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VCE Mathematical Methods ½

Quadratics Exam Skills [1.4]

Workbook

Outline:



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- Perfect Squares
- Difference of Squares
- Completing the Square
- Solving by Factorisation
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- Discriminant
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- Graphing Quadratics
- Finding a Rule of a Quadratic From a Graph
- Quadratic Inequalities
- Hidden Quadratics

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- Finding Turning Point efficiently
- Modelling using Quadratics
- Family of Functions

Exam 1

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Section A: Recap

Sub-Section: Factorising Quadratics

Let's quickly revise how we factorised quadratics!

Factorising Quadratics



$$y = (x - a)(x - b)$$

► Steps:

1. Divide by the coefficient of the leading term. (If applicable)
2. Consider the factors of the constant term.
3. (If Positive Constant Term): See which pair of factors can add up to the coefficient of the x term.
(If Negative Constant Term): See which pair of factors can subtract from the coefficient of the x term.
4. Construct the linear factors.

Question 1

Factorise the following expressions:

a. $x^2 + 6x + 8$

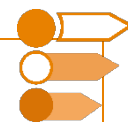
$$= (x+4)(x+2) //$$

b. $x^2 - 5x + 6$

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

Space for Personal Notes

Sub-Section: Perfect Squares



Let's quickly revise perfect squares!



Perfect Squares



$$(a + b)^2 = \underline{a^2 + 2ab + b^2}$$

$$(a - b)^2 = \underline{a^2 - 2ab + b^2}$$

- Perfect squares are special quadratic expressions that are made up of two **identical** linear factors.
- In other words, when a linear factor is squared, it becomes a perfect square.

Question 2

Factorise the following expressions using the perfect square formula.

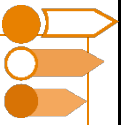
a. $x^2 + 6x + 9$

$$= (x + 3)^2 //$$

b. $4x^2 - 12x + 9$

$$= (2x - 3)^2 //$$

Sub-Section: Difference of Squares



Let's quickly revise the difference between squares!



Difference of Squares



$$a^2 - b^2 = \underline{(a+b)(a-b)}$$

Question 3

Factorise the following expressions:

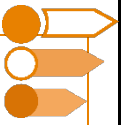
a. $x^2 - 16$

$$= (x-4)(x+4)$$

b. $9x^2 - 4$

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

Sub-Section: Completing the Square



Let's quickly revise completing the square!



Completing the Square



➤ When we complete the square of a quadratic $x^2 + bx + c$, we write it in the form:

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

➤ Steps:

1. We halve the coefficient of x .

2. Subtract the half of the coefficient of x squared outside the square bracket.

$$(a+b)^2 = a^2 + 2ab + b^2$$

Question 4

Complete the square for each quadratic.

a. $x^2 - 6x + 4$

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

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

b. $2x^2 + 16x + 17$

$$= 2(x^2 + 8x) + 17$$

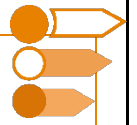
$$= 2((x+4)^2 - 4^2) + 17$$

$$= 2(x+4)^2 - 32 + 17$$

$$= 2(x+4)^2 - 15$$

Space for Personal Notes

Sub-Section: Solving by Factorisation



Solving by Factorisation

$$(x - a)(x - b) = 0$$

$$x = a \text{ or } b$$

Null Factor Law

► Steps:

1. Factorise the quadratic.

2. Equate each factor to 0 and solve for x .

Question 5

Solve each of the following quadratic equations for x :

a. $x^2 - 6x + 8 = 0$

$$(x-4)(x-2) = 0$$

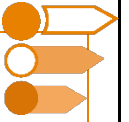
$$\hookrightarrow x = 2 \text{ or } x = 4 //$$

b. $2x^2 - 3x - 5 = 0$

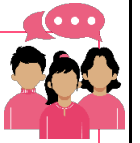
$$(2x-5)(x+1) = 0$$

$$\hookrightarrow \therefore x = -1 \text{ or } x = \frac{5}{2} //$$

Sub-Section: Quadratic Formula



Discussion: What do we do if the quadratic is not easy to factorise?



↪ Use the Quadratic Formula!

The Quadratic Formula



$$\text{for } ax^2 + bx + c = 0$$

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

Space for Personal Notes

~~Question 6~~

Solve each of the following quadratic equations for x .

a. $x^2 - 4x - 8 = 0$

b. $2x^2 + 4x + 1$

Sub-Section: Discriminant



The Discriminant

► Definition:

- The discriminant, often denoted by Δ (Delta), is the part **inside** the square root of the quadratic formula.

$$\text{Discriminant} = \Delta = b^2 - 4ac$$

if $\Delta > 0$, there are 2 solns.

if $\Delta = 0$, there is 1 soln.

if $\Delta < 0$, there are 0 solns.

Question 7

Determine how many unique roots exist in each of the following quadratic equations:

$$x^2 - 7x + 5 = 0$$

$$\Delta = (-7)^2 - 4(1)(5)$$

$$= 49 - 20$$

$$= 29$$

\therefore As $\Delta > 0$,
there are 2
real solns for x .

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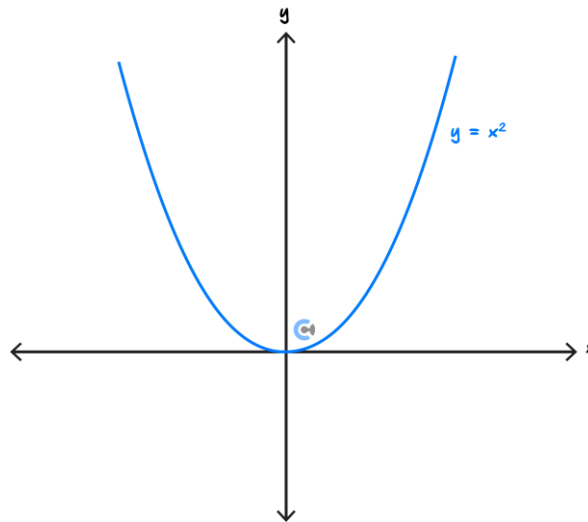
Sub-Section: Parabola and Symmetry



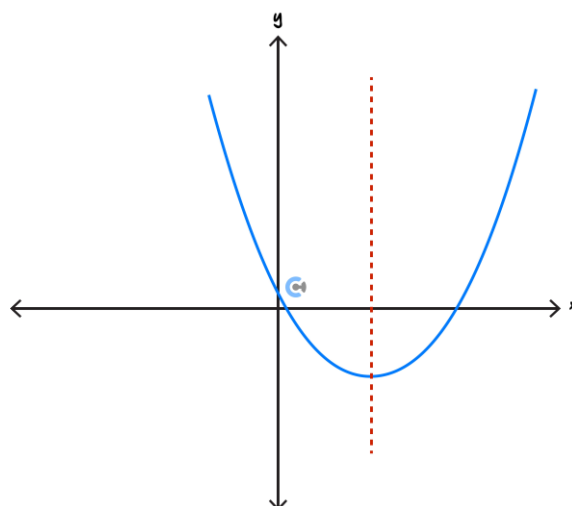
Parabola

► Definition:

The shape of the graph of a quadratic is known as a parabola.



