

مراجعة نهاية الفصل 2026م غير محلول



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف العاشر المتقدم ← رياضيات ← الفصل الثالث ← ملفات متنوعة ← الملف

تاريخ إضافة الملف على موقع المناهج: 18:34:18 2026-06-15

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منهج انجليزي | ملخصات وتقارير | مذكرات وبنوك | الامتحان النهائي | للمدرس

المزيد من مادة
رياضيات:

إعداد: Nuzhat

التواصل الاجتماعي بحسب الصف العاشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف العاشر المتقدم والمادة رياضيات في الفصل الثالث

إجابة مراجعة نهاية الفصل 2026م

1

مراجعة نهاية الفصل 2026م غير محلول

2

ملزمة هيكل ريفيل

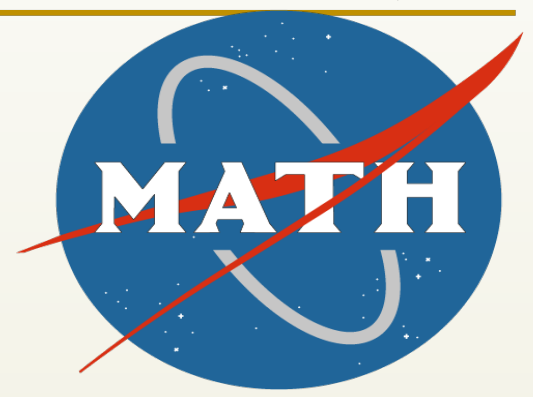
3

ملزمة هيكل الصف العاشر المتقدم

4

مراجعة هيكل الامتحان النهائي غير محلول

5



BE

READY

END OF TERM 3

REVISION

MATHS

GRADE 10 ADV

COMPILED BY
MRS NUZHAT

مدير المجمع
أمجد الجبر

وحدة الشؤون الأكاديمية
جلال عبدالرحمن صالح
حمدة العامري

EOT COVERAGE TERM -3

Question*	Learning Outcome/Performance Criteria**	Reference(s) in the Student Book (English Version)	
		المرجع في كتاب الطالب (النسخة الإنجليزية)	
		Example/Exercise	Page
السؤال*	نتائج التعلم / معايير الأداء**	مثال / تمرين	الصفحة
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*	Questions might appear in a different order in the actual exam, or on the exam paper.		
*	قد تظهر الأسئلة بترتيب مختلف في الامتحان الفعلي، أو على ورقة الامتحان .		
**	As it appears in the textbook, and LMS.		
**	كما وردت في كتاب الطالب و LMS .		

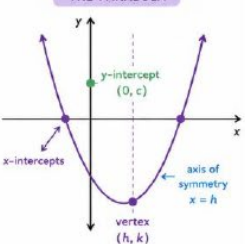
END OF TERM 03 REVISION 2025-2026 – MATHS- AL
KHAWANEEJ COMPLEX. THE MATERIAL IS JUST INTENDED
FOR TRAINING

1	Analyze the characteristics of the graphs of quadratic functions. Graph quadratic functions	27-32	11
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Complete parts a-c for each quadratic function.

- a. Find the y-intercept, the equation of the axis of symmetry, and the x-coordinate of the vertex.
- b. Make a table of values that includes the vertex.
- c. Use this information to graph the function.

THE PARABOLA



STANDARD FORM

$f(x) = ax^2 + bx + c$

a = determines opening
 b = affects axis of symmetry
 c = y-intercept $(0, c)$

DIRECTION

Determined by the value of a :

$a > 0$
opens upward

$a < 0$
opens downward

27. $f(x) = 2x^2 - 6x - 9$

28. $f(x) = -3x^2 - 9x + 2$

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

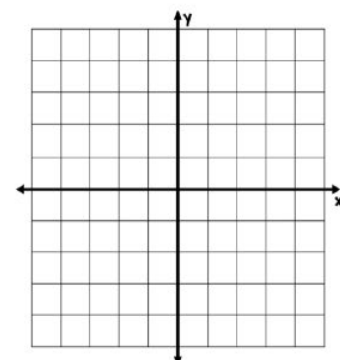
2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

4. Table of Values

x	y =	(x, y)

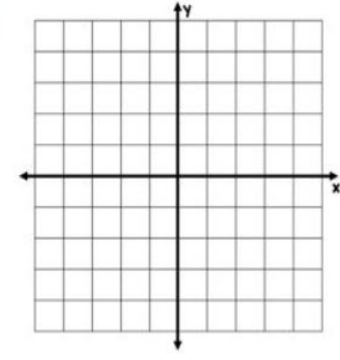
5. Graph



4. Table of Values

x	y =	(x, y)

5. Graph



29. $f(x) = -4x^2 + 5x$

30. $f(x) = 2x^2 + 11x$

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

31. $f(x) = 0.25x^2 + 3x + 4$

32. $f(x) = -0.75x^2 + 4x + 6$

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

Quadratic Function: $y =$ _____

1. y-intercept
Set $x = 0$.
 $y =$ _____

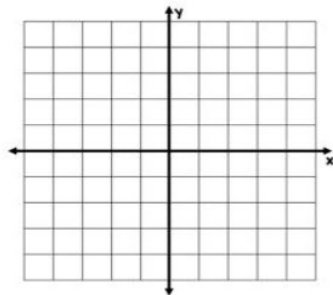
2. Axis of Symmetry
 $x = -\frac{b}{2a}$
 $x =$ _____

3. x-coordinate of Vertex
The x-coordinate of the vertex is the axis of symmetry.

4. Table of Values

x	y =	(x, y)

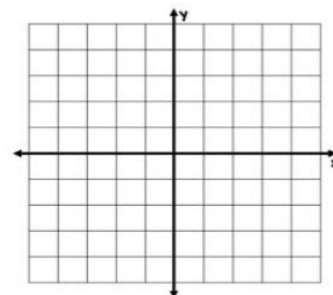
5. Graph



4. Table of Values

x	y =	(x, y)

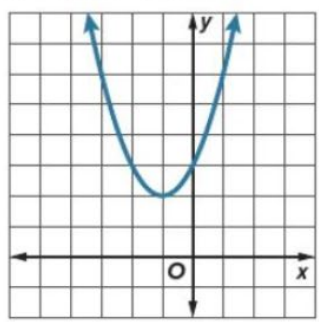
5. Graph



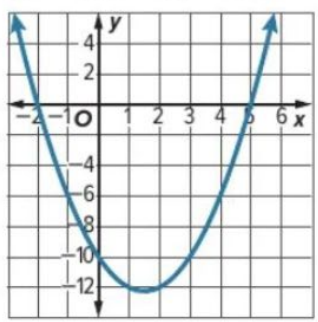
2	Solve quadratic equations by graphing	1-3	17
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Use the related graph of each equation to determine its solutions.

