Day 346 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Solve $-x - 7 < 12$.

Solve $-x^2 - 7x - 12 = 0$: $-(x + 4)(x + 3) = 0$
Critical values $x = -4$ and $x = -3$.
The graph is an ∩-shaped parabola, so take the regions outside the roots.
Answer: $x < -4$ or $x > -3$

2 Constant acceleration: s = ut + ½at² (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A cyclist moves in a straight line with constant acceleration 0.5 m s^{-2}. Its initial speed is 6 m s^{-1}. Find the distance travelled in 10 s.

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

$s = 6 \times 10 + \frac{1}{2} \times 0.5 \times 10^2$

Answer: 85 m

3 Solve trig equation in radians (calculator) (All boards)

Solve $4 \tan x = 4$ for $0 \leq x \leq 2\pi$.
Give your answers to 3 significant figures.

$\tan x = 1$
Reference angle = $\tan^{-1}(1.000) = 0.7854$ radians
tan is positive in the first and third quadrants.
$x = 0.785, 3.93$
Answer: $x = 0.785, 3.93$

4 Expanding brackets with surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Expand and simplify $(4 - \sqrt{2})(5 + \sqrt{2})$.

$= 20 + 4\sqrt{2} - 5\sqrt{2} - 2$
$= 18 - \sqrt{2}$
Answer: $18 - \sqrt{2}$

5 Binomial: cumulative probabilities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(19, 0.5)$. Find $P(X < 10)$, giving your answer to 3 s.f.

$P(X < 10) = P(X \leq 9)$
Answer: 0.500

6 Moments: reactions on a uniform beam (AQA, Edexcel, OCR, MEI)

A uniform beam AB of mass 10 kg and length 2 m rests horizontally on supports at A and B. A load of mass 20 kg is placed on the beam 0.5 m from A. Take g = 9.8 m s^{-2}. Find the reaction at B.

Moments about A:
$R_B \times 2 = 10 \times 9.8 \times 1 + 20 \times 9.8 \times 0.5$
$R_B \times 2 = 196$
Answer: 98 N

7 Maximum value from R form (All boards)

$f(x) = 5 \sin x + 12 \cos x + 2$.
Write f(x) in the form $R \sin(x + \alpha) + 2$, with α in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{5^2 + 12^2} = 13$, $\tan \alpha = \frac{12}{5}$ so $\alpha = 67.4°$

$f(x) = 13 \sin(x + 67.4°) + 2$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 13 + 2
Answer: f(x) = 13 sin(x + 67.4°) + 2; maximum 15

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8 Tangent condition for a line and a curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The line $y = 2x + k$ is a tangent to the curve $y = x^2$.
Find the value of k.

$x^2 = 2x + k$
$x^2 - 2x + (0 - k) = 0$
A tangent touches once: discriminant = 0
$(-2)^2 - 4(0 - k) = 0$
Answer: $k = -1$

9 Iteration $x_{n+1} = g(x_n)$ (All boards)

$x_{n+1} = (4x_n + 7)^{\frac{1}{3}}$, with $x_0 = 2$.
Find x_1, x_2 and x_3 to 3 decimal places.

$x_1 = 2.4662$
$x_2 = 2.5644$
$x_3 = 2.5842$
Answer: $x_1 = 2.466$, $x_2 = 2.564$, $x_3 = 2.584$

10 Stratified sampling (AQA, Edexcel, OCR, MEI, Eduqas)

A stratified sample of size 13 is taken from 104 students: 72 Under 30, 32 30 to 50.
How many 30 to 50 should be in the sample?

$\text{Number} = 13 \times \frac{32}{104}$
$= 4$
Answer: 4