(\frac{1}{4}\right) \cdot \left(\frac{1}{4}\right) \cdot \left(\frac{1}{4}\right) = \frac{1}{64}$
Substitute values for the variables , then evaluate →	$a^2 - b^3$ if $a = -0.5$ and $b = 3$ $a^2 - b^3 = (-0.5)^2 - (3)^3$ $= (-0.5)(-0.5) - (3 \cdot 3 \cdot 3)$ $= 0.25 - 27 = -26.75$

<p>Monomials</p> <ul style="list-style-type: none"> A monomial is an algebraic expression with only one term. 	$6a, -m^2,$ $5, 3x^2y$
<ul style="list-style-type: none"> Product of Powers <p>When multiplying monomials with the same base, keep the base and add the exponents.</p> $a^m \cdot a^n = a^{m+n}$	$7^2 \cdot 7^4 = 7^{4+2} = 7^6$ $-4b^2(-2b^3) = (-4)(-2)b^{2+3} = 8b^5$
<ul style="list-style-type: none"> Quotient of Powers <p>When dividing monomials with the same base, keep the base and subtract the exponents.</p> $\frac{a^m}{a^n} = a^{m-n}$	$\frac{x^{10}}{x^3} = x^{10-3} = x^7$ $\frac{35a^6}{-5a} = -7a^{6-1} = -7a^5$
<ul style="list-style-type: none"> Power of a Power <p>To find the power of a power, multiply the exponents.</p> $(a^m)^n = a^{m \cdot n}$	$(y^2)^5 = y^{2 \cdot 5} = y^{10}$ $(5^3)^2 = 5^{3 \cdot 2} = 5^6$ $[(4^2)^3]^5 = [4^6]^5 = 4^{30}$
<ul style="list-style-type: none"> Power of a Product <p>To find the power of a product, find the product of each factor raised to the power.</p> $(ab)^m = a^m \cdot b^m$	$(2x^2y^3)^3 = 2^3x^{2 \cdot 3}y^{3 \cdot 3} = 8x^6y^9$ $(-4m^5)^3 = (-4)^3m^{5 \cdot 3} = -64m^{15}$

<p>Scientific Notation</p> <ul style="list-style-type: none"> A number written as the product of a factor (greater than or equal to 1, and less than 10) and a power of 10. $a \times 10^n$ <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; text-align: center;"> $1 \leq a < 10$ </div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; text-align: center;"> n is an integer </div> </div>	$51,000 = 5.1 \times 10^4$ 5.1×10^4 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; text-align: center;"> <p style="color: red; margin: 0;">Factor</p> <ul style="list-style-type: none"> • greater than or equal to 1 • less than 10 </div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; text-align: center;"> <p style="color: blue; margin: 0;">Power of 10</p> <p style="margin: 0;">10 raised to a integer power</p> </div> </div>
<ul style="list-style-type: none"> How to write numbers in scientific notation 	$236,785 \rightarrow 2.36785 \times 10^5$ $0.00062 \rightarrow 6.2 \times 10^{-4}$
<ul style="list-style-type: none"> How to write numbers in standard form 	$3.2 \times 10^5 \rightarrow 320000$
<ul style="list-style-type: none"> Multiplying and dividing: Use the commutative and associative properties. 	$4 \times 10^3 \times 2 \times 10^6 = 8 \times 10^9$ $\frac{12 \times 10^{13}}{6 \times 10^5} = 2 \times 10^8$
<ul style="list-style-type: none"> Adding and subtracting: Rewrite one number so that both numbers have the same exponent. 	$5.1 \times 10^3 - 1.9 \times 10^2$ $= 5.1 \times 10^3 - 0.19 \times 10^3 = 4.91 \times 10^3$

<p>Roots</p> <ul style="list-style-type: none"> Finding square roots Every positive number has a positive and negative square root. $\text{If } a^2 = b, \quad \text{then } a = \pm\sqrt{b}$ 	$3^2 = 9, \quad \text{so } \pm 3 = \pm\sqrt{9}$ $\pm\sqrt{144} = \pm 12$ $-\sqrt{\frac{9}{25}} = -\frac{3}{5}$
<ul style="list-style-type: none"> Finding cube roots $\text{If } a^3 = b, \quad \text{then } a = \sqrt[3]{b}$ 	<p>Solve this equation: $m^3 = 64$</p> $m = \sqrt[3]{64}$ $m = 4$
<ul style="list-style-type: none"> Estimating Roots Use the perfect squares and perfect cubes you know to estimate the square root or cube root of a number that is not a perfect square or cube. 	<p>Estimate $\sqrt{70}$</p> <p>You know $8^2 = 64$ and $9^2 = 81$.</p> $64 < 70 < 81$ $8^2 < 70 < 9^2$ $\sqrt{8^2} < \sqrt{70} < \sqrt{9^2}$ $8 < \sqrt{70} < 9$ <p>70 is closer to 64 than 81, so the best integer estimate for $\sqrt{70}$ is 8.</p>

Chapter 1 Revision Questions

Rational Numbers

Write each fraction or mixed number as a decimal.

1. $\frac{3}{5}$

2. $\frac{5}{8}$

3. $-9\frac{11}{30}$

4. $-\frac{9}{32}$

Write each decimal as a fraction or mixed number in simplest form.

5. -0.8

6. 0.44

7. -1.35

8. Refer to the table on the right.

a. Express the fraction for Asian as a decimal.

b. Find the decimal equivalent for the fraction of the population that is African American.

c. Write the fraction for Hispanic as a decimal.

Population of Florida by Race	
Race	Fraction of Total Population
Asian	$\frac{1}{50}$
African American	$\frac{4}{25}$
Hispanic	$\frac{1}{5}$

11. Nuclear power provided 78% of the energy used in France in 2005. Write 0.78 as a fraction in simplest form.

Powers and Exponents

Write each expression using exponents.

1. $2 \cdot 2 \cdot 2 \cdot 2$

2. $c \cdot \frac{1}{4} \cdot c \cdot \frac{1}{4} \cdot \frac{1}{4}$

3. $s \cdot 6 \cdot s \cdot s \cdot 6 \cdot 6 \cdot s$

4. $8 \cdot x \cdot 2 \cdot 2 \cdot 2 \cdot x \cdot 8$

5. $a \cdot (-4) \cdot b \cdot a \cdot b \cdot (-4) \cdot (-4)$

6. $\frac{1}{3} \cdot n \cdot 4 \cdot n \cdot \frac{1}{3} \cdot n \cdot 4 \cdot 4$

Evaluate each expression.

7. 4^3

8. $(-8)^3$

Evaluate each expression if $g = 2$ and $h = -3$.

9. $(g + h)^3$

10. $h^4 - (h - g)^3$

11. A scientist estimates that after a certain amount of time, there would be $2^5 \cdot 3^3 \cdot 10^5$ bacteria in a Petri dish. About how many bacteria is this?

Multiply and Divide Monomials

1. $5^9 \cdot 5^3$

2. $3^8 \cdot 3$

3. $c \cdot c^6$

4. $(2h^7)(-7h)$

5. $\frac{a^4c^6}{a^2c}$

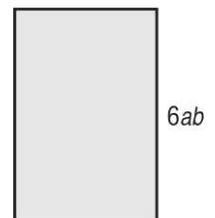
6. $\frac{4^8 \cdot 5^3 \cdot 7^6}{4^6 \cdot 5^2 \cdot 7^5}$

7. $3m^3n^2(8mn^3)$

8. $(3ab^2)(a^2c^5)$

9. After making a down payment, Mr. Mahmood will make 6^2 monthly payments of 6^3 dollars each to pay for his new car. What is the total of the monthly payments?

18. The area of the rectangle in the figure is $24a^2b^3$ square units. Find the width of the rectangle.



Powers of Monomials

Simplify.

1. $(9^4)^2$

2. $(d^7)^6$

3. $(m^5)^5$

4. $(z^7)^3$

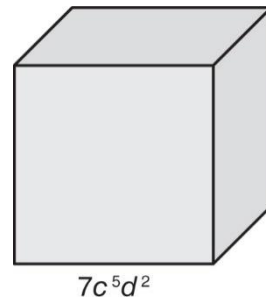
5. $(-5a^2b^7)^7$

6. $(2m^5g^{11})^6$

7. Express the area of the square as a monomial.



8. Express the volume of the cube as a monomial.



9. Alanood loves beads and wants to know which amount would be more, a thousand beads or $(6^2)^3$ beads?

Negative Exponents

Write each expression using a positive exponent.

1. 4^{-5}

2. 5^{-7}

3. m^{-9}

Write each fraction as an expression using a negative exponent.

4. $\frac{1}{12^3}$

5. $\frac{1}{81}$

6. $\frac{1}{t^6}$

7. A hospital spent 9^5 dirhams on new medical equipment this year. Last year, they spent 9^7 dollars. How many times more money did they spend last year than this year?

8. 1 milligram is equal to 10^{-3} grams. Write this number using a positive exponent.

Scientific Notation

Write each number in standard form.

1. 6.7×10^1

2. 6.143×10^4

7. 3.35×10^{-5}

8. 7.3×10^{-6}

Write each number in scientific notation.

9. 34

10. 273

13. 0.00916

14. 2,204,000,000

16. The table lists the populations of five countries. List the countries from least to greatest population.

Country	Population
Australia	2.4×10^7
Brazil	1.9×10^8
Egypt	7.7×10^7
Luxembourg	4.7×10^5
Singapore	4.4×10^6

Compute with Scientific Notation

Evaluate each expression. Express the result in scientific notation.

1. $(5.8 \times 10^5)(6.4 \times 10^2)$

2. $(3.92 \times 10^6)(2.2 \times 10^4)$

3. $\frac{2.952 \times 10^6}{3.6 \times 10^3}$

4. $\frac{2.052 \times 10^7}{5.4 \times 10^4}$

5. $(6.9 \times 10^7) + (2.12 \times 10^5)$

6. $(1.78 \times 10^4) + (5.35 \times 10^3)$

7. $(8.4 \times 10^7) - (6.3 \times 10^6)$

8. $(9.62 \times 10^5) - (2.58 \times 10^3)$

16. The diameter of Mars is about 6.8×10^3 kilometers. The diameter of Earth is about 1.2763×10^4 kilometers. About how much greater is Earth's diameter than the diameter of Mars?

Roots

Find each square root or cube root.

1. $\sqrt{16}$

2. $-\sqrt{9}$

3. $\sqrt{36}$

6. $\sqrt[3]{729}$

7. $-\sqrt{0.04}$

8. $\sqrt{-289}$

ALGEBRA Solve each equation. Check your solution(s).

9. $900 = y^2$

10. $1024 = h^2$

11. $c^2 = \frac{49}{64}$

16. Hessa has 196 pepper plants that she wants to plant in square formation. How many pepper plants should she plant in each row?

Estimate Roots

Estimate to the nearest integer.

1. $\sqrt{5}$

2. $\sqrt{18}$

3. $\sqrt{80}$

4. $\sqrt[3]{510}$

5. $\sqrt[3]{999}$

6. $\sqrt[3]{119}$

7. $\sqrt{77}$

8. $\sqrt{171}$

9. $\sqrt{230}$

10. The formula $s = \sqrt{18d}$ can be used to find the speed s of a car in miles per hour when the car needs d feet to come to a complete stop after slamming on the brakes. If it took a car 12 feet to come to a complete stop after slamming on the brakes, estimate the speed of the car, to the nearest integer.

