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Year 10 Mathematics

Quadratic Algebra II [3.2]

Workshop Solutions

Error Logbook:

New Ideas/Concepts	Didn't Read Question
Pg / Q #: ____________________ Notes:	Pg / Q #: ____________________ Notes:
Algebraic/Arithmetic/ Calculator Input Mistake	**Working Out Not Detailed Enough**
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Section A: Recap

Sub-Section [3.2.1]: Carry Out the Process of Completing the Square

Definition

Completing the Square for Monic expression

- To complete the square of a quadratic expression: $x^2 + bx + c$.
  - **Step 1:** Halve the coefficient of the middle (x) term, $\frac{b}{2}$.
  - **Step 2:** Square $x + \frac{b}{2}$ (Note: b can be $+$ or $-$).
  - **Step 3:** In order to keep the original quadratic the same, subtract $\left(\frac{b}{2}\right)^2$ from the expression.
  - **Step 4:** Keep constant c in the equation.
- So, we can write the formula as $\left(x + \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c$.
- If you ever forget how to do it, you can watch these two TikTok videos!

Definition

Completing the Square for Non-Monic Expressions

- To complete the square of a quadratic expression:

$$ax^2 + bx + c$$

- **Step 1:** Take out the factor a for the first two terms:

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

- **Step 2:** Halve the coefficient of the middle (x) term, $\frac{b}{a}$.

- **Step 3:** Square $x + \frac{b}{2a}$ (Note: $\frac{b}{a}$ can be $+$ or $-$).
- **Step 4:** In order to keep the original quadratic the same, subtract $\left(\frac{b}{2a}\right)^2$ from the expression in the bracket.
- **Step 5:** Keep constant c in the equation.

$$ax^2 + bx + c = a\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a} + c$$

Question 1

Complete the square for the following quadratic expression.

a. $x^2 - 10x + 1$

Here, $a = 1, b = -10, c = 1$

Half the coefficient of middle term, $-\frac{10}{2} = -5$

Now,

$$x^2 - 10x + 1 = x^2 - 10x + (-5)^2 - (-5)^2 + 1$$
$$= (x^2 - 10x + (-5)^2) - 25 + 1$$
$$= (x - 5)^2 - 24$$

b. $2x^2 + 6x + 1$

$$2x^2 + 6x + 1 = 2(x^2 + 3x) + 1 \qquad (1)$$

Here complete the square for $x^2 + 3x$.

So, $a = 1, b = 3, c = 0$

Half the coefficient of middle term, $\frac{3}{2}$

Now,

$$x^2 + 3x = x^2 + 3x + \left(\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 = \left(x + \frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 \qquad (2)$$

Sub (2) into (1),

$$2(x^2 + 3x) + 1 = 2\left(\left(x + \frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2\right) + 1$$
$$= 2\left(x + \frac{3}{2}\right)^2 - 2\left(\frac{3}{2}\right)^2 + 1 = 2\left(x + \frac{3}{2}\right)^2 - \frac{9}{2} + 1$$
$$= 2\left(x + \frac{3}{2}\right)^2 - \frac{7}{2}$$

Question 2 Additional Question.

Complete the square for the following quadratic expression.

a. $3x^2 - 12x + 2$

$$3x^2 - 12x + 2 = 3(x^2 - 4x) + 2 \quad (1)$$

Here complete the square for $x^2 - 4x$.

$$So, a = 1, b = -4, c = 0$$

Half the coefficient of middle term, $-\frac{4}{2} = -2$

Now,

$$x^2 - 4x = x^2 - 4x + (-2)^2 - (-2)^2$$
$$= (x-2)^2 - 4 \quad (2)$$

Sub (2) into (1),

$$3(x^2 - 4x) + 2 = 3((x-2)^2 - 4) + 2$$
$$= 3(x-2)^2 - 3(4) + 2 = 3(x-2)^2 - 12 + 2$$
$$= 3(x-2)^2 - 10$$