Axis of Symmetry



Axis of symmetry: $x = -\frac{b}{2a}$

Question 8

Find the axis of symmetry of each of the following quadratic hence, the coordinate of turning point.

$$y = 2x^2 - 6x + 5$$

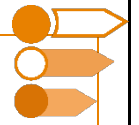
$$\begin{aligned} \text{TP: } x &= \frac{-(-6)}{2(2)} = \frac{6}{4} = \frac{3}{2} \Rightarrow y\left(\frac{3}{2}\right) = 2\left(\frac{9}{4}\right) - 6\left(\frac{3}{2}\right) + 5 \\ &= \frac{9}{2} - 9 + 5 \\ &= -\frac{9}{2} + 5 = -\frac{1}{2} \end{aligned}$$

$\therefore \text{TP: } \left(\frac{3}{2}, -\frac{1}{2}\right)$

NOTE: When a question asks for coordinates, you must mention both the x and y -value of the point.

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Sub-Section: Graphing Quadratics



Turning Point Form

- The turning point form of a quadratic is given by:

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

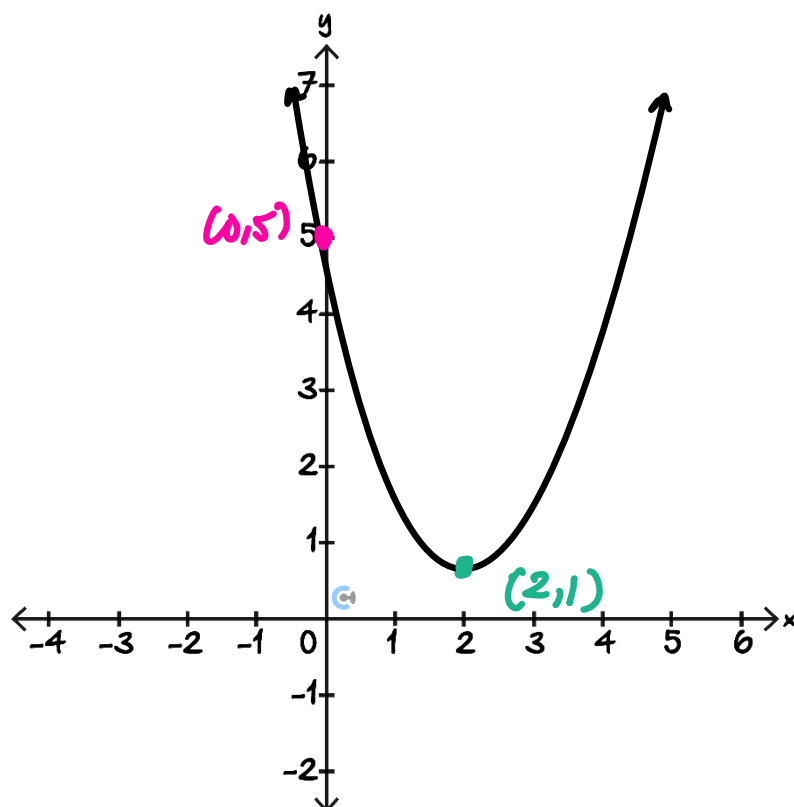
Turning point = (h, k)

- The turning point form is obtained by completing the square.

Question 9

Sketch the graph of the following quadratic equation, labelling the coordinates of all axes intercepts and the turning point.

$$y = (x - 2)^2 + 1 \quad \rightarrow \text{TP: } (2, 1)$$



1. TP
2. Shape
↑
3. Ints
y-int: x=0
 $y = (0 - 2)^2 + 1$
 $= 4 + 1$
 $= 5$



Intercept Form

- The x -intercept form of a quadratic is given by:

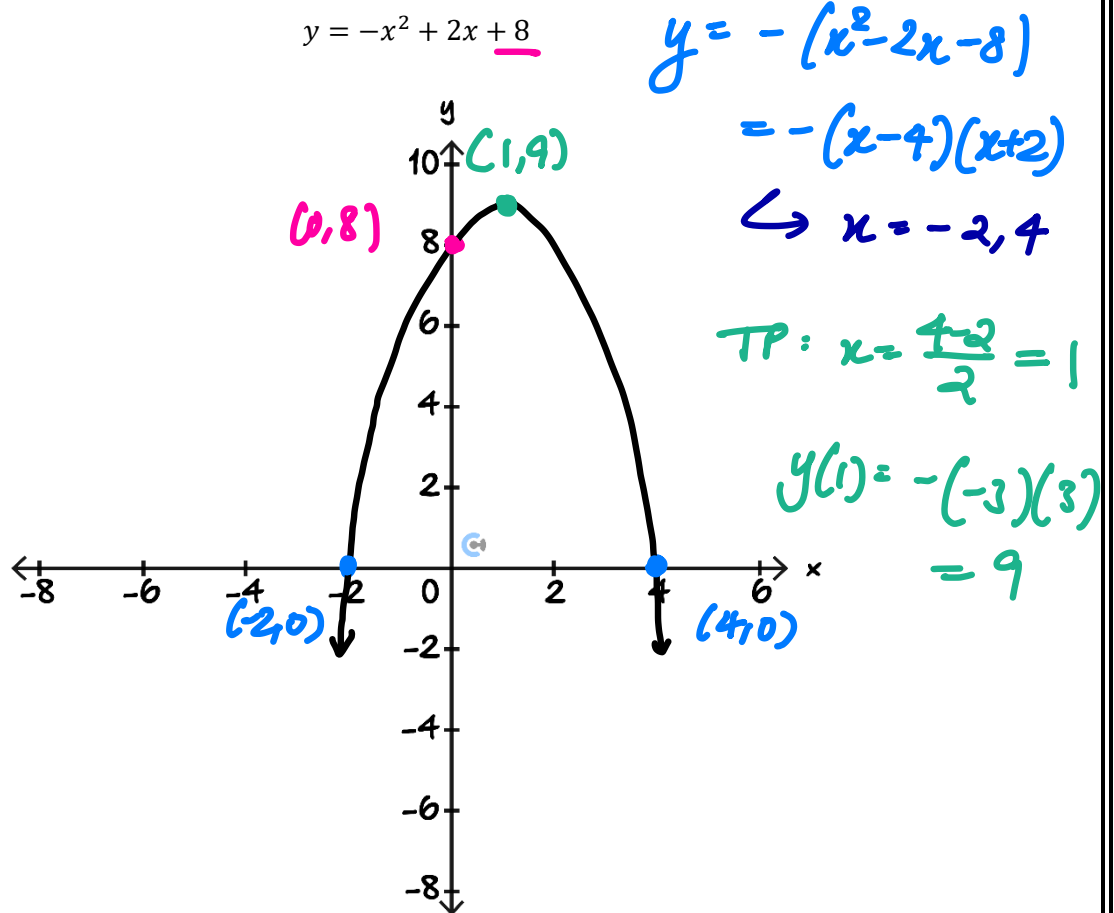
$$y = a(x - b)(x - c)$$

x -intercepts: $(b, 0)$ and $(c, 0)$

- The axis of symmetry is located exactly in the middle of the two x -intercepts.

