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STEM SMART Single Maths 2 - Quadratic Equations

Completing the Square 1

Essential GCSE Maths 29.1

Subject & topics: Maths | Algebra | Quadratics **Stage & difficulty:** GCSE P3, A Level P1

Express the following in completed square form.

Part A

$x^2 - 2x - 8$

$$x^2 - 2x - 8$$

- $(x-1)^2 - 6$
- $(x-2)^2 - 12$
- $(x-1)^2 - 9$
- $(x+1)^2 - 8$

Part B

$x^2 + 6x - 5$

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

- $(x - 3)^2 - 14$
- $(x + 6)^2 - 41$
- $(x + 3)^2 - 14$
- $(x + 6)^2 - 5$

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STEM SMART Single Maths 2 - Quadratic Equations

Completing the Square 3

Essential GCSE Maths 29.3

Subject & topics: Maths | Algebra | Quadratics **Stage & difficulty:** GCSE P3, A Level P1

Express the following in completed square form.

Give your answers in the form $b(x+a)^2+c$, use improper (top heavy) fractions rather than mixed fractions in your answers.

Part A

$2x^2-8x+2$

$$2x^2-8x+2$$

The following symbols may be useful: x

Part B

$3x^2-18x-7$

$$3x^2-18x-7$$

The following symbols may be useful: x

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Factorise 1

Pre-Uni Maths for Sciences B1.1

Subject & topics: Maths | Algebra | Quadratics **Stage & difficulty:** GCSE P2, A Level P1

Consider the equation $3b^2 - 2b - 1 = 0$.

Part A

Factorise the left hand side

Give the factorised form of the expression on the left hand side of the equation.

The following symbols may be useful: b

Part B

Find the root closest to zero

Give the exact value of the root closest to zero.

The following symbols may be useful: b

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Quadratic Equations 4

Pre-Uni Maths for Science B1.9

Subject & topics: Maths | Algebra | Quadratics **Stage & difficulty:** GCSE C3, A Level P1

Solve the equation below; leave the answer in surd form:

$$\frac{3-v}{1-3v} = \frac{2+v}{1+2v}.$$

The following symbols may be useful: `sqrt(), v, ±`

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Graphs of Quadratic Functions 4

Essential GCSE Maths 27.4

Subject & topics: Maths | Functions | Graph Sketching **Stage & difficulty:** GCSE P2, A Level P1

Without drawing graphs, find for each function:

(i) the y-intercept (ii) where the graph crosses the x-axis.

Part A

$y = x^2 + x - 2$

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

(i) the y-intercept

$y =$ ☐

(ii) the x-intercepts

lower value: $x =$ ☐

higher value: $x =$ ☐

Part B

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

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

(i) the y-intercept

$y =$ ☐

(ii) the x-intercepts

lower value: $x =$ ☐

higher value: $x =$ ☐

Part C

$y = x^2 - 8x + 15$

$$y = x^2 - 8x + 15$$

(i) the y-intercept

$y =$ ☐

(ii) the x-intercepts

lower value: $x =$ ☐

higher value: $x =$ ☐

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Graphs of Quadratic Functions 11

Essential GCSE Maths 27.11

Subject & topics: Maths | Functions | Graph Sketching **Stage & difficulty:** GCSE C3, A Level C1

The formula $s = ut + \frac{1}{2}at^2$ is used to calculate the height s of projectiles (such as balls) as a function of time.

Plot or sketch a graph of s against t for $0 \leqslant t \leqslant 7$, given that $u = 29.43\,\mathrm{m/s}$ and $a = -9.81\,\mathrm{m/s^2}$.

Part A

What is the maximum height?

What is the maximum height reached? Give your answer to 3 sf.

Part B

How long to return to its starting height?

How long does a projectile modelled by this graph take to return to its starting height? You may assume the projectile was launched at $t = 0$. Give your answer to 3 sf.

Part C

What is the relative position of the projectile?

At $t = 7\,\mathrm{s}$, what is the height of the projectile relative to its starting position? Give your answer to 3 sf.

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Quadratics: Graphs and Discriminants 1ii

Subject & topics: Maths **Stage & difficulty:** A Level P1

Part A

Find discriminant

Calculate the discriminant of $-2x^2 + 7x + 3$.

How many **distinct** real roots does the equation $-2x^2 + 7x + 3 = 0$ have?

Part B

Possible values of p

The quadratic equation $2x^2 + (p + 1)x + 8 = 0$ has equal roots. Find the possible values of p and enter the greatest possible value of p.