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

Here, $a = 1, b = 2, c = 5$

Half the coefficient of middle term, $\frac{2}{2} = 1$

Now,

$$x^2 + 2x + 5 = x^2 + 2x + (1)^2 - (1)^2 + 5$$
$$= (x^2 + 2x + (1)^2) - 1 + 5$$
$$= (x+1)^2 + 4$$

Sub-Section [3.2.2]: Factorise by First Completing the Square

Factorising Monic Expression by Completing the Square

$$x^2 + bx + c$$

- **Step 1:** Complete the square by using the formula:

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

- **Step 2:** Simplify the expression and combine like terms $-\left(\frac{b}{2}\right)^2$ and c.

- **Step 3:** Factorise using the difference between two squares.

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

Factorising Non-Monic Expression by Completing the Square

$$ax^2 + bx + c$$

- **Step 1:** Complete the square using the formula:

$$ax^2 + bx + c = a\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a} + c$$

- **Step 2:** Simplify the expression and combine like terms $-\frac{b^2}{4a}$ and c.

- **Step 3:** Factorise using the difference between two squares:

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

Question 3

Factorise the following quadratics using the method of completing the square:

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

Here, $a = 1, b = 6, c = 4$

Half the coefficient of middle term, $\frac{6}{2} = 3$

Now,

$$x^2 + 6x + 4 = x^2 + 6x + (3)^2 - (3)^2 + 4$$
$$= (x+3)^2 - 5 = (x+3)^2 - \left(\sqrt{5}\right)^2$$
$$= \left(x + 3 + \sqrt{5}\right)\left(x + 3 - \sqrt{5}\right) \quad \left(a^2 - b^2 = (a+b)(a-b)\right)$$

b. $7x^2 - 14x + 1$

$$7x^2 - 14x + 1 = 7(x^2 - 2x) + 1 \quad (1)$$

Here complete the square for $x^2 - 2x$.

$So, a = 1, b = -2, c = 0$

Half the coefficient of middle term, $-\frac{2}{2} = -1$

Now,

$$x^2 - 2x = x^2 - 2x + (-1)^2 - (-1)^2 = (x-1)^2 - 1 \quad (2)$$

Sub (2) into (1),

$$7(x^2 - 2x) + 1 = 7((x-1)^2 - 1) + 1$$
$$= 7(x-1)^2 - 6 = \left(\sqrt{7}(x-1)\right)^2 - \left(\sqrt{6}\right)^2$$
$$= \left(\sqrt{7}(x-1) + \sqrt{6}\right)\left(\sqrt{7}(x-1) - \sqrt{6}\right) \quad \left(a^2 - b^2 = (a+b)(a-b)\right)$$
$$= \left(\sqrt{7}x - \sqrt{7} + \sqrt{6}\right)\left(\sqrt{7}x - \sqrt{7} - \sqrt{6}\right)$$

Question 4 Additional Question.

Factorise the following quadratics using the method of completing the square:

a. $5x^2 + 20x + 4$

$$5x^2 + 20x + 4 = 5(x^2 + 4x) + 4 \quad (1)$$

Here complete the square for $x^2 + 4x$.

So, $a = 1, b = 4, c = 0$

Half the coefficient of middle term, $\frac{4}{2} = 2$

Now,

$$x^2 + 4x = x^2 + 4x + (2)^2 - (2)^2 = (x + 2)^2 - 4 \quad (2)$$

Sub (2) into (1),

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

$$= 5(x + 2)^2 - 16 = \left(\sqrt{5}(x + 2)\right)^2 - (4)^2$$

$$= \left(\sqrt{5}(x + 2) + 4\right)\left(\sqrt{5}(x + 2) - 4\right) \quad \left(a^2 - b^2 = (a + b)(a - b)\right)$$

$$= \left(\sqrt{5}x + 2\sqrt{5} + 4\right)\left(\sqrt{5}x + 2\sqrt{5} - 4\right)$$

