Day 54 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Mutually exclusive events (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A and B are mutually exclusive, with P(A) = 0.5 and P(B) = 0.2.
(a) Find P(A ∪ B).
(b) Find the probability that neither A nor B happens.

(a) Mutually exclusive, so P(A ∩ B) = 0
P(A ∪ B) = 0.5 + 0.2 = 0.7
(b) 1 − 0.7 = 0.3
Answer: (a) 0.7 (b) 0.3

2 Line through two axis intercepts (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a line meeting the axes at A and B.
Find (a) the equation of AB in the form px + qy = r with integers p, q and r, (b) the length AB.

Gradient = $\frac{-2-0}{0-3} = \frac{2}{3}$

Using y = mx + c with c = −2: y = $\frac{2}{3}$x − 2, so 2x − 3y = 6

$AB^2 = 3^2 + 2^2 = 13$
Answer: (a) 2x − 3y = 6 (b) $\sqrt{13}$

3 Simplify using identities (All boards)

Simplify $\frac{\sin x}{\tan x}$.

$\tan x = \frac{\sin x}{\cos x}$, so $\frac{\sin x}{\tan x} = \sin x \times \frac{\cos x}{\sin x}$
Answer: cos x

4 Discriminant: equal roots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The equation $2x^2 + 4x + c = 0$ has equal roots.
Find the value of c.

Equal roots: $b^2 - 4ac = 0$
$4^2 - 4 \times 2 \times c = 0$
16 = 8c
Answer: c = 2

5 Solve trig equation in radians (calculator) (All boards)

Solve 5 tan x = 3 for $0 \leq x \leq 2\pi$.
Give your answers to 3 significant figures.

$\tan x = \frac{3}{5}$

Reference angle = $\tan^{-1}(0.6000)$ = 0.5404 radians
tan is positive in the first and third quadrants.
x = 0.540, 3.68
Answer: x = 0.540, 3.68

6 Car towing a caravan (All boards)

A car of mass 1000 kg tows a caravan of mass 800 kg on a level road with acceleration 0.75 m s^{-2}. Resistances: 400 N on the car, 100 N on the caravan. Find the driving force and the tow bar tension.

Whole system: D − 400 − 100 = 1800 × 0.75
Caravan: T − 100 = 800 × 0.75
Answer: D = 1850 N, T = 700 N

7 Solve a^x = b using logarithms (All boards)

Solve $6^{3x} = 30$.
Give your answer to 3 significant figures.

Take logs: $3x \log 6 = \log 30$

$x = \dfrac{\log 30}{3 \log 6} = 0.633$

Answer: $x = 0.633$

8 Partial fractions (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

Express $\dfrac{-2x - 14}{(x - 1)(x - 5)}$ in partial fractions.

Write $\dfrac{-2x - 14}{(x - 1)(x - 5)} = \dfrac{A}{(x - 1)} + \dfrac{B}{(x - 5)}$

$-2x - 14 = A(x - 5) + B(x - 1)$
$x = 1$: $-16 = A(-4)$ so $A = 4$
$x = 5$: $-24 = B(4)$ so $B = -6$

Answer: $\dfrac{4}{(x - 1)} + \dfrac{-6}{(x - 5)}$

9 Hypothesis test for a normal mean (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A population is $N(\mu, 4^2)$. H_0: $\mu = 125$, H_1: $\mu < 125$.

A sample of 49 has mean $\bar{x} = 123.11$.
Test at the 5% level. Critical value: $z = -1.645$.

$z = (\bar{x} - \mu) \div (\sigma \div \sqrt{n}) = (123.11 - 125) \div (4 \div 7)$
$z = -3.31$
-3.31 is inside the critical region, so reject H_0

Answer: $z = -3.31$; reject H_0

10 Velocity-time graph: acceleration and distance (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a car over 21 seconds as it moves in a straight line.
(a) Find its acceleration in the first 5 s.
(b) Find the total distance travelled.

(a) acceleration = gradient = $\dfrac{15}{5}$

(b) distance = area of trapezium

$= \dfrac{1}{2}(10 + 21) \times 15$

Answer: (a) 3 m s^{-2} (b) 232.5 m