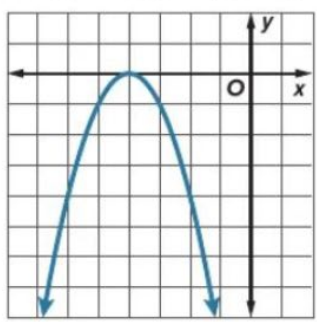
1. $x^2 + 2x + 3 = 0$



2. $x^2 - 3x - 10 = 0$



3. $-x^2 - 8x - 16 = 0$



3	Perform operations with complex numbers	29-32	25
---	---	-------	----

Simplify.

29. $(6 - 3i) + (4 - 2i)$

30. $(-11 + 4i) - (1 - 5i)$

31. $(2 + i)(3 - i)$

32. $(5 - 2i)(4 - i)$

4	Perform operations with pure imaginary numbers	7-12	25
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DEFINITION

A pure imaginary number has:

- no real part (real part = 0)
- the form bi , where $b \in \mathbb{R}$ and $b \neq 0$

Examples:

$2i, -5i, \frac{1}{3}i, \sqrt{7}i$

QUICK REFERENCE

Examples	Key Facts
$3i, -7i, \frac{1}{2}i, \sqrt{10}i$	$i^2 = -1$ $i^3 = -i$ $i^4 = 1$ - Powers repeat every 4

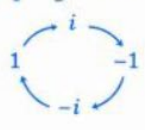
THE IMAGINARY UNIT i

$i = \sqrt{-1}$

Key powers of i :

$i^1 = i$
 $i^2 = -1$
 $i^3 = -i$
 $i^4 = 1$

The powers repeat every 4!



Simplify.

7. $\sqrt{-23} \cdot \sqrt{-46}$

8. $\sqrt{-6} \cdot \sqrt{-3}$

9. $\sqrt{-5} \cdot \sqrt{-10}$

10. $(3i)(-2i)(5i)$

11. i^{11}

12. $4i(-6i)^2$

5	Complete the square in the case of a trinomial that is not a perfect square	19-24	39
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Find the value of c that makes each trinomial a perfect square. Then write the trinomial as a perfect square trinomial.

19. $x^2 + 10x + c$

20. $x^2 - 14x + c$

21. $x^2 + 24x + c$

22. $x^2 + 5x + c$

23. $x^2 - 9x + c$

24. $x^2 - x + c$

STEPS (FINDING c ONLY)

1

Factor out a from the first two terms.

$$ax^2 + bx + c = a\left(x^2 + \frac{b}{a}x\right) + c$$

2

Take half of $\frac{b}{a}$ and square it.

$$\left(\frac{b}{2a}\right)^2$$

This is the value of c .

• We add and subtract this value in the full method, but here we only need c .

3

Therefore,

$$c = \left(\frac{b}{2a}\right)^2 = \frac{b^2}{4a^2}$$

6	Solve quadratic equations by using the Quadratic Formula	24-30	48
		36-38	

THE QUADRATIC FORMULA

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where a , b , and c are coefficients from $ax^2 + bx + c = 0$ and $a \neq 0$.

WHAT THE DISCRIMINANT TELLS US

The discriminant is $D = b^2 - 4ac$.

- $D > 0 \rightarrow$ two distinct real solutions
- $D = 0 \rightarrow$ one real solution (a repeated root)
- $D < 0 \rightarrow$ two complex (imaginary) solutions

Find the value of the discriminant for each quadratic equation. Then describe the number and type of roots for the equation.

24. $x^2 - 8x + 16 = 0$

25. $x^2 - 11x - 26 = 0$

26. $3x^2 - 2x = 0$

27. $20x^2 + 7x - 3 = 0$

28. $5x^2 - 6 = 0$

29. $x^2 - 6 = 0$

30. $x^2 + 8x + 13 = 0$

6	Solve quadratic equations by using the Quadratic Formula	24-30	48
		36-38	

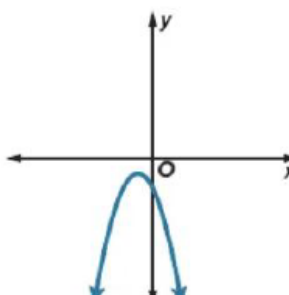
USING THE DISCRIMINANT
 $D = b^2 - 4ac$

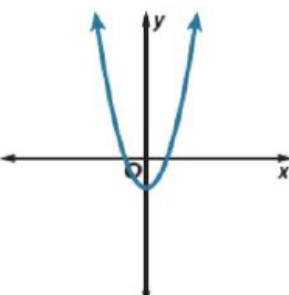
$D > 0$	Two distinct real roots	Graph crosses the x -axis at two points.
$D = 0$	One real root (double root)	Graph touches the x -axis at one point.
$D < 0$	No real roots (two complex roots)	Graph does not touch or cross the x -axis.

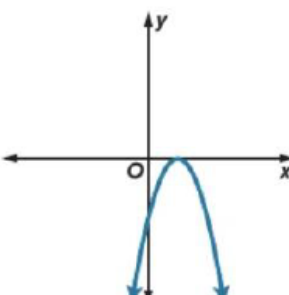
**QUICK TIPS**

- The vertex tells you the minimum (opens up) or maximum (opens down).
- The axis of symmetry is $x = h$.
- The y -intercept is c .
- If the graph crosses the x -axis twice $\rightarrow D > 0$.
- Touches once $\rightarrow D = 0$. Does not cross $\rightarrow D < 0$.

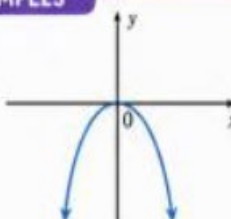
REGULARITY Describe the discriminant of the related equation of each graph. Then determine the type and number of roots.

36. 

37. 

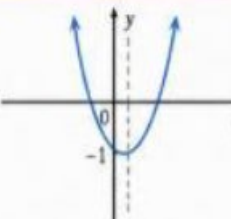
38. 

EXAMPLES

36. 