The following symbols may be useful: p

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Quadratics: Graphs and Discriminants 3ii

Subject & topics: Maths **Stage & difficulty:** A Level P1

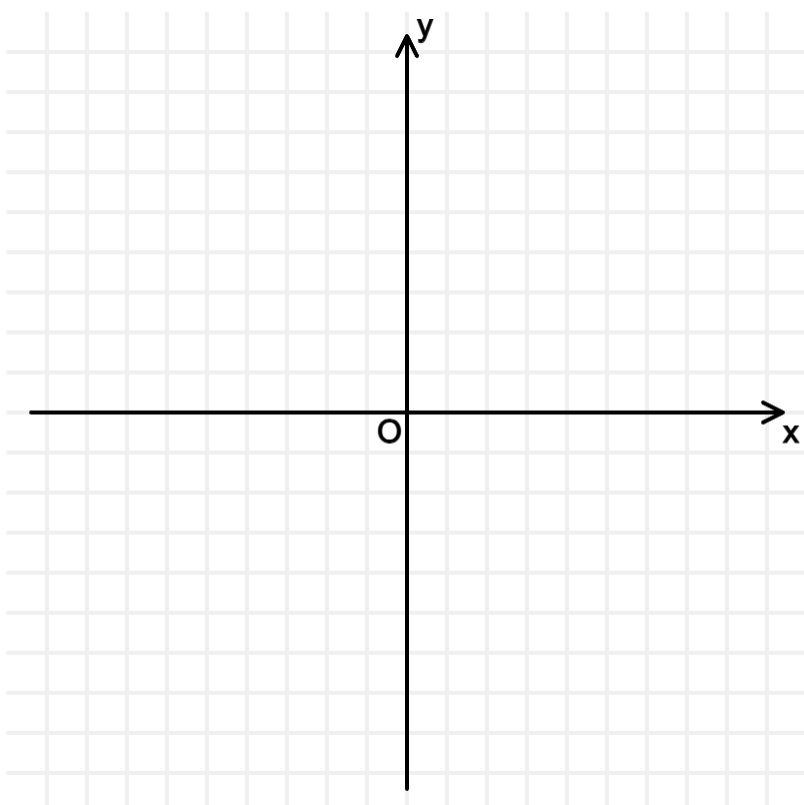
Part A
Roots of equation

Find the roots of the equation $x^2 + 8x + 10 = 0$. Give your answer in the form $a \pm b$, where a and b are in simplified surd form.

The following symbols may be useful: ±

Part B
Sketch the curve

Sketch the curve $y = x^2 + 8x + 10$.



Part C

Solve inequality

Solve the inequality $x^2 + 8x + 10 \leq 0$.

Construct your answer from the items below.

Items:

$<$ $>$ x $< x <$ $\leq x \leq$ $< x$ or $x <$ $\leq x$ or $x \leq$ $\leq$ $\geq$ $-8 - 2\sqrt{6}$ $-8 + 2\sqrt{6}$

$-4 - \sqrt{6}$ $-4 + \sqrt{6}$ -4 4 -6 6

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Quadratic Inequalities

Pre-Uni Maths for Sciences A2.5

Subject & topics: Maths | Algebra | Manipulation **Stage & difficulty:** GCSE C3, A Level P1

Solve the following quadratic inequalities.

Part A

$3x^2 - 2x - 8 \leq 0$

Solve the inequality $3x^2 - 2x - 8 \leq 0$.

Construct your answer from the items below.

Items:

$<$ $>$ x $< x <$ $\leq x \leq$ $< x$ or $x <$ $\leq x$ or $x \leq$ $\leq$ $\geq$ $-\frac{4}{3}$ $\frac{4}{3}$ -2 2

Part B

$-2x^2 + 5 < 7x + 11$

Solve the inequality $-2x^2 + 5 < 7x + 11$.

Construct your answer from the items below.

[ ] [ ] [ ]

Items:

$<$ $>$ x $< x <$ $\leq x \leq$ $< x$ or $x <$ $\leq x$ or $x \leq$ $\leq$ $\geq$ $-\frac{3}{2}$ $\frac{3}{2}$ -2 2

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Quadratic Equations 5

Pre-Uni Maths for Sciences B1.10

Subject & topics: Maths | Algebra | Quadratics **Stage & difficulty:** GCSE C3, A Level C1

Show that the solution to the equation $mp^2 + bp + k = 0$ can be written as $p = -\gamma \pm \sqrt{\gamma^2 - \omega^2}$.

Part A

Find an expression for γ

Hence find an expression for γ in terms of one or more of the constants m, b and k in the original equation.

The following symbols may be useful: `b, gamma, k, m, omega`

Part B

Find an expression for ω

Also give an expression for ω in terms of one or more of the constants m, b and k.

The following symbols may be useful: `b, gamma, k, m, omega`

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