Day 335 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Normal distribution: symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(30, 10^2)$ and $P(30 < X < 50) = 0.025$.
Find $P(X > 50)$.

$P(X > 30) = 0.5$ as the mean is 30
$P(X > 50) = 0.5 - 0.025$
Answer: 0.475

2 Solve basic trig equation (exact, degrees) (All boards)

Solve $\tan x = \sqrt{3}$ for $0° \leq x \leq 360°$.

Reference angle: $\tan 60° = \sqrt{3}$
tan is positive in the first and third quadrants.
$x = 60°, 240°$
Answer: x = 60°, 240°

3 Free fall: dropped from a height (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A brick is dropped from rest from the top of a bridge of height 44.1 m. Take $g = 9.8$ m s^{-2} and ignore air resistance. Find (a) the time taken to reach the ground, (b) its speed on hitting the ground.

(a) $s = ut + \frac{1}{2}at^2$: $44.1 = \frac{1}{2} \times 9.8 \times t^2$

$44.1 = 4.9t^2$, so $t^2 = 9$
(b) $v = u + at = 9.8 \times 3$
Answer: (a) 3 s (b) 29.4 m s^{-1}

4 Transforming a graph with a labelled turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve $y = f(x)$. The maximum point is shown. Write down the coordinates of the maximum point on the curve with equation
(a) $y = f(x - 1)$ (b) $y = 2f(x)$

(a) $y = f(x - 1)$: the maximum point moves to (5, 4).
(b) $y = 2f(x)$: the maximum point moves to (4, 8).
Answer: (a) (5, 4) (b) (4, 8)

5 Binomial: finding parameters (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(n, p)$ has mean 2 and variance 1.5.
Find n and p.

$np = 2$ and $npq = 1.5$
$q = 1.5 \div 2 = 0.75$, so $p = 0.25$
$n = 2 \div 0.25$
Answer: n = 8, p = 0.25

6 Identity then solve (sin² to cos) (All boards)

Solve $-2\sin^2 x + \cos x + 1 = 0$
for $0° \leq x \leq 360°$.

Use $\sin^2 x = 1 - \cos^2 x$: $2\cos^2 x + \cos x - 1 = 0$

Factorise and solve: $\cos x = -1$ or $\cos x = \frac{1}{2}$

$x = 60°, 180°, 300°$
Answer: x = 60°, 180°, 300°

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7 Position of a point relative to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x + 1)^2 + (y + 4)^2 = 25$.
Determine whether the point P(5, −5) is inside, outside or on the circle.

Distance^2 from the centre (−1, −4) to P:
$(5 - (-1))^2 + (-5 - (-4))^2 = 36 + 1 = 37$
$r^2 = 25$, and $37 > 25$.
Answer: P is outside the circle

8 Two objects moving towards each other (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Two cyclists start at the same time from points A and B, 126 m apart, and cycle directly towards each other at constant speeds of 6 m s^{-1} and 3 m s^{-1}. Find the time until they meet.

Closing speed = 6 + 3 = 9 m s^{-1}
Time = $\frac{126}{9}$
Answer: 14 s

9 Recurrence relations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A sequence is defined by $u_{n+1} = 4u_n - 5$, $u_1 = 1$.
Find u_2, u_3 and u_4.

$u_2 = 4 \times 1 - 5 = -1$
$u_3 = 4 \times (-1) - 5 = -9$
$u_4 = 4 \times (-9) - 5 = -41$
Answer: $u_2 = -1$, $u_3 = -9$, $u_4 = -41$

10 Maximum value from R form (All boards)

f(x) = 5 sin x + 12 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).

$R = \sqrt{5^2 + 12^2} = 13$, $\tan \alpha = \frac{12}{5}$ so $\alpha = 67.4°$
f(x) = 13 sin(x + 67.4°) + 6
sin(x + α) has maximum value 1, so f(max) = 13 + 6
Answer: f(x) = 13 sin(x + 67.4°) + 6; maximum 19