Day 277 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Simplifying surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{24} + \sqrt{150}$, giving your answer in the form $p\sqrt{6}$.

$\sqrt{24} = 2\sqrt{6}$ and $\sqrt{150} = 5\sqrt{6}$

Sum = $(2 + 5)\sqrt{6}$

Answer: $7\sqrt{6}$

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

Find $\int (4x + 3)^2 \, dx$.

Reverse the chain rule: raise the power by 1, divide by the new power and by 4

Here a = 4

Answer: $\frac{(4x + 3)^3}{12} + c$

3 Interpreting the PMCC (AQA, Edexcel, OCR, MEI, Eduqas)

The product moment correlation coefficient between revision time and test score is $r = -0.86$.

Interpret this value.

r is close to -1, so there is strong negative linear correlation.

As revision time increases, test score tends to decrease.

Answer: strong negative linear correlation

4 Definite integrals (exact) (All boards)

Find the exact value of

$\int_0^{\frac{\pi}{4}} 12 \sin 4x \, dx$.

$[-3 \cos 4x]$ from 0 to $\frac{\pi}{4}$

$= -3 \cos \pi - (-3 \cos 0) = 3 + 3$

Answer: 6

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

A particle of mass 2 kg slides from rest down a smooth plane inclined at angle α to the horizontal, where $\sin \alpha = \frac{1}{2}$. Take $g = 9.8$ m s^{-2}.

Find (a) its acceleration, (b) its speed after 2 s.

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

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

(b) $v = u + at = 0 + 4.9 \times 2$

Answer: (a) 4.9 m s^{-2} (b) 9.8 m s^{-1}

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

An arithmetic series has first term 2 and common difference 3. Find the smallest n for which the sum of the first n terms exceeds 300.

$S_n = \frac{n}{2}[4 + 3(n - 1)] = \frac{n(3n + 1)}{2}$

$S_{13} = 260$ and $S_{14} = 301$

The sum first exceeds 300 when n = 14.

Answer: n = 14

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7 Particle on a smooth table connected to a hanging particle (All boards)

A 4 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 3 kg particle, as shown. The system is released from rest. Take g = 9.8 m s^{-2}. Find the tension.

Table particle: T = 4 a
Hanging particle: 3 × 9.8 − T = 3 a
Adding: 29.4 = 7 a
Answer: 16.8 N

8 Systematic sampling (AQA, Edexcel, OCR, MEI, Eduqas)

A systematic sample of 30 houses is taken from a numbered list of 450.
The first one selected is number 4. Find the number of the 9th one selected.

Interval = 450 ÷ 30 = 15
Number = 4 + 8 × 15
Answer: 124

9 Find the angle of a sector (All boards)

A sector has radius 10 cm and area 75.0 cm^2.
Find the angle of the sector in radians and the arc length.

$\frac{1}{2} \times 10^2 \times \theta = 75.0$, so $\theta = 1.5$
Arc length = $r\theta = 10 \times 1.5 = 15.0$ cm
Answer: θ = 1.5 radians; arc length 15.0 cm

10 Transforming a point on a graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The point P(4, 1) lies on the curve y = f(x).
Write down the coordinates of the image of P on
(a) y = f(x + 2) (b) y = f(x) + 2

(a) y = f(x + 2) subtracts 2 from x, so P maps to (2, 1).
(b) y = f(x) + 2 adds 2 to y, so P maps to (4, 3).
Answer: (a) (2, 1) (b) (4, 3)