Day 181 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Gradient and parallel or perpendicular lines (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the equation of the line parallel to
$3x - 4y = -10$ that passes through $(2, -3)$.
Give the answer in the form $y = mx + c$.

Rearrange: $y = \frac{3}{4}x + \frac{5}{2}$, so the gradient is $\frac{3}{4}$.

$y - (-3) = \frac{3}{4}(x - 2)$

$y = \frac{3}{4}x - \frac{9}{2}$

Answer: $y = \frac{3}{4}x - \frac{9}{2}$

2 Constant acceleration: v = u + at (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moving in a straight line has initial speed 7 m s^{-1} and constant acceleration 1.5 m s^{-2}.
Find its speed after 10 s.

$v = u + at$
$v = 7 + 1.5 \times 10$
Answer: 22 m s^{-1}

3 Evaluating fractional and negative indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Evaluate $4^{-\frac{3}{2}}$.

$4^{-\frac{3}{2}} = \frac{1}{4^{\frac{3}{2}}}$

$4^{\frac{1}{2}} = 2$, so $4^{\frac{3}{2}} = 2^3 = 8$

$= \frac{1}{8}$

Answer: $\frac{1}{8}$

4 Exponential growth and decay model (All boards)

The number of bacteria is $N = 100\,e^{0.05t}$, where t is the time in hours.
Find (a) N when t = 10, (b) the time when N = 200.
Give answers to 3 s.f.

(a) $N = 100\,e^{0.05 \times 10} = 100\,e^{0.5} = 165$
(b) $e^{0.05t} = 2$, so $0.05t = \ln 2$

$t = \frac{\ln 2}{0.05} = 13.9$ hours

Answer: (a) 165 (b) 13.9 hours

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

8 pairs of data on height and arm span have r = 0.75.
Test, at the 5% significance level, for evidence of positive correlation. The critical value is 0.6215.

$H_0: \rho = 0$, $H_1: \rho > 0$
r = 0.75 is beyond the critical value 0.6215
Reject H_0
Answer: Reject H_0: there is evidence of positive correlation

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6 Compound growth: find n (All boards)

A population of 400 grows by 2% each year.
After how many whole years will it first exceed 600?

$400 \times 1.02^n > 600$, so $1.02^n > 1.5$

$n > \frac{\log 1.5}{\log 1.02} = 20.48$

The least whole number of years is 21

Answer: 21 years

7 Tree diagrams (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The tree diagram shows probabilities for events R and L.
Find the probability that exactly one of R and L happens.

Exactly one: (R and L′) or (R′ and L)
$= 0.5 \times 0.7 + 0.5 \times 0.4$

Answer: 0.55

8 Maximum value from R form (All boards)

$f(x) = 6 \sin x + 8 \cos x + 5$.
Write f(x) in the form $R \sin(x + \alpha) + 5$, with α in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{6^2 + 8^2} = 10$, $\tan \alpha = \frac{8}{6}$ so $\alpha = 53.1°$

$f(x) = 10 \sin(x + 53.1°) + 5$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 10 + 5

Answer: f(x) = 10 sin(x + 53.1°) + 5; maximum 15

9 Sigma notation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The nth term of a sequence is $u_n = 2n + 6$.

Find $\sum_{r=1}^{11} u_r$.

$u_1 = 8$, $u_{11} = 28$

Sum $= \frac{11}{2}(8 + 28)$

$= 198$

Answer: 198

10 Stone thrown down from a cliff (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A stone is thrown vertically downwards at 3 m s^{-1} from the top of a cliff and hits the sea after 2 s. Taking g = 9.8 m s^{-2}, find the height of the cliff.

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

$s = 3 \times 2 + \frac{1}{2} \times 9.8 \times 2^2$

$s = 6 + 19.6$

Answer: 25.6 m