Day 226 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Degrees and radians (All boards)

(a) Convert 120° to radians, giving your answer in terms of π.

(b) Convert $\frac{3\pi}{4}$ radians to degrees.

(a) $120° = 120 \times \frac{\pi}{180} = \frac{2\pi}{3}$

(b) $\frac{3\pi}{4}$ radians $= \frac{3\pi}{4} \times \frac{180}{\pi} = 135°$

Answer: (a) $\frac{2\pi}{3}$ radians (b) 135°

2 Moments: balancing a plank (AQA, Edexcel, OCR, MEI)

A light plank rests on a pivot. A child of mass 30 kg sits 1 m from the pivot on one side. Where must a child of mass 25 kg sit on the other side for the plank to balance horizontally?

Moments about the pivot:

$30 