Day 110 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Binomial expansion: positive integer powers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the first four terms, in ascending powers of x, of the expansion of $(1 - x)^7$.

$(1 + y)^7 = 1 + 7y + 21y^2 + 35y^3 + ...$ with $y = -x$

$= 1 + 7(-x) + 21(-x)^2 + 35(-x)^3$

Answer: $1 - 7x + 21x^2 - 35x^3$

2 Modelling assumptions (All boards)

In a mechanics model, a plank is described as rigid.
State what this assumption means for the motion or forces in the model.

Modelling assumption: rigid plank.
The assumption means: i.t does not bend, so it remains straight under load
Answer: It does not bend, so it remains straight under load

3 Types of data (AQA, Edexcel, OCR, MEI, Eduqas)

Classify each variable as qualitative, discrete or continuous.
(a) the number of texts sent in a day
(b) the type of transport used to get to school
(c) the number of cars in a car park

(a) discrete: it is counted, so takes separate values
(b) qualitative: it is described by words, not numbers
(c) discrete: it is counted, so takes separate values
Answer: (a) discrete; (b) qualitative; (c) discrete

4 Solve trig equation (calculator, degrees) (All boards)

Solve $\cos x = 0.45$ for $0° \leq x \leq 360°$.
Give your answers to 1 decimal place.

Reference angle: $\cos^{-1}(0.450) = 63.3°$
cos is positive in the first and fourth quadrants.
$x = 63.3°$ or $x = 296.7°$
Answer: $x = 63.3°, 296.7°$

5 Normal distribution: diagram and symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the density of $X \sim N(90, 4^2)$.
a and b are equal distances from the mean. The shaded area, $P(X > b)$, is 0.31.
Find $P(a < X < b)$.

By symmetry $P(X < a) = 0.31$
$P(a < X < b) = 1 - 2 \times 0.31$
Answer: 0.38

6 Finding an unknown using the factor theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

When $x^3 + kx^2 - 3x + 2$ is divided by $(x + 1)$, the remainder is -1. Find the value of k.

$f(-1) = -1$
$-1 + k + 5 = -1$
$k = -5$
Answer: $k = -5$

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

A curve has equation $xy = 3$.
Find dy/dx in terms of x and y, and hence the gradient at (3, 1).

Differentiate both sides with respect to x (using dy/dx for y terms)

$dy/dx = -\frac{y}{x}$

At (3, 1): $dy/dx = -\frac{1}{3}$

Answer: $dy/dx = -\frac{y}{x}$; gradient $-\frac{1}{3}$

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

A 3 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 1 kg particle, as shown. The system is released from rest. Take $g = 9.8$ m s^{-2}. Find the tension.

Table particle: $T = 3a$
Hanging particle: $1 \times 9.8 - T = 1a$
Adding: $9.8 = 4a$
Answer: 7.35 N

9 Maximum value from R form (All boards)

$f(x) = 6 \sin x + 8 \cos x + 1$.
Write f(x) in the form $R \sin(x + \alpha) + 1$, 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 $\alpha = 53.1°$

$f(x) = 10 \sin(x + 53.1°) + 1$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 10 + 1
Answer: f(x) = 10 sin(x + 53.1°) + 1; maximum 11

10 Linear inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $15 \leq 3x + 3 \leq 33$.

Subtract 3 from each part: $12 \leq 3x \leq 30$
Divide each part by 3.
Answer: $4 \leq x \leq 10$