

Completing the Square 3

Essential GCSE Maths 29.3

GCSE

A Level

P

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P

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



Physics. *You work it out.*

Graphs of Quadratic Functions 4

Essential GCSE Maths 27.4

GCSE

P

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A Level

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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

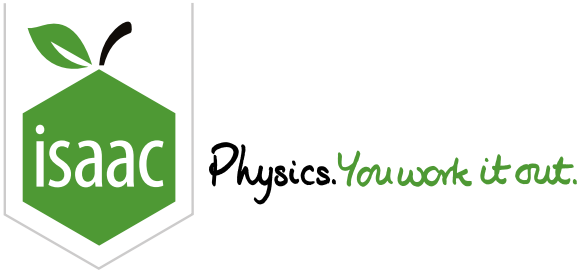
lower value: $x =$

higher value: $x =$

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Graphs of Quadratic Functions 11

Essential GCSE Maths 27.11

GCSE

A Level

C

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C

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 $0 \leq t \leq 7$, given that $u = 29.43 \text{ m/s}$ and $a = -9.81 \text{ m/s}^2$.

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?

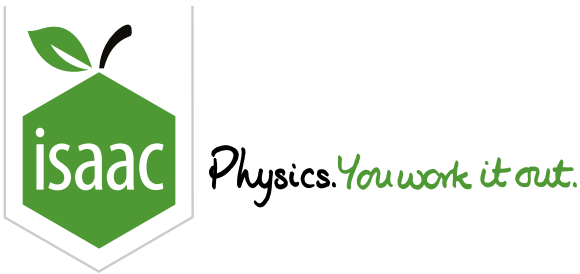
How long does a projectile modelled by this graph take to return to its starting height? You may assume the projectile was launched at $t = 0$. Give your answer to 3 sf.

Part C What is the relative position of the projectile?

At $t = 7 \text{ s}$, 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 2ii

A Level

P

P

P

The quadratic equation $x^2 + kx + k = 0$ has no real roots for x .

Part A Find discriminant

Write down the discriminant of $x^2 + kx + k$ in terms of k .

The following symbols may be useful: k

Part B Possible values of k

Hence find the set of values k can take.

Construct your answer from the items below.

Items:

<

>

k

$< k <$

$\leq k \leq$

$> k$ or $k >$

$\geq k$ or $k \geq$

\leq

\geq

-4

-3

-2

-1

0

1

2

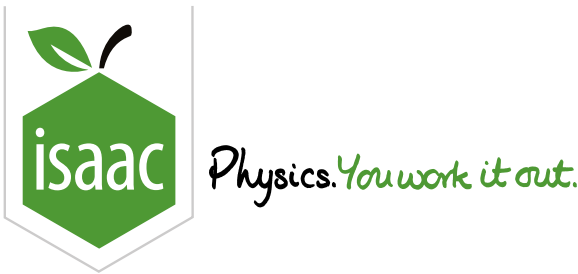
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Linear-Quadratic 3

Pre-Uni Maths for Sciences B2.7

GCSE

A Level

Solve the simultaneous equations $p^2 + 2pq + 4q^2 = 7$ and $2p = q + 1$.

If your answer is a decimal number, round it to **two decimal places**.

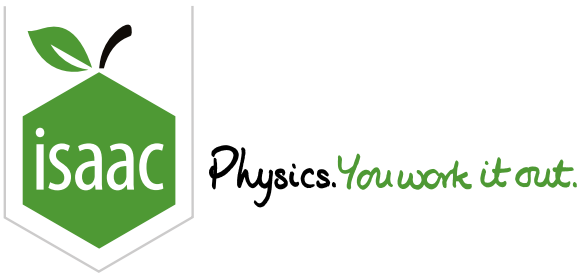
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Quadratic Inequalities

Pre-Uni Maths for Sciences A2.5

GCSE

A Level

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

$< x <$

$\leq x \leq$

$< x \text{ or } x <$

$\leq x \text{ or } x \leq$

\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

$< x <$

$\leq x \leq$

$< x \text{ or } x <$

$\leq x \text{ or } x \leq$

\leq

\geq

$-\frac{3}{2}$

$\frac{3}{2}$

-2

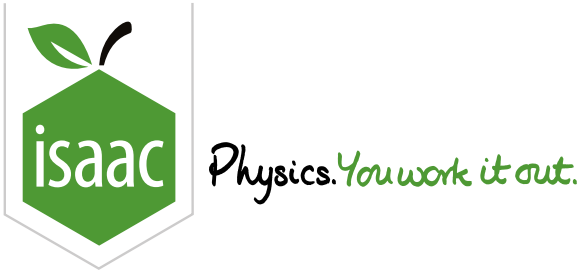
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Quadratic Equations 5

Pre-Uni Maths for Sciences B1.10

GCSE

A Level

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 , γ , k , m , ω

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 , γ , k , m , ω

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Linear-Quadratic 6

Pre-Uni Maths for Science B2.10

GCSE

A Level

C C C

P P P

A particle of mass M , travelling at speed u , collides head-on and elastically with a stationary particle of mass m . After the collision the particles of mass M and of mass m travel at (non-zero) speeds v and w respectively.

By applying the laws of conservation of momentum and kinetic energy we can write down two simultaneous equations for the collision: $Mu = Mv + mw$ and $\frac{1}{2}Mu^2 = \frac{1}{2}Mv^2 + \frac{1}{2}mw^2$

Part A w (speed of particle of mass m after collision)

Find an expression for w , the speed of the particle of mass m after the collision, in terms of u , M and m .

The following symbols may be useful: M , m , u , v , w

Part B v (speed of particle of mass M after collision)

Find the corresponding expression for v , the speed of the particle of mass M after the collision, in terms of u , M and m .

The following symbols may be useful: M , m , u , v , w

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Physics. *You work it out.*

Algebra and Roots: Cubics 2ii

Further A



The cubic equation $x^3 - 6x^2 + kx + 10 = 0$ has roots $p - q$, $p + q$ and p .

Part A p

Find p by considering the sum of roots.

The following symbols may be useful: p

Part B q

Find q by considering the product of roots. Take q to be positive.

The following symbols may be useful: q

Part C k

Find k .

The following symbols may be useful: k

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Algebra and Roots: Cubics 1i

Further A



The cubic equation $3x^3 - 9x^2 + 6x + 2 = 0$ has roots α , β and γ .

Part A $\alpha + \beta + \gamma$

Give the value of $\alpha + \beta + \gamma$.

Part B $\alpha\beta + \alpha\gamma + \beta\gamma$

Give the value of $\alpha\beta + \alpha\gamma + \beta\gamma$.

Part C $\alpha\beta\gamma$

Give the value of $\alpha\beta\gamma$.

Part D Transformed cubic

The cubic equation $x^3 + ax^2 + bx + c = 0$ has roots α^2 , β^2 and γ^2 .

Find a .

The following symbols may be useful: a

Find b .

The following symbols may be useful: b

Find c .

The following symbols may be useful: c

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