Day 248 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Large data set: handling readings (AQA, Edexcel, OCR, MEI, Eduqas)

Seven daily sunshine readings (hours) from the Large Data Set are: n/a, 2.6, 1, n/a, 1.2, 1.4, 0.6.
Here 'n/a' means no reading was recorded.
Leaving these out, find the mean to 3 s.f.

Leave out the 2 'n/a' readings, leaving 5 values
Total = 6.8
Mean = 6.8 ÷ 5
Answer: 1.36 hours

2 Starting from rest: find the time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car starts from rest and moves in a straight line with constant acceleration 3 m s^{-2}.
It travels 54 m. Find the time taken.

$s = ut + \frac{1}{2}at^2$ with $u = 0$

$54 = \frac{1}{2} \times 3 \times t^2$

$t^2 = 36$
Answer: 6 s

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

Find the equation of the line parallel to
$x + 3y = -7$ that passes through $(5, -4)$.
Give the answer in the form $y = mx + c$.

Rearrange: $y = -\frac{1}{3}x - \frac{7}{3}$, so the gradient is $-\frac{1}{3}$.

$y - (-4) = -\frac{1}{3}(x - 5)$

$y = -\frac{1}{3}x - \frac{7}{3}$

Answer: $y = -\frac{1}{3}x - \frac{7}{3}$

4 3D vectors: distance, magnitude and midpoint (All boards)

A has coordinates $(-3, 0, 0)$ and B has coordinates $(-1, 6, -3)$.
Find (a) the vector AB, (b) the distance AB, (c) the midpoint of AB.

(a) $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \begin{pmatrix} 2 \\ 6 \\ -3 \end{pmatrix}$

(b) $|AB| = \sqrt{2^2 + 6^2 + 3^2} = 7$

(c) Midpoint $= (-2, 3, -\frac{3}{2})$

Answer: (a) $\begin{pmatrix} 2 \\ 6 \\ -3 \end{pmatrix}$ (b) 7 (c) $(-2, 3, -\frac{3}{2})$

5 Vertical motion under gravity: thrown upwards (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A ball is thrown vertically upwards with speed 9.8 m s^{-1}. Take $g = 9.8$ m s^{-2}.
(a) Find the time taken to reach its greatest height.
(b) Find the greatest height reached.

(a) $v = u + at$: $0 = 9.8 - 9.8t$, so $t = 1$

(b) $v^2 = u^2 + 2as$: $0 = 9.8^2 - 2 \times 9.8 \times s$

$s = \frac{96.04}{19.6}$

Answer: (a) 1 s (b) 4.9 m

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

Express 6 sin x + 8 cos x in the form R sin(x + α), where R > 0 and 0° < α < 90°.
Give α to 1 decimal place.

R sin(x + α) = R sin x cos α + R cos x sin α
R cos α = 6 and R sin α = 8
R = $\sqrt{6^2 + 8^2}$ = 10, tan α = $\frac{8}{6}$, α = 53.1°

Answer: 10 sin(x + 53.1°)

7 Parametric equations to Cartesian form (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A line has parametric equations
x = 4t + 4, y = 3t − 1.
Find its equation in the form y = mx + c.

From x = 4t + 4: t = $\frac{x - 4}{4}$

y = 3 × $\frac{x - 4}{4}$ − 1

Answer: y = $\frac{3}{4}$x − 4

8 Continuous random variable: finding k (CIE)

The continuous random variable X has probability density function f(x) = kx^2 for 0 ≤ x ≤ 1, and 0 otherwise.
Find the value of k.

∫ from 0 to 1 of k x^2 dx = 1

k × $\frac{1^3}{3}$ = 1

Answer: k = 3

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

The line y = x + k is a tangent to the curve
y = x^2 − 3x + 4.
Find the value of k.

x^2 − 3x + 4 = x + k
x^2 − 4x + (4 − k) = 0
A tangent touches once: discriminant = 0
(−4)^2 − 4(4 − k) = 0

Answer: k = 0

10 Partial fractions: find the constants (All boards)

Express $\frac{7x + 17}{(x + 3)(x + 1)}$ in the form $\frac{A}{x + 3} + \frac{B}{x + 1}$.
Find the values of A and B.

7x + 17 ≡ A(x + 1) + B(x + 3)
x = −3: −4 = A(−2), so A = 2
x = −1: 10 = B(2), so B = 5

Answer: A = 2, B = 5