11. The formula for the area of a square is $A = s^2$, where s is the length of a side. Estimate the length of a side for each square.

Area =
40 square
inches

Compare Real Numbers

Name all sets of numbers to which each real number belongs.

1. $\frac{8}{4}$

2. $9.\bar{3}$

3. $\sqrt{5}$

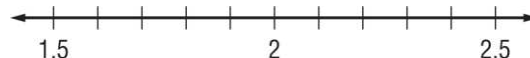
Replace each \bullet with $<$, $>$, or $=$ to make a true statement.

4. $1.7 \bullet \sqrt{3}$

5. $\sqrt{6} \bullet 2\frac{1}{2}$

Order each set of numbers from least to greatest. Verify your answer by graphing on a number line.

6. $1.84, \sqrt{5}, \frac{5}{2}, 2.3, \sqrt{3}$



7. The *geometric mean* of two numbers a and b is \sqrt{ab} . Find the geometric mean of 32 and 50.

8. If the area of a square is 33 square centimeters, which is greater: the length of a side of the square to the nearest tenth of a centimeter or $\sqrt{40}$?

Chapter 2: Expressions and Equations

<p>Solving equations with rational coefficients (fractions and decimals).</p> <ul style="list-style-type: none"> For fraction coefficients use the multiplicative inverse. The multiplicative inverse of $\frac{a}{b}$ is $\frac{b}{a}$. When you multiply them you get 1. For decimal coefficients, divide both sides by the decimal. Check the solution by substituting into the original equation. 	<p><u>Example:</u> Solve $\frac{2}{3}x = 10$. Multiply both sides by $\frac{3}{2}$.</p> $\left(\frac{3}{2}\right) \cdot \left(\frac{2}{3}\right)x = \left(\frac{3}{2}\right) \cdot \left(\frac{10}{1}\right)$ $\left(\frac{\cancel{3}^1}{\cancel{2}_1}\right) \cdot \left(\frac{\cancel{2}^1}{\cancel{3}_1}\right)x = \left(\frac{3}{2}\right) \cdot \left(\frac{10}{1}\right)$ $x = \frac{30}{2} = 15$ <p>Check: $\frac{2}{3}(15) \stackrel{?}{=} 10$ $\frac{30}{3} = 10 \checkmark$</p> <p>Solve $-2.5x = 50$. Divide both sides by -2.5</p> $\frac{-2.5x}{-2.5} = \frac{50}{-2.5}$ $x = -20$ <p>Check: $-2.5(-20) \stackrel{?}{=} 50$ $50 = 50 \checkmark$</p>
<p>Two-step equations</p> <ul style="list-style-type: none"> Do two operations to isolate the variable. 	<p><u>Example:</u> Solve $3x - 2 = 13$ The two operations are multiplication and subtraction. Do the opposite operations. First, add 2 to both sides:</p> $3x - 2 + 2 = 13 + 2$ $3x = 15$ <p>Next, divide both sides by 3.</p> $\frac{3x}{3} = \frac{15}{3}$ <p>You get: $x = 5$</p> <p>Check: $3(5) - 2 \stackrel{?}{=} 13$ $15 - 2 = 13 \checkmark$</p>
<p>Write two-step equations</p> <ul style="list-style-type: none"> Read the description carefully. Define the variable. Translate the key math terms (quotient, less than, the same as, ...) into symbols (\div, $-$, $=$, ...) in an equation. 	<p><u>Example:</u> <i>One more than the quotient of a number and three is equal to five.</i> Let a be the number. (Choose any variable you like.) Quotient of a number and three: $\frac{a}{3}$ One more than that: $\frac{a}{3} + 1$ Is equal to five: $\frac{a}{3} + 1 = 5$</p> <p>This equation, $\frac{a}{3} + 1 = 5$, can be solved in two steps.</p>

Solve equations with variables on both sides

- Use the properties of equality to bring all terms with variables to one side.
- Then isolate that variable.

Example: Solve $\frac{5}{8}m + 1 = \frac{1}{4}m - 8$

Subtract 1 from both sides:

$$\begin{aligned}\frac{5}{8}m + 1 - 1 &= \frac{1}{4}m - 8 - 1 \\ \frac{5}{8}m &= \frac{1}{4}m - 9\end{aligned}$$

Subtract $\frac{1}{4}m$ from both sides.

$$\frac{5}{8}m - \frac{1}{4}m = \frac{1}{4}m - 9 - \frac{1}{4}m$$

Convert $\frac{1}{4}$ to $\frac{2}{8}$ so you can subtract.

$$\begin{aligned}\frac{5}{8}m - \frac{2}{8}m &= -9 \\ \frac{3}{8}m &= -9\end{aligned}$$

Multiply both sides by $\frac{8}{3}$.

$$\begin{aligned}\left(\frac{8}{3}\right)\frac{3}{8}m &= \left(\frac{8}{3}\right)(-9) \\ m &= -24\end{aligned}$$

Check your answer by substituting -24 into the original equation.

Solve multi-step equations

- When you see parentheses in an equation use the **distributive property**.

$$a(b + c) = a \cdot b + a \cdot c$$

Example:

Solve $10 - n = 2(3n - 16)$

First, use the distributive property on the right hand side.

$$10 - n = 6n - 32$$

Bring the variable terms together on one side.

$$10 - n + n = 6n + n - 32$$

$$10 = 7n - 32$$

$$10 + 32 = 7n - 32 + 32$$

$$42 = 7n$$

Divide both sides by 7 to isolate the variable, n .

$$\frac{42}{7} = \frac{7n}{7}$$

$$6 = n$$

Remember to check the solution by substituting back into the original equation.

Check: $10 - n = 2(3n - 16)$

$$10 - 6 \stackrel{?}{=} 2(3(6) - 16)$$

$$4 \stackrel{?}{=} 2(18 - 16)$$

$$4 \stackrel{?}{=} 2(2)$$

$$4 = 4 \checkmark$$

Solve Equations with Rational Coefficients

Solve each equation. Check your work.

1. $\frac{1}{8}x = 5$

2. $\frac{8}{9}p = \frac{12}{18}$

3. $0.3v = 1.35$

4. $-2.3f = 9.2$

Define a variable. Then write and solve an equation for each situation.

5. In the eighth grade, 322 students come to school by bus. This is $\frac{7}{10}$ of the total number of students in the eighth grade. How many students are in the eighth grade?

6. Rashid is going on holiday. He budgeted AED 1125 for food and drink. This is 0.45 of his total budget. How much does Rashid have in his total budget?

Solve Two-Step Equations

Solve each equation. Check your solution.

1. $3n + 4 = 7$

2. $9 = 2s + 1$

3. $-5 = 3m - 14$

4. $5 = 9 - 2x$

5. Ms. Noura shops at a store that has an annual membership fee of AED 30. Today she paid her annual membership and bought several fruit baskets costing AED 15 each as gifts for her coworkers. Her total was AED 105. Solve the equation $15b + 30 = 105$ to find the number of fruit baskets Ms. Noura purchased.
6. Latifa bought 5 reams of paper at the store for a total of AED 21. The tax on her purchase was AED 1. Solve $5x + 1 = 21$ to find the price for each ream of paper.

Write Two-Step Equations

Translate each sentence into an equation.

1. Four more than twice a number is 8.
2. Seven less than the quotient of a number and 2 is 10.

Define a variable. Then write and solve an equation to find each number.

3. The difference between 5 times a number and 3 is 12.
4. Eight more than the quotient of a number and 5 is 3.
5. Khalid bought a canvas and 8 tubes of paint for AED 84.95. If the canvas cost AED 36.95, how much did each tube of paint cost?
6. Three consecutive integers can be represented by n , $n + 1$, and $n + 2$. If the sum of three consecutive integers is 57, what are the integers?

Solve Equations with Variables on Each Side

Solve each equation. Check your solution.

1. $8c = 5c + 21$

2. $a + 18 = 7a$

3. $4x - 9 = 6x - 13$

4. $5c - 15 = 2c + 6$

Write and solve an equation to solve each exercise.

5. Jassim has 45 CDs in his collection, and Majed has 61. If Jassim buys 4 new CDs each month and Majed buys 2 new CDs each month, after how many months will Jassim and Majed have the same number of CDs?

6. The Star Shipping Company charges AED 14 plus AED 2 per kilogram to ship an overnight package. Discount Shipping Company charges AED 20 plus AED 1.50 per kilogram to ship an overnight package. For what weight is the charge the same for the two companies?

Solve Multi-Step Equations

Solve each equation. Check your solution.

1. $4(2 + 3c) = 56$

2. $63 = -3(1 - 2n)$

3. $-29 = 5(2a - 1) + 2a$

4. $-4(2 - y) + 3y = 3(y - 4)$

5. Two cyclists leave town at the same time on the same road going in the same direction. Cyclist *A* is going 6 miles per hour faster than cyclist *B*. After 8 hours, cyclist *A* has traveled three times the distance as cyclist *B*. Use the equation $24x = 8(x + 6)$ to find how fast cyclist *B* is traveling.

6. Huda sells coffee on the beach. She charges AED 15 for a regular cappuccino but charges AED 5 more if she uses almond milk. Last week she made 5 more almond cappuccinos than regular cappuccinos. If she made AED 415 last week, how many regular cappuccinos did she sell?

Chapter 3: Equations in Two Variables

Constant rate of change

A **linear relationship** follows this rule:

$$\frac{\text{change in } y}{\text{change in } x} = \text{constant}$$

Linear relationships show a **constant rate of change**.

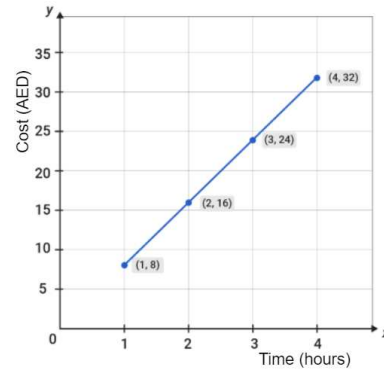
One quantity is changing constantly in relation to another quantity.

Liters of paint needed to make a mixture of pink paint	
Red (liters), x	White (liters), y
2	5
4	10
6	15
8	20

Red arrows on the left indicate a change of +2 in x for each step. Blue arrows on the right indicate a change of +5 in y for each step.

$\frac{\text{change in } y}{\text{change in } x} = \frac{5}{2}$ for each line. This table shows a linear relationship with a constant rate of change.

This graph also shows a constant rate of change



Choose two points, e.g. (4, 32) and (1, 8):

$\frac{\text{change in } y}{\text{change in } x} = \frac{32-8}{4-1} = \frac{24}{4} = 6$ for each pair of points. When the points are joined together they form a straight line.

If you extend this line it does not pass through the origin (0, 0) so the relationship is **not proportional**.

Slope

To find the slope divide the vertical change (the **rise**) by the horizontal change (the **run**).

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

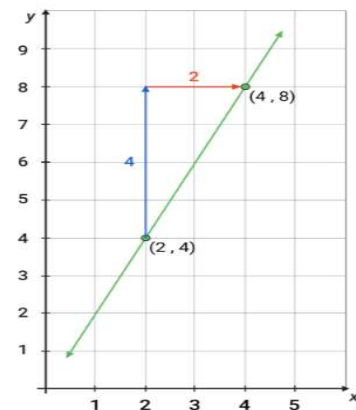
or

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

You can find slope by using points from a table or from a graph.

