Day 217 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Constant acceleration: distance from average speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A lorry moving in a straight line with constant acceleration increases its speed from 10 m s^{-1} to 14 m s^{-1} in 4 s.
Find the distance it travels in this time.

$s = \frac{(u + v)}{2} t$

$s = \frac{(10 + 14)}{2} \times 4$

Answer: 48 m

2 Find the angle of a sector (All boards)

A sector has radius 8 cm and arc length 10.0 cm.
Find the angle of the sector in radians and the area of the sector.

$\theta = \frac{\text{arc length}}{r} = \frac{10.0}{8} = 1.25$

$\text{Area} = \frac{1}{2}r^2\theta = \frac{1}{2} \times 8^2 \times 1.25 = 40.0 \text{ cm}^2$

Answer: θ = 1.25 radians; area 40.0 cm^2

3 The remainder theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the remainder when $2x^3 + 3x^2 - 7x + 7$ is divided by $(x - 2)$.

Remainder = f(2)
= 16 + 12 + (−14) + 7
= 21
Answer: 21

4 Counting: arrangements and selections (CIE)

In how many ways can a team of 2 be chosen from 8 players?

$^8C_2 = \frac{8 \times 7}{2 \times 1}$

Answer: 28

5 Smooth inclined plane: acceleration and speed (All boards)

A particle of mass 3 kg slides from rest down a smooth plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{1}{2}$. Take $g = 9.8 \text{ m s}^{-2}$.
Find (a) its acceleration, (b) its speed after 3 s.

(a) Parallel to slope: $mg \sin\alpha = ma$

$a = 9.8 \times \frac{1}{2}$

(b) $v = u + at = 0 + 4.9 \times 3$

Answer: (a) 4.9 m s^{-2} (b) 14.7 m s^{-1}

6 Partial fractions: find the constants (All boards)

Express $\frac{8x + 28}{(x + 5)(x + 1)}$ in the form $\frac{A}{x + 5} + \frac{B}{x + 1}$.
Find the values of A and B.

$8x + 28 \equiv A(x + 1) + B(x + 5)$
$x = -5$: $-12 = A(-4)$, so $A = 3$
$x = -1$: $20 = B(4)$, so $B = 5$
Answer: A = 3, B = 5

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7 Recurrence relations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A sequence is defined by $u_{n+1} = 3u_n + 7$, $u_1 = 5$.

Find u_2, u_3 and u_4.

$u_2 = 3 \times 5 + 7 = 22$

$u_3 = 3 \times 22 + 7 = 73$

$u_4 = 3 \times 73 + 7 = 226$

Answer: $u_2 = 22$, $u_3 = 73$, $u_4 = 226$

8 Collinear points using vectors (All boards)

A(−2, −1), B(10, 3) and C(25, k).

Given that A, B and C are collinear, find k.

$\text{AB} = \begin{pmatrix} 12 \\ 4 \end{pmatrix}$, $\text{AC} = \begin{pmatrix} 27 \\ k + 1 \end{pmatrix}$

AC = $\frac{9}{4}$ AB, so $27 = \frac{9}{4} \times 12$, giving the multiple $\frac{9}{4}$

$k + 1 = \frac{9}{4} \times 4$, so $k = 8$

Answer: $k = 8$

9 Conditional probability formula (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$P(A \cap B) = 0.54$ and $P(B) = 0.9$.

Find $P(A \mid B)$.

$P(A \mid B) = P(A \cap B) \div P(B)$

$= 0.54 \div 0.9$

Answer: 0.6

10 Gradient of a tangent to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The circle $(x - 2)^2 + (y + 3)^2 = 169$ passes through P(−3, −15).

Find the gradient of the tangent to the circle at P.

Centre C(2, −3).

Gradient of CP = $\frac{-15 - (-3)}{-3 - 2} = \frac{12}{5}$

The tangent is perpendicular to CP: gradient = $-1 \div \frac{12}{5}$

Answer: $-\frac{5}{12}$