Day 58 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Modelling assumptions (All boards)

In a mechanics model, wind is ignored in a model of a falling coin.
State what this assumption means for the motion or forces in the model.

Modelling assumption: wind.
The assumption means: n.o horizontal force acts, so the coin falls vertically
Answer: No horizontal force acts, so the coin falls vertically

2 Double angle: find sin 2A and cos 2A (All boards)

A is acute and $\cos A = \frac{24}{25}$.

Find the exact values of sin 2A and cos 2A.

$\sin A = \sqrt{1 - \cos^2 A} = \frac{7}{25}$

$\sin 2A = 2 \sin A \cos A = 2 \times \frac{7}{25} \times \frac{24}{25} = \frac{336}{625}$

$\cos 2A = 2\cos^2 A - 1 = 2 \times \frac{576}{625} - 1 = \frac{527}{625}$

Answer: $\sin 2A = \frac{336}{625}$, $\cos 2A = \frac{527}{625}$

3 Gradient and parallel or perpendicular lines (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the equation of the line parallel to
$3x + 2y = -2$ that passes through $(-1, 6)$.
Give the answer in the form $y = mx + c$.

Rearrange: $y = -\frac{3}{2}x - 1$, so the gradient is $-\frac{3}{2}$.

$y - 6 = -\frac{3}{2}(x - (-1))$

$y = -\frac{3}{2}x + \frac{9}{2}$

Answer: $y = -\frac{3}{2}x + \frac{9}{2}$

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

A car moves in a straight line with constant acceleration 2 m s^{-2}. Its initial speed is 9 m s^{-1}. Find the distance travelled in 6 s.

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

$s = 9 \times 6 + \frac{1}{2} \times 2 \times 6^2$

Answer: 90 m

5 Two-tailed binomial test (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim B(12, p)$. H_0: $p = 0.2$, H_1: $p \neq 0.2$. In a sample, $x = 0$.
Test at the 5% significance level.

Two-tailed test, so compare with $0.05 \div 2 = 0.025$
$P(X \leq 0) = 0.0687$
$0.0687 > 0.025$, so do not reject H_0
Answer: Do not reject H_0 ($P(X \leq 0) = 0.0687$)

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6 Rewrite a sin x + b cos x in R form (All boards)

Express 8 sin x + 15 cos x in the form R cos(x − α), where R > 0 and 0° < α < 90°.
Give α to 1 decimal place.

R cos(x − α) = R cos x cos α + R sin x sin α
R cos α = 15 and R sin α = 8

R = $\sqrt{8^2 + 15^2}$ = 17, tan α = $\frac{8}{15}$, α = 28.1°

Answer: 17 cos(x − 28.1°)

7 Perpendicular bisector (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A is (−4, 4) and B is (0, 12).
Find the equation of the perpendicular bisector of AB, in the form ax + by = c with integer a, b and c.

Midpoint of AB = (−2, 8)

Gradient of AB = $\frac{8}{4}$ = 2, so perpendicular gradient = $-\frac{1}{2}$

$y - 8 = -\frac{1}{2}(x - (-2))$

Multiply out and rearrange.
Answer: x + 2y = 14

8 Binomial: at least one success (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Each customer buys a coffee with probability 0.3.
Find the probability that at least one of 10 customers buys a coffee, to 3 s.f.

P(zero) = 0.7^{10}
P(at least one) = $1 - 0.7^{10}$
Answer: 0.972

9 Solve trig equation in radians (exact) (All boards)

Solve sin x = $\frac{\sqrt{2}}{2}$ for $0 \leq x \leq 2\pi$.
Give your answers in terms of π.

Reference angle: $\frac{\pi}{4}$

sin is positive in the first and second quadrants.

x = $\frac{\pi}{4}$, $\frac{3\pi}{4}$

Answer: x = $\frac{\pi}{4}$, $\frac{3\pi}{4}$

10 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 = −2, so a = −2 and c = −2.

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

$\frac{k}{2} = -1$, so k = −2

Answer: a = −2, c = −2, k = −2