In this graph, you have two points, (2, 4) and (4, 8).

$$\begin{aligned} \text{slope} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{8-4}{4-2} = \frac{4}{2} = 2 \end{aligned}$$



Find the slope of the linear relationship in this table:

Number of Employees, x	0	3	6	9
Number of Hours, y	6	11	16	21

Use any two points, e.g. (6, 16) and (9, 21).

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{21 - 16}{9 - 6} = \frac{5}{3}$$

Equations in $y = mx$ form

- An equation written in the form, $y = mx$, represents a linear relationship that is a **direct variation**.
- The slope, m , is the **constant of variation**.
- $m = \frac{y}{x}$
- The graph of a direct variation always goes through the origin $(0, 0)$.

Q Can you write a direct variation equation if you have an x -value and y -value?

✓ Yes. For example:

*A hot-air balloon rises 1,110 m in 5 minutes.
Write and solve a direct variation equation to find how high it rises in 7 minutes.*

$$y = mx, \text{ so } m = \frac{y}{x} = \frac{1,110}{5} = 222$$

The direct variation equation is $y = 222x$.

How high will the balloon rise in 7 minutes?

Substitute:

$$y = 222x$$

$$y = 222(7)$$

$$y = 1,554$$

The hot-air balloon rises 1,554 m in 7 minutes.

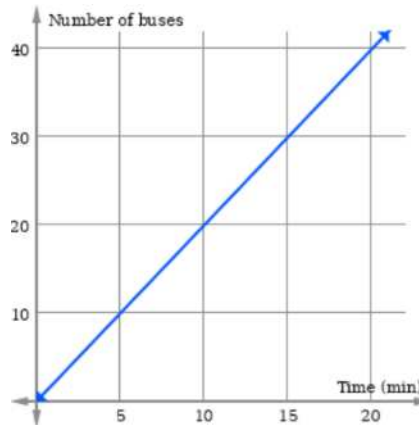
Example 1: Determine if the linear function represented in this table is a direct variation.

Age, x	8	9	10	11
Grade, y	3	4	5	6

$$m = \frac{y}{x} = \frac{3}{8} \quad m = \frac{y}{x} = \frac{4}{9} \quad m = \frac{y}{x} = \frac{5}{10} = \frac{1}{2}$$

The value of m is different each time, so this is not a direct variation.

Example 2: This graph below shows a direct variation. It passes through $(0, 0)$. Find the constant of variation.



Use one point, for example $(15, 30)$.

$$m = \frac{y}{x} = \frac{30}{15} = 2$$

This is the **slope** of the line.

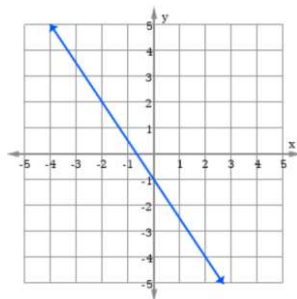
There are two buses each minute.

Slope-intercept form

$$y = mx + b$$

slope \uparrow \uparrow y-intercept

You can look at a graph and write the equation.



The y-intercept is -1 .

So, $b = -1$

Find one more point

on the line, for example $(2, -2)$.

From $(0, -1)$ to $(2, -2)$ the rise is 3 and the run is -2 .

The slope is $\frac{3}{-2} = -\frac{3}{2}$. So, $m = -\frac{3}{2}$.

The equation of the line is $y = -\frac{3}{2}x - 2$.

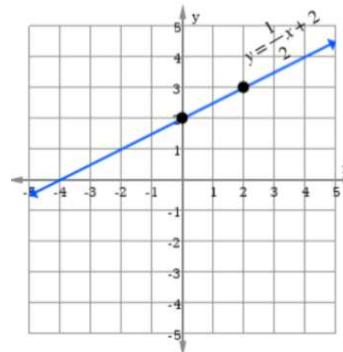
Example 1: Graph a line with a slope of $\frac{1}{2}$ and a y-intercept of 2 .

First, plot the y-intercept at $(0, 2)$.

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{1}{2}$$

From that point, rise 1 and run 2 . Plot another point.

with

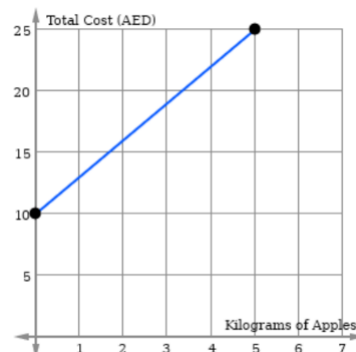


line.

Join them an extended straight

- In a real-life problem, the y-intercept represents the **initial value** and the slope represents the **rate of change**.

Example 2:
Hamad buys apples for AED 3 per kilogram. The shop charges a delivery fee. Find the slope and interpret the y-intercept.



The rate of change, AED 3 per kilogram, is the slope. So, $m = 3$. The y-intercept is the delivery charge of AED 10.

The equation of the line is $y = 3x + 10$

Graph a line using intercepts

- To find the **x-intercept** let $y = 0$.
- To find the **y-intercept** let $x = 0$.
- Use the two intercepts to graph the line.
- A **standard form** equation is written $Ax + By = C$, where $A \geq 0$ and A, B and C are integers

You can interpret the x- and y-intercepts of a standard form equation:

*You have AED 240 to buy gifts.
 A box of chocolates, x , costs AED 40. A basket of fruit, y , costs AED 60.
 This can be represented by the equation $40x + 60y = 240$.*

You can find that the x-intercept is at $(6, 0)$, and the y-intercept is $(0, 4)$.

This means you can buy 6 boxes of chocolates and zero baskets of fruit for AED 240.

Or, you can buy zero boxes of chocolate and 4 baskets of fruit for AED 240.

Example 1: Find the x- and y-intercepts of the equation. Use them to graph the equation.

$$y = \frac{2}{3}x - 4$$

x-intercept: put $y = 0$

$$0 = \frac{2}{3}x - 4$$

$$4 = \frac{2}{3}x$$

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

$$6 = x \quad \text{The x-intercept is at } (6, 0).$$

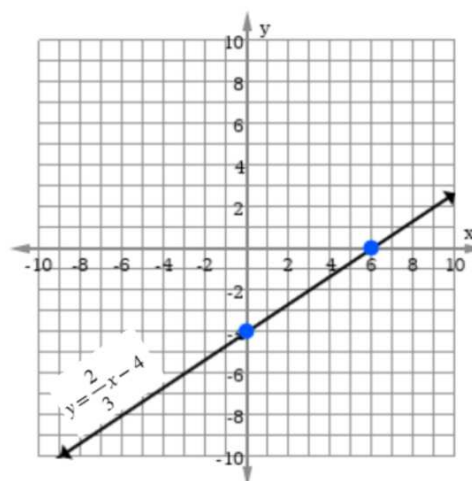
y-intercept: put $x = 0$

$$y = \frac{2}{3}(0) - 4$$

$$y = 0 - 4$$

$$y = -4 \quad \text{The y-intercept is at } (0, -4).$$

Plot the two points and join them with a straight line.



Write linear equations

- **Point-slope** form

$$y - y_1 = m(x - x_1)$$

m is the slope of the line, (x_1, y_1) is a point on the line.

- **Slope-intercept** form

$$y = mx + b$$

m is the slope and b is the y-intercept.

Q. How do I know which form to use?

- ✓ If you are given a point and the slope, use the point-slope form.
- ✓ If you are given the slope and the y-intercept, use the slope-intercept form.
- ✓ If you are given two points, use $m = \frac{y_2 - y_1}{x_2 - x_1}$ to find the slope. Then use the point-slope form.

Example 1:

Write an equation of a line that passes through $(8, -1)$ and has a slope of $\frac{1}{2}$.

$$(x_1, y_1) = (8, -1) \text{ and } m = \frac{1}{2}$$

$$y - y_1 = m(x - x_1)$$

$$y - -1 = \frac{1}{2}(x - 8)$$

$$\boxed{y + 1 = \frac{1}{2}(x - 8)}$$
 This is in point-slope form.

$$y + 1 = \frac{1}{2}x - 4$$

$$\boxed{y = \frac{1}{2}x - 5}$$
 This is in slope-intercept form.

Example 2:

Write an equation of the line that passes through $(2, 3)$ and $(5, 5)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 3}{5 - 2} = \frac{2}{3}$$

$$y - y_1 = m(x - x_1)$$

$$\boxed{y - 3 = \frac{2}{3}(x - 2)}$$
 Point-slope form

$$y - 3 = \frac{2}{3}x - \frac{4}{3}$$

$$\boxed{y = \frac{2}{3}x + \frac{5}{3}}$$
 Slope-intercept form.

Solve systems of equations by graphing

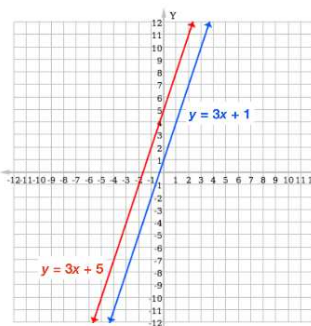
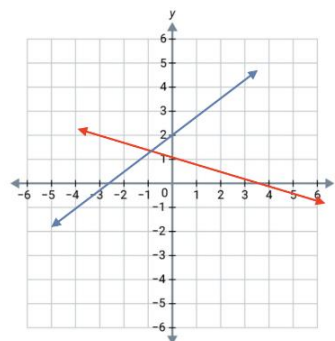
- A system of equations is two or more equations that have the **same variables** (usually x and y).
- When you are asked to **solve** a system of equations you are looking for a **point of intersection** of the two graphs.
- Draw graphs of both lines and look for a point of intersection.

Q. How do I know how many solutions a system of equations has?

- ✓ If the lines have **different slopes**, they intersect at one point. There is **one** solution.
- ✓ If the lines have the **same slopes** and different y-intercepts, they are parallel and do not intersect. There is **no** solution.

Different slopes.

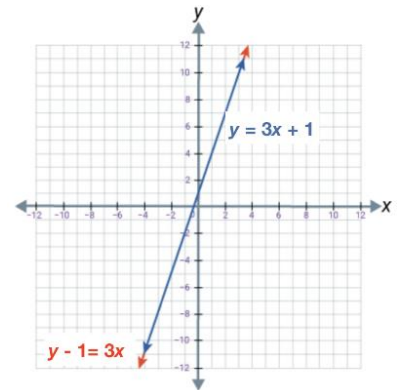
One solution
(the point of intersection).



Same slopes,
different y-
intercepts.
No solution.

- ✓ If the lines are laying on top of each other, they are the **same line**. There are an **infinite number** of solutions.

Same line.
Infinite number of solutions.



Solve systems of equations algebraically

- Instead of graphing the two equations you can use **substitution** to find the point of intersection (if any).

Example 1:

Solve this system of equations:

Equation 1: $y = -2x - 6$

Equation 2: $y = 4x$

Substitute the y -value in **equation 1** into equation 2, then solve for x .

$$4x = -2x - 6$$

$$4x + 2x = -6$$

$$6x = -6$$

$$\boxed{x = -1}$$
 This is the x -value of the solution.

Substitute this x -value into **equation 2** and solve for y .

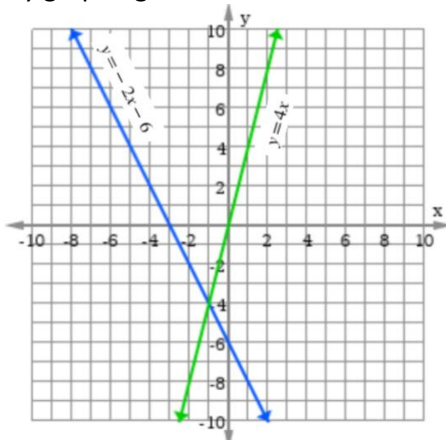
$$y = 4x$$

$$y = 4(-1)$$

$$\boxed{y = -4}$$
 This is the y -value of the solution.

