Day 302 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Conditional probability: two-way tables (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Of 80 people, 33 are girls. 21 of the girls and 22 of the boys walk to work.
One person is chosen at random.
Given that the person walks to work, find the probability they are a girl.

43 people walk to work in total: 21 + 22
P = 21 ÷ 43
Answer: $\frac{21}{43}$

2 Simplify using identities (All boards)

Simplify $4 - 4\sin^2 x$.

Take out 4: $4(1 - \sin^2 x) = 4\cos^2 x$
Answer: $4\cos^2 x$

3 Maximum friction on a horizontal surface (All boards)

A box of mass 20 kg rests on rough horizontal ground. The coefficient of friction is 0.2.
Taking g = 9.8 m s^{-2}, find the maximum friction force that can act on the box.

R = mg = 20 × 9.8 = 196
$F_{max} = \mu R = 0.2 \times 196$
Answer: 39.2 N

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

Find the coefficient of x^2 in the expansion of
$(1 + x)^7$.

Term in x^2: ${}^7C_2 \times 1^5 \times (1\ x)^2$
= 21 × 1 × 1
Answer: 21

5 3D vectors: distance, magnitude and midpoint (All boards)

A has coordinates (2, 4, 2) and B has coordinates (0, 13, 8).
Find (a) the vector AB, (b) the distance AB, (c) the midpoint of AB.

(a) $AB = OB - OA = \begin{pmatrix} -2 \\ 9 \\ 6 \end{pmatrix}$
(b) $|AB| = \sqrt{2^2 + 9^2 + 6^2} = 11$
(c) Midpoint = $(1, \frac{17}{2}, 5)$
Answer: (a) $\begin{pmatrix} -2 \\ 9 \\ 6 \end{pmatrix}$ **(b) 11 (c)** $(1, \frac{17}{2}, 5)$

6 Centre and radius of a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $x^2 + y^2 - 2x + 4y - 40 = 0$.
Find the centre and the radius of the circle.

Complete the square in x and in y:
$(x - 1)^2 + (y + 2)^2 = 45$
Centre $(1, -2)$, radius = $3\sqrt{5}$
Answer: Centre (1, −2), radius $3\sqrt{5}$

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7 Conditional probability (Bayes) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The probability that a machine is set up wrongly is 0.5. If so, the probability that an item is faulty is 0.4; otherwise it is 0.3. Given that an item is faulty, find the probability that a machine is set up wrongly.

P(both) = 0.5 × 0.4 = 0.2; P(not first and second) = 0.5 × 0.3 = 0.15
P(second) = 0.2 + 0.15 = 0.35
P = 0.2 ÷ 0.35

Answer: $\frac{4}{7}$ = **0.571**

8 Tension in a string supporting a hanging mass (All boards)

A particle of mass 12 kg hangs from a light string and is raised vertically with acceleration 0.5 m s^{-2}.
Taking g = 9.8 m s^{-2}, find the tension.

$T - mg = ma$
$T = 12 \times 9.8 + 12 \times 0.5$
Answer: 123.6 N

9 Solve trig equation in radians (exact) (All boards)

Solve $\sin x = \frac{\sqrt{3}}{2}$ for $0 \leq x \leq 2\pi$.

Give your answers in terms of π.

Reference angle: $\frac{\pi}{3}$

sin is positive in the first and second quadrants.

$x = \frac{\pi}{3}, \frac{2\pi}{3}$

Answer: $\mathbf{x = \frac{\pi}{3}, \frac{2\pi}{3}}$

10 The remainder theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the remainder when $x^3 - 4x^2 - 2x - 1$ is divided by $(2x - 5)$.

Put $2x - 5 = 0$: $x = \frac{5}{2}$

Remainder = $f(\frac{5}{2}) = \frac{125}{8} + (-25) + (-5) + (-1)$

$= -\frac{123}{8}$

Answer: $\mathbf{-\frac{123}{8}}$