**Day 136** **A Level Maths: C Tier 10-a-day: Model Solutions**

## 1 Constant acceleration: finding the initial speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moving in a straight line with constant acceleration 3 m $s^{-2}$ travels 250 m in 10 s.
Find its initial speed.

$s = ut + \frac{1}{2}at^2$

$250 = 10\,u + \frac{1}{2} \times 3 \times 10^2$

$10\,u = 100$

**Answer: 10 m $s^{-1}$**

## 2 Straight line through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find an equation of the line through A(−5, 0) and B(3, 2), in the form ax + by + c = 0, where a, b and c are integers.

Gradient $= \frac{2-0}{3-(-5)} = \frac{1}{4}$

$y - 0 = \frac{1}{4}(x - (-5))$

Multiply out and rearrange to integer coefficients.

**Answer: $x - 4y + 5 = 0$**

## 3 Stratified sampling (AQA, Edexcel, OCR, MEI, Eduqas)

A stratified sample of size 20 is taken from 200 students: 120 Biology, 50 Chemistry, 30 Physics.
How many Chemistry should be in the sample?

Number $= 20 \times \frac{50}{200}$

$= 5$

**Answer: 5**

## 4 Integrating acceleration to find velocity (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line. Its acceleration at time t seconds is $(2t - 3)$ m $s^{-2}$.
When t = 0 its velocity is 2 m $s^{-1}$.
Find its velocity when t = 3.

$v = \int a\,dt = t^2 - 3t + c$
$t = 0, v = 2$ gives $c = 2$
When t = 3: $v = 9 + -9 + 2$

**Answer: 2 m $s^{-1}$**

## 5 Normal distribution: inverse (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(20, 5^2)$. Given that $P(X < a) = 0.6$, find a to 3 s.f.

$P(Z < z) = 0.6$, so $z = 0.2533$ (from the inverse normal function)
$a = 20 + 0.2533 \times 5$

**Answer: 21.3**

## 6 Rearrange and iterate (All boards)

(a) Show that $x^2 - 4x - 3 = 0$ can be rearranged to $x = \sqrt{4x + 3}$.
(b) Use $x_{n+1}$ = this formula with $x_0 = 3$ to find $x_1$, $x_2$ to 3 d.p.

(a) $x^2 = 4x + 3$, so $x = \sqrt{4x + 3}$ $(x > 0)$
(b) $x_1 = 3.8730$, $x_2 = 4.3002$

**Answer: (a) shown (b) $x_1 = 3.873$, $x_2 = 4.300$**

## 7 Equation of a reciprocal graph from asymptotes (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the graph of $y = \frac{k}{x - a} + c$ with its asymptotes. Find the values of a, c and k.

The asymptotes are $x = 2$ and $y = -1$, so $a = 2$ and $c = -1$.

Through $(0, -3)$: $-3 = \frac{k}{0 - 2} + -1$

$\frac{k}{-2} = -2$, so $k = 4$

**Answer: $a = 2$, $c = -1$, $k = 4$**

## 8 Solve a logarithmic equation (two logs) (All boards)

Solve $\ln(x + 2) - \ln x = \ln 3$.

$\ln \frac{x + 2}{x} = \ln 3$, so $\frac{x + 2}{x} = 3$

$x + 2 = 3x$, so $2 = 2x$

$x = 1$

**Answer: $x = 1$**

## 9 Finding a quadratic from its turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a sketch of a quadratic curve.

Find its equation in the form $y = a(x - p)^2 + q$.

The turning point is $(2, -1)$, so $y = a(x - 2)^2 - 1$.

The curve passes through $(0, 3)$:

$3 = a(-2)^2 - 1$, so $4 = 4a$

$a = 1$

**Answer: $y = (x - 2)^2 - 1$**

## 10 Solve with a shifted angle (All boards)

Solve $\sin(x + 45°) = -\frac{\sqrt{3}}{2}$ for $0° \leq x \leq 360°$.

Let $u = x + 45°$, so $45° \leq u \leq 405°$

$\sin u = -\frac{\sqrt{3}}{2}$: $u = 240°, 300°$

$x = u - 45°$: $x = 195°, 255°$

**Answer: $x = 195°, 255°$**