Question 10

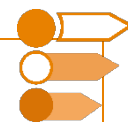
Sketch the graph of the following quadratic equation, labelling the coordinates of all axes intercepts, as well as the turning point.



NOTE: When a is negative, the x -intercepts stay the same, but the **shape** of the parabola becomes a **negative** parabola instead.



Sub-Section: Finding a Rule of a Quadratic from a Graph



Let's try to do it the other way around!

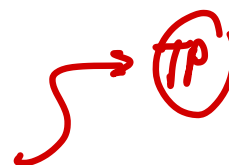


Finding the Equation of a Quadratic



➤ Form 1: Turning Point Form

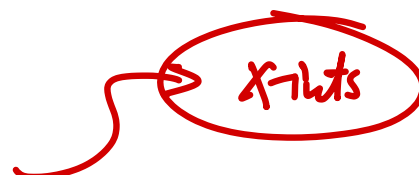
$$y = a(x - h)^2 + k$$



Recommended when a turning point is easy to identify.

➤ Form 2: x -intercept Form

$$y = a(x - b)(x - c)$$



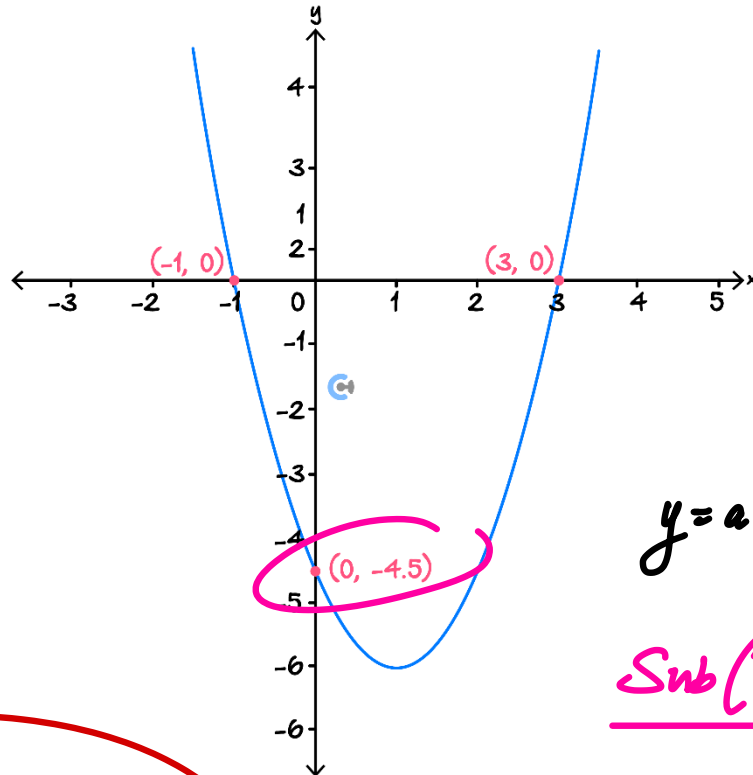
Recommended when both x -intercepts are easy to identify.

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Question 11

Find the equations of the quadratics graphed below. Show your working.

a.



$$y = a(x+1)(x-3)$$

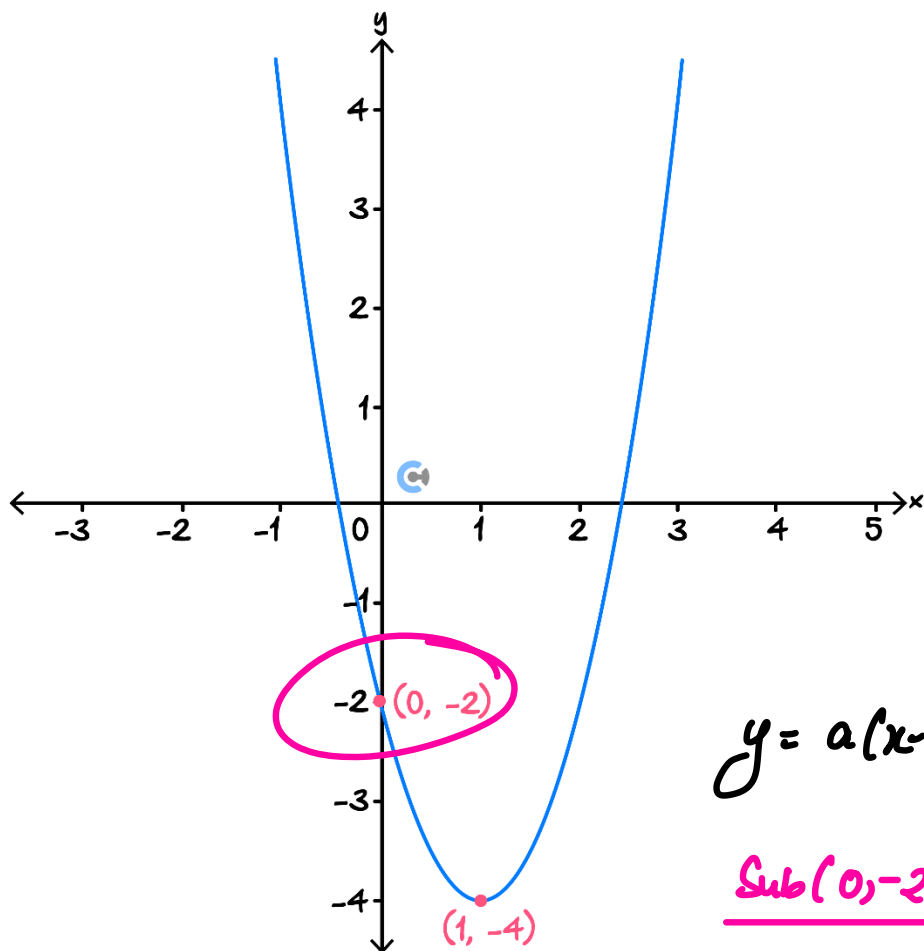
Sub $(0, -\frac{9}{2})$:

$$-\frac{9}{2} = a(1)(-3)$$

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

$\therefore y = \frac{3}{2}(x+1)(x-3)$

b.



$$y = a(x-1)^2 - 4$$

Sub (0, -2):

$$-2 = a(-1)^2 - 4$$

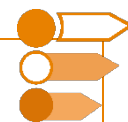
$$\therefore a = 2$$

$$\therefore y = 2(x-1)^2 - 4$$

NOTE: Never forget the a coefficient!