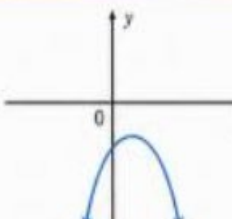
- Opens down $\rightarrow a < 0$
- Vertex at $(0, 0) \rightarrow h = 0, k = 0$
- Axis of symmetry: $x = 0$
- y -intercept: $(0, 0) \rightarrow c = 0$
- Equation: $y = a(x - 0)^2 + 0 = ax^2$
Take $a = -1$ (any negative works) $\rightarrow y = -x^2$
- Standard form: $y = -x^2 \rightarrow a = -1, b = 0, c = 0$
- Discriminant: $D = b^2 - 4ac = 0^2 - 4(-1)(0) = 0$

$D = 0 \rightarrow$ One real root (double root)
The graph touches the x -axis at one point.

37. 

- Opens up $\rightarrow a > 0$
- Vertex at $(0, -1) \rightarrow h = 0, k = -1$
- Axis of symmetry: $x = 0$
- y -intercept: $(0, -1) \rightarrow c = -1$
- Equation: $y = a(x - 0)^2 - 1 = ax^2 - 1$
Take $a = 1 \rightarrow y = x^2 - 1$
- Standard form: $y = x^2 - 1 \rightarrow a = 1, b = 0, c = -1$
- Discriminant: $D = 0^2 - 4(1)(-1) = 4 > 0$

$D > 0 \rightarrow$ Two distinct real roots
The graph crosses the x -axis at two points.

38. 

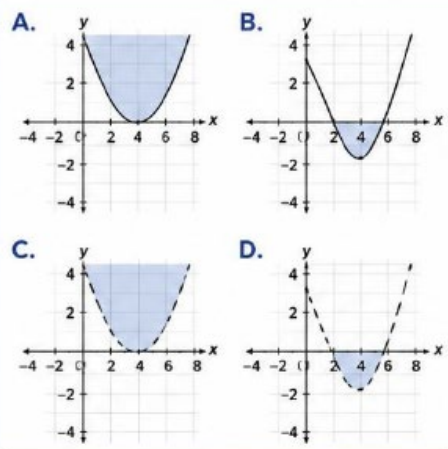
- Opens down $\rightarrow a < 0$
- Vertex at $(0, -2) \rightarrow h = 0, k = -2$
- Axis of symmetry: $x = 0$
- y -intercept: $(0, -2) \rightarrow c = -2$
- Equation: $y = a(x - 0)^2 - 2 = ax^2 - 2$
Take $a = -1 \rightarrow y = -x^2 - 2$
- Standard form: $y = -x^2 - 2 \rightarrow a = -1, b = 0, c = -2$
- Discriminant: $D = 0^2 - 4(-1)(-2) = -8 < 0$

$D < 0 \rightarrow$ No real roots
The graph does not touch or cross the x -axis.

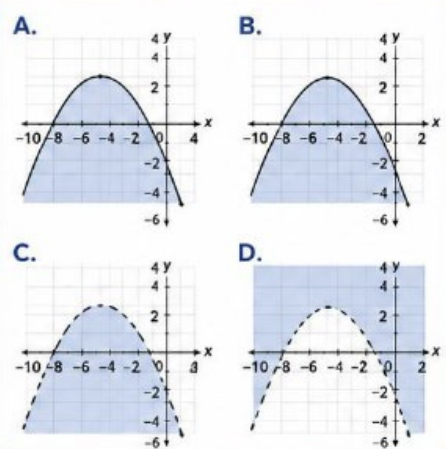
7	Solve quadratic inequalities in one variable	13-18	55
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Solve each inequality by graphing.

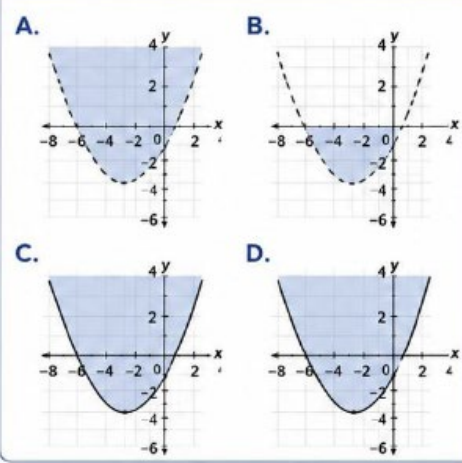
13. $x^2 - 6x + 9 \leq 0$



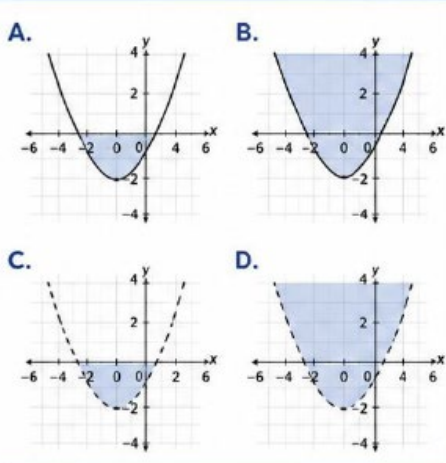
14. $-x^2 - 4x + 32 \geq 0$



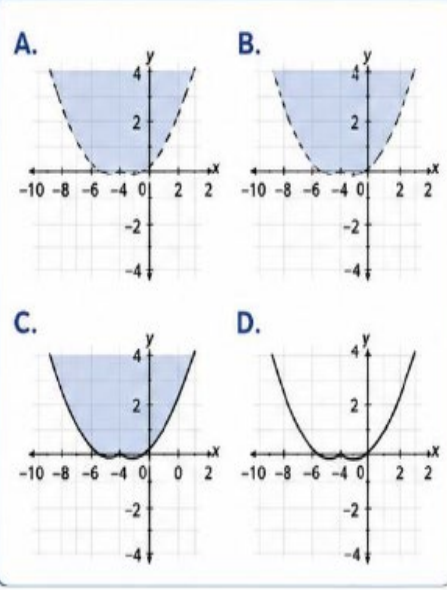
15. $\frac{3}{4}x^2 + \frac{3}{4}x - 10 > 5$