b. $x^2 - 8x + 11$

Here, $a = 1, b = -8, c = 11$

Half the coefficient of middle term, $-\frac{8}{2} = -4$

Now,

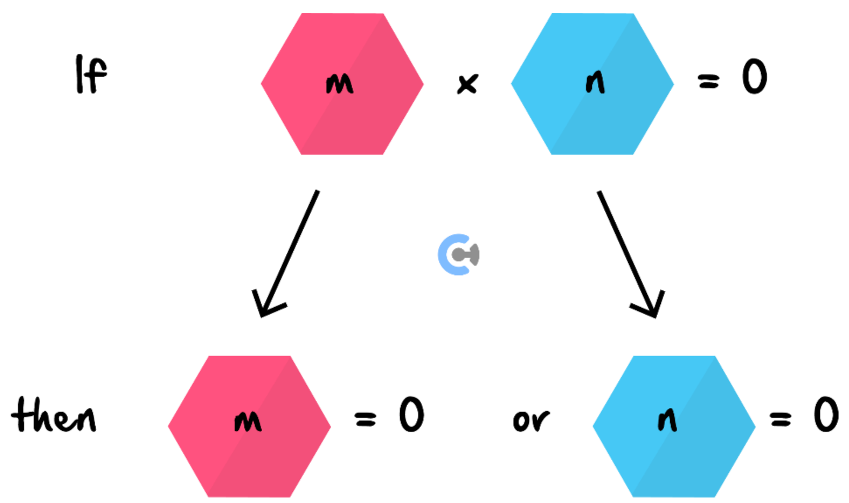
$$x^2 - 8x + 11 = x^2 - 8x + (-4)^2 - (-4)^2 + 11$$

$$= (x - 4)^2 - 5 = (x - 4)^2 - \left(\sqrt{5}\right)^2$$

$$= \left(x - 4 + \sqrt{5}\right)\left(x - 4 - \sqrt{5}\right) \quad \left(a^2 - b^2 = (a + b)(a - b)\right)$$

Sub-Section [3.2.3]: Solve a Quadratic Equation Using Factorisation & the Null Factor Law

- The null factor law simply states:



Question 5

Solve the following equations:

a. $m^2 = 14m$

$$m^2 = 14m$$
$$m^2 - 14m = 0$$
$$m(m - 14) = 0$$
$$\text{Then}, m = 0 \quad \text{or} \quad m - 14 = 0 \Rightarrow m = 14$$

b. $n^2 - n - 20 = 0$

$$n^2 - n - 20 = 0$$
$$n^2 - 5n + 4n - 20 = 0$$
$$n(n-5) + 4(n-5) = 0$$
$$(n-5)(n-4) = 0$$
$$\Rightarrow n - 5 = 0 \text{ or } n - 4 = 0$$
$$n = 5 \text{ or } n = 4$$

c. $2x^2 - 20x - 32 = 0$

$$2x^2 - 20x - 32 = 0$$
$$2(x^2 - 10x - 16) = 0$$
Now, using completing the square method
$$2(x^2 - 10x + (-5)^2 - (-5)^2 - 16) = 0$$
$$2((x-5)^2 - 41) = 0$$
$$2\left((x+5)^2 - \left(\sqrt{41}\right)^2\right) = 0$$
$$2\left(x + 5 + \sqrt{41}\right)\left(x + 5 - \sqrt{41}\right) = 0$$
Then, $x + 5 + \sqrt{41} = 0$ or $x + 5 - \sqrt{41} = 0$
$$\Rightarrow x = -5 - \sqrt{41} \text{ or } x = -5 + \sqrt{41}$$

Sub-Section [3.2.4]: Use the Quadratic Formula to Solve a Quadratic Equation

The Quadratic Formula

- For any quadratic equation $ax^2 + bx + c = 0$, the general formula of solutions is:

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

  - Where a, b are the coefficients of x^2, x respectively, and c is the constant term.