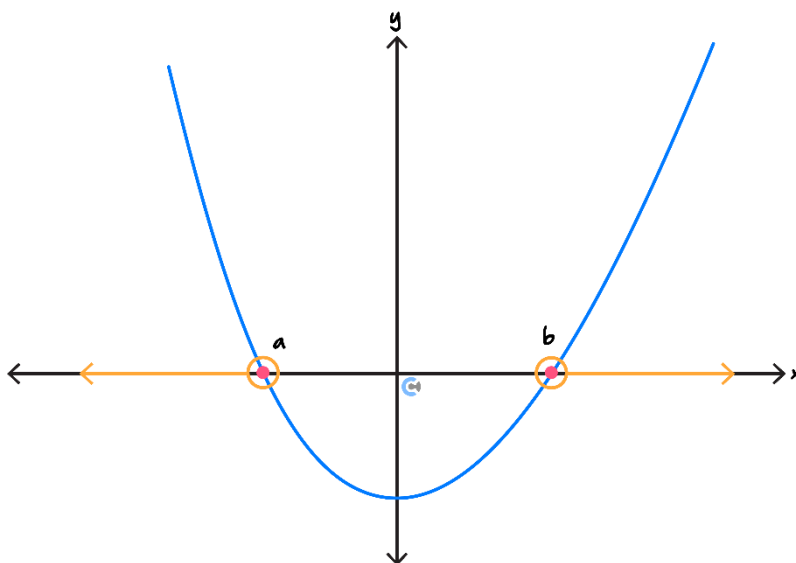
Sub-Section: Quadratic Inequalities



How can we tackle quadratic inequalities?



Quadratic Inequalities



► For quadratic inequalities, we always Sketch the function.

► Steps:

1. Sketch the function.
2. See where the y -value is within the inequality.
3. Find the corresponding x -values.

Discussion: Why do we look at y -value < 1 if the function < 1 ?



$y = f(x)$

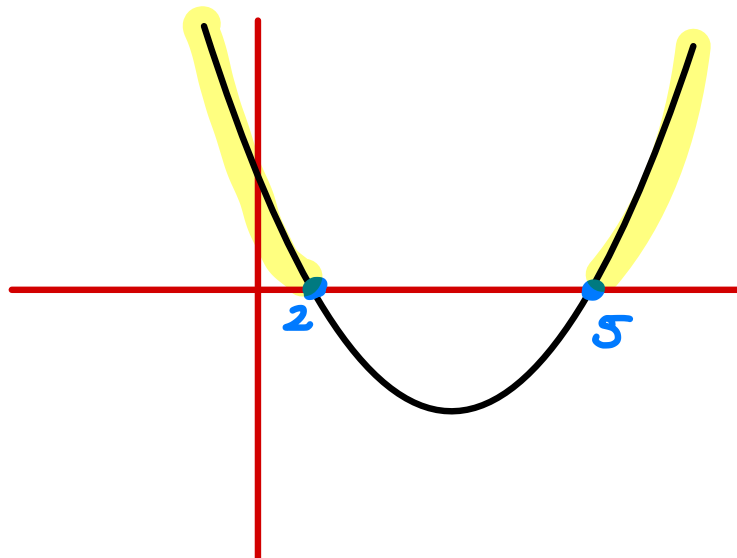
Question 12

Solve each of the following for x :

a. $(x - 2)(x - 5) > 0$

$\hookrightarrow x = 2 \text{ or } x = 5$

$\therefore x < 2 \text{ or } x > 5$



b. $2x^2 - 7x + 6 \leq 0$

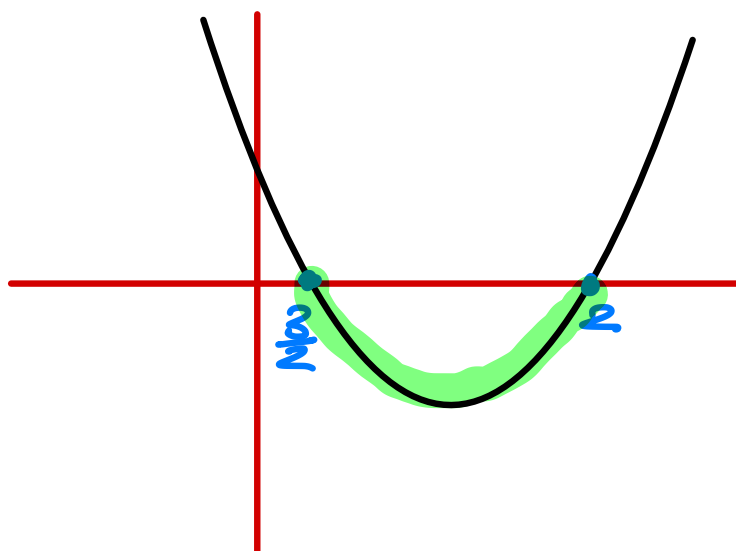
$(2x - 3)(x - 2) \leq 0$

$\hookrightarrow x = \frac{3}{2}, 2$

$\hookrightarrow \therefore x \in [\frac{3}{2}, 2]$

OR

$\frac{3}{2} \leq x \leq 2$



$a^2 < 4$

$-2 < a < 2$

$-\sqrt{4} < a < +\sqrt{4}$

$a^2 > 4$

$a > 2 \text{ or } a < -2$

$a > +\sqrt{4} \text{ or } a < -\sqrt{4}$

Sub-Section: Hidden Quadratics

Let's take a look at hidden quadratics!

Hidden Quadratics

➤ Instead of:

$$af(x)^2 + bf(x) + c = 0$$

➤ We can let $f(x) = X$ to have:

$$aX^2 + bX + c = 0$$

Question 13

a. Solve $(x - 2)^2 + 5(x - 2) + 6 = 0$ for x .

Let $a = x - 2$:

$$\therefore a^2 + 5a + 6 = 0$$

$$(a + 3)(a + 2) = 0$$

$$\therefore a = -3 \text{ or } a = -2$$

$$x - 2 = -3 \text{ or}$$

$$x - 2 = -2$$

$$\therefore x = -1 \text{ or } x = 0$$

b. Solve $x^4 - 13x^2 + 36 = 0$ for x .

Let $a = x^2$

$$\therefore a^2 - 13a + 36 = 0$$

$$(a-9)(a-4) = 0$$

$$a = 9 \text{ or } a = 4$$

$$\therefore x^2 = 9 \text{ or } x^2 = 4$$

$$\rightarrow \therefore x = \pm 3 \text{ or } x = \pm 2 //$$

Space for Personal Notes

Section B: Quadratics Exam Skills

Sub-Section: Finding Turning Point efficiently

How do we complete the square very quickly?

Completing the square quickly.

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

► Steps

1. Find the turning point using $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$.
2. Use the leading coefficient as a .

Question 14 Walkthrough

Complete the square for $y = 2x^2 - 4x + 5$.

$$TP: x = \frac{-(-4)}{2(2)} = 1$$

$$y(1) = 2 - 4 + 5 = 3$$

$$TP: (1, 3)$$

$$y = \underline{\underline{2}}(x - 1)^2 + 3$$



Active Recall: Completing the square quickly

- Find the turning point using $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$.
- Use the leading coefficient as a .

