Day 245 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Velocity at time t with constant acceleration (vectors) (AQA, Edexcel, OCR, MEI, Eduqas)

A particle has initial velocity $(4\mathbf{i} + 5\mathbf{j})$ m s^{-1} and constant acceleration $(2\mathbf{i} + \mathbf{j})$ m s^{-2}.
Find its velocity after 2 s.

$v = u + at$
$v = (4\mathbf{i} + 5\mathbf{j}) + 2(2\mathbf{i} + \mathbf{j})$
$= (4\mathbf{i} + 5\mathbf{j}) + (4\mathbf{i} + 2\mathbf{j})$
Answer: $(8\mathbf{i} + 7\mathbf{j})$ m s^{-1}

2 Large data set: handling readings (AQA, Edexcel, OCR, MEI, Eduqas)

Seven daily rainfall readings (mm) from the Large Data Set are: 4.4, tr, 3.8, 1, 4.8, tr, 4.6.
Here 'tr' means a trace, which is treated as 0.
Find the mean daily rainfall to 3 s.f.

Replace each 'tr' by 0
Total = 18.6
Mean = 18.6 ÷ 7
Answer: 2.66 mm

3 Solving quadratics: surd answers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^2 + 6x - 4 = 0$, giving your answers in the form $p \pm \sqrt{q}$.

Complete the square: $(x + 3)^2 - 9 - 4 = 0$
$(x + 3)^2 = 13$
$x + 3 = \pm\sqrt{13}$
Answer: $x = -3 \pm \sqrt{13}$

4 Partial fractions: find the constants (All boards)

Express $\frac{-5x - 11}{(x + 4)(x + 1)}$ in the form $\frac{A}{x + 4} + \frac{B}{x + 1}$.
Find the values of A and B.

$-5x - 11 \equiv A(x + 1) + B(x + 4)$
$x = -4$: $9 = A(-3)$, so $A = -3$
$x = -1$: $-6 = B(3)$, so $B = -2$
Answer: $A = -3$, $B = -2$

5 Equilibrium of forces given as vectors (AQA, Edexcel, OCR, MEI, Eduqas)

Three forces $(-5\mathbf{i} - \mathbf{j})$ N, $(p\mathbf{i} + q\mathbf{j})$ N and $(8\mathbf{i} - 4\mathbf{j})$ N act on a particle which is in equilibrium. $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors. Find the values of p and q.

Sum of forces = 0:
i components: $p + (-5) + (8) = 0$
j components: $q + (-1) + (-4) = 0$
Answer: $p = -3$, $q = 5$

6 Finding an unknown using the factor theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$(x - 3)$ is a factor of $x^3 + kx^2 - 4x - 42$.
Find the value of k.

Let $f(x) = x^3 + kx^2 - 4x - 42$. Then $f(3) = 0$:
$27 + 9k - 54 = 0$
$9k = 27$
Answer: $k = 3$

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7 Maximum value from R form (All boards)

f(x) = 8 sin x + 15 cos x + 6.
Write f(x) in the form R sin(x + α) + 6, with α in degrees to 1 d.p., and state the maximum value of f(x).

R = $\sqrt{8^2 + 15^2}$ = 17, tan α = $\frac{15}{8}$ so α = 61.9°

f(x) = 17 sin(x + 61.9°) + 6
sin(x + α) has maximum value 1, so f(max) = 17 + 6
Answer: f(x) = 17 sin(x + 61.9°) + 6; maximum 23

8 Conditional probability (Bayes) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The probability that a patient takes the drug is 0.5. If so, the probability that the patient recovers is 0.5; otherwise it is 0.2.
Given that the patient recovers, find the probability that a patient takes the drug.

P(both) = 0.5 × 0.5 = 0.25; P(not first and second) = 0.5 × 0.2 = 0.1
P(second) = 0.25 + 0.1 = 0.35
P = 0.25 ÷ 0.35
Answer: $\frac{5}{7}$ = 0.714

9 Double angle equation (All boards)

Solve tan 2x = $\sqrt{3}$ for 0° ≤ x ≤ 180°.

Let u = 2x, so 0° ≤ u ≤ 360°
tan u = $\sqrt{3}$: u = 60°, 240°, 420°, 600°
Divide by 2: x = 30°, 120°
Answer: x = 30°, 120°

10 Equation of a circle from a diagram (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a circle with the centre marked.
The circle touches the x-axis. Find the equation of the circle.

The circle touches the x-axis, so the radius equals the y-coordinate of the centre: r = 4.
Centre (2, 4): $(x - a)^2 + (y - b)^2 = r^2$
Answer: $(x - 2)^2 + (y - 4)^2 = 16$