Day 311 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 F = ma: find the acceleration (All boards)

A horizontal force of 64 N acts on a crate of mass 50 kg on a smooth horizontal surface.
Find the acceleration.

F = ma
64 = 50 a
Answer: 1.28 m s^{-2}

2 Partial fractions: find the constants (All boards)

Express $\frac{x+1}{(x+2)(x+3)}$ in the form $\frac{A}{x+2} + \frac{B}{x+3}$.
Find the values of A and B.

$x + 1 \equiv A(x + 3) + B(x + 2)$
$x = -2$: $-1 = A(1)$, so $A = -1$
$x = -3$: $-2 = B(-1)$, so $B = 2$
Answer: A = −1, B = 2

3 Arithmetic series: sum of terms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the sum of the first 14 terms of the series
7 + 12 + 17 + 22 + ...

a = 7, d = 5, n = 14
$S_n = \frac{n}{2}[2a + (n - 1)d] = \frac{14}{2}[2(7) + 13 \times 5]$
= 553
Answer: 553

4 Angle between vectors (scalar product) (CIE)

a = −2**j** + 3**k** and b = −3**j** + 4**k**.
Find the angle between a and b, to 1 decimal place.

a.b = (0)(0) + (−2)(−3) + (3)(4) = 18
$|a| = \sqrt{13}$, $|b| = \sqrt{25}$
$\cos\theta = \frac{18}{\sqrt{13} \times \sqrt{25}}$, so θ = 3.2°
Answer: 3.2°

5 Hypothesis test for correlation (AQA, Edexcel, OCR, MEI, Eduqas)

25 pairs of data on age of a car and its value have r = 0.28.
Test, at the 5% significance level, for evidence of positive correlation. The critical value is 0.3365.

H_0: ρ = 0, H_1: ρ > 0
r = 0.28 is not beyond the critical value 0.3365
Do not reject H_0
Answer: Do not reject H_0: there is not enough evidence of positive correlation

6 Optimisation (algebraic set-up) (All boards)

A rectangle has perimeter 24 cm.
Find the maximum possible area of the rectangle and the dimensions that give it.

Sides x and 12 − x, so $A = x(12 - x) = 12x - x^2$
$dA/dx = 12 - 2x = 0$, so x = 6
$d^2A/dx^2 = -2 < 0$, so it is a maximum; A = 6 × 6
Answer: A = 36 cm^2, a 6 cm square

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7 Arithmetic series: smallest n (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The nth term of an arithmetic sequence is $2n + 2$.
Find the smallest n for which the term exceeds 800.

$2n + 2 > 800$
$n > 399$
The smallest integer n is 400.
Answer: n = 400

8 Standard deviation from summary data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

For 10 values, $\Sigma x = 110$ and $\Sigma x^2 = 1480$.
Find the mean and the standard deviation.

Mean $= 110 \div 10 = 11$

Variance $= \frac{1480}{10} - 11^2 = 148 - 121 = 27$

Standard deviation $= \sqrt{27}$
Answer: mean = 11, standard deviation = 5.20

9 Friction: acceleration along rough ground (All boards)

A block of mass 2 kg is pulled along rough horizontal ground by a horizontal force of 12.8 N.
The coefficient of friction is 0.5. Take $g = 9.8$ m s^{-2}. Find the acceleration.

$R = 2 \times 9.8 = 19.6$
$F = \mu R = 0.5 \times 19.6 = 9.8$
$P - F = ma$: $12.8 - 9.8 = 2a$
Answer: 1.5 m s^{-2}

10 Binomial expansion: positive integer powers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the coefficient of x^2 in the expansion of
$(1 - x)^8$.

Term in x^2: ${}^8C_2 \times 1^6 \times (-1\,x)^2$
$= 28 \times 1 \times 1$
Answer: 28