Day 177 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Classify each variable as qualitative, discrete or continuous.
(a) the type of transport used to get to school
(b) a person's favourite colour
(c) the number of texts sent in a day

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

2 Factorised trig equation (All boards)

Solve $(2\cos x - 1)(\cos x + 1) = 0$ for $0° \leq x \leq 360°$.

Either $2\cos x - 1 = 0$ or $\cos x + 1 = 0$

$\cos x = \frac{1}{2}$: $x = 60°, 300°$

$\cos x = -1$: $x = 180°$
Answer: $x = 60°, 180°, 300°$

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

Solve $5 \leq 3x + 2 \leq 14$.

Subtract 2 from each part: $3 \leq 3x \leq 12$
Divide each part by 3.
Answer: $1 \leq x \leq 4$

4 Braking: deceleration and time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A lorry travelling at 15 m s^{-1} brakes uniformly and comes to rest after travelling 30 m.
(a) Find the deceleration.
(b) Find the time taken to stop.

(a) $v^2 = u^2 + 2as$: $0 = 15^2 + 2 \times a \times 30$
so $a = -3.75$, a deceleration of 3.75

(b) $s = \frac{(u + v)}{2}t$: $30 = 7.5\,t$

Answer: (a) 3.75 m s^{-2} (b) 4 s

5 Product rule (All boards)

Use the product rule to differentiate
$y = x^1 \cos 2x$.

$u = x^1$, $v = \cos 2x$
$u' = 1$, $v' = -2\sin 2x$
$dy/dx = u'v + uv'$, which simplifies to the answer below
Answer: $dy/dx = \cos 2x - 2x \sin 2x$

6 Geometric sequences (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

In a geometric sequence $u_3 = 216$ and $u_4 = 324$.
Find the first term and the common ratio.

$r = u_4 \div u_3 = 324 \div 216 = \frac{3}{2}$

$a = u_3 \div r^2 = 96$

Answer: $a = 96$, $r = \frac{3}{2}$

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

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

Table particle: $T = 2a$
Hanging particle: $3 \times 9.8 - T = 3a$
Adding: $29.4 = 5a$
Answer: 11.76 N

8 Solving quadratics: surd answers (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $x^2 - 2x - 5 = 0$, giving your answers in the form $p \pm \sqrt{q}$.

Complete the square: $(x - 1)^2 - 1 - 5 = 0$
$(x - 1)^2 = 6$
$x - 1 = \pm\sqrt{6}$
Answer: $x = 1 \pm \sqrt{6}$

9 Hypotheses for a binomial test (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A player says that she wins a game with probability 0.75.
A researcher thinks that the probability is different. Let p be the probability that she wins a game.
Write down suitable hypotheses for a test on p.

H_0 states the claimed value; H_1 matches the researcher's belief.
Two-tailed test
Answer: H_0: $p = 0.75$, H_1: $p \neq 0.75$

10 Integrate using partial fractions (All boards)

$\frac{2x + 3}{(x + 1)(x + 2)} \equiv \frac{A}{x + 1} + \frac{B}{x + 2}$.

Find A and B, and hence find $\int \frac{2x + 3}{(x + 1)(x + 2)}\,dx$.

$2x + 3 \equiv A(x + 2) + B(x + 1)$
$x = -1$ gives $A = 1$; $x = -2$ gives $B = 1$
$\int \left(\frac{1}{x + 1} + \frac{1}{x + 2}\right) dx = 1 \ln|x + 1| + 1 \ln|x + 2| + c$
Answer: $A = 1$, $B = 1$; $\ln|x + 1| + \ln|x + 2| + c$