Day 22 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Arithmetic sequences: nth term (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

An arithmetic sequence begins $-4, -1, 2, 5, \ldots$
Find (a) an expression for the nth term,
(b) the 14th term.

$a = -4$, $d = 3$
$u_n = a + (n - 1)d = -4 + (n - 1)(3) = 3n - 7$
$u_{14} = 35$
Answer: (a) $3n - 7$ (b) 35

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

Find $\int (2x + 5)^5 \, dx$.

Reverse the chain rule: raise the power by 1, divide by the new power and by 2
Here $a = 2$
Answer: $\frac{(2x + 5)^6}{12} + c$

3 Regression: prediction and reliability (AQA, Edexcel, OCR, MEI, Eduqas)

For 7 data pairs, with hours of revision from 10 to 20, the regression line is $E = 19 + 2h$.
Estimate exam score when $h = 25$ and comment on the reliability.

$E = 19 + 2 \times 25 = 69$
25 is outside the range 10 to 20, so this is extrapolation.
Answer: E = 69; estimate is unreliable, as 25 is outside the data range (extrapolation)

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

The curve $y = x^2 + 3x$ is translated by the vector $\begin{pmatrix} 1 \\ -5 \end{pmatrix}$.

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

Replace x by $(x - 1)$ and add -5:
$y = f(x - 1) - 5$
Expand and collect terms.
Answer: $y = x^2 + x - 7$

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

The scatter diagram shows time on phone and hours of sleep for a group.
Describe the correlation.

The points show no pattern: as time on phone increases, hours of sleep shows no consistent trend.
Answer: no correlation

6 Power of an engine: driving force (CIE)

A car's engine works at a constant rate of 7.5 kW. Find the driving force when the vehicle is moving at 15 m s^{-1}.

$P = Fv$
$7500 = F \times 15$
Answer: 500 N

7 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 $x = -1$ and $y = -1$, so $a = -1$ and $c = -1$.

Through (0, 1): $1 = \frac{k}{0 - (-1)} + -1$

$\frac{k}{1} = 2$, so $k = 2$

Answer: $a = -1$, $c = -1$, $k = 2$

8 Differentiate tan, sec, cosec, cot (All boards)

Differentiate y = 1 tan x with respect to x.

Use the standard result: d/dx(tan x) = $\sec^2 x$

Answer: dy/dx = 1 $\sec^2 x$

9 Car towing a caravan (All boards)

A car of mass 1500 kg tows a caravan of mass 1000 kg on a level road with acceleration 0.25 m s^{-2}. Resistances: 200 N on the car, 100 N on the caravan. Find the driving force and the tow bar tension.

Whole system: D − 200 − 100 = 2500 × 0.25

Caravan: T − 100 = 1000 × 0.25

Answer: D = 925 N, T = 350 N

10 Collinear points using vectors (All boards)

A(−2, −2), B(0, −4) and C(2, −6).

Show that A, B and C are collinear and find AB : BC.

AB = $\begin{pmatrix} 2 \\ -2 \end{pmatrix}$ and BC = $\begin{pmatrix} 2 \\ -2 \end{pmatrix}$

AB = $2\begin{pmatrix} 1 \\ -1 \end{pmatrix}$ and BC = $2\begin{pmatrix} 1 \\ -1 \end{pmatrix}$, so AB and BC are parallel with common point B

Hence A, B, C are collinear and AB : BC = 2 : 2

Answer: collinear; AB : BC = 2 : 2