



# Chapter 1: Quadratic Equations



# Chapter Analysis

- 1. Solving Quadratic Equations using:**
  - **Completing the Square**
  - **Quadratic Formula**
  - **Graphical Method**
- 2. Solving Fractional Equations by reducing to Quadratic Equations**
- 3. Solving Real-World Problems involving Quadratic Equations**
- 4. Sketching the graph of Quadratic Functions**



# Solving Quadratic Equation by Completing the Square

## Example

$$(x - 2)^2 - 9 = 0$$

$$(x - 2)^2 = 9$$

$$(x - 2) = 3 \quad \text{or} \quad (x - 2) = -3$$

$$x = 5 \quad \text{or} \quad x = -1$$

\*Whenever you apply a square root, there will always be a positive and negative answer\*



Tip: If you end up with an equation looking like this:  $(x - 2)^2 + 9 = 0$ , there is no solution as  $(x - 2)^2$  can never be negative.

## Steps

In terms of the general case:

$$\begin{aligned}
 f(x) &= ax^2 + bx + c \\
 &= a\left(x^2 + \frac{b}{a}x\right) + c \\
 &= a\left[\left(x + \frac{b}{2a}\right)^2 - \left(\frac{b}{2a}\right)^2\right] + c \\
 &= a\left(x + \frac{b}{2a}\right)^2 + \left[c - a\left(\frac{b}{2a}\right)^2\right] \\
 &= a(x - h)^2 + k
 \end{aligned}$$

Real example:

$$\begin{aligned}
 f(x) &= x^2 + 9x + 12 \\
 &= \left(x + \frac{9}{2}\right)^2 - \left(\frac{9}{2}\right)^2 + 12 \\
 &= \left(x + 4\frac{1}{2}\right)^2 - 8\frac{1}{4}
 \end{aligned}$$

## Steps:

1. Rearrange the quadratic equation  $f(x) = ax^2 + bx + c = 0$  in the form of

$$f(x) = a(x - h)^2 + k = 0$$

2. Make  $(x - h)^2$  the subject of the equation

$$f(x) = (x - h)^2 = \frac{k}{a}$$

3. Take the square roots of both sides of the equation and solve for the values of  $x$

$$x = h + \sqrt{\frac{k}{a}}$$

$$x = h - \sqrt{\frac{k}{a}}$$



## Solving Quadratic Equation by Quadratic Formula

- Method works for ANY quadratic equation
- Steps:
  1. The roots of the quadratic equation  $f(x) = ax^2 + bx + c = 0$  can be obtained by

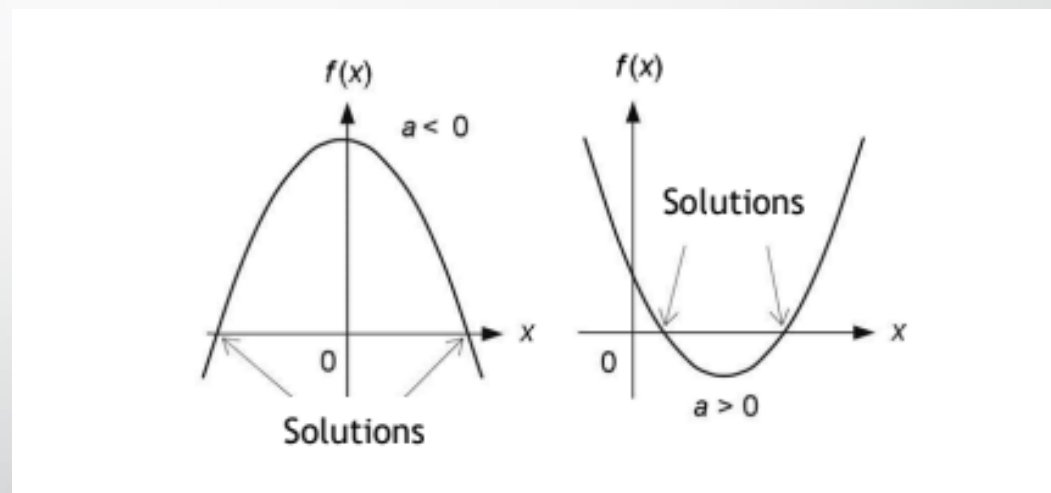
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, a \neq 0$$

Tip 1: When the question said to express your answer in 3.s.f or 2d.p, you should use the quadratic formula to get the solutions.

Tip 2: If you get a negative value for  $b^2 - 4ac$ , there is no solution!

## Solving Quadratic Equation by Graphical Method

- Using the graphical method, the solutions of the quadratic equation are the points of intersection between the quadratic curve and the  $x$ -axis.