Question 6

Solve the quadratic equation $x^2 - 7x + 9 = 0$ using the quadratic formula. Leave your answer in surd form.

$$x^2 - 7x + 9 = 0$$

Here, $a = 1, b = -7, c = 9$

Using quadratic formula,

$$x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(1)(9)}}{2(1)}$$

$$= \frac{7 \pm \sqrt{49 - 36}}{2} = \frac{7 \pm \sqrt{13}}{2}$$

Thus, $x = \frac{7+\sqrt{13}}{2}$ or $x = \frac{7-\sqrt{13}}{2}$

Question 7 Additional Question.

Solve the quadratic equation $4x^2 - 10x + 4 = 0$ using the quadratic formula.

$$4x^2 - 10x + 4 = 0$$

Here, $a = 4, b = -10, c = 4$

Using quadratic formula,

$$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(4)(4)}}{2(4)}$$

$$= \frac{10 \pm \sqrt{100 - 64}}{8} = \frac{10 \pm \sqrt{36}}{8} = \frac{10 \pm 6}{8}$$

Thus, $x = \frac{10+6}{8} = 2$ or $x = \frac{10-6}{8} = \frac{1}{2}$

Sub-Section [3.2.5]: Use the Discriminant to Determine the Number of Solutions of a Quadratic Equation

The Discriminant

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

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

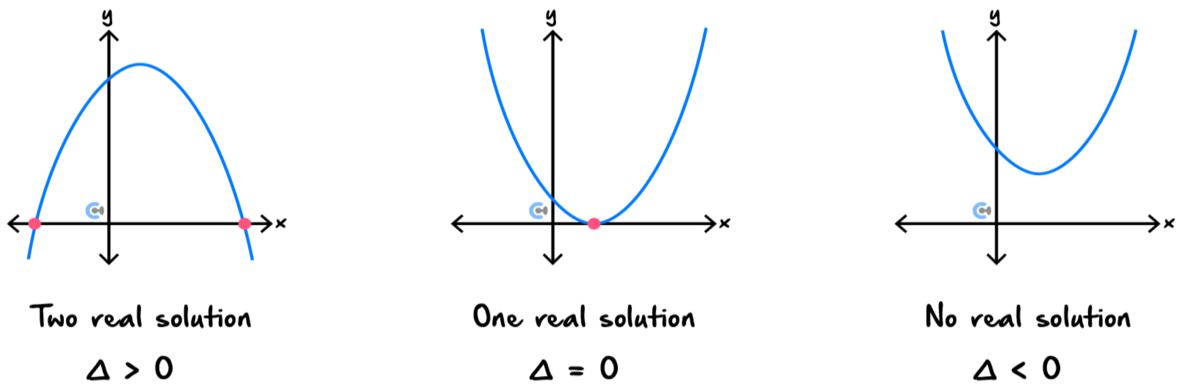
- The discriminant gives us very useful information about the number of unique solutions that exist in the quadratic equation.

$$\text{If } \Delta > 0, 2 \text{ distinct real solutions exist.}$$

$$\text{If } \Delta = 0, 1 \text{ real solution exists.}$$

$$\text{If } \Delta < 0, \text{no real solutions exist.}$$

- Corresponding graph for each scenario.



Question 8

Find the discriminant for each of the following quadratic equations. Hence, state the number of real solutions they have. You do not need to solve the equations.

a. $x^2 - 4x + 10 = 0$

$$x^2 - 4x + 10 = 0$$

Here $a = 1, b = -4, c = 10$

$D = b^2 - 4ac$

$= (-4)^2 - 4(1)(10) = 16 - 40 = -24 < 0$

$\therefore$ No real solution exists.

b. $2x^2 - 5\sqrt{2}x + 4 = 0$

$$2x^2 - 5\sqrt{2}x + 4 = 0$$

Here, $a = 2, b = -5\sqrt{2}, c = 4$

$D = b^2 - 4ac$

$= \left(-5\sqrt{2}\right)^2 - 4(2)(4) = 50 - 32 = 18 > 0$

$\therefore$ 2 distinct real solutions exists.

Question 9 Additional Question.