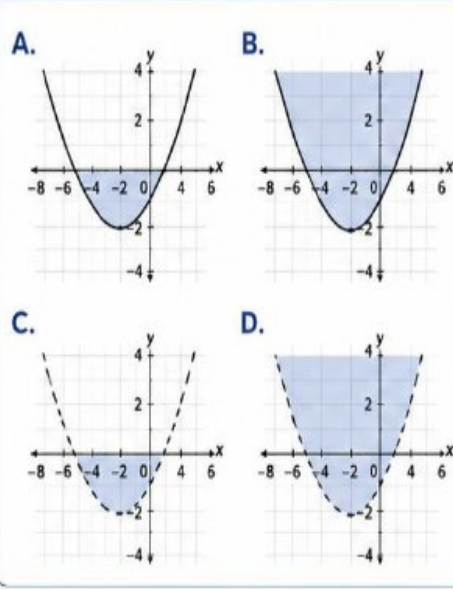
16. $x^2 - x - 6 \leq 0$



17. $x^2 + 8x + 16 \geq 0$



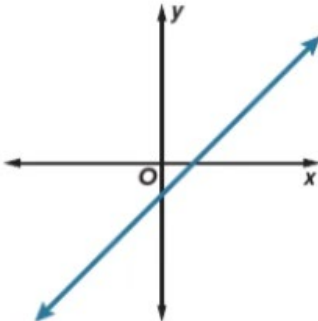
18. $x^2 - 2x - 24 \leq 0$



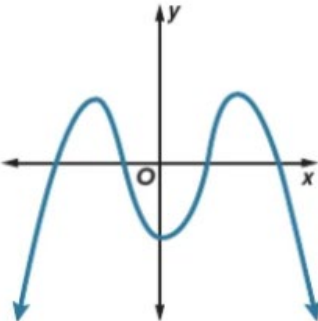
8	Graph polynomial functions and locate their zeros	15-20	80
		23-26	81

Use the graph to state the number of real zeros of the function.

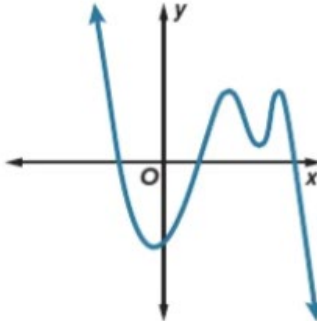
15.



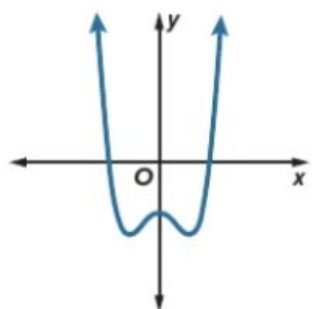
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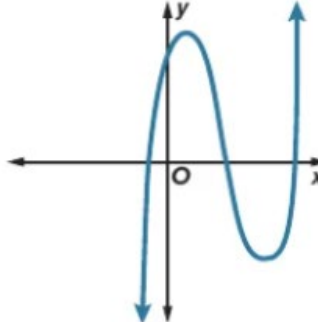
17.



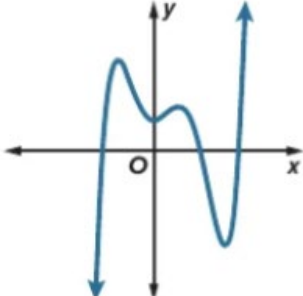
18.



19.



20.



Describe the end behavior, state the degree and leading coefficient of each polynomial. If the function is not a polynomial, explain why.

23.

 $f(x) = -5x^4 + 3x^2$

24.

 $g(x) = 2x^5 + 6x^4$

25.

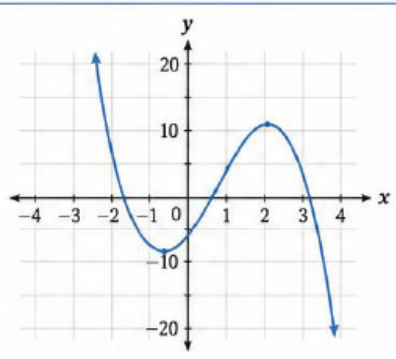
 $g(x) = 8x^4 + 5x^5$

26.

 $h(x) = 9x^6 - 5x^7 + 3x^2$

9	Find the relative maxima and minima of polynomial functions	5-8	89
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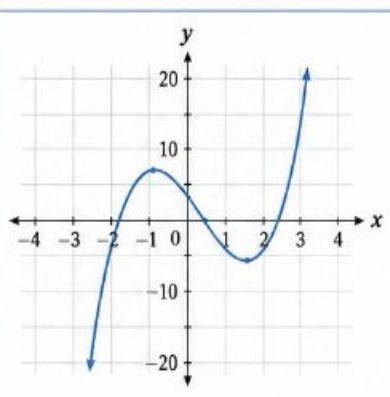
5. $f(x) = -2x^3 + 12x^2 - 8x$



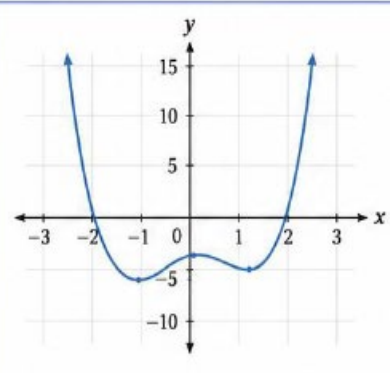
IMPORTANT NOTES

- Relative extrema can only occur at critical numbers.
- Always check the behavior of $f'(x)$ around each critical number.
- Endpoints of an interval must be checked separately for absolute maxima and minima.

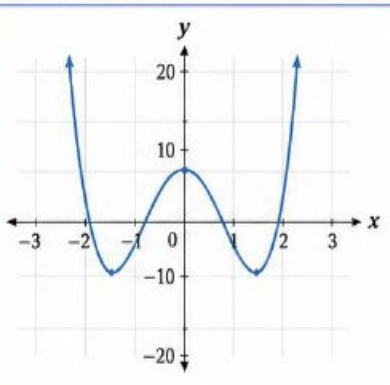
6. $f(x) = 2x^3 - 4x^2 - 3x + 4$



7. $f(x) = x^4 + 2x - 1$



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



10	Divide polynomials using synthetic division	11-16	105
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EXAMPLE: Divide $3x^3 - 4x^2 + 2x + 5$ by $(x - 2)$.

$c = 2 \rightarrow 2$
 from $x - 2$

3	-4	2	5
↓	↘	↘	↘
	6	4	12
3	2	6	17
Quotient Coefficients $(3x^2 + 2x + 6)$			Remainder 17

STEPS:

- Write the value c on the left.
- Write the coefficients of the dividend on the top row.
- Bring down the first coefficient.
- Multiply by c and write the product under the next coefficient.
- Add and bring down. Repeat until the end.

SO REMEMBER:

- The bottom row (except the last number) gives the quotient.
- The last number is the remainder.

 Therefore: $3x^3 - 4x^2 + 2x + 5 = (x - 2)(3x^2 + 2x + 6) + 17$

Simplify using synthetic division.