Question 15

Complete the square for $y = -3x^2 + 12x - 1$.

$$\begin{aligned}
 \text{TP: } x &= \frac{-(12)}{2(-3)} = 2 & \rightarrow y(2) &= -12 + 24 - 1 \\
 & & &= 11 \\
 & & \text{TP: } &(2, 11) \\
 & \therefore y &= -3(x-2)^2 + 11
 \end{aligned}$$

Space for Personal Notes

Sub-Section: Modelling using Quadratics



Modelling with Quadratics

- Focus on key points such as turning points, x -intercepts and y -intercepts.

Question 16 Walkthrough.

$\rightarrow ax^2+bx+c$

$\rightarrow TP: (2,10)$

" $y=0$ "

A quadratic bridge has the highest point at $(2,10)$ and hits the ground at $x = 10$. $\Rightarrow x\text{-int}: (10,0)$

\hookrightarrow is parabola

Find the equation of the quadratic bridge.

$TP: (2,10)$

$x\text{-int}: (10,0)$

$$\Rightarrow \therefore y = a(x-2)^2 + 10$$

Sub $(10,0)$:

$$0 = a(10-2)^2 + 10$$

$$a = \frac{-10}{64} = -\frac{5}{32}$$

$$\therefore y = -\frac{5}{32}(x-2)^2 + 10$$

Question 17

A ramp is modelled by a quadratic equation and passes through $(1,3)$, $(2,6)$ and $(-1,9)$.

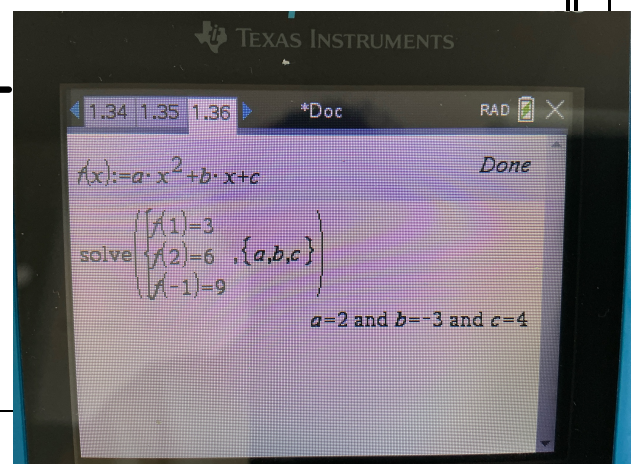
Find the equation of the ramp.

\hookrightarrow menu
3
1
7

$$f(1)=3 \quad f(2)=6 \quad f(-1)=9$$

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

$$\therefore y = 2x^2 - 3x + 4$$



Sub-Section: Family of Functions



Family of Functions

- **Definition:** Functions with unknowns.
- **Question Type:** Find the unknown value to satisfy a certain condition.

Question 18 Walkthrough.

Consider the function $f(x) = -x^2 + 3x - k$.

Find the value(s) of k if the maximum is less than 6.

TP-y value < 6

$$TP: x = \frac{-3}{2(-1)} = \frac{3}{2}$$

$$y\left(\frac{3}{2}\right) = -\frac{9}{4} + \frac{9}{2} - k$$

$$= \frac{9}{4} - k$$

$$\frac{9}{4} - k < 6$$

$$k > \frac{9}{4} - 6$$

$$\Rightarrow \therefore k > \frac{-15}{4}$$

$$x = \frac{-b}{2a}$$

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

TP-x value

$$y = \frac{9}{4} - k$$

$$TP-y < 6$$

NOTE: When VCAA writes value(s), the number of solutions should be more than one.

ALSO NOTE: For maximum and minimum, focus on the turning points.

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Question 19

Consider the function $f(x) = 2x^2 - kx - 4$.

- a. Find the x -intercepts of f in terms of k .

$$x = \frac{-(-k) \pm \sqrt{(-k)^2 - 4(2)(-4)}}{2(2)} = \frac{k \pm \sqrt{k^2 + 32}}{4}$$

- b. Find the values of k such that the distance between two x -intercepts is less than 5.

$$\frac{\sqrt{k^2 + 32}}{2} < 5$$

$$\sqrt{k^2 + 32} < 10$$

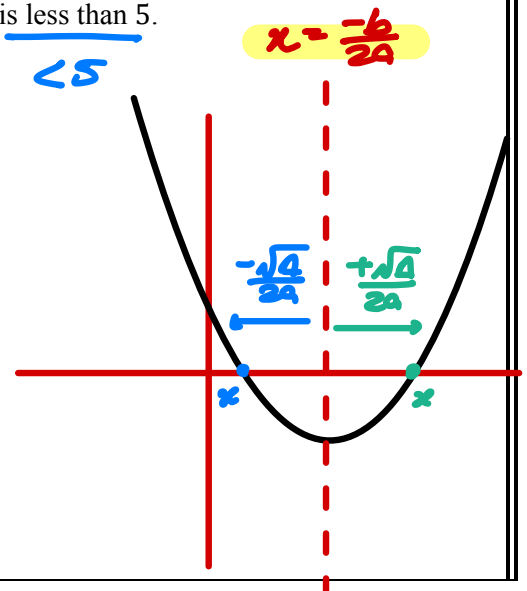
$$k^2 + 32 < 100$$

$$k^2 < 68$$

\Downarrow

$$-\sqrt{68} < k < \sqrt{68}$$

$$\Rightarrow -2\sqrt{17} < k < 2\sqrt{17}$$



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

Section C: Exam 1 (20 Marks)

Question 1 (3 marks)

The sum of two children's age is 7 and the product of their ages is 12.

- a. Write down a quadratic equation in the form $ax^2 + \underline{bx} + \underline{c} = 0$ that can be solved to find the ages of the children. (1 mark)

$$x^2 + 7x + 12 = 0$$

- b. Find the ages of the children. (2 marks)

$$(x + \underline{4})(x + \underline{3}) = 0$$

$$\hookrightarrow \therefore \text{Ages} = 3, 4 //$$

Space for Personal Notes

Question 2 (4 marks)

Consider the function $f(x) = x^2 - 3x - 4$.