Find the discriminant for each of the following quadratic equations. Hence, state the number of real solutions they have. You do not need to solve the equations.

a. $4x^2 + 4x + 1 = 0$

$$4x^2 + 4x + 1 = 0$$

Here, $a = \ b = 4, c = 1$

$D = b^2 - 4ac$

$= (4)^2 - 4(4)(1) = 16 - 16 = 0$

$\therefore$ only 1 real solution exist.

b. $9x^2 - 1 = 0$

$$9x^2 - 1 = 0$$

Here $a = 9, b = 0, c = -1$

$D = b^2 - 4ac$

$= (0)^2 - 4(9)(-1) = 36 > 0$

$\therefore$ 2 distinct real solutions exists.

Section B: Short Answer Questions (22 Marks)

Question 10 (2 marks)

Determine how many solutions the following equation has:

$$x^2 + 3x + 1 = 7x - 1$$

```
In[18]:= Discriminant[x^2 + 3 x + 1 - 7 x + 1, x]
Out[18]= 8

(*Therefore 2 solutions*)
```

Question 11 (4 marks)

Complete the square by finding the missing values.

a. $\left(x - \frac{\square}{8}\right)^2 = x^2 - \frac{10}{8}x + \frac{\square}{64}$. (2 marks)

We know, $(a-b)^2 - a^2 - 2ab + b^2$.

Compare $\left(x - \frac{\square}{8}\right)^2 = x^2 - \frac{10}{8}x + \frac{\square}{64}$ with $(a-b)^2 - a^2 - 2ab + b^2$

$a = x, b = \frac{\square}{8}$ and $2ab = \frac{10}{8}x \Rightarrow 2 \times x \times \frac{5}{8}$

Thus, $\left(x - \frac{\boxed{5}}{8}\right)^2 = x^2 - \frac{10}{8}x + \frac{\boxed{25}}{64}$

b. $x^2 - 5x + \square = (x - \square)^2$. (2 marks)

Compare $x^2 - 5x + \square = (x - \square)^2$ with $(a-b)^2 - a^2 - 2ab + b^2$

$a = x, b =$ unknown and $2ab = 5x \Rightarrow 2 \times x \times \frac{5}{2}$

Thus, $x^2 - 5x + \boxed{\frac{25}{4}} = \left(x - \boxed{\frac{5}{2}}\right)^2$

Question 12 (6 marks)

Solve for x using factorisation.

a. $\frac{9+3x}{2x} = x$. (3 marks)

$$\frac{9+3x}{2x} = x$$
$$9 + 3x = 2x \times x = 2x^2$$
$$2x^2 - 3x - 9 = 0$$
$$2x^2 - 6x + 3x - 9 = 0$$
$$2x(x-3) + 3(x-3) = 0$$
$$(x-3)(2x+3) = 0$$
Thus, $x - 3 = 0$ or $2x + 3 = 0$

$\Rightarrow x = 3$ or $x = -\frac{3}{2}$

b. $(x-3)^2 = 2x + 2$. (3 marks)

$$(x-3)^2 = 2x + 2$$
Since, $(a-b)^2 = a^2 - 2ab + b^2$
$$\Rightarrow x^2 - 6x + 9 = 2x + 2$$
$$x^2 - 6x + 9 - 2x - 2 = 0$$
$$x^2 - 8x + 7 = 0$$
$$x^2 - 7x - x + 7 = 0$$
$$x(x-7) - 1(x-7) = 0$$
$$(x-7)(x-1) = 0$$
Thus, $x - 1 = 0$ or $x - 7 = 0$

$\Rightarrow x = 1$ or $x = 7$

Question 13 (4 marks)

If the equation $(1+k^2)x^2+2kqx+q^2-p^2=0$ has a unique real solution, then find q^2 in terms of p and k.