11. $(3v^2 - 7v - 10)(v - 4)^{-1}$

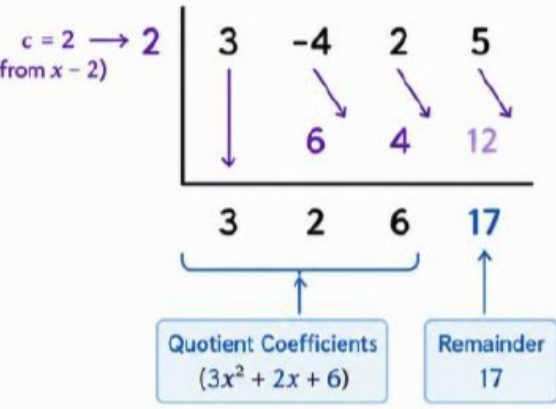
12. $(3t^4 + 4t^3 - 32t^2 - 5t - 20)(t + 4)^{-1}$

13. $\frac{y^3 + 6}{y + 2}$

14. $\frac{2x^3 - x^2 - 18x + 32}{2x - 6}$

10	Divide polynomials using synthetic division	11-16	105
----	---	-------	-----

EXAMPLE: Divide $3x^3 - 4x^2 + 2x + 5$ by $(x - 2)$.



STEPS:

- 1 Write the value c on the left.
- 2 Write the coefficients of the dividend on the top row.
- 3 Bring down the first coefficient.
- 4 Multiply by c and write the product under the next coefficient.
- 5 Add and bring down. Repeat until the end.



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- The bottom row (except the last number) gives the quotient.
- The last number is the remainder.

Therefore: $3x^3 - 4x^2 + 2x + 5 = (x - 2)(3x^2 + 2x + 6) + 17$

15. $(4p^3 - p^2 + 2p) \div (3p - 1)$

16. $(3c^4 + 6c^3 - 2c + 4)(c + 2)^{-1}$

11	Divide Polynomials	1-4	105
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Simplify each expression.

1. $\frac{15y^3 + 6y^2 + 3y}{3y}$

2. $(4f^5 - 6f^4 + 12f^3 - 8f^2)(4f^2)^{-1}$

3. $(6j^2k - 9jk^2) \div (3jk)$

4. $(4a^2h^2 - 8a^3h + 3a^4) \div (2a^2)$

HOW TO DO IT

- 1 Divide the **first term** of the polynomial by the single term.
- 2 Divide **each remaining term** by the same single term.
- 3 Simplify each result using the rules of exponents and arithmetic.
- 4 Write the simplified terms in order.

REMEMBER

You are not finding a “quotient” and “remainder” here—this is different from long division. You are simply dividing **each term**.



TIPS

- Remember the rule: $x^a \div x^b = x^{a-b}$
- Any number divided by a variable stays as a fraction.
- Keep track of signs!

12	Use the Binomial Theorem to write and find the coefficients of specified terms in binomial expansions	9-12&22,26	111&112
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Expand each binomial.

9. $(3x + 4y)^5$

10. $(2c - 2d)^7$

11. $(8h - 3j)^4$

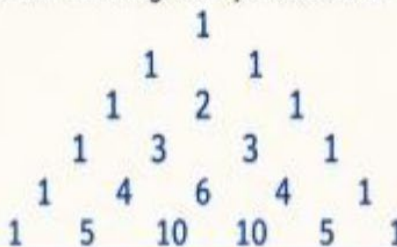
12. $(4a + 3b)^6$

22. REGULARITY Use Pascal's Triangle to find the fourth term in the expansion of $(2x + 7)^6$. Why is it the same as the fourth term in the expansion of $(7 + 2x)^6$?

26. PERSEVERE Find the sixth term of the expansion of $(\sqrt{a} + \sqrt{b})^{12}$.

PASCAL'S TRIANGLE

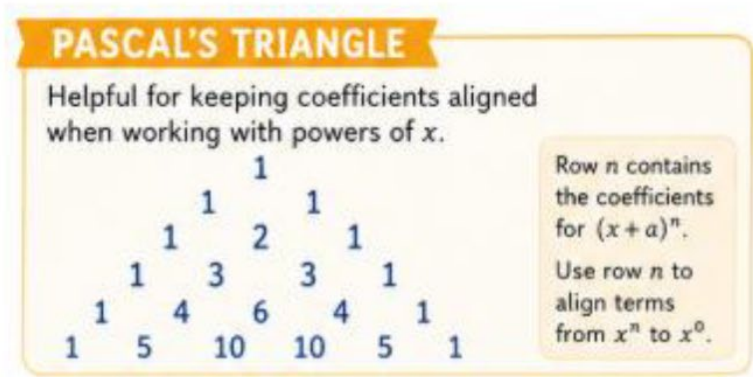
Helpful for keeping coefficients aligned when working with powers of x .



Row n contains the coefficients for $(x + a)^n$.

Use row n to align terms from x^n to x^0 .

13	Use Pascal's Triangle to write binomial expansions	1-6	111
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Use Pascal's triangle to expand each binomial.

1. $(x - y)^3$

2. $(a + b)^4$

3. $(g - h)^4$

4. $(m + 1)^4$

5. $(y - z)^6$

6. $(d + 2)^8$

14	Graph polynomial functions and locate their zeros	Example 1	119
		1-6	121

Example 1 Solve a Polynomial Equation by Graphing

Use a graphing calculator to solve $x^4 + 3x^2 - 5 = -4x^3$ by graphing.

Step 1 Find a related function. Write the equation with 0 on the right.

$x^4 + 3x^2 - 5 = -4x^3$ Original equation

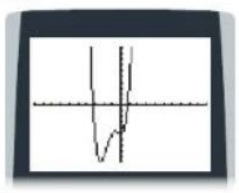
$x^4 + 3x^2 - 5 + 4x^3 = -4x^3 + 4x^3$ Add $4x^3$ to each side.

$x^4 + 4x^3 + 3x^2 - 5 = 0$ Simplify.

A related function is $f(x) = x^4 + 4x^3 + 3x^2 - 5$.

Step 2 Graph the related function.

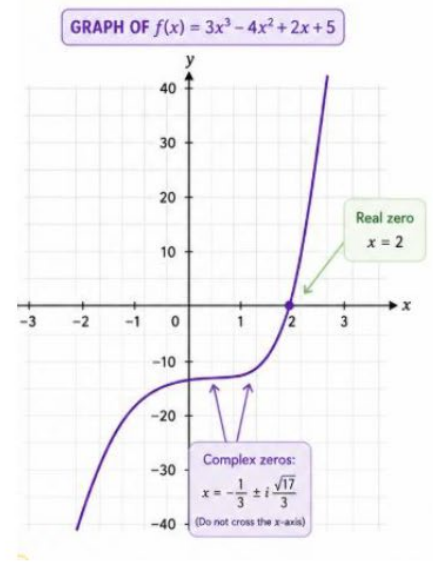
Enter the equation in the **Y =** list and graph the function.