The solution is $(-1, -4)$.

Check by graphing:



You can see the point of intersection is $(-1, -4)$.

- You can solve real-world problems with this method.

Example 2:

Hessa made cheese rolls and zaatar rolls for her class. In total there were 28 rolls. She made three times as many cheese rolls as zaatar rolls.

Write and solve a systems of equations for this situation.

First, let x = number of cheese rolls, and y = number of zaatar rolls.

Equation 1: $x + y = 28$, because the total is 28.

Equation 2: $y = 3x$, because there were three times as many cheese rolls as zaatar rolls.

Substitute $y = 3x$ into **equation 1**.

$$x + y = 28$$

$$x + 3x = 28$$

$$4x = 28$$

$$\boxed{x = 7}$$

Substitute this x -value into **equation 2** and solve for y .

$$y = 3x$$

$$y = 3(7)$$

$$\boxed{y = 21}$$

The solution is $(7, 28)$.

This means Hessa made 7 cheese rolls and 21 zaatar rolls.

You can check by graphing.

Constant Rate of Change

Determine whether the relationship between the two quantities described in each table is linear. If so, find the constant rate of change. If not, explain your reasoning.

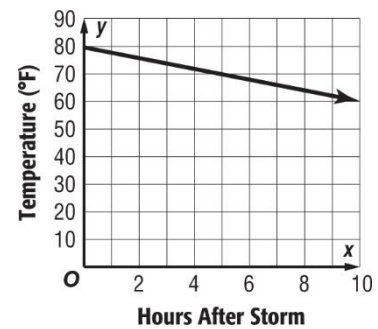
1.

Hours Spent Babysitting	Money Earned (AED)
1	10
3	30
5	50
7	70

2.

Number of Trees	Number of Apples
5	100
10	120
15	150
20	160

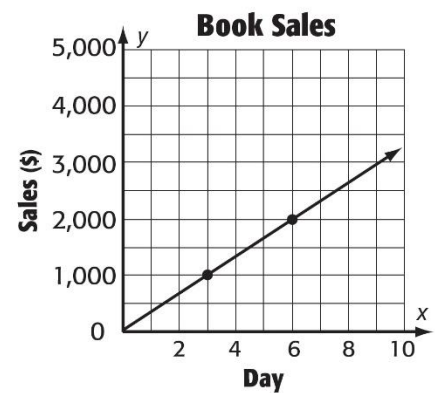
3. Determine whether a proportional relationship exists between the two quantities shown in this graph. Explain your reasoning.



4. Look at the graph showing book sales in a book store.

a. Find the constant rate of change and interpret its meaning.

b. Determine whether a proportional linear relationship exists between the two quantities shown in the graph. Explain your reasoning.



Slope

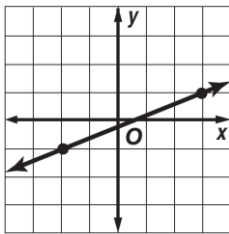
Find the slope of the line that passes through each pair of points.

1. $A(-2, -4), B(2, 4)$

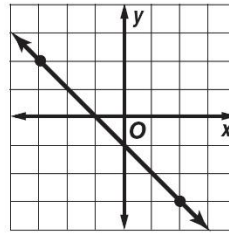
2. $E(3, 4), F(4, -2)$

Find the slope of each line.

3.

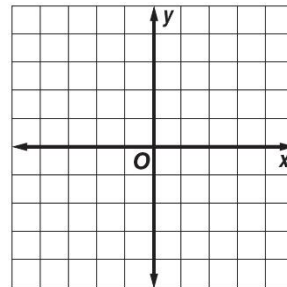


4.



5. The points given in this table lie on a line. Find the slope of the line. Then graph the line.

x	-1	1	3	5
y	-2	0	2	4



Equations in $y = mx$ Form

For Exercises 1 and 2, determine whether each linear function is a direct variation. If so, state the constant of variation.

1.

Price, x	AED 5	AED 10	AED 15	AED 20
Tax, y	AED 0.41	AED 0.82	AED 1.23	AED 1.64

2.

Hours, x	11	12	13	14
Distance, y (miles)	154	167	180	193

3. If y varies directly with x , write an equation for this direct variation: $y = -5$ when $x = 2$.
Then find y when $x = 8$.

4. The power absorbed by a solar panel varies directly with its area. If an 8 square meter panel absorbs 8,160 watts of power, how much power does a 12 square meter solar panel absorb?

Slope-Intercept Form

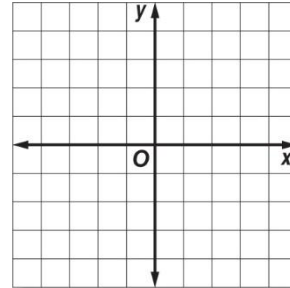
State the slope and the y-intercept for the graph of each equation.

1. $y = \frac{1}{2}x - 5$

2. $y = 2x + 2$

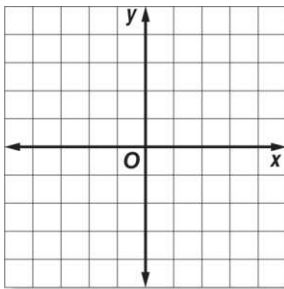
3. $y = 3x - 1$

4. Graph a line with a slope of $\frac{3}{2}$ and a y-intercept of -4 .

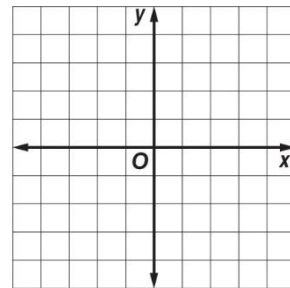


Graph each equation using the slope and the y-intercept.

5. $y = 3x - 3$



6. $y = -x + 1$

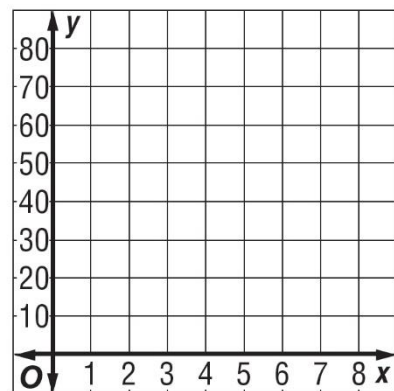


7. The entrance fee to the campsite is AED 15. A tent costs AED15 per night. The total cost y for a camping trip for x nights can be represented by the equation $y = 15x + 15$.

a. Graph the equation.

b. Use the graph to find the total cost for 4 nights.

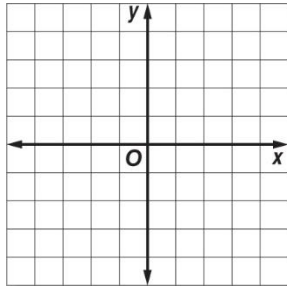
c. Interpret the slope and the y-intercept.



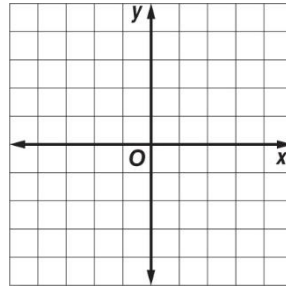
Graph a Line Using Intercepts

State the x - and y -intercepts of each function. Then graph the function.

1. $3x - 5y = 15$



2. $4x - 6y = 12$



State the x - and y -intercepts of each function.

3. $-6x + 8y = 24$

4. $\frac{3}{4}x - 6y = 18$

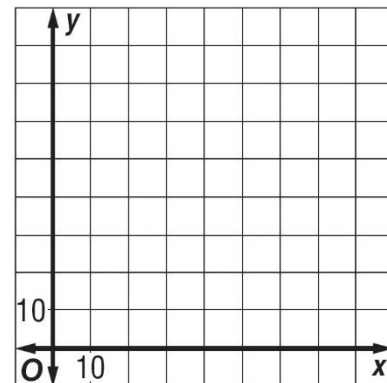
5. $-\frac{1}{4}x - \frac{1}{3}y = 12$

6. Mr. Juma raises cows and chickens on his farm.

Altogether, his cows and chickens have 140 legs.

This can be represented by the function $4x + 2y = 140$.

Graph the function. Then interpret the x - and y -intercepts.



7. Mansoor has a total of AED 290 in ten-dirham and five-dirham notes. This can be represented by the function $10x + 5y = 290$. Find and interpret the x - and y -intercepts.

Write Linear Equations

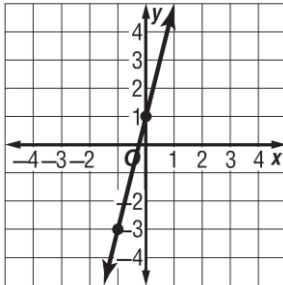
Write an equation in point-slope form and slope-intercept form for each line.

1. passes through $(8, -4)$, slope = $\frac{1}{2}$

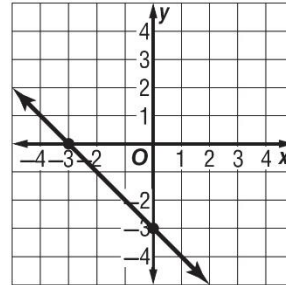
2. passes through $(3, -8)$, slope = 3

Write the equation, for each of these graphed lines, in point-slope form.

3.



4.



5. The table shows the temperature of a liquid at certain hours.

Assuming the temperature change is linear, write an equation in point-slope form to represent the temperature y at x hours.

Hours	Temperature (°C)
1	35
2	39

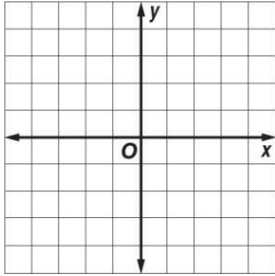
6. After 2 hours, a truck traveled 70 miles. After 2.25 hours on the same trip, the truck had traveled 78.75 miles. Write an equation in point-slope form to represent the distance y of the truck after x hours.

Solve Systems of Equations by Graphing

Solve each system of equations by graphing.

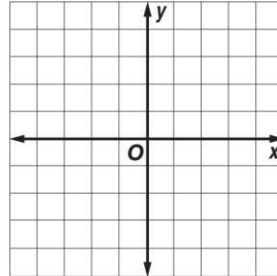
1. $y = x + 4$

$y = -2x - 2$



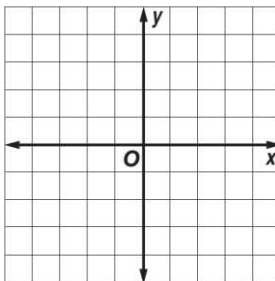
2. $y = 5x - 4$

$y = 5x$



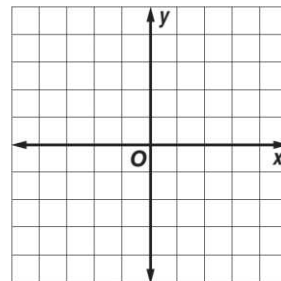
3. $y = x - 1$

$y - x = -1$

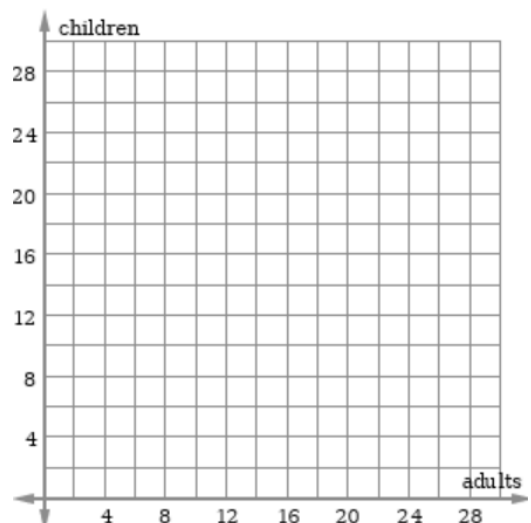


4. $y = 6x - 3$

$y = -3$



5. There are twenty-six members in the Chess Club. There are four more children than adults in the club. Write and solve a system of equations to find the number of children and adults in the Chess Club.