Compare $(1+k^2)x^2+2kqx+q^2-p^2=0$ with $ax^2+bx+c=0$.
So, $a=1+k^2$, $b=2kq$, $c=q^2-p^2$

Since, given equation has unique solution $\Rightarrow D=0$

$$b^2-4ac=0$$

$$(2kq)^2-4(1+k^2)(q^2-p^2)=0$$

$$4k^2q^2-4(q^2-p^2+k^2q^2-k^2p^2)=0$$

$$4k^2q^2-4q^2+4p^2-4k^2q^2+4k^2p^2=0$$

$$-4q^2+4p^2+4k^2p^2=0$$

$$-q^2+p^2+k^2p^2=0$$

$$q^2=p^2+k^2p^2$$

$$q^2=p^2(1+k^2)$$

Question 14 (3 marks) **Extension.**

Solve the following equation for x.

$$x^4-13x^2+36=0$$

```
In[24]:= Solve[x^4 - 13 x^2 + 36 == 0, x]
Out[24]= {{x → -3}, {x → -2}, {x → 2}, {x → 3}}
```

Question 15 (3 marks) **Extension.**

Find the value(s) of m for which the graphs of $y = mx + 2$ and $y = x^2 + 3x + 2$ have One point of intersection.

$m = 3$

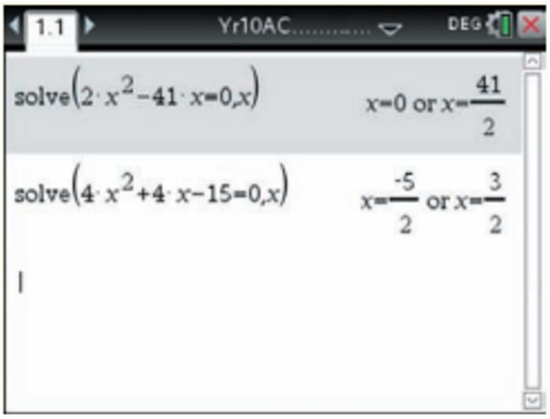
```
In[55]:= Solve[m*x + 2 == x^2 + 3 x + 2, x]
Out[55]= {{x → 0}, {x → -3 + m}}
```

Section C: Technology Recap

Calculator Commands: Solving Equations Using CAS

TI-Nspire

- In a Calculator page use Menu > Algebra > Solve and type as shown ending with x.



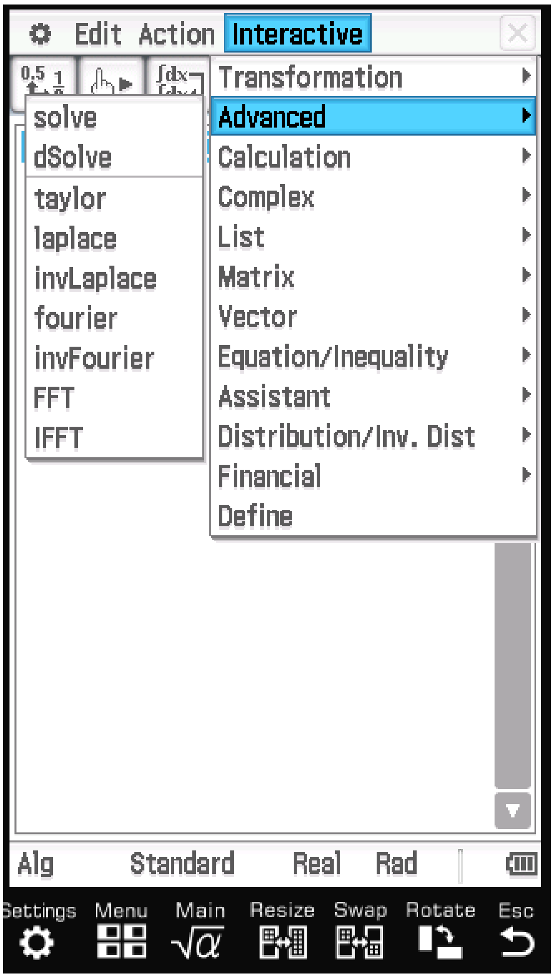
- Note: If your answers are decimal then change the Calculation Mode to Auto in Settings on the Home Screen.