Step 3 Find the zeros.

Use the **zero** feature from the **CALC** menu.

The real zeros are about -3.22 and 0.84 .



Use a graphing calculator to solve each equation by graphing. If necessary, round to the nearest hundredth.

1. $\frac{2}{3}x^3 + x^2 - 5x = -9$
2. $x^3 - 9x^2 + 27x = 20$
3. $x^3 + 1 = 4x^2$

4. $x^6 - 15 = 5x^4 - x^2$
5. $\frac{1}{2}x^5 = \frac{1}{5}x^2 - 2$
6. $x^8 = -x^7 + 3$

15	Factorize polynomials	1-10	127
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COMMON FACTORISATION METHODS				
1. HIGHEST COMMON FACTOR (HCF) Factor out the greatest common factor of all terms. Example: $12x^3 + 18x^2 - 6x$ $= 6x(2x^2 + 3x - 1)$	2. FACTORISING TRINOMIALS $x^2 + bx + c$ Find two numbers that multiply to c and add to b . Rewrite and factor by grouping. Example: $x^2 + 7x + 12$ $= x^2 + 3x + 4x + 12$ $= x(x + 3) + 4(x + 3)$ $= (x + 3)(x + 4)$	3. DIFFERENCE OF TWO SQUARES Use $a^2 - b^2 = (a - b)(a + b)$. Example: $9x^2 - 16$ $= (3x)^2 - 4^2$ $= (3x - 4)(3x + 4)$	4. SUM AND DIFFERENCE OF TWO CUBES Use the special formulas. Sum of two cubes: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$ Difference of two cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ Example: $x^3 + 8$ $= x^3 + 2^3$ $= (x + 2)(x^2 - 2x + 4)$ $x^3 - 27$ $= x^3 - 3^3$ $= (x - 3)(x^2 + 3x + 9)$	5. FACTORISING BY GROUPING Group terms and factor out the common factor from each group. Example: $ax + ay + bx + by$ $= a(x + y) + b(x + y)$ $= (a + b)(x + y)$

Factor completely. If the polynomial is not factorable, write *prime*.

1. $8c^3 - 27d^3$
2. $64x^4 + xy^3$
3. $a^8 - a^2b^6$
4. $x^6y^3 + y^9$
5. $18x^6 + 5y^6$
6. $w^3 - 2y^3$
7. $gx^2 - 3hx^2 - 6fy^2 - gy^2 + 6fx^2 + 3hy^2$
8. $12ax^2 - 20cy^2 - 18bx^2 - 10ay^2 + 15by^2 + 24cx^2$
9. $a^3x^2 - 16a^3x + 64a^3 - b^3x^2 + 16b^3x - 64b^3$
10. $8x^5 - 25y^3 + 80x^4 - x^2y^3 + 200x^3 - 10xy^3$

16	Find all of the rational zeros of a polynomial function	22-27	128
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Solve each equation.

22. $x^4 + 6x^2 + 5 = 0$

23. $x^4 - 3x^2 - 10 = 0$



24. $4x^4 - 14x^2 + 12 = 0$

25. $9x^4 - 27x^2 + 20 = 0$

26. $4x^4 - 5x^2 - 6 = 0$

27. $24x^4 + 14x^2 - 3 = 0$

17	Use factor theorem to determine factors of polynomials.	31-38	140
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STEP 1: USE SYNTHETIC DIVISION
Test possible zeros using synthetic division.
 $f(-1) = 0$, so $(x + 1)$ is a factor.

-1

1

-4

1

6

↓

-1

5

-6

1

-5

6

0

Quotient:
 $x^2 - 5x + 6$

Remainder 0
 $\Rightarrow (x + 1)$ is a factor

STEP 2: WRITE THE FACTORS AND USE TRINOMIALS
We have one linear factor $(x + 1)$ and a quadratic factor $x^2 - 5x + 6$.
Factor the quadratic using trinomials that multiply to 6 and add to -5 .

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

$-2 + -3 = -5$ $(-2)(-3) = 6$

Factors:
 $(x + 1), (x - 2), (x - 3)$

★ **KEY TAKEAWAY:**

- Use the Factor Theorem to find linear factors $(x - c)$.
- Divide using synthetic division.
- Factor any remaining quadratic using trinomials.
- Write the factored form as a product of all factors.

STEP 3: WRITE THE FACTORED FORM
Combine all the factors.

$f(x) = (x + 1)(x - 2)(x - 3)$

Check (optional):
 $(x + 1)(x - 2)(x - 3) = x^3 - 4x^2 + x + 6$ ✓

31. $x^3 + 2x^2 - x - 2; x + 1$

32. $x^3 + x^2 - 5x + 3; x - 1$

33. $x^3 + 3x^2 - 4x - 12; x + 3$

34. $x^3 - 6x^2 + 11x - 6; x - 3$

17	Use factor theorem to determine factors of polynomials.	31-38	140
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35. $x^3 + 2x^2 - 33x - 90; x + 5$

36. $x^3 - 6x^2 + 32; x - 4$

37. $x^3 - x^2 - 10x - 8; x + 2$

38. $x^3 - 19x + 30; x - 2$



KEY TAKEAWAY:

- Use the Factor Theorem to find linear factors $(x - c)$.
- Divide using synthetic division.
- Factor any remaining quadratic using trinomials.
- Write the factored form as a product of all factors.

18	Determine the number and type of roots for a polynomial equation	17-25	149
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1. USING THE DEGREE

A polynomial of degree n has exactly n roots (solutions) when counting multiplicity. These roots may be real or complex.

Degree (n)	Maximum number of roots
1	1 root
2	2 roots
3	3 roots
n	n roots

Note: Complex roots occur in conjugate pairs $a + bi$ and $a - bi$.

Example 2

State the possible number of positive real zeros, negative real zeros, and imaginary zeros of each function.

State the possible number of positive real zeros, negative real zeros, and imaginary zeros of each function.

