Day 71 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Pythagorean identity: find cos and tan (All boards)

θ is acute and $\sin\theta = \frac{24}{25}$.

Find the exact values of $\cos\theta$ and $\tan\theta$.

$\sin^2\theta + \cos^2\theta = 1$, so $\cos^2\theta = 1 - \frac{576}{625} = \frac{49}{625}$

θ is acute, so $\cos\theta = \frac{7}{25}$

$\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{24}{7}$

Answer: $\cos\theta = \frac{7}{25}$, $\tan\theta = \frac{24}{7}$

2 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows distance from city and house price for a group.
Describe the correlation.

The points lie loosely around a line with negative gradient.
As distance from city increases, house price tends to decrease.
Answer: weak negative correlation

3 Simplifying algebraic indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{4x^6} \times 5x^{-2}$.

$\sqrt{4x^6} = (4x^6)^{\frac{1}{2}} = 2x^3$
$2x^3 \times 5x^{-2} = 10x$
Answer: 10x

4 Power of an engine: driving force (CIE)

A car's engine works at a constant rate of 5 kW. Find the driving force when the vehicle is moving at 10 m s^{-1}.

$P = Fv$
$5000 = F \times 10$
Answer: 500 N

5 Equation of a transformed curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The curve $y = x^2 + 2x - 3$ is translated by the vector $\begin{pmatrix}3\\4\end{pmatrix}$.

Find the equation of the new curve, giving your answer in the form $y = ax^2 + bx + c$.

Replace x by $(x - 3)$ and add 4:
$y = f(x - 3) + 4$
Expand and collect terms.
Answer: $y = x^2 - 4x + 4$

6 Quadratic in sin or cos (All boards)

Solve $4\cos^2 x - 1 = 0$ for $0° \le x \le 360°$.

Factorise: $(2\cos x + 1)(2\cos x - 1) = 0$ (as a quadratic in cos x)
$\cos x = -\frac{1}{2}$ or $\cos x = \frac{1}{2}$
$x = 60°, 120°, 240°, 300°$
Answer: x = 60°, 120°, 240°, 300°

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7 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 = 3.

Centre (0, 3): $(x - a)^2 + (y - b)^2 = r^2$

Answer: $x^2 + (y - 3)^2 = 9$

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

A block is on the point of sliding down a rough plane inclined at α to the horizontal, where $\tan \alpha = \frac{7}{24}$. Find the coefficient of friction.

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

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

Answer: $\frac{7}{24}$

9 Integrate (ax + b)^n and related (All boards)

Find $\int e^{5x + 3}\, dx$.

$\int e^{ax + b}\, dx = \frac{1}{a} e^{ax + b}$

Here a = 5

Answer: $\frac{1}{5} e^{5x + 3} + c$

10 Normal distribution: inverse (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(50, 8^2)$. Given that $P(X > a) = 0.75$, find a to 3 s.f.

$P(Z > z) = 0.75$, so $z = -0.6745$ (from the inverse normal function)
$a = 50 + -0.6745 \times 8$
Answer: 44.6