- Use Menu > Algebra > Solve and type as shown.

Casio ClassPad

- In the Main application, type and highlight the equation.

- Tap Interactive > Advanced > Solve.



- Tap OK.

$$\text{solve}(2\cdot x^2+3\cdot x-1=0,x)$$

$$\left\{x=\frac{-\sqrt{17}}{4}-\frac{3}{4},\ x=\frac{\sqrt{17}}{4}-\frac{3}{4}\right\}$$

Question 16

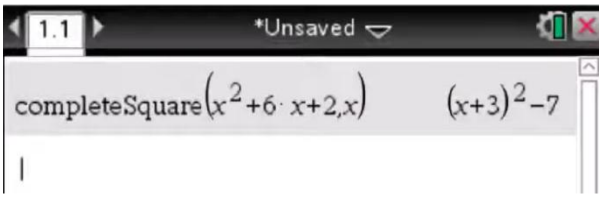
Solve:

$$x^2 - x - 210 = 0$$

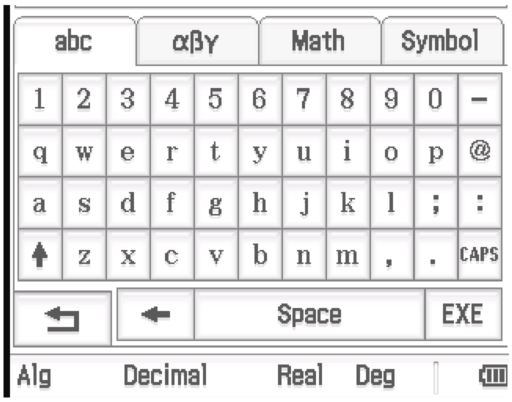
$x = 15$ or $x = -14$

Calculator Commands: Factorising Via CAS

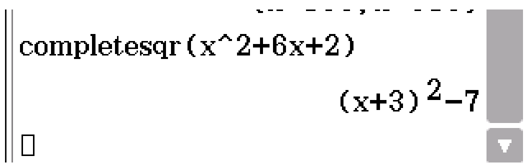
- **TI-Nspire**
  - Menu > 3 Algebra > 5 Complete the Square.



- **Casio ClassPad**
  - Add keyboard, select 'abc'.



  - Type in 'completesqr' and enter the expression in the bracket.



Question 17

Factorise the expression by completing the square:

$$x^2 - 9x + 1$$

$$x^2 - 9x + 1 = \left(x - \frac{9}{2} - \frac{\sqrt{77}}{2}\right)\left(x - \frac{9}{2} + \frac{\sqrt{77}}{2}\right)$$

Section D: Extended Response Questions (16 Marks)

Question 18 (6 marks)

Lucas is a cyclist riding along a curved track. His speed S (in metres per second) along the track at any position x (in metres) is given by:

$$S = -2x^2 + 8x + 6$$

a. Express the equation in the form of $S = a(x-h)^2 + k$. (2 marks)

$$\begin{aligned} S &= -2x^2 + 8x + 6 \\ &= -2(x^2 - 4x - 3) \\ &= -2(x^2 - 4x + (-2)^2 - (-2)^2 - 3) \\ &= -2((x-2)^2 - 4 - 3) \\ &= -2(x-2)^2 + 14 \end{aligned}$$

b. Hence or otherwise, determine the maximum speed and the position x where it occurs. (1 mark)

$S = -2(x-2)^2 + 14$

Since maximum of $y = -ax^2 + b$ occurs at $x = 0$, maximum of S occurs at $x - 2 = 0$.

$\Rightarrow x = 2$

Sub $x = 2$ into $S = -2(x-2)^2 + 14$

$S = 14$

Thus maximum speed is $14m/s$ occurring at $x = 2$ metres.

c. Use the null factor law to find the exact positions where Lucas's speed is zero. Express the answers as surd form. (2 marks)

Find exact position when $S = 0$.