17. $g(x) = 3x^3 - 4x^2 - 17x + 6$

	Positive	Negative	Imaginary
A.	2	1	0
B.	1	2	0
C.	3	0	0
D.	1	1	1

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

	Positive	Negative	Imaginary
A.	2	1	0
B.	1	2	0
C.	3	0	0
D.	1	1	1

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

	Positive	Negative	Imaginary
A.	2	1	0
B.	1	2	0
C.	0	3	0
D.	1	1	1

20. $p(x) = x^3 - x^2 + 4x - 6$

	Positive	Negative	Imaginary
A.	2	0	1
B.	1	1	1
C.	0	2	1
D.	1	2	0

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

	Positive	Negative	Imaginary
A.	2	2	0
B.	1	3	0
C.	4	0	0
D.	2	0	2

22. $f(x) = x^4 - x^3 - 5x^2 + 6x + 1$

	Positive	Negative	Imaginary
A.	2	2	0
B.	1	3	0
C.	0	2	2
D.	2	0	2

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

	Positive	Negative	Imaginary
A.	4	0	0
B.	3	1	0
C.	2	2	0
D.	1	1	2

24. $f(x) = 2x^3 - 7x^2 - 2x + 12$

	Positive	Negative	Imaginary
A.	2	1	0
B.	1	2	0
C.	3	0	0
D.	1	1	1

25. $f(x) = -3x^5 + 5x^4 + 4x^2 - 8$

	Positive	Negative	Imaginary
A.	2	2	1
B.	1	1	3
C.	3	1	1
D.	0	2	3

26. $f(x) = x^4 - 2x^2 - 5x + 19$

	Positive	Negative	Imaginary
A.	2	0	2
B.	1	1	2
C.	0	2	2
D.	3	1	0

19	Find the composition of functions	21-30	165
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If $f(x) = 3x$, $g(x) = x + 4$, and $h(x) = x^2 - 1$, find each value.

21. $f[g(1)]$
22. $g[h(0)]$
23. $g[f(-1)]$

24. $h[f(5)]$
25. $g[h(-3)]$
26. $h[f(10)]$

27. $f[h(8)]$
28. $[f \circ (h \circ g)](1)$
29. $[f \circ (g \circ h)](-2)$

30. $h[f(-6)]$

WHAT IS COMPOSITION?

The composition of two functions f and g is a new function.

The composition $f \circ g$ means "do g first, then f ."

The composition $g \circ f$ means "do f first, then g ."

x
(input)

$\xrightarrow{g}$

$g(x)$

$\xrightarrow{f}$

$f(g(x))$
(output)

20	Find the inverse of a function or relation. Determine whether two functions or relations are inverses	17-22	172
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Determine whether each pair of functions are inverse functions. Write yes or no.

17. $f(x) = x - 1$
 $g(x) = 1 - x$

18. $f(x) = 2x + 3$
 $g(x) = \frac{1}{2}(x - 3)$

1 ALGEBRAIC METHOD (COMPOSITION)

Check both $f(g(x)) = x$ and $g(f(x)) = x$.

EXAMPLE:

Determine whether $f(x) = 3x - 2$ and $g(x) = \frac{x+2}{3}$ are inverses.

Step 1: Find $f(g(x))$.

$$f(g(x)) = f\left(\frac{x+2}{3}\right) = 3\left(\frac{x+2}{3}\right) - 2$$
$$= (x+2) - 2 = x \quad \checkmark$$

Step 2: Find $g(f(x))$.

$$g(f(x)) = g(3x - 2) = \frac{(3x - 2) + 2}{3}$$
$$= \frac{3x}{3} = x \quad \checkmark$$

Conclusion: Since $f(g(x)) = x$ and $g(f(x)) = x$,
 f and g are inverses.

19. $f(x) = 5x - 5$
 $g(x) = \frac{1}{5}x + 1$

20. $f(x) = 2x$
 $g(x) = \frac{1}{2}x$

21. $h(x) = 6x - 2$
 $g(x) = \frac{1}{6}x + 3$

22. $f(x) = 8x - 10$
 $g(x) = \frac{1}{8}x + \frac{5}{4}$

21	Simplify expressions in exponential or radical form	1-12	179
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II. PROPERTIES OF RADICALS		
Property	Rule (for $a \geq 0, b > 0; n \geq 2$)	Example
1 Product property	$\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$	$\sqrt[3]{3} \cdot \sqrt[3]{12} = \sqrt[3]{36} = 6$
2 Quotient property	$\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$	$\frac{\sqrt[3]{27}}{\sqrt[3]{3}} = \sqrt[3]{9} = 3$
3 Power property	$(\sqrt[n]{a})^m = \sqrt[n]{a^m}$	$(\sqrt[3]{5})^3 = 5$
4 Root of a power	$\sqrt[n]{a^m} = a^{\frac{m}{n}} \quad (a \geq 0)$	$\sqrt[3]{8^2} = 8^{\frac{2}{3}} = 4$
5 Extracting perfect n^{th} powers	$\sqrt[n]{a^m b} = a^{\frac{m}{n}} \sqrt[n]{b} \quad (a \geq 0)$	$\sqrt[3]{54} = \sqrt[3]{27 \cdot 2} = 3\sqrt[3]{2}$
6 Change of index	$\sqrt[n]{a} = \sqrt[nm]{a^m} = (\sqrt[m]{a})^{n/m}$	$\sqrt[3]{8} = \sqrt[4]{8^2} = (\sqrt[4]{8})^2$

Simplify.

1. $\pm \sqrt{121x^4y^{16}}$

2. $\pm \sqrt{225a^{16}b^{36}}$

3. $\pm \sqrt{49x^4}$

4. $-\sqrt{16c^4d^2}$

5. $-\sqrt{81a^{16}b^{20}c^{12}}$

6. $-\sqrt{400x^{32}y^{40}}$

7. $\sqrt[4]{16(x-3)^{12}}$

8. $\sqrt[8]{x^{16}y^8}$

9. $\sqrt[4]{81(x-4)^4}$

10. $\sqrt[6]{x^{18}}$

11. $\sqrt[4]{a^{12}}$

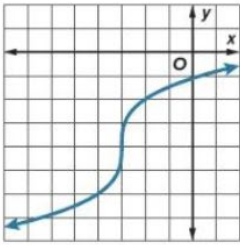
12. $\sqrt[3]{a^{12}}$

Example 7 Write a Radical Function

Write a radical function for the graph of $g(x)$.

Step 1 Identify the index.

Because the domain and range for $g(x)$ is all real numbers, the index is odd. This function can be represented by $g(x) = a\sqrt[3]{x-h} + k$.



Step 2 Identify any transformations.

The function has been translated 3 units left and 4 units down.

Therefore, $h = -3$ and $k = -4$. To find the value of a , use a point as well as the values of h and k .

