Day 279 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Simplify $\sqrt{18} + \sqrt{8}$, giving your answer in the form $p\sqrt{2}$.

$\sqrt{18} = 3\sqrt{2}$ and $\sqrt{8} = 2\sqrt{2}$

Sum $= (3 + 2)\sqrt{2}$

Answer: $5\sqrt{2}$

2 Comparing distributions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The journey times in minutes for two groups: Route A has mean 67, standard deviation 15; Route B has mean 80, standard deviation 9.

Compare the two sets of data.

The mean measures the average: Route B has the higher mean.

The standard deviation measures spread: Route B has the smaller standard deviation, so it is more consistent.

Answer: Route B has the higher mean; Route B is more consistent

3 Iteration $x_{n+1} = g(x_n)$ (All boards)

$x_{n+1} = \dfrac{2}{x_n^2 + 1} + 1$, with $x_0 = 2$.

Find x_1, x_2 and x_3 to 3 decimal places.

$x_1 = 1.4000$

$x_2 = 1.6757$

$x_3 = 1.5252$

Answer: $x_1 = 1.400$, $x_2 = 1.676$, $x_3 = 1.525$

4 Algebraic division (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Divide $f(x) = x^3 + 8x^2 + 18x + 5$ by $(x + 3)$.

Find the quotient and the remainder.

Use synthetic division with $a = -3$:

Bottom row: 1, 5, 3, -4

Quotient: $x^2 + 5x + 3$

Remainder: -4

Answer: Quotient $x^2 + 5x + 3$, remainder -4

5 Velocity zero (quadratic in t) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line. Its velocity at time t seconds is $v = (t^2 - 11t + 28)$ m s^{-1}.

(a) Find the times when the particle is at rest.

(b) Find its acceleration at the first of these times.

(a) $t^2 - 11t + 28 = 0$

$(t - 4)(t - 7) = 0$

(b) $a = \dfrac{dv}{dt} = 2t - 11$; at $t = 4$, $a = 8 - 11$

Answer: (a) $t = 4$ and $t = 7$ (b) -3 m s^{-2}

6 Perpendicular bisector (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A is $(2, -1)$ and B is $(4, -9)$.

Find the equation of the perpendicular bisector of AB, in the form $ax + by = c$ with integer a, b and c.

Midpoint of AB $= (3, -5)$

Gradient of AB $= \dfrac{-8}{2} = -4$, so perpendicular gradient $= \dfrac{1}{4}$

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

Multiply out and rearrange.

Answer: $x - 4y = 23$

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7 Integrate using partial fractions (All boards)

$\frac{4x + 7}{(x + 1)(x + 4)} \equiv \frac{A}{x + 1} + \frac{B}{x + 4}$.

Find A and B, and hence find $\int \frac{4x + 7}{(x + 1)(x + 4)}\, dx$.

$4x + 7 \equiv A(x + 4) + B(x + 1)$

$x = -1$ gives $A = 1$; $x = -4$ gives $B = 3$

$\int \left(\frac{1}{x + 1} + \frac{3}{x + 4}\right) dx = 1 \ln |x + 1| + 3 \ln |x + 4| + c$

Answer: A = 1, B = 3; ln |x + 1| + 3 ln |x + 4| + c

8 Rough slope: limiting equilibrium or sliding (All boards)

A brick is on the point of sliding down a rough plane inclined at α to the horizontal, where $\tan \alpha = \frac{3}{4}$. Find the coefficient of friction.

Perpendicular: $R = mg \cos \alpha$

Parallel (limiting): $F = mg \sin \alpha$

$\mu = \frac{F}{R} = \tan \alpha$

Answer: $\frac{3}{4}$

9 Trapezium rule from a function (AQA, Edexcel, OCR, MEI, Eduqas)

Use the trapezium rule with 4 strips to estimate

$\int_0^3 \sqrt{x^3 + 3}\, dx$,

giving your answer to 3 significant figures.

$h = \frac{3 - 0}{4} = 0.75$; $x = 0, 0.75, 1.5, 2.25, 3$

$y = 1.732, 1.850, 2.525, 3.793, 5.477$

Area $\approx \frac{h}{2}$[first + last + 2(sum of the rest)] $= \frac{0.75}{2}[1.732 + 5.477 + 2 \times 8.168]$

$= 8.83$

Answer: 8.83

10 Box plots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The box plot summarises the delivery times, in minutes, of a pizza company.

Find the range and the interquartile range.

Range $= 80 - 40 = 40$

IQR $= 70 - 50 = 20$

Answer: range = 40, IQR = 20