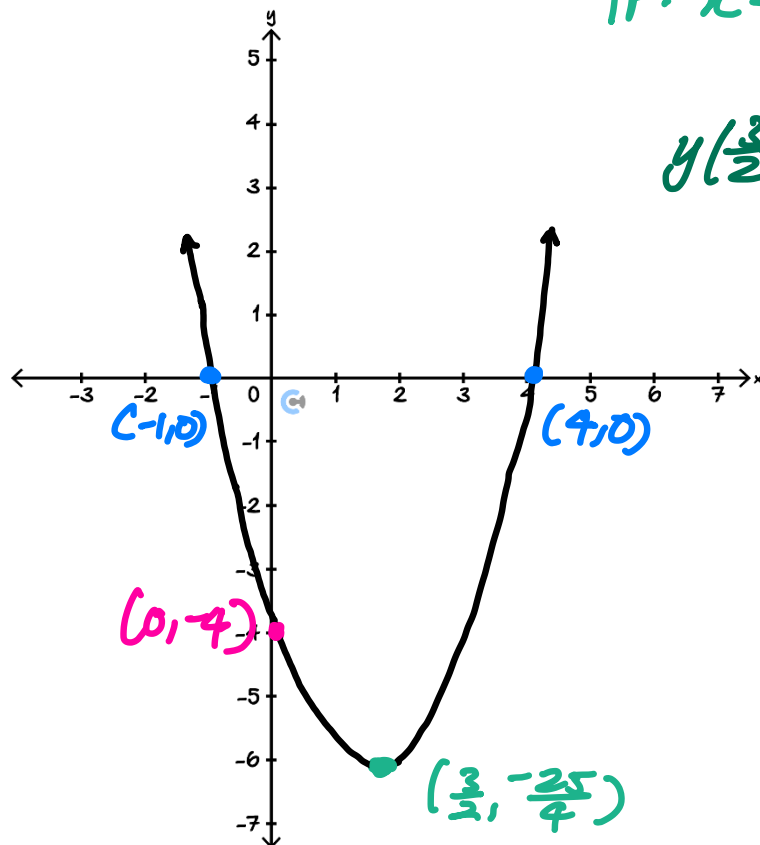
- a. Solve the equation $f(x) = 0$. (1 mark)

$$x^2 - 3x - 4 = 0$$

$$(x-4)(x+1) = 0$$

$$\rightarrow x = -1, 4$$

- b. Sketch the graph of $y = f(x)$ on the axes below. Label the turning point and all axes intercept with coordinates. (2 marks)



$$TP: x = \frac{4-1}{2} = \frac{3}{2}$$

$$\begin{aligned} y\left(\frac{3}{2}\right) &= \left(\frac{3}{2}\right)^2 - 3\left(\frac{3}{2}\right) - 4 \\ &= \frac{9}{4} - \frac{9}{2} - 4 \\ &= -\frac{9}{4} - 4 \\ &= -\frac{25}{4} \end{aligned}$$

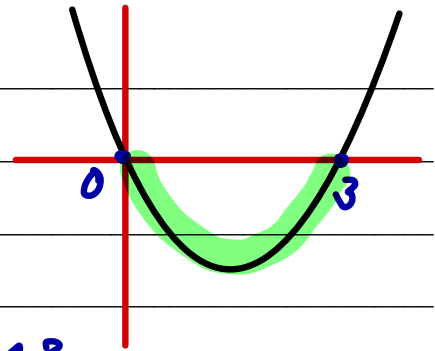
c. Hence, find the value(s) of x such that $\underline{f(x)} + \underline{4} < 0$. (1 mark)

$$x^2 - 3x - 4 + 4 < 0$$

$$x^2 - 3x < 0$$

$$x(x-3) < 0$$

$$\hookrightarrow x < 0 \vee x > 3 \Rightarrow \therefore \underline{0 < x < 3}$$



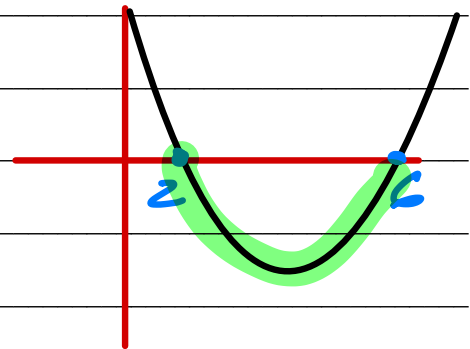
Question 3 (2 marks)

Solve the inequality $x^2 - 8x + 12 \leq 0$.

$$(x-6)(x-2) \leq 0$$

$$\hookrightarrow x = 2, 6$$

$$\therefore \underline{2 \leq x \leq 6}$$



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Question 4 (3 marks)

Solve the equation $x^4 + 5x^2 - 36 = 0$, for real values of x .

Let $a = x^2$:

$$a^2 + 5a - 36 = 0$$

$$(a+9)(a-4) = 0$$

$a = -9$ or $a = 4$
 \rightarrow reject as $a \geq 0$

$$x^2 = 4$$

$$x = \pm 2 //$$

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Question 5 (3 marks)

Consider the function $f(x) = x^2 - 2kx + 5$, where k is a real number. Find all possible values of k if $f(x)$ is always greater than 1.

$$f(x) > 1$$

$$x^2 - 2kx + 5 > 1$$

$$x^2 - 2kx + 4 > 0$$

$y > 0 \Rightarrow$ No roots

$\Delta < 0$

$$\Delta = (-2k)^2 - 4(1)(4) < 0$$

$$4k^2 - 16 < 0$$

$$k^2 - 4 < 0$$

$$k^2 < 4$$

$$\therefore -2 < k < 2$$

Question 6 (5 marks)

Consider the function $f(x) = x^2 - kx - 1$, where k is a real number.

- a. Show that the graph $y = f(x)$ always has two x-intercepts. (1 mark)

$$\Delta > 0$$

$$\Delta = (-k)^2 - 4(1)(-1) > 0$$

$$k^2 + 4 > 0$$

\therefore As $k^2 \geq 0$

$\therefore k^2 + 4 > 0$

and there will always be 2 x-intercepts

- b. Find the values of k such that the distance between the two x-intercepts is less than 4. (3 marks)

$$\frac{\sqrt{4}}{4} < 4$$

$$\left(\frac{\sqrt{k^2+4}}{1}\right)^2 < (4)^2 \Rightarrow k^2+4 < 16$$

$$k^2 < 12$$

||

$$\therefore -\sqrt{12} < k < \sqrt{12}$$

$$\therefore -2\sqrt{3} < k < 2\sqrt{3}$$

- c. Find the minimum possible distance between the two x-intercepts. (1 mark)

$$\sqrt{k^2+4}$$

$$\begin{aligned} \hookrightarrow \text{min of } \sqrt{k^2+4} &\Rightarrow \text{min of } k^2+4 \Rightarrow \text{min of } k^2 \\ \textcircled{2} &= \sqrt{4} &= 4 &= k^2=0 \\ & & &\text{when } k=0 \end{aligned}$$

Space for Personal Notes

$$k=0 \Rightarrow k^2=0 \Rightarrow k^2+4=4 \Rightarrow \sqrt{k^2+4}=2$$

this distance = 2

$$3-5 = -2$$

Section D: Tech Active Exam Skills

Calculator Commands: Solving equations



➤ Mathematica

Solve[

In[122]:= Solve[x^2 - 4 x - 9 == 0, x]
 Out[122]= {{x -> 2 - Sqrt[13]}, {x -> 2 + Sqrt[13]}}

➤ TI-Nspire

Menu→3→1.

solve(x^2-4x-9=0,x)
 $x = -(\sqrt{13} - 2)$ or $x = \sqrt{13} + 2$

➤ Casio Classpad

Action→Advanced→Solve.

solve(x^2-4x-9=0, x)
 $\{x = -\sqrt{13} + 2, x = \sqrt{13} + 2\}$

Calculator Commands: Completing the Square



➤ TI-Nspire

Menu→3→5
 completeSquare
 (func, var).

completeSquare(x^2-6x+8,x) (x-3)^2-1

➤ Mathematica

no inbuilt function need
 udf.