Solve Systems of Equations Algebraically

Solve each system of equations algebraically.

1. $y = x - 14$

$y = -6x$

2. $y = -x + 9$

$y = 2x$

3. $y = x + 15$

$y = -4x$

4. $y = -x - 10$

$y = 4x$

5. $y = x + 24$

$y = -7x$

6. $y = -x + 18$

$y = 8x$

Write and solve a system of equations that represents each situation. Interpret the solution.

7. Mariam watched 6 times as many hours of television over the weekend as Zahra. Together they watched a total of 14 hours of television. How many hours of television did each person watch over the weekend?

8. Eissa drove a total of 248 kilometers on Monday. He drove 70 fewer kilometers in the morning than he did in the afternoon. How many kilometers did he drive in the afternoon?

Chapter 4: Functions

Relations and representing relations

A linear equation can be represented in many ways, including in a **table**, in a set of **ordered pairs**, in **words** and in a **graph**.

- The **domain** of a relation is the set of x -coordinates.
- The **range** of a relation is the set of y -coordinates.

x	y
2	16
4	32
6	48
8	64

A red oval highlights the x -values (2, 4, 6, 8) and is labeled "domain". A blue oval highlights the y -values (16, 32, 48, 64) and is labeled "range".

In this table, the domain is $\{2, 4, 6, 8\}$ and the range is $\{16, 32, 48, 64\}$.

- You can use relations to write equations.
- You can use equations to find unknown values.

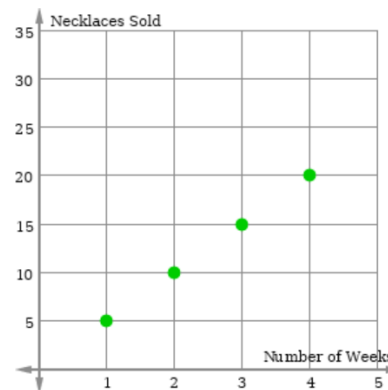
Example:

Sara sells 5 necklaces each week for 4 weeks. The set of ordered pairs is $(1, 5), (2, 10), (3, 15), (4, 20)$.

(a) Make a **table**. State the **domain** and the **range**. Then **graph** the ordered pairs.

Number of Weeks, x	Necklaces Sold, y
1	5
2	10
3	15
4	20

domain = $\{1, 2, 3, 4\}$, range = $\{5, 10, 15, 20\}$



(b) **Write an equation** to find the number of necklaces, y , sold in x weeks. Use the equation to find the number of necklaces sold in 9 weeks.

Find the slope, m , using any two points. For example, $(2, 10)$ and $(4, 20)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{20 - 10}{4 - 2} = \frac{10}{2} = 5$$

Find the y -intercept using $y = mx + b$ (Use any point for example $(3, 15)$ for x and y .)

$$\begin{aligned} y &= mx + b \\ 15 &= 5(3) + b \\ 15 &= 15 + b \\ 0 &= b \end{aligned}$$

So, the equation is $y = 5x + 0$, which is $y = 5x$.

In 9 weeks, she sold $y = 5(9) = 45$ necklaces.

Functions

Here is an example of a function:

$$f(x) = 3x - 2$$

- The **input** is x .
- The **output** is $f(x)$.
- We **find** $f(x)$ by substituting the value of x into the function.

Q. What is a **function table**?

- ✓ It is a table we use to find the outputs for a function. It looks like this:

x	Rule	$f(x)$

input

output

The **rule** is this part of a function.

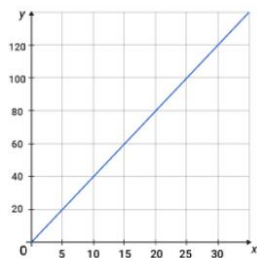
$$f(x) = 3x - 2$$

- ✓ The variable for the input, or **domain**, is the **independent variable**.
- ✓ The variable for the output, or **range**, is the **dependent variable**.

Linear Functions

- You can graph a linear function by plotting the ordered pairs on a coordinate plane.
- Data on a graph can be **continuous** or **discrete**.

Continuous data cannot be counted and have an infinite number of possible values. So, there is no space between data values. Graphs of continuous data are represented by solid lines.



Example 1:

Find $f(3)$ if $f(x) = 5x + 1$

Substitute 3 for x .

$$f(3) = 5(3) + 1$$

$$f(3) = 15 + 1$$

$$f(3) = 16$$

Example 2:

Make a function table for $f(x) = 3x - 2$.

State the domain and range of the function.

Choose some values for the input. For example: $-2, 0, 2, 4$.

Substitute into the rule. Find the output, $f(x)$.

x	$3x - 2$	$f(x)$
-2	$3(-2) - 2$	-8
0	$3(0) - 2$	-2
2	$3(2) - 2$	4
4	$3(4) - 2$	10

The **domain** is $\{-2, 0, 2, 4\}$ and the **range** is $\{-8, -2, 4, 10\}$.

Example:

A shop makes mobile phone covers with your name on them. They charge AED 15 for the cover and AED 2 for each letter of your name.

(a) Write a function to represent the total cost of any number of letters.

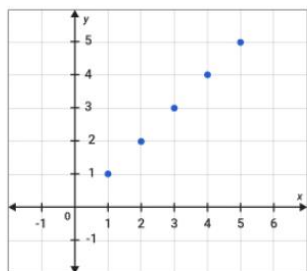
The **independent variable**, x , is the number of letters on the phone cover.

The **dependent variable**, y , is the total cost of the phone cover with letters.

The **initial value** (or y -intercept) is AED 15.

The function is $y = 2x + 15$

Discrete data can be counted and have a certain number of values. So, there is a space between possible data values for a given domain. Graphs of discrete data are represented by dots.



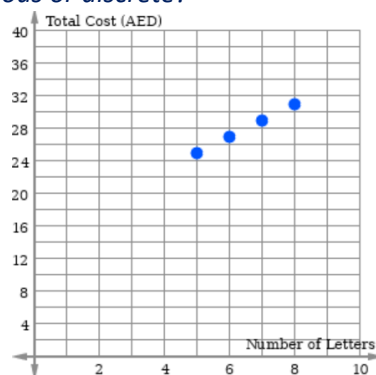
(b) Complete a function table to find the cost for 5, 6, 7, and 8 letters.

x	$2x + 15$	y
5	$2(5) + 15$	25
6	$2(6) + 15$	27
7	$2(7) + 15$	29
8	$2(8) + 15$	31

The ordered pairs are (5, 25), (6, 27), (7, 29) and (8, 31).

(c) Graph the function. Is the data continuous or discrete?

You cannot have half of a letter! So, the data is **discrete**.



Compare Properties of Functions and Construct Functions

- You know the slope-intercept form

$$y = mx + b$$

m is the slope and b is the y -intercept.

- We also say m is the **rate of change** and b is **initial value**.
- You can **interpret** the rate of change and the initial value and use them to **compare** functions.

Q. How do I interpret the rate of change?

In the example shown, if x is the number of kilograms of apples and y is the total cost, then the table represents a shop that has a greater unit rate. The apples cost more per kilogram in the shop represented by the table.

Q. What does the initial value tell us?

In the example shown, the table has a y -intercept at $y = 4$. The graph has a y -intercept at $y = 15$. This could be the delivery charge, or the cost of packaging. The details are usually in the words of the question.

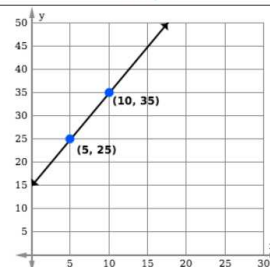
Example:

Compare the rate of change for each function.

Table

x	y
0	4
1	9
2	14
3	19

Graph



First, choose two points from the table to find the slope of the function represented by the table.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 4}{1 - 0} = \frac{5}{1} = 5$$

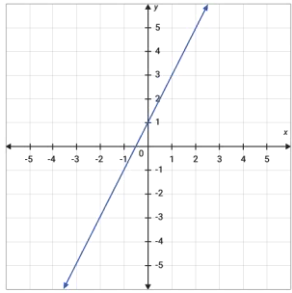
Then, use the two points in the graph to find the slope of that function.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{35 - 25}{10 - 5} = \frac{10}{5} = 2$$

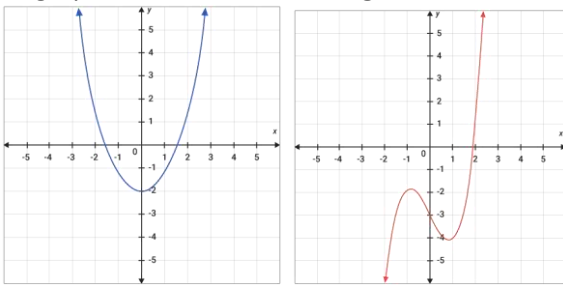
The function represented by the **table** has the **greatest** rate of change.

Linear and Nonlinear Functions

- You know a **linear** function is a function whose graph forms a **straight line**.



- A **nonlinear** function is a function whose graph does **not** form a **straight line**.



Example:

The charges for a massage chair in a mall are shown in the table.

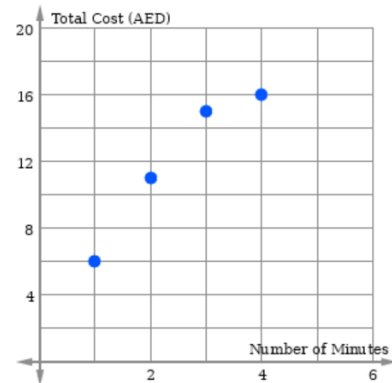
Determine whether this represents a linear or a nonlinear function.

Number of Minutes, x	1	2	3	4
Total Cost (AED), y	6	11	15	16

First, check the rate of change. As x increases by 1, y increases by a smaller amount each time. The rate of change is **not constant**, so this function must be **nonlinear**.

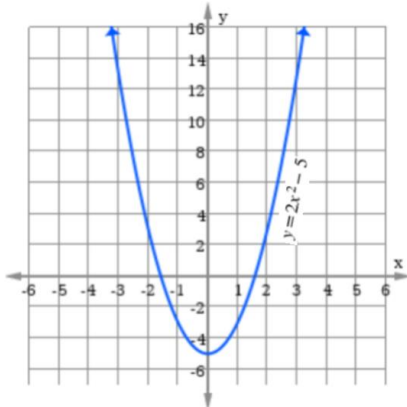
Check by graphing:

It is clearly not a linear function. It is a nonlinear function.



