Day 194 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Arithmetic sequences: nth term (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

In an arithmetic sequence $u_2 = 15$ and $u_{11} = 60$.

Find the first term and the common difference.

Subtract: $(11 - 2)d = 60 - 15$

$9d = 45$, so $d = 5$

$a = u_2 - 1\,d = 15 - 5 = 10$

Answer: $a = 10$, $d = 5$

2 Driving force and resistance (All boards)

A car of mass 800 kg is driven along a straight horizontal road by a driving force of 1500 N against a constant resistance of 300 N.

Find the acceleration of the car.

Resultant force $= 1500 - 300 = 1200$ N

$F = ma$: $1200 = 800\,a$

Answer: $1.5\ \text{m s}^{-2}$

3 Find a and b in y = ab^x (All boards)

The curve $y = ab^x$ passes through (0, 5) and $(2, \frac{5}{9})$.

Find the values of a and b.

$x = 0$: $y = a \times b^0 = a$, so $a = 5$

$x = 2$: $5 \times b^2 = \frac{5}{9}$, so $b^2 = \frac{1}{9}$

$b = \frac{1}{3}$

Answer: $a = 5$, $b = \frac{1}{3}$

4 Completing the square (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Write $-2x^2 - 8x - 10$ in the form $a(x + p)^2 + q$.

Take out a factor -2: $-2(x^2 + 4x + 5)$

$x + 4 = (x + 2)^2 - 4$

$-2[(x + 2)^2 - 4] - 10 = -2(x + 2)^2 - 2$

Answer: $-2(x + 2)^2 - 2$

5 Factorised trig equation (All boards)

Solve $(\tan x + 1)(\tan x - 1) = 0$ for $0° \leq x \leq 360°$.

Either $\tan x + 1 = 0$ or $\tan x - 1 = 0$

$\tan x = -1$: $x = 135°, 315°$

$\tan x = 1$: $x = 45°, 225°$

Answer: $x = 45°, 135°, 225°, 315°$

6 Normal approximation to the binomial (CIE)

$X \sim B(120, 0.3)$. Use a normal approximation to find $P(X \leq 39)$, to 3 s.f.

$np = 36$ and $npq = 25.2$, so use $Y \sim N(36, 25.2)$

Continuity correction: $P(Y < 39.5)$

$z = (39.5 - 36) \div \sqrt{25.2}$

Answer: 0.757

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7 Parametric differentiation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$x = 4t^2 + 1$, $y = 3t^3 - t$.
Find dy/dx in terms of t, and its value when t = 1.

$dx/dt = 8t$, $dy/dt = 9t^2 - 1$

$$dy/dx = \frac{dy}{dt \div dx/dt} = \frac{9t^2 - 1}{8t}$$

At t = 1: dy/dx = 1

Answer: $\mathbf{dy/dx = \frac{9t^2 - 1}{8t}; 1}$

8 Constant acceleration: s = ut + ½at² (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car moves in a straight line with constant acceleration 0.5 m s^{-2}. Its initial speed is 7 m s^{-1}. Find the distance travelled in 8 s.

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

$$s = 7 \times 8 + \frac{1}{2} \times 0.5 \times 8^2$$

Answer: 72 m

9 Histograms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The histogram shows the times, t minutes, taken by some people to complete a puzzle.
Find the number of people who took between 25 and 35 minutes.

Frequency = frequency density × class width
$25 \leq t < 30$: $6 \times 5 = 30$
$30 \leq t < 35$: $3 \times 5 = 15$
Total = 30 + 15
Answer: 45

10 The factor theorem and factorising (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = 2x^3 + 18x^2 + 52x + 48$
(a) Show that (x + 2) is a factor of f(x).
(b) Factorise f(x) completely.

$f(-2) = (-16) + 72 + (-104) + 48 = 0$, so (x + 2) is a factor.

$f(x) = (x + 2)(2x^2 + 14x + 24)$

$2x^2 + 14x + 24 = 2(x + 4)(x + 3)$

Answer: (b) f(x) = 2(x + 4)(x + 3)(x + 2)