Compsq
 Complete a quadratic in the form $ax^2 + bx + c$ to turning point form.
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➤ Casio Classpad

No function.

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Section E: Exam 2 (19 Marks)

Question 7 (1 mark)

Find the value(s) of k for which the quadratic equation below has exactly one unique real solution.

$$3x^2 - \frac{2}{5}kx + k = 0$$

$$\Delta = 0$$

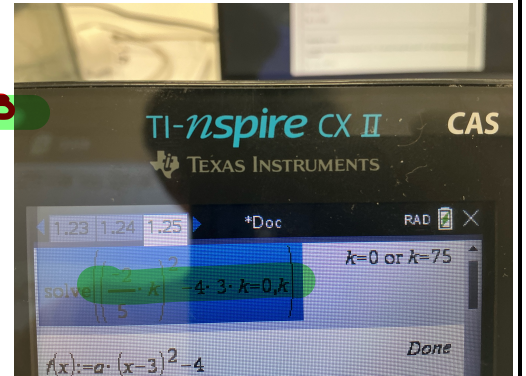
A. $k = -75$

☒ B. $k = 0,75$

C. $k = \frac{2}{5}$

D. $k = 0,50$

$$\Delta = \left(-\frac{2}{5}k\right)^2 - 4(3)(k) = 0$$



Question 8 (1 mark)

A quadratic function has a turning point at $(3, -4)$ and goes through the point $(5, -8)$. What is the equation of the function?

~~A. $-(x-3)^2 + 4$~~

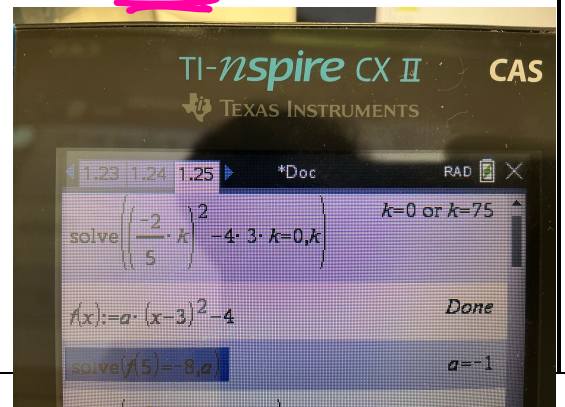
~~B. $(x-3)^2 - 4$~~

~~C. $-(x+3)^2 - 4$~~

☒ D. $-(x-3)^2 - 4$

$$y = a(x-3)^2 - 4$$

$$f(5) = -8 \Rightarrow \text{Sub for } a!$$



~~Question 9 (1 mark)~~

The function $f(x) = 3x^2 + mx + 5$ is always greater than 2. The possible of m are:

A. $m = \pm 10$

B. $0 < m < 12$

☒ C. $-6 < m < 6$

D. $-9 < m < 9$

$$3x^2 + mx + 5 > 2$$

$$3x^2 + mx + 3 > 0$$

No roots

$$\Delta < 0$$

$$m^2 - 4(3)(3) < 0$$

$$m^2 < 36$$

$$\therefore -6 < m < 6$$

Question 10 (1 mark)

$x = -4, y = 0$

$f(-4) = 0$

If one root of the quadratic equation $3x^2 + px - 12 = 0$ is -4 , the value of p is:

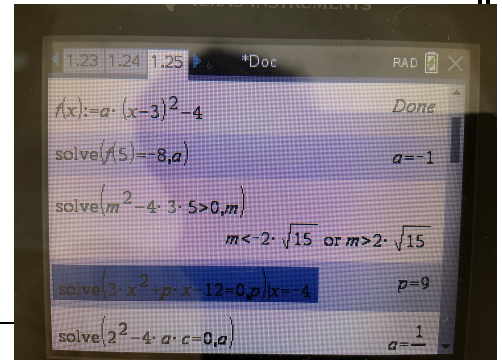
x -intercept

A. -9

B. 9

C. -4

D. 4



Question 11 (1 mark)

The equation $ax^2 + 2x + c = 0$ has only one real solution if:

A. $c^2 = 4a$

$\Delta = 0$

B. $c^2 < 4a$

$(2)^2 - 4(a)(c) = 0$

C. $c^2 > 4a$

D. $ac = 1$

$4 = 4ac$

$ac = 1$

Question 12 (7 marks)

Emily is standing at the top of a cliff overlooking the ocean. She is 80 metres above the ocean. She tosses a ball into the air. The height, h , of the ball after t seconds is given by:

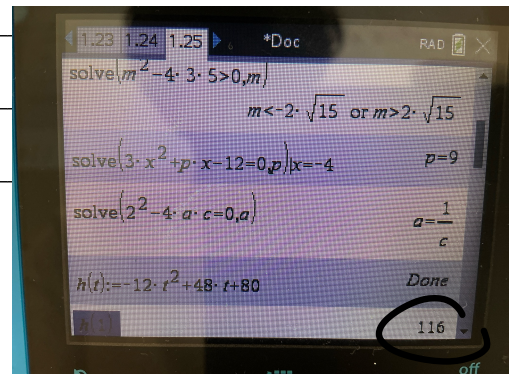
$h = -12t^2 + 48t + 80.$

a. What is the height of the ball above the ocean after $t = 1$ second? (1 mark)

$h(t)$

$t = 1$

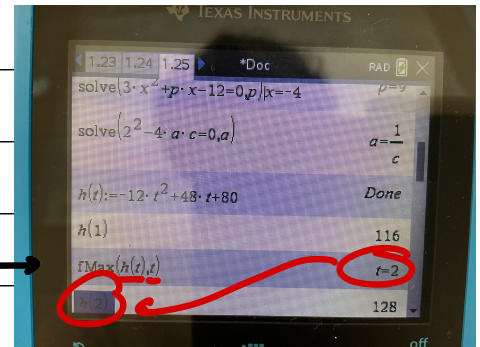
$h(1) = 116 \text{ m}$



- b. What is the maximum height above the ocean that the ball reaches? (1 mark)

Max height = 128m

Menu → 4 → 78



- c. What is the time taken for the ball to reach its maximum height? (1 mark)

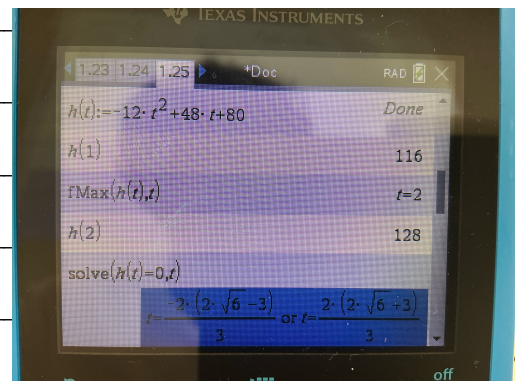
$\therefore t = 2 \text{ seconds}$

- d. How many seconds does it take for the ball to land in the ocean? Give an exact value. (2 marks)