Quadratic Functions

- A **quadratic function** is a function that can be written in the form $y = ax^2 + bx + c$, where $a \neq 0$.
- The graph of a quadratic function is called a **parabola**.
- If the coefficient of the squared term is **positive** the parabola will open **upward**.



Example:

The quadratic equation $p = 50 + 2r^2$ represents the profit, p , made by a factory that produces r ovens.

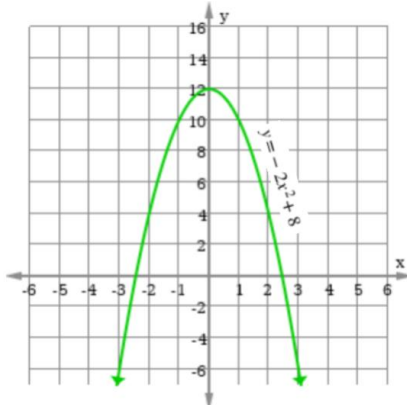
Graph this function. Then use your graph to estimate the profit for 5 ovens.

First, use a function table to find a set of ordered pairs.

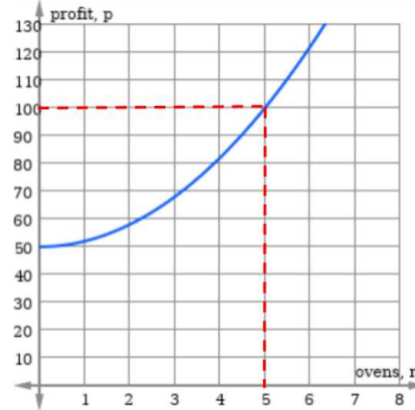
r	$50 + 2r^2$	p	(r, p)
0	$50 + 2(0)$	50	(0, 50)
2	$50 + 2(4)$	58	(2, 58)
4	$50 + 2(16)$	82	(4, 82)
6	$50 + 2(36)$	122	(6, 122)

Then, plot the points and join them with a smooth curve to help find unknown values.

- If the coefficient of the x^2 term is **negative** the parabola will open **downward**.



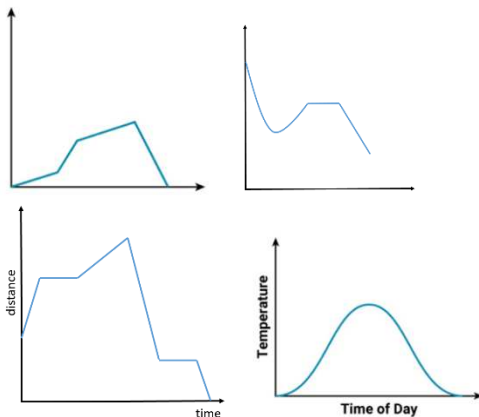
- You can use a parabola to find an unknown value.



To find the profit when they sell 5 ovens, draw a vertical line from $x = 5$ up to the graph, then draw a horizontal line to the profit axis. The profit for 5 ovens will be AED 100.

Qualitative Graphs

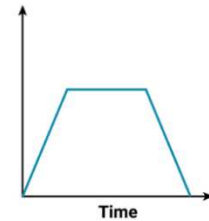
These are graphs that give you a **general idea** of the change in one variable in relation to another. They usually have **no numbers** on the axes. Here are some examples:



- Use a **straight** line to show a constant rate of change. The steepness of a graph tells you how quick or slow the rate of change is.
- Use a **curved** line to show a rate of change that is not constant.
- Use a **horizontal** line to show a period of no change.
- You need to be able to **sketch** a qualitative graph.
- You need to be able to **analyze** a qualitative graph.

Example 1:

This graph shows how the noise level changed in a classroom. Describe the change in the noise level over time.

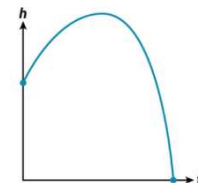


The **first part** of the graph shows a **constant increase** in the noise level (the line is increasing from left to right).

Then, there was a period of **no change** in the noise level (the horizontal line tells us this). The **last part** shows a **constant decrease** in the noise level (the line is decreasing from left to right).

Example 2:

This graph shows the height, h , of a ball. Describe how the height changed over time.



The ball started from a height (the starting point is not zero). The height **increased** at a rate that was **not constant** (the upward curved line tells us that). Then the height **decreased** at a rate that was **not constant**, until the ball hit the ground (it ended at a height of zero).

Relations and Representing Relationships

1. A real estate company sells 8 houses per month.

a. Write an equation to find the total number of houses h sold in any number of months m .

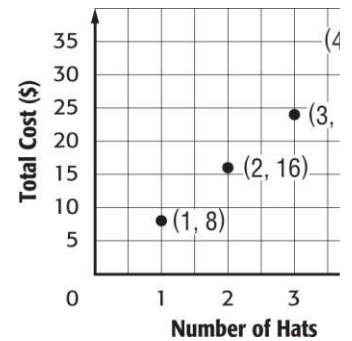
b. Use the equation to determine how many houses are sold in 15 months.

Months, m	Total Houses, h
1	8
2	16
3	24
4	32

2. The graph shows the total cost of hats that are on sale at The Hat Shop.

a. Write an equation to find the total cost c of any number of hats h .

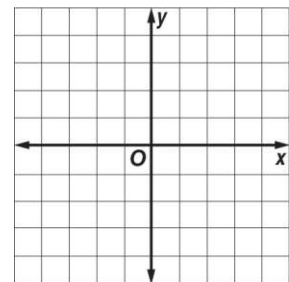
b. Use the equation to find the cost of 30 hats.



Express each relation as a table and a graph. Then state the domain and range.

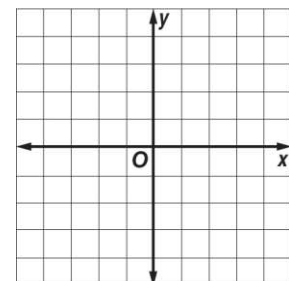
3. $\{(4, -2), (-1, 1), (2, -3), (3, 0)\}$

x	y



4. $\{(3, 4), (1, -2), (4, -1), (2, 2)\}$

x	y



Functions and Linear Functions

Find each function value.

1. $f(2)$ if $f(x) = x + 4$

2. $f(9)$ if $f(x) = x - 8$

3. $f(3)$ if $f(x) = 2x + 2$

4. Choose four values for x to make a function table for the function, $f(x) = 2x - 7$.
Then state the domain and range of the function.

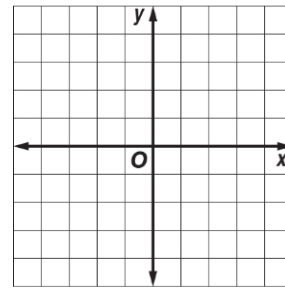
x	$2x - 7$	$f(x)$

5. The school baseball team wants to have each player's name imprinted on the player's jacket. The cost is AED 75 plus AED 8.50 for each name. Write a function to represent the cost $c(n)$ for n names.
What is the cost to have names imprinted on 25 jackets?

Complete the function table. Then graph the function.

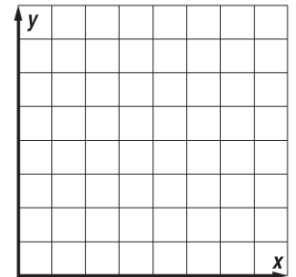
6. $y = 2x - 1$

x	$2x - 1$	y	(x, y)
-1			$(-1, -3)$
0			
1			
2			



7. A fitness center has set a goal to have 500 members. The fitness center already has 150 members and adds an average of 25 members per month. The function $f(x) = 150 + 25x$ represents the membership after x months.

Graph the function to determine the number of months it will take for the fitness center to reach its membership goal. Is the function continuous or discrete? Explain.

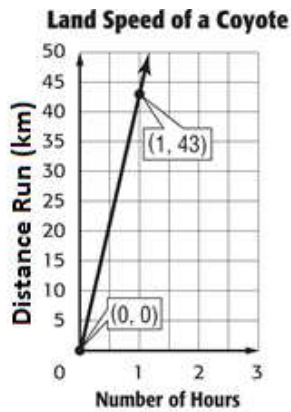


Compare Properties of Functions

1. The speeds of a coyote and a giraffe are shown in the graph and table below.

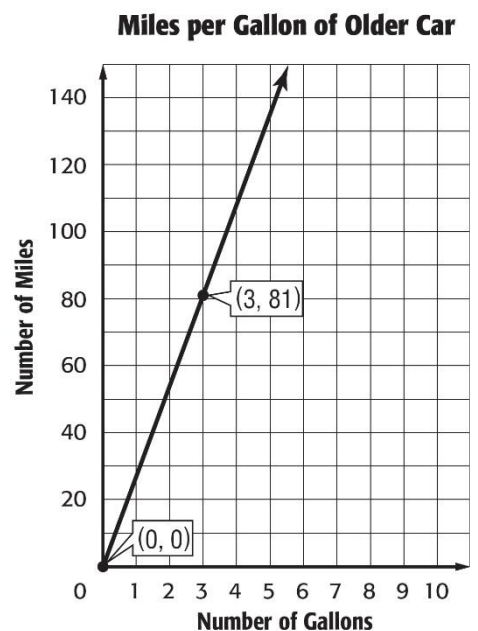
a. Compare the functions by comparing the rates of change.

b. How much farther does a coyote run than a giraffe after 3 hours?



Land Speed of a Giraffe	
Number of Hours	Distance Run (km)
0.5	16
1	32
1.5	48

2. A new car gets 33 miles per gallon of gas. The graph shows the number of miles, y , that an older car gets per gallon, x , of gas. Compare the miles per gallon for each car.



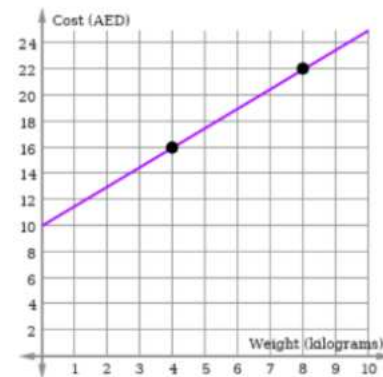
Construct and Analyze Functions

1. The total cost of renting a vacation home includes a deposit and a daily rental fee of AED 1,250. A family rents the vacation home for 5 days and pays AED 7,000. Assume the relationship is linear. Find and interpret the rate of change and the initial value.

2. The Students' Council rented a candy floss machine to sell candy floss as a fundraiser for the Red Crescent. They paid an initial fee and then an hourly charge. The table shows the cost per hour. Assume the relationship between the two quantities is linear. Find and interpret the rate of change and initial value.

Number of Hours, x	2	3	4	5
Cost (AED), y	30	35	40	45

3. This graph shows the cost, y , for x kilograms of cucumbers from a local vegetable shop. They offer home delivery but at a charge. Assume the relationship between the two quantities is linear. Find and interpret the rate of change and initial value.



Linear and Nonlinear Functions

Determine whether each table represents a *linear* or a *nonlinear* function. Explain.

1.

<i>x</i>	1	2	3	4
<i>y</i>	8	12	16	20

2.

<i>x</i>	0	2	4	6
<i>y</i>	5	3	0	-4

3.

<i>x</i>	3	0	-3	-6
<i>y</i>	1	6	11	16

4.

<i>x</i>	-1	0	1	2
<i>y</i>	-2	0	2	4

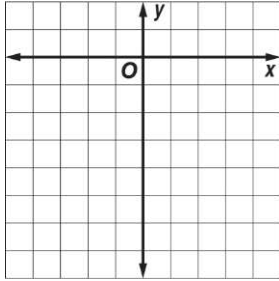
5. The table shows the charge for a long-distance call as a function of the number of minutes the call lasts. Is the charge a linear or nonlinear function of the number of minutes? Explain.

