Essential GCSE Maths 29.3

GCSE   A Level

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

Essential GCSE Maths 27.4

GCSE   A Level

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) Find the y-intercept

(ii) Where does the graph cross the x-axis?

Enter the lower value.

Enter the higher value.

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

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

(i) Find the y-intercept

(ii) Where does the graph cross the x-axis?

Enter the lower value.

Enter the higher value.

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

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

(i) Find the y-intercept

(ii) Where does the graph cross the x-axis?

Enter the lower value.
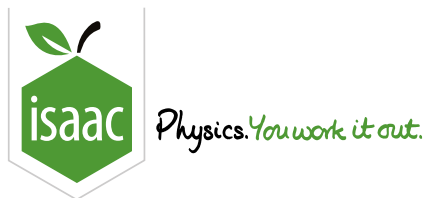

Enter the higher value.

Gameboard:

STEM SMART Double Maths 2 - Quadratic & Cubic
Equations

isaac Physics. *You work it out.*

Essential GCSE Maths 27.11

GCSE   **A Level**

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 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 s.f..

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 s.f..

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 s.f..

Gameboard:

STEM SMART Double Maths 2 - Quadratic & Cubic Equations

Home **Gameboard** **Maths** Quadratics: Graphs and Discriminants 2ii

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.

What form does your answer take? Choose from the list below, where a and b are constants and $a < b$, and then find a and/or b.

- ○ $k < a$

- ○ $k \leq a$

- ○ $k > a$

- ○ $k \geq a$

- ○ $a < k < b$

- ○ $a \leq k \leq b$

- ○ $k < a$ or $k > b$

- ○ $k \leq a$ or $k \geq b$

Write down the value of a.

Write down the value of b (or if your chosen form has no b, write "n").

The following symbols may be useful: n

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STEM SMART Double Maths 2 - Quadratic & Cubic
Equations

Linear-Quadratic 3

GCSE   A Level

Pre-Uni Maths for Science C1.7

Solve the simultaneous equations $p^2 + 2pq + 4q^2 = 7$ and $2p = q + 1$. (Where appropriate give your answer in the form of a proper or improper fraction.)

Part A p furthest from zero and q

Find the value of p furthest from zero given that $p^2 + 2pq + 4q^2 = 7$ and $2p = q + 1$.

The following symbols may be useful: p, q

Find q for the value of p found above.

The following symbols may be useful: p, q

Part B p closest to zero and q

Find the value of p closest to zero given that $p^2 + 2pq + 4q^2 = 7$ and $2p = q + 1$.

The following symbols may be useful: p, q

Find q for the value of p found above.

The following symbols may be useful: p, q

Quadratic Inequalities

Pre-Uni Maths for Science A2.5

GCSE　　A Level

Solve the following quadratic inequalities.

Part A　　$3x^2 - 2x - 8 \leq 0$

Solve the inequality $3x^2 - 2x - 8 \leq 0$. Firstly select the form of your answer from the choices given below, where a and b are constants and $a < b$, and then find a and/or b.

Select the form of your answer from the choices given below.

◯　$x > b$ only

◯　$x < a$ or $x > b$

◯　$x \geq b$ only

◯　$x < a$ only

◯　$a \leq x \leq b$

◯　$x \leq a$ or $x \geq b$

◯　$x \leq a$ only

◯　$a < x < b$

Given your deduction above, find a.

Given your deduction above, find b.

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

Solve the inequality $-2x^2 + 5 < 7x + 11$. Firstly select the form of your answer from the choices given below, where c and d are constants, and then find c and/or d.

Select the form of your answer from the choices given below.

○ $x \leq c$ or $x \geq d$

○ $c < x < d$

○ $c \leq x \leq d$

○ $x < c$ only

○ $x < c$ or $x > d$

○ $x > d$ only

○ $x \leq c$ only

○ $x \geq d$ only

Given your deduction above, find c.

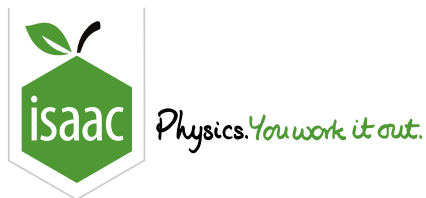Given your deduction above, find d.

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**STEM SMART Double Maths 2 - Quadratic & Cubic
Equations**

Quadratic Equations 5

GCSE   A Level

Pre-Uni Maths for Science B1.10

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

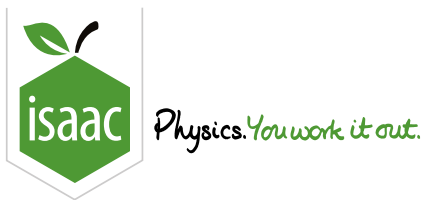Also give an expression for ω in terms of one or more of the constants m, b and k.

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

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STEM SMART Double Maths 2 - Quadratic & Cubic Equations

isaac Physics. *You work it out.*

Linear-Quadratic 6

GCSE   **A Level**

Pre-Uni Maths for Science C1.10

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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Gameboard:

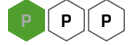**STEM SMART Double Maths 2 - Quadratic & Cubic Equations**

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.
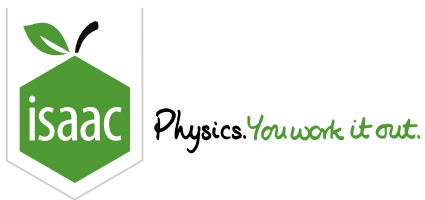
The following symbols may be useful: q

Part C k

Find k.

The following symbols may be useful: k

Adapted with permission from UCLES, A Level, OCR FP1 Specimen paper, Paper 4725, Question 2.

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

Adapted with permission from UCLES, A Level, June 2012, Paper 4725, Question 10.