$g(x) = a\sqrt[3]{x-h} + k$ Cube root function
 $-2 = a\sqrt[3]{-2 - (-3)} + (-4)$ $h = -3, k = -4, (x, g(x)) = (-2, -2)$
 $-2 = a \cdot 1 - 4$ Simplify.
 $a = 2$ Simplify.

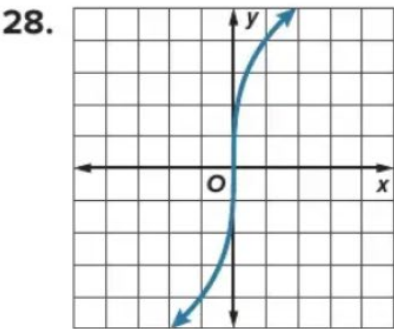
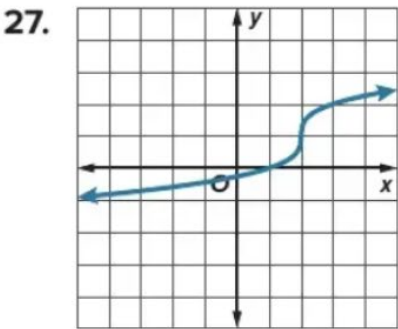
Step 3 Write the function.

Substitute the values of a , h , and k to write the function. The graph is represented by $g(x) = 2\sqrt[3]{x+3} - 4$.

Step 3 Write the function.

Substitute the values of a , h , and k to write the function. The graph is represented by $g(x) = 2\sqrt[3]{x+3} - 4$.

Write a radical function for each graph.



$y = a\sqrt[b]{b(x-h)} + k$

a : vertical stretch reflection b : horizontal stretch r compression h : horizontal shift k : vertical shift

Transformation	How it affects the graph	Example	Graph feature changes
$a\sqrt{x}$	Vertical stretch by $ a $. Reflect in x -axis if $a < 0$.	$y = 2\sqrt{x}$ $y = -\sqrt{x}$	Range: $y \geq 0$ or $y \leq 0$
$\sqrt{bx}$	Horizontal compression by $b > 1$. Horizontal stretch by $0 < b < 1$.	$y = \sqrt{4x}$ $y = \sqrt{\frac{1}{4}x}$	Domain: $x \geq 0$
$\sqrt{x-h}$	Shift right h units (left if $h < 0$).	$y = \sqrt{x-3}$	Domain: $x \geq h$ Start: $(h, 0)$
$\sqrt{x} + k$	Shift up k units (down if $k < 0$).	$y = \sqrt{x} - 2$	Range: $y \geq k$ Start: $(0, k)$
$a\sqrt[b]{b(x-h)} + k$	Combination of all transformations.	$y = -2\sqrt[3]{x-1} + 4$	

23	Add, subtract, multiply, and divide radical expressions	11-16	199
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Simplify.

11. $\sqrt{2} + \sqrt{8} + \sqrt{50}$

1

ADDITION

Add like radicals (same index and radicand).

RULE: $a\sqrt{b} + c\sqrt{b} = (a + c)\sqrt{b}$

12. $\sqrt{12} - 2\sqrt{3} + \sqrt{108}$

2

SUBTRACTION

Subtract like radicals (same index and radicand).

RULE: $a\sqrt{b} - c\sqrt{b} = (a - c)\sqrt{b}$

13. $8\sqrt{5} - \sqrt{45} - \sqrt{80}$

14. $2\sqrt{48} - \sqrt{75} - \sqrt{12}$

15. $\sqrt{28x} - \sqrt{14} + \sqrt{63x}$

16. $\sqrt{135} + 5\sqrt{10d} - 3\sqrt{60}$

24	Simplify radical expressions	5-10	199
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Simplify.

5. $\sqrt[4]{64a^4b^4}$

6. $\sqrt[3]{-8d^2f^5}$

7. $\sqrt{\frac{25}{36}r^2t}$

8. $\sqrt{\frac{192k^4}{64}}$

9. $\sqrt[5]{\frac{3072h^8}{243f^5}}$

10. $\sqrt[3]{\frac{432n^{12}}{64q^6}}$

KEY PROPERTIES OF RADICALS ($a \geq 0, b \geq 0, n \geq 2$)					
1 PRODUCT PROPERTY $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ Multiply under the same radical. Example: $\sqrt{3} \cdot \sqrt{12} = \sqrt{3 \cdot 12} = \sqrt{36} = 6$	2 QUOTIENT PROPERTY $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}} \quad (b \neq 0)$ Divide under the same radical. Example: $\frac{\sqrt{18}}{\sqrt{2}} = \sqrt{\frac{18}{2}} = \sqrt{9} = 3$	3 POWER PROPERTY $(\sqrt[n]{a})^m = \sqrt[n]{a^m}$ A radical to the same power as its index eliminates the radical. Example: $(\sqrt[3]{7})^3 = 7$	4 ROOT OF A POWER $\sqrt[n]{a^m} = a^{\frac{m}{n}} \quad (a \geq 0)$ Bring the exponent out as a fraction. Example: $\sqrt[3]{a^6} = a^{\frac{6}{3}} = a^2$	5 EXTRACT PERFECT n^{th} POWERS $\sqrt[n]{a^m b} = a^{\frac{m}{n}} \sqrt[n]{b} \quad (a \geq 0)$ Take out perfect n^{th} powers from under the radical. Example: $\sqrt{50} = \sqrt{25 \cdot 2} = 5\sqrt{2}$	6 CHANGE OF INDEX $\sqrt[n]{a} = \sqrt[mn]{a^m} \quad (a \geq 0)$ Convert to an equivalent radical with a different index. Example: $\sqrt{2} = \sqrt[4]{2^2}$

25	Solve radical equations	1-6	207
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Solve each equation.

1. $5\sqrt{j} = 1$

2. $\sqrt{b - 5} = 4$

3. $\sqrt{3n + 1} = 5$

4. $2 + \sqrt{3p + 7} = 6$

5. $\sqrt{k - 4} - 1 = 5$

6. $5 = \sqrt{2g - 7}$

GENERAL STRATEGY

- 1 Isolate the radical term on one side of the equation.
- 2 Raise both sides to an appropriate power to remove the radical.
- 3 Simplify and solve the resulting equation.
- 4 Check all solutions in the original equation.
- 5 Discard any **extraneous solutions** (solutions that do not work).

★ **IMPORTANT!**
Always check your solutions in the original equation! Squaring (or higher powers) can create extraneous solutions.