Minutes	1	2	3	4
Cost (AED)	5	10	15	20

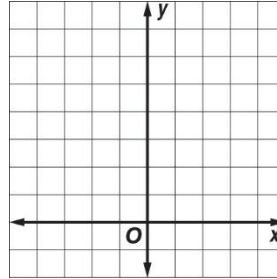
Quadratic Functions

Graph each function.

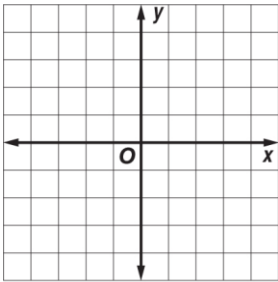
1. $y = -4x^2$



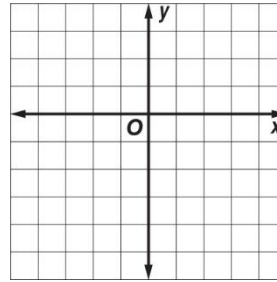
2. $y = x^2 + 4$



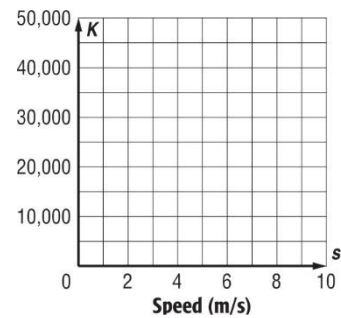
3. $y = 3x^2 + 1$



4. $y = -3x^2 + 3$

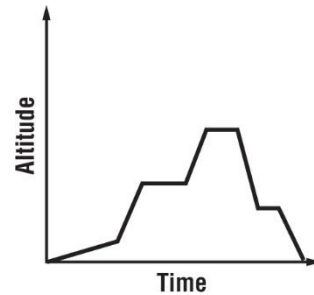


13. The quadratic equation $K = 500s^2$ models the kinetic energy in joules of a 1,000-kilogram car moving at a speed of s meters per second. Graph this function. Then use your graph to estimate the kinetic energy at a speed of 8 meters per second.

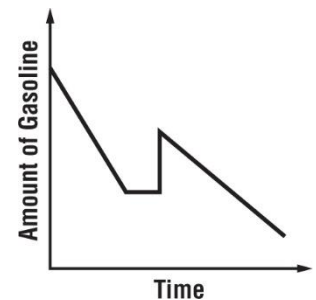


Qualitative Graphs

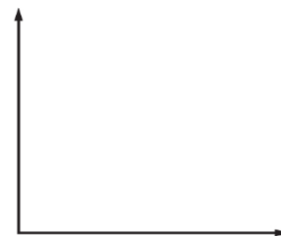
1. The graph below shows the altitude of a hiker during a hike.
Describe the change in altitude over time.



2. The graph below displays the amount of gasoline in a vehicle over time.
Describe the change in the amount of gasoline over time.



5. Yasser monitored his heart rate while exercising.
During the warm up, his heart rate increased slowly.
While exercising, his heart rate increased rapidly and then steadied.
During cool down, his heart rate lowered quickly.
Sketch a qualitative graph to represent the situation.



Circle the letter corresponding to the correct answer.

1) Write 1.2 as a fraction or mixed number in simplest form.

a) $1\frac{2}{100}$

b) $1\frac{2}{5}$

c) $\frac{12}{100}$

d) $1\frac{1}{5}$

2) Simplify $(-2b)(3b^4)$ using the laws of exponents,

a) $-5b^4$

b) $-6b^5$

c) b^4

d) $6b^5$

3) Write 64,300 in scientific notation,

a) 64.3×10^3

b) 64.3×10^4

c) 6.43×10^4

d) 6.43×10^3

4) Find the cube root: $\sqrt[3]{-125}$

a) -5

b) 5

c) no real root

d) -25

5) Order the set of numbers $\{\sqrt{61}, \frac{10}{3}, \sqrt[3]{166}, 7\frac{1}{2}\}$ from least to greatest.

a) $\{\frac{10}{3}, \sqrt[3]{166}, 7\frac{1}{2}, \sqrt{61}\}$

b) $\{\sqrt{61}, \frac{10}{3}, \sqrt[3]{166}, 7\frac{1}{2}\}$

c) $\{\frac{10}{3}, \sqrt{61}, \sqrt[3]{166}, 7\frac{1}{2}\}$

d) $\{\sqrt{61}, \frac{10}{3}, 7\frac{1}{2}, \sqrt[3]{166}\}$

6) Solve the equation, $1.4m = 3.5$

a) $m = 4.9$

b) $m = 2.5$

c) $m = 2.1$

d) $m = 2.3$

7) Identify the slope, m , in this equation: $y = -\frac{4}{5}x - 8$

a) $m = -8$

b) $m = \frac{4}{5}$

c) $m = -\frac{4}{5}$

d) $m = 8$

8) Translate the sentence into an equation:

The sum of three times a number and five is seven.

a) $3 + 5x = 7$

b) $3x + 5 = 7$

c) $3x - 5 = 7$

d) $5 - 3x = 7$

9) Write the equation for the direct variation represented in this table:

x	0	2	4	6
y	0	8	16	24

a) $y = 4x$

b) $y = \frac{1}{4}x$

c) $y = 4x + 2$

d) $y = 2x$

10) State the domain of the function represented in this table of values:

x	y
5	8
7	11
10	17
15	27

a) $\{5, 7, 8, 11\}$

b) $\{5, 7, 10, 15\}$

c) $\{8, 11, 17, 27\}$

d) $\{10, 15, 17, 27\}$

11) Find $f(2)$ if $f(x) = -3x - 8$

a) $f(2) = -14$

b) $f(2) = -2$

c) $f(2) = 18$

d) $f(2) = 0$

12) Which of these equations shows a nonlinear function?

a) $2x + 3y = 5$

b) $y = 2x^2 + 2$

c) $y = 2x + 2$

d) $y = \frac{x}{4}$

13) Write an equation in point-slope form of a line that passes through $(-2, 3)$ and has a slope of -2 .

a) $y + 3 = -2(x + 2)$

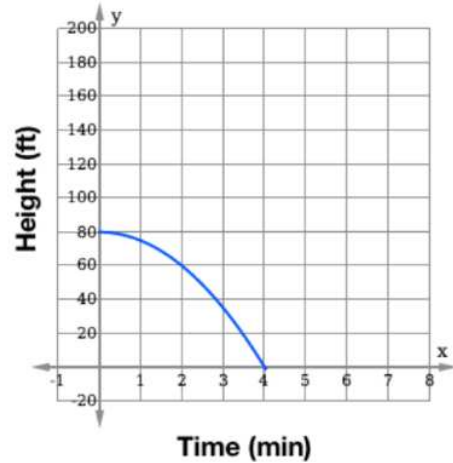
b) $y - 3 = -2(x - 2)$

c) $y - 3 = -2(x + 2)$

d) $y + 2 = -2(x - 3)$

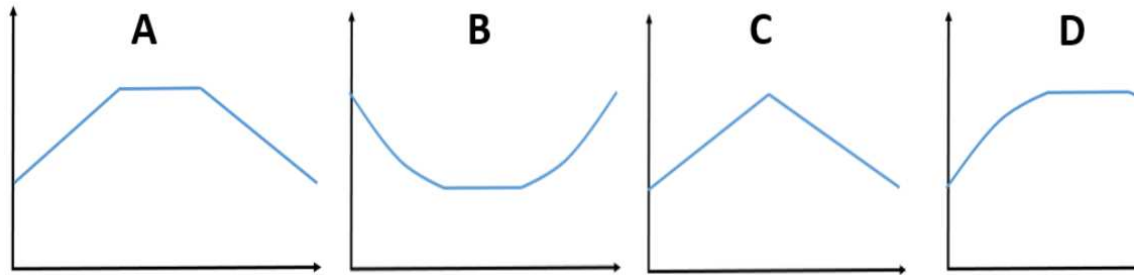
14) A snowflake is falling from the top of a building. The change in height is represented in the graph.

Use the graph to estimate the height of the snowflake at 2 minutes.



- a) 75 ft
- b) 59 ft
- c) 40 ft
- d) 47 ft

15) A car decreased its speed at a rate that was not constant, then it stayed at the same speed for a while and after that it increased its speed at a rate that was not constant. Which graph represent this situation?



- a) Graph A
- b) Graph B
- c) Graph C
- d) Graph D

Show all your work when answering these questions.

16) Evaluate the expression, $b^3 - (a + b)^2$, if $a = 3$ and $b = -2$.

17) A company has set aside AED 10^7 for employee bonuses for National Day.

If the company has 10^4 employees and the money is divided equally among them, how much will each employee receive?

18) This table shows the population in some countries.

How many more people live in Saudi Arabia than in the U.A.E?

Give your answer in scientific notation.

Country	Population
Australia	2.4×10^7
Egypt	9.7×10^7
Mongolia	3.1×10^6
Saudi Arabia	3.3×10^7
U.A.E	9.3×10^6

19) Khalifa wants to take some swimming lessons. It costs AED 150 to join the swimming club. Then it costs AED 45 for each lesson.

(a) Write an equation to represent the total cost, y , for x lessons.



(b) Khalifa has AED 420 to spend. Use the equation to find how many lessons he can attend.

20) (a) Solve the equation:

$$3(4x - 1) + 13 = 5(2 + 2x) + 2x$$

(b) State if the equation has one solution, no solution or infinitely many solutions.

21) Determine whether the relationship between the two quantities described in the table is linear.

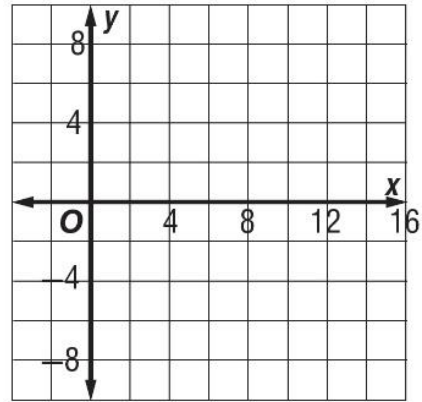
If so, find the constant rate of change.

If not, explain your reasoning.

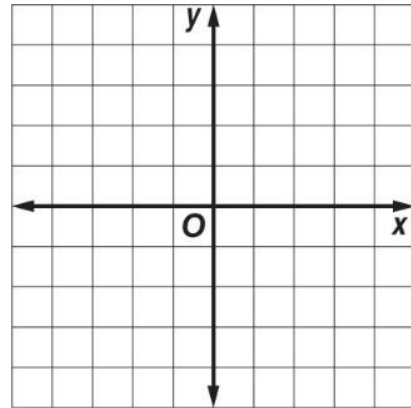
Time (min)	Temperature ($^{\circ}\text{C}$)
9	60
10	64
11	68
12	72

22) The points given in this table lie on a line. Find the slope of the line. Then graph the line.

x	-2	3	8	13
y	-2	-1	0	1



23) Graph a line with a slope of 3 and a y -intercept of -2.



24) Write an equation in slope-intercept form for the line that passes through $(5, -1)$ and $(-10, 8)$.

