



Essential GCSE Maths 29.2

Express the following in completed square form:

Part A Complete the square

$$x^2 - x - 5$$

- ☐ $(x - 1)^2 - 4$
 - ☐ $(x - \frac{1}{2})^2 - \frac{21}{4}$
 - ☐ $(x - 1)^2 - 6$
 - ☐ $(x + 1)^2 - 6$
-

Part B Complete the square

$$x^2 - 5x + 4$$

- ☐ $(x - \frac{5}{2})^2 - \frac{9}{4}$
 - ☐ $(x - 5)^2 + 4$
 - ☐ $(x - 5)^2 - 21$
 - ☐ $(x - \frac{5}{2})^2 + \frac{13}{2}$
-



Essential GCSE Maths 27.4

Without drawing graphs, find for each function:

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

Part A Find information about the curve

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

(i) Find the y -intercept

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

Enter the lower value.

Enter the higher value.

Part B Find information about the curve

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

(i) Find the y -intercept

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

Enter the lower value.

Enter the higher value.

Part C Find information about the curve

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

(i) Find the y -intercept

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

Enter the lower value.

Enter the higher value.



Linear Quadratic 5



A particle of mass $2M$ is travelling at speed u towards a stationary particle of mass M and collides head-on and elastically with it. After the collision both particles are moving -- the particle of mass $2M$ has a (non-zero) speed v and the particle of mass M has a (non-zero) speed w .

Using the laws of conservation of momentum and kinetic energy we can write down two simultaneous equations for the collision: $2Mu = 2Mv + Mw$ and $\frac{1}{2}(2M)u^2 = \frac{1}{2}(2M)v^2 + \frac{1}{2}Mw^2$.

Find an expression for w , the final speed of the particle of mass M , in terms of u .

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

Find the corresponding expression for v , the final speed of the particle of mass $2M$, in terms of u .

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

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Essential GCSE Maths 27.11

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 $0 \leq t \leq 7$, 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 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 $t = 7 \text{ s}$, what is the height of the projectile relative to its starting position? Give your answer to 3 s.f..



Quadratics: Graphs and Discriminants 2ii



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

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 .

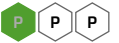
Write down the value of b (or if your chosen form has no b , write "n").

The following symbols may be useful: n



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.

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Linear-Quadratic 3



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



Physics. *You work it out.*

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Linear-Quadratic 6



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 $\frac{1}{2}Mu^2 = \frac{1}{2}Mv^2 + \frac{1}{2}mw^2$

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

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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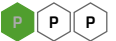
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Linear-Quadratic 4

GCSE



A Level



Starting with the equations $v = u + at$ and $s = ut + \frac{1}{2}at^2$, eliminate t to find an equation relating s , u , v and a . Give your answer as an equation with v^2 only on the left hand side.

The following symbols may be useful: a , s , u , v

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