$-2(x-2)^2 + 14 = 0$

$14 - 2(x-2)^2 = 0$

$\left(\sqrt{14}\right)^2 - \left(\sqrt{2}(x-2)\right)^2 = 0$

$\left(\sqrt{14} - \sqrt{2}(x-2)\right)\left(\sqrt{14} + \sqrt{2}(x-2)\right) = 0 \quad \{a^2 - b^2 = (a-b)(a+b)\}$

Thus, $\sqrt{14} - \sqrt{2}(x-2) = 0$ or $\sqrt{14} + \sqrt{2}(x-2) = 0$

$x = \frac{\sqrt{14}}{\sqrt{2}} + 2 = \sqrt{7} + 2$, or

$x = -\frac{\sqrt{14}}{\sqrt{2}} + 2 = -\sqrt{7} + 2$ (not possible, x cannot be negative)

Hence, At $\left(2 + \sqrt{7}\right)$ metres Lucas' s speed is zero.

d. Hence or otherwise, determine if Lucas stops beyond 5 metres. (1 mark)

Since, $2 < \sqrt{7} < 3$

$$\Rightarrow 2 + 2 < \sqrt{7} + 2 < 3 + 2$$
$$4 < \sqrt{7} + 2 < 5$$

Since, $\sqrt{7} + 2 < 5$, Lucas does not stop beyond 5 metres.

Question 19 (10 marks)

Dreamworld on the Gold Coast, Australia, features a ride called The Giant Drop, where riders are lifted to a great height before being released in free fall. The height h (in metres) of a rider on The Giant Drop can be modelled by:

$$h = -5t^2 + 20t + 115$$

Where t is the time (in seconds) after launch, and v_0 is the initial upward velocity in metres per second. The tower itself is 115 metres tall, and the ride propels passengers 16 metres above the tower before they fall.

a. Find the time t when the rider reaches its maximum height. (2 marks)

From (a), $t_{max} = \frac{v_0}{10}$

Sub $v_0 = 20$ into $t_{max} - \frac{v_0}{10}$.

$$t_{max} = \frac{20}{10} = 2\ sec$$

b. Determine how long the rider spends above 130 metres before falling back below this height. (3 marks)

Solve for $h = 130$.

$$-5t^2 + 20t + 115 = 130$$
$$-5t^2 + 20t - 15 = 0$$

Using quadratic formula,

$$t = \frac{-20 \pm \sqrt{20^2 - 4(-5)(-15)}}{2(-5)} = \frac{-20 \pm \sqrt{100}}{-10} = \frac{1}{10}(20 \mp 10)$$

$$t = \frac{1}{10}(20 - 10), \frac{1}{10}(20 + 10) = 1, 3$$

So, the rider is above 130 metres from 1 to 3

Thus, time above $130m = 3 - 1 = 2\ sec$.

c. Determine how many times the rider reaches the launch height of 115 *meters* by calculating the discriminant of the quadratic equation. (2 marks)

$$-5t^2 + 20t + 115 = 115$$
$$-5t^2 + 20t = 0$$

Here, $a = -5, b = 20, c = 0$

so, $D = (20)^2 - 4(-5)(0) = 400 > 0$

Hence, rider reaches the launch height 2 times.

d. Solve for t when $h = 115\ m$ using the quadratic formula to verify the total ride time. (3 marks)

$$h = 115$$
$$-5t^2 + 20t + 115 = 115$$
$$-5t^2 + 20t = 0$$

Using quadratic formula:

$t = \frac{-20 \pm \sqrt{400}}{2(-5)}$ (from (d), $D = 400$)

$$t = \frac{-20 \pm 20}{-10} = 2 \mp 2$$

Thus, $t = 2 - 2,\ 2 + 2$

$$t = 0, \qquad t = 4$$

Hence, total ride time is 4 sec.

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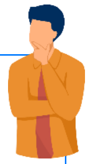
Year 10 Mathematics

Free 1-on-1 Consults



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