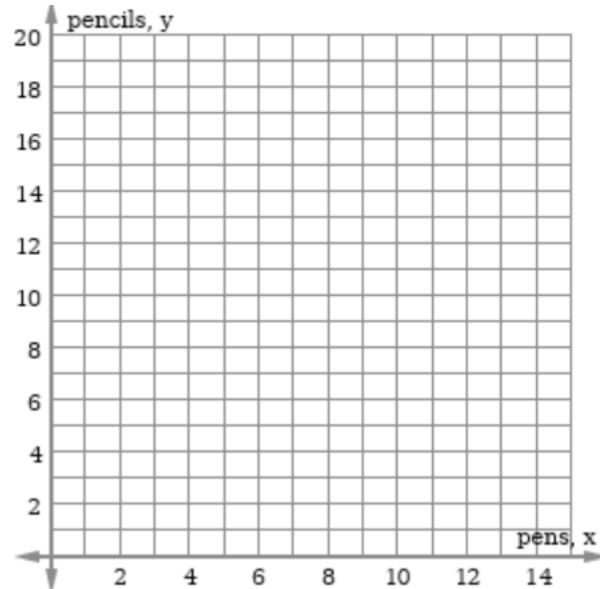
25) Noura has AED 48 to spend on pens and pencils.

A pen, x , costs AED 4.

A pencil, y , costs AED 3.

The number of pens and pencils she can buy is represented by the equation $4x + 3y = 48$.

(a) Use the x - and y -intercepts to graph the equation.



(b) Interpret the x - and y -intercepts.

End of Mock Test A

Circle the letter corresponding to the correct answer.

26) Write 0.28 as a fraction in simplest form.

a) $2\frac{8}{10}$

b) $\frac{28}{10}$

c) $\frac{7}{25}$

d) $\frac{7}{50}$

27) Simplify $8m^5(2m^3)$ using the laws of exponents

a) $16m^{15}$

b) $10m^8$

c) $10m^{15}$

d) $16m^8$

28) Write 3.45×10^{-3} in standard form.

a) 0.0345

b) 0.00345

c) 0.000345

d) 3,450

29) Find the cube root: $\sqrt[3]{-8}$

a) 2

b) -2

c) no real root

d) -4

30) Order the set of numbers $\{\sqrt{52}, 4, \sqrt[3]{301}, 8\frac{1}{10}\}$ from least to greatest.

a) $\{4, \sqrt[3]{301}, \sqrt{52}, 8\frac{1}{10}\}$

b) $\{4, \sqrt{52}, \sqrt[3]{301}, 8\frac{1}{10}\}$

c) $\{4, 8\frac{1}{10}, \sqrt{52}, \sqrt[3]{301}\}$

d) $\{4, 8\frac{1}{10}, \sqrt[3]{301}, \sqrt{52}\}$

31) Solve the equation, $\frac{2}{3}k = 1\frac{1}{3}$

a) $k = \frac{2}{3}$

b) $k = \frac{1}{3}$

c) $k = 2$

d) $k = 3$

32) Identify the slope, m , in this equation: $y = -\frac{2}{7}x - \frac{2}{3}$

a) $m = -\frac{2}{3}$

b) $m = \frac{2}{7}$

c) $m = -\frac{2}{7}$

d) $m = -\frac{7}{2}$

33) Translate the sentence into an equation:

The difference between 10 and $\frac{1}{4}$ of a number is 8.

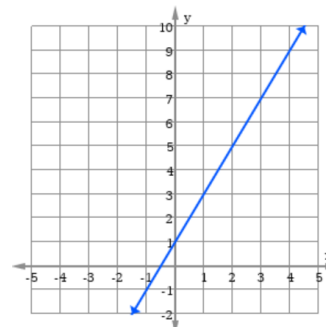
a) $10 - 8x = \frac{1}{4}$

b) $\frac{1}{4}x - 8 = 10$

c) $\frac{1}{4}x - 10 = 8$

d) $10 - \frac{1}{4}x = 8$

34) Write the equation for the function represented in this graph:



a) $y = 3x - 1$

b) $y = \frac{1}{2}x + 1$

c) $y = 2x + 1$

d) $y = 2x$

35) State the range of the function represented in this table of values:

x	y
5	8
7	11
10	17
15	27

- a) {5, 7, 8, 11} b) {5, 7, 10, 15}
- c) {8, 11, 17, 27} d) {10, 15, 17, 27}

36) Find $f(-3)$ if $f(x) = 10 - 7x$

- a) $f(-3) = -11$ b) $f(-3) = -9$
- c) $f(-3) = 21$ d) $f(-3) = 31$

37) Which of these equations shows a linear function?

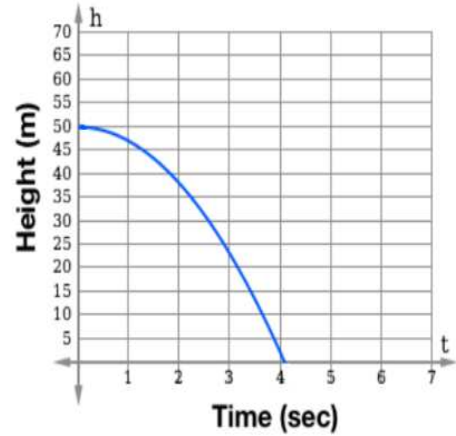
- a) $x = 4$ b) $y = 2x^2 + 3x - 2$
- c) $y = 2x + 2$ d) $y = \frac{2}{3}x^2$

38) Write an equation in point-slope form of a line that passes through (1, 5) and has a slope of -3 .

- a) $y + 5 = 3(x + 1)$ b) $y + 5 = -3(x + 1)$
- c) $y - 1 = -3(x - 5)$ d) $y - 5 = -3(x - 1)$

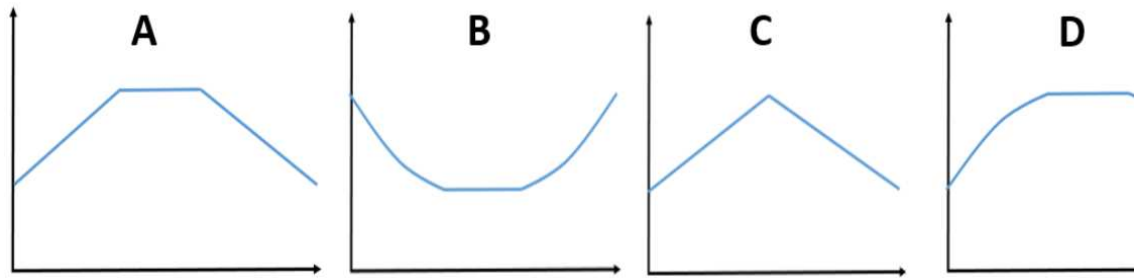
39) A ball is dropped from a height.
The change in height is shown in the graph.

Use the graph to estimate the time when the ball was at 35 meters.



- a) 0.2 seconds b) 1.2 seconds
c) 2.2 seconds d) 3.2 seconds

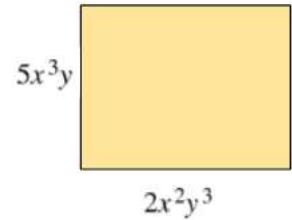
40) A car increased its speed at a constant rate, then decrease its speed at a constant rate.
Which graph represent this situation?



- a) Graph A b) Graph B
c) Graph C d) Graph D

Show all your work when answering these questions.

- 41) The length of this rectangle is $2x^2y^3$.
The width of this rectangle is $5x^3y$.
Write the area of the rectangle as a monomial.



- 42) This table shows the population in some countries.
How many times bigger is the population of the U.A.E. than the population of Mongolia?

Country	Population
Australia	2.4×10^7
Egypt	9.7×10^7
Mongolia	3.1×10^6
Saudi Arabia	3.3×10^7
U.A.E	9.3×10^6

- 43) Khalifa paid AED 250 to join a Falconry Club. He is learning how to handle a falcon.
Each lesson costs AED 75.
(a) Write an equation to represent the total cost, y , for x lessons.



- (b) Use the equation to find the total amount Khalifa pays if he attends 8 lessons.

44) (a) Solve the equation:

$$7 + 2(m - 1) = 3(2 + m) - m$$

(b) State if the equation has one solution, no solution or infinitely many solutions.

45) Determine whether the relationship between the two quantities described in the table is linear.

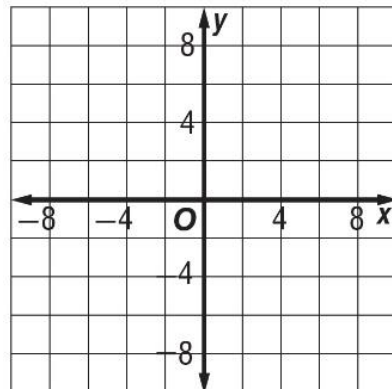
If so, find the constant rate of change.

If not, explain your reasoning.

Number of Trees	Number of Apples
5	100
10	200
15	300
20	400

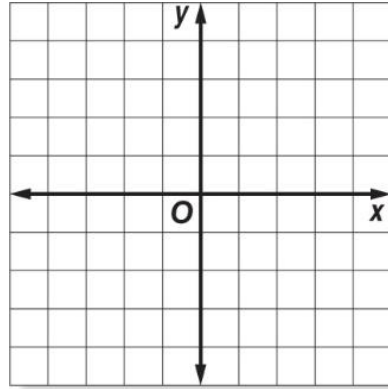
46) The points given in this table lie on a line. Find the slope of the line. Then graph the line.

x	-1	2	5	8
y	3	-1	-5	-9



47) (a) Graph a line with a slope of 2 and a y-intercept of 1.

(b) Label the line with the equation of the line written in slope-intercept form.

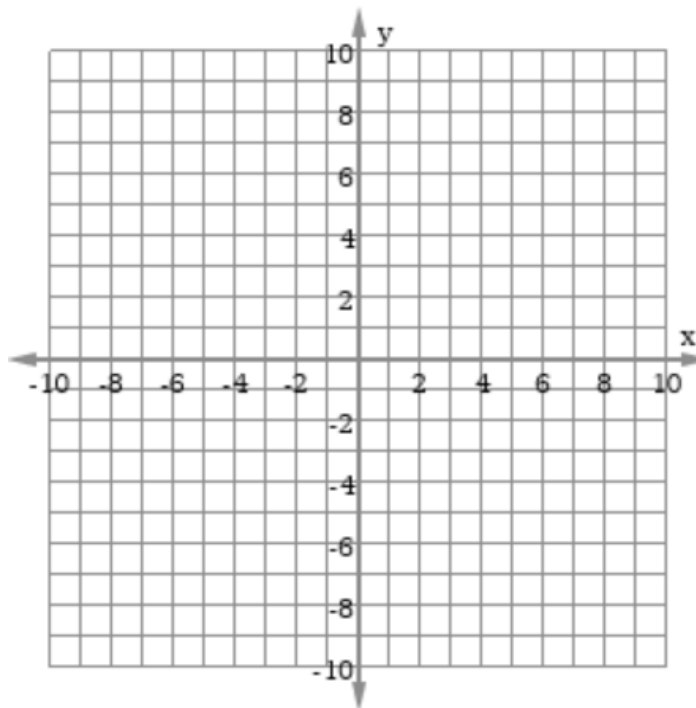


48) Write an equation in point-slope form for the line that passes through $(-1, 5)$ and $(2, 7)$.

49) Solve this system of equations by graphing:

$$y = 2x - 5$$

$$y = \frac{1}{4}x + 2$$



End of Mock Test B