# Solving Fractional Equations by reducing to Quadratic Equations

Step 1: Identify the lowest common denominator between the two fractions.

Step 2: Make the denominators of the fractions to be the same.

Step 3: Convert the fractional equations into a quadratic equation.

## Common Mistake Made

Example of an incorrect cancellation:

$$\frac{2(x-5)\cancel{(x+5)} - x^2 + 10x}{(x-1)\cancel{(x+5)}}$$

- Performing a cancellation like this is unacceptable as the  $(x+5)$  term only appears for the  $2(x-5)(x+5)$  and  $(x+5)(x-1)$  term. The  $-x^2 + 10x$  expression does not contain  $(x+5)$  term, hence we cannot cancel the  $(x+5)$  term like this

$$\frac{2x}{2x-3} + 1 = \frac{1}{2-3x}$$
$$\frac{1}{2-3x} - \frac{2x}{2x-3} = 1$$
$$\frac{(2x-3) - 2x(2-3x)}{(2-3x)(2x-3)} = 1$$
$$2x-3-4x+6x^2 = 4x-6-6x^2+9x$$
$$12x^2-15x+3=0$$
$$3(4x^2-5x+1)=0$$
$$3(4x-1)(x-1)=0$$
$$x = \frac{1}{4} \quad \text{or} \quad x = 1$$

4x	-1	-x
x	-1	-4x
4x <sup>2</sup>	1	-5x



# Solving Real-World Problems involving Quadratic Equations

Example:

## Worked Example A10.1.3

Nancy is planning a holiday to the United States. On 1 March 2017, she exchanged S\$3000 into US dollars (US\$) at Kumar's Money Exchange at a rate of US\$1 = S\$x

- Find an expression, in terms of  $x$ , for the amount of US\$ she will receive from Kumar's Money Exchange
- On 15 March 2017, she decided to exchange another S\$2100 into US\$ at Lee's Money Exchange at a rate of US\$1 = S\$( $x - 0.1$ ). Find an expression, in terms of  $x$ , for the amount of US\$ she received from Lee's Money Exchange
- Given that Nancy received a total of US\$3500 from the two Money Exchanges, form an equation in  $x$  and show that it simplifies to the following equation

$$70x^2 - 109x + 6 = 0$$

- Solve the equation  $70x^2 - 109x + 6 = 0$ , giving your answer to 4 decimal places
- Suggest a reason as to why one of the answers has to be rejected
- Hence, find the exchange rate between S\$ and US\$ offered by Lee's Money Exchange
- Is it better for Nancy to change her currency on 1 March or 15 March? Justify your answer with appropriate workings

[S4 CCHS(Y) P2/2017 PRELIM Qn 2]

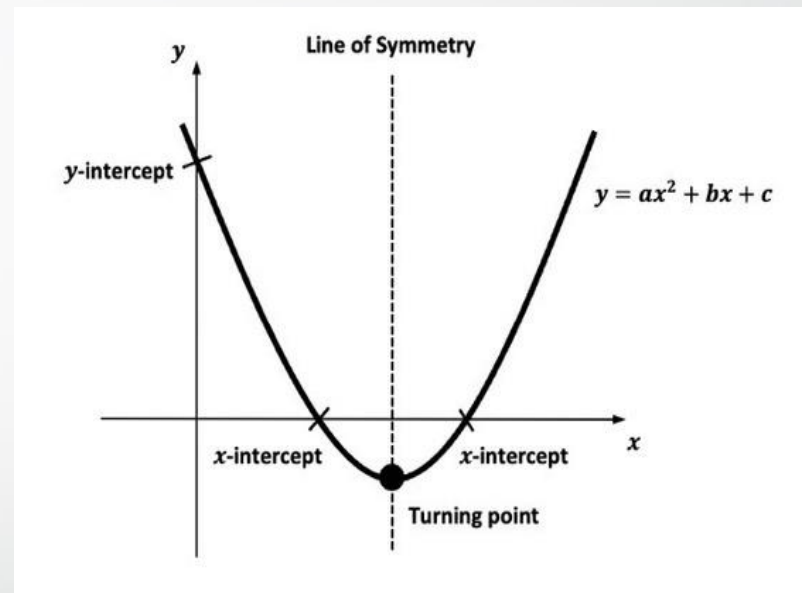
## Things to take note of:

- Do not spend too much time trying to solve part (c). Focus on the next few parts instead. If you are unable to obtain the equation shown, you can still solve part (d) as the question has provided you with the correct quadratic equation to use!
- In part (d), the question has said to give your answer to 4 d.p, hence use **QUADRATIC FORMULA**.
- You don't have to reject any solutions in part (d) as it's merely asking you to solve the equation. You should only reject when you are applying the value with the context of the question.

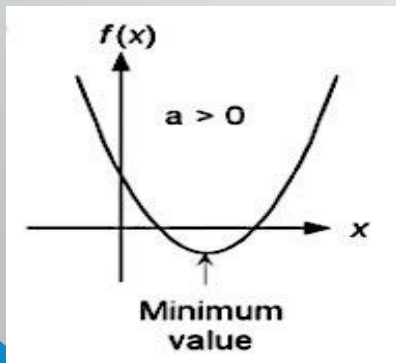


# Sketching the graph of Quadratic Functions

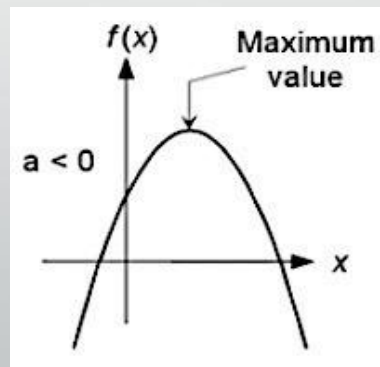
- To find the  $x$ -intercept, sub  $y = 0$ .
- To find the  $y$ -intercept, sub  $x = 0$ .
- To find the turning point, use either Complete the square (Refer to page 3) or finding the line of symmetry (we can compute the line of symmetry by finding the midpoint:  $\frac{x_1 + x_2}{2}$ , where  $x_1$  and  $x_2$  are the  $x$ -intercepts.)
- To determine the shape of the graph, we look at the coefficient of  $x^2$ .
  - If the coefficient of  $x^2$  is more than 0, it is a happy face.
  - If the coefficient of  $x^2$  is less than 0, it is a sad face.



Happy Face



Sad Face



The solutions of the quadratic equation are the points of intersection between the quadratic curve and the  $x$ -axis.



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We have about 700+ students under our care which we work closely with on a week-on-week basis!

## SOME STATS

### SG FASTEST GROWING TUTORIAL BRAND

We believe in uplifting the student community!



OVERMUGGED, 'O' Levels Channel  
6,214 subscribers



OVERMUGGED, 'A' Levels Channel  
2,778 subscribers

*One of SG largest Telegram student community*



# LEADERS IN THE CHANGING EDUCATION LANDSCAPE

FEATURED ON STRAITS TIMES


Our efforts to go out of our way to support our students were captured by local new publications.

OVERMUGGED was SG first tuition center to host large scale mock exam!

Our student's needs comes first!


**Vulcan Post** 12h · 🌐

Overmugged launched a tuition subscription plan for 'O' Levels subjects to make education more affordable and accessible, and has achieved a six-figure revenue in its first year.



**TODAY** June 16 at 5:49 PM · 🌐

One Primary 6 student who is sitting mock exams told TODAY: "I feel stress didn't do any exams all the way until prelims and PSLE... I'll be unfamiliar with environment and I cannot concentrate."



**OVERMUGGED:** This 28-year-old built S'pore's first online tuition subscription service

You and 8 others · 1 comment · 5 shares

Like · Comment · Share

**TODAYONLINE.COM**

Hundreds sign up for tuition centre mock exams costing up to \$100 after scrapping of all mid-year school exams

53 · Like

**Many in Primary 6 and Secondary 4 seek to build experience ahead of national exams**

Wong Shihing

Handfuls of students are turning to tuition centres to take mock exams for their primary and secondary school exams. The centres are also offering mock exams for their primary and secondary school exams. The centres are also offering mock exams for their primary and secondary school exams.



**P6 and Sec 4 students flock to tuition centres for mock exams after scrapping of school midterms**

Wong Shihing  
The Straits Times

## With midterms scrapped, students take mock exams at tuition centres



Students taking a mock exam paper at tuition centre Overmugged. Tuition centres said they organised such sessions following strong demand after mid-year exams were scrapped for all primary and secondary schools from 2023. Education Minister Chan Chun Sing said in March 2022 that the move would give students space to develop their interests and skills outside of their learning and life in school. The mid-year exams have been progressively removed for various levels since 2019. They will be gradually removed for P6 and secondary students from 2023.

MOE said schools will continue to use a range of assessments and activities to monitor student learning progress. Students who opted to take mock exams, as well as their parents, said it was necessary to take them to be better prepared for the high-stakes P11 and O levels.

Li Li-Ying, a Sec 4 student from Singapore Chinese Girls' School, said that exam material has to do with all the revision of all the subjects. It is a relief to have a chance to try out the material before the actual exam. She said she was familiar with the exam-taking experience.

MOE said that schools can provide more support to students who are struggling with their learning. MOE noted that schools can provide more support to students who are struggling with their learning. MOE noted that schools can provide more support to students who are struggling with their learning.

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# OUR LOCATIONS



**BUKIT TIMAH**  
**Tan Kah Kee**  
2 min walk from Tan Kah Kee MRT.



**Kovan**  
**Upper Serangoon Road**  
5min walk from Kovan MRT.



**MARINE PARADE**  
**PARKWAY CENTER**  
Upcoming TE line in 2024.



**TOA PAYOH**  
**CLASSROOM**  
Conveniently located near Toa Payoh MRT



**JURONG EAST**  
**CLASSROOM**  
Right beside Jurong East MRT



**WOODLANDS**  
**CLASSROOM**  
Right beside Woodlands MRT



**TAMPINES**  
**READY IN 2024**  
Right beside Tampines MRT



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**CONSISTENT HARD WORK,**  
**OVER A LONG PERIOD OF TIME.**

We work hard consistently alongside you, week in, week out.

**We grind hard when no one is watching** because we know that when it comes time for exams, we will be one cut above the rest.



# LEARNING RESOURCES

IF YOU THOUGHT THE FREE MATERIALS ARE GOOD,  
Wait till you see the resources our own students get!



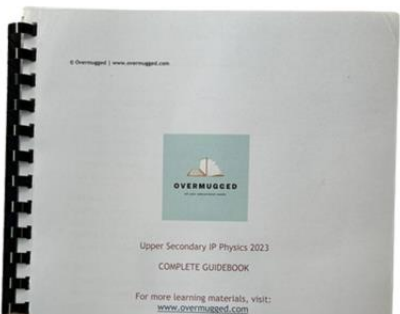
## WEEKLY WORKSHEETS

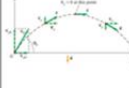
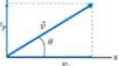
Topical, Thematic, Mock Test, Mock Exam,  
Prelim Prep, Practical Prep



## EXCLUSIVE CHEATSHEETS

Revision booklets, extra cheatsheets,  
Practical Assessment booklet



TOPIC: KINEMATICS			
Concept	Definition	Formula	Remarks
Linear motion	<ul style="list-style-type: none"> <li>Object that is moving in a straight line</li> <li>1-D motion</li> </ul>	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$	<ul style="list-style-type: none"> <li>Motion can be represented (upwards or right) or -ve (down or left) sign.</li> <li>Equations can only be used if acceleration is constant.</li> </ul>
2-D Motion	<ul style="list-style-type: none"> <li>Object that is moving in a projectile trajectory (x and y directions)</li> <li>2-D motion</li> <li>Acceleration is experienced in both axes</li> <li>Vertical and horizontal motion are independent of each other</li> </ul>	<p>Horizontal motion (acceleration = 0)</p> $v_x = u_x$ $s_x = u_x t$	<ul style="list-style-type: none"> <li>Acceleration always act down</li> <li>Projectile will free fall and parabolic if resistance is negligible</li> </ul> 
		<p>Vertical motion (uniform vertical acceleration = g)</p> $v_y = u_y + at$ $s_y = u_y t + \frac{1}{2}at^2$ $v_y^2 = u_y^2 + 2as$	
2 Vectors	Analyse the horizontal and vertical motion separately	<p>For a vector <math>\vec{v}</math> pointing at an angle <math>\theta</math> from the horizontal:</p> $v_x = v \cos\theta \text{ (horizontal)}$ $v_y = v \sin\theta \text{ (vertical)}$  $v = \sqrt{v_x^2 + v_y^2}$ $\tan\theta = \frac{v_y}{v_x} \Rightarrow \theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$	

**MARCH PRACTICE QUESTIONS 2021**  
SECONDARY 4 EXPRESS  
SECONDARY 5 NORMAL ACADEMIC

ELEMENTARY MATHEMATICS 4048/01

Specimen Paper  
Date: 3 March 2021  
Candidates answer on separate writing paper

Mean THESE INSTRUCTIONS FIRST

Answer all questions.  
If working is needed for any question it must be shown with the answer.  
Division of marks for correct working will result in total marks.  
You are expected to use a scientific calculator to evaluate explicit numerical expressions.  
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures.  
Give answers in degrees to one decimal place.  
For  $\pi$ , use either your calculator value of 3.142, unless the question requires the answer in terms of  $\pi$ .

Topic names will be listed above each question for your benefit and revision

Upon completion of solutions:  
Each candidate have exactly 2 weeks to submit their solution.  
Take a picture or send the digital version of your solutions to me (Kahen) via Telegram (@Kahen\_tutari) or WhatsApp (90583779).  
Ensure that all workings are clear and legible.  
Solutions will be marked based on your presentation, accuracy and completeness of your solution.  
A markers' report and the full solutions will be provided at the end of the month.

Setter: Ong Kai Wen  
This question paper consists of 2 printed pages including the cover page

not reached in a time $t$ if $v_y = 0$	$v_y^2 = (u \sin\theta)^2 - 2gh$ $\Delta H = \frac{u^2 \sin^2\theta}{2g}$	<p>With air resistance,</p> <ul style="list-style-type: none"> <li>Drag force acts in the same as the weight of object.</li> <li>Net acceleration <math>&gt;&gt; g</math></li> <li>Maximum height reached lower.</li> </ul>
if $v_y = 0$	$v_y = u \sin\theta - gt_{up}$ $\Delta t_{up} = \frac{u \sin\theta}{g}$	<p>With air resistance,</p> <ul style="list-style-type: none"> <li>Drag force acts in the same as the weight of object.</li> <li>Net acceleration <math>&gt;&gt; g</math></li> <li>Final vertical speed smaller than vertical speed</li> <li>Average speed upwards <math>&gt;&gt; g</math></li> </ul>

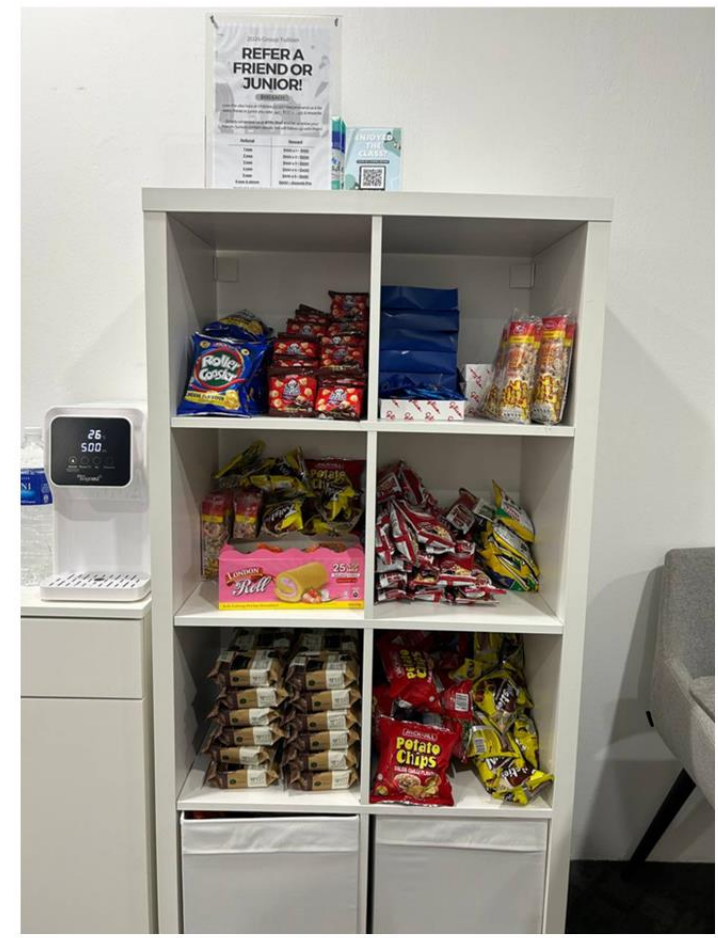




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- No extra material fee.
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## 'O' LEVELS

- \$80/lesson
- \$85/lesson (weekend)

## INTEGRATED PROGRAM

- \$90/lesson
- \$95/lesson (weekend)

## 'A' LEVELS

- \$100/lesson
- \$105/lesson (weekend)
- 10% if signing up for 2 'A' Levels subject & above*

*Fees are collected at the start of the term (every 3 months).*



# ACADEMIC YEAR

## TERM 1: NOV – JAN

### Topical Recaps

Key highlight: Christmas Party

## TERM 2: FEB – APR

### Topical Mastery

Key highlight: March Holiday Cohesion Program

## TERM 3: MAY – JUL

### Prelim/EOY Preparation

Key highlight: Mock Prelim/EOY

## TERM 4: AUG – OCT

### 'O' Levels / 'A' Levels Preparation

Key highlight: Mock Exams, Science Practical Assessment







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