Day 106 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Linear inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $5x - 6 < -4x + 4$.

Collect x terms: $9x < 10$

Divide by 9: $x < \frac{10}{9}$

Answer: $x < \frac{10}{9}$

2 Conditional probability formula (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$P(A \cap B) = 0.35$ and $P(B) = 0.5$.
Find $P(A \mid B)$.

$P(A \mid B) = P(A \cap B) \div P(B)$
$= 0.35 \div 0.5$
Answer: 0.7

3 Describing transformations of graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Describe the single transformation that maps the graph of $y = f(x)$ onto the graph of $y = -f(x)$.

$y = -f(x)$ is obtained from $y = f(x)$ by a:
reflection in the x-axis
Answer: reflection in the x-axis

4 Counting: arrangements and selections (CIE)

In how many ways can a team of 3 be chosen from 10 players?

$^{10}C_3 = \frac{10 \times 9 \times 8}{3 \times 2 \times 1}$

Answer: 120

5 Parametric differentiation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A curve has parametric equations
$x = 1t$, $y = 2t^2 + 1$.
Find the gradient at the point where $t = 1$.

$dx/dt = 1$, $dy/dt = 4t$

$dy/dx = \frac{4t}{1}$

At $t = 1$: $dy/dx = 4$
Answer: 4

6 Real roots and the discriminant (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of k for which
$2x^2 - 4x + k = 0$ has no real roots.

$b^2 - 4ac < 0$
$16 - 8k < 0$
Answer: $k > 2$

7 Rough slope: limiting equilibrium or sliding (All boards)

A crate is on the point of sliding down a rough plane inclined at α to the horizontal, where $\tan \alpha = \frac{5}{12}$. Find the coefficient of friction.

Perpendicular: $R = mg \cos \alpha$
Parallel (limiting): $F = mg \sin \alpha$

$\mu = \frac{F}{R} = \tan \alpha$

Answer: $\frac{5}{12}$

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8 Integrate using double angle formulae (All boards)

Use a double angle formula to find
$\int \sin^2 5x \, dx$.

$\cos 2\theta = 1 - 2\sin^2\theta$, so $\sin^2 5x = \frac{1}{2}(1 - \cos 10x)$

Integrate term by term

Answer: $\frac{x}{2} - \frac{\sin 10x}{20} + c$

9 Constant velocity vector: when does it reach a point? (AQA, Edexcel, OCR, MEI, Eduqas)

A particle moves with constant velocity
$(2\mathbf{i} + 5\mathbf{j})$ m s^{-1}. It is at the point with position vector $(-\mathbf{j})$ m at t = 0. Find the time when its position vector is $(10\mathbf{i} + 24\mathbf{j})$ m.

$r = r_0 + vt$
$(10\mathbf{i} + 24\mathbf{j}) = (-\mathbf{j}) + t(2\mathbf{i} + 5\mathbf{j})$
Equating i components: $10 = 0 + 2t$
Answer: 5 s

10 Area enclosed by a parabola (diagram) (All boards)

The diagram shows the curve $y = 3x(7 - x)$.
Find the area of the shaded region, between the curve and the x-axis.

The curve meets the x-axis where x = 0 and x = 7

Area = $\int_0^7 3(7x - x^2)\,dx = [3(\frac{7x^2}{2} - \frac{x^3}{3})]$ from 0 to 7

$= 3(\frac{7^3}{2} - \frac{7^3}{3})$

$= \frac{343}{2}$

Answer: $\frac{343}{2}$