$\therefore h(t) = 0$

$\therefore t = 2 - \frac{4\sqrt{6}}{3}$ or $t > 0$ reject as

$t = 2 + \frac{4\sqrt{6}}{3}$



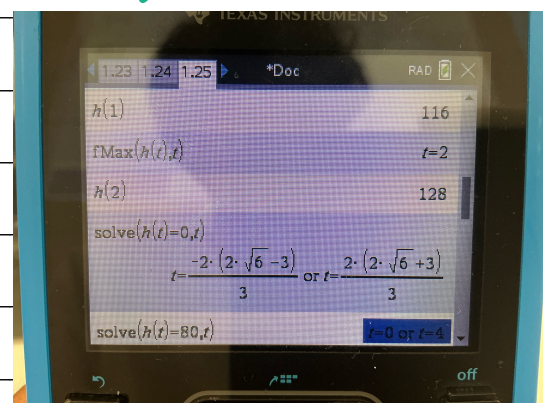
- e. After Emily throws the ball upwards, when exactly does the ball pass her on its way down? (2 marks)

$h(t) = 80$

$\therefore h(t) = 80$

$\therefore t = 0$ or $t = 4$ reject as $t > 0$

4 seconds



Question 13 (7 marks)

A cricket player hits a ball, and the ball's trajectory is modelled by the quadratic equation:

$$h(x) = ax^2 + bx + c,$$

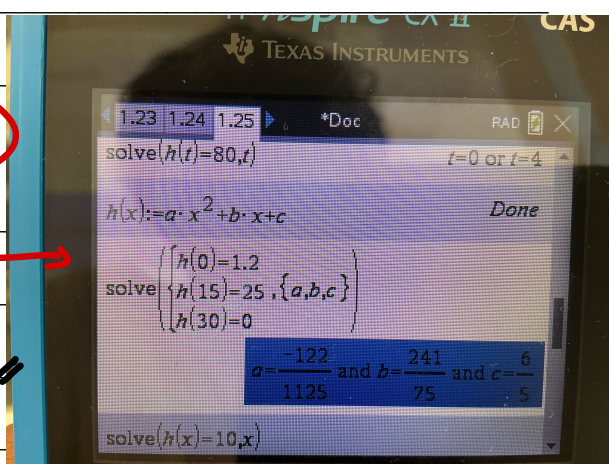
Where $h(x)$ is the height of the ball (in metres) above the ground, and x is the horizontal distance (in metres) from where the ball was hit.

The following conditions are given:

- The ball is hit from a height of 1.2 metres, i.e., $h(0) = 1.2$. ↗ $h(0) = 1.2$
 - The ball reaches a height of 25 metres when it has traveled 15 metres horizontally. ↗ $h(15) = 25$
 - The ball hits the ground after travelling 30 metres horizontally, i.e., $h(30) = 0$. ↗ $h(30) = 0$
- a. Using the given conditions, set up and solve a system of equations to determine the values of a , b , and c . (3 marks)

Menu → 3 → 7

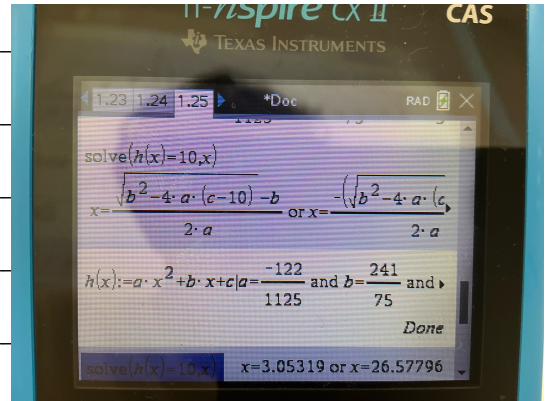
$$\therefore a = \frac{-122}{1125}, b = \frac{241}{75}, c = \frac{6}{5}$$



- b. Determine the horizontal distance the ball has travelled when its height is 10 metres. Provide both possible values of x correct to two decimal places. (2 marks)

$$\therefore h(x) = 10$$

$$\therefore x = 3.05\text{m or } x = 26.58\text{m}$$



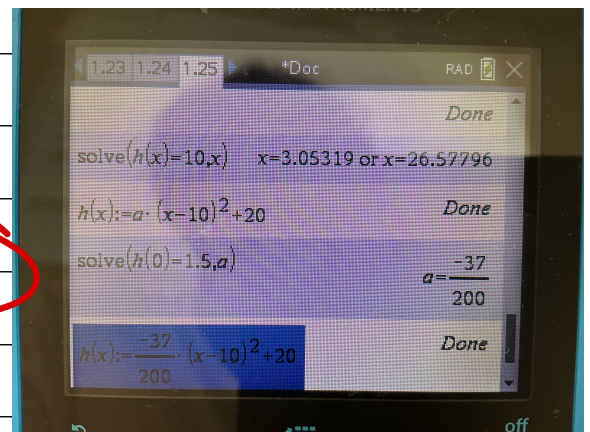
Another player hits a ball, and the ball's trajectory is modelled by a quadratic equation $h_2(x)$.

This player's ball:

- Is hit from a height of 1.5 metres, i.e., $h_2(0) = 1.5$.
 - Reaches its maximum height of 20 metres at a horizontal distance of 10 metres.
- c. Find the equation of $h_2(x)$ in turning point form. (2 marks)

$$h(x) = a(x-10)^2 + 20$$

$$\therefore h_2(x) = \frac{-37}{200}(x-10)^2 + 20$$



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Contour Check

Learning Objective: [1.1.1] - Find factorised form of quadratics

Key Takeaways

- ☐ Perfect square is in the form of _____.
- ☐ Differences of squares are in the form of $a^2 - b^2$ _____.
- ☐ Complete the square form of $x^2 + bx + c =$ _____.

Learning Objective: [1.1.2] - Find solutions and number of solutions to quadratic equations

Key Takeaways

- ☐ We can solve for quadratic equations by first _____.
- ☐ Alternatively, we can use the quadratic formula given by $x =$ _____.
- ☐ The discriminant is given by _____ which dictates the number of solutions.

Learning Objective: [1.1.3] - Graph and find rules from the graph of quadratic equations

Key Takeaways

- ☐ Every quadratic can be put into the turning point given by $y =$ _____.
- ☐ _____ all quadratic can be put into the x -intercept form given by $y =$ _____.
- ☐ We can use x -intercept form or turning point form to find the rule.

Learning Objective: [1.1.4] - Solving Quadratic Inequalities and hidden quadratics

Key Takeaways

- ☐ For quadratic inequalities, we always _____.
- ☐ For hidden quadratics, look for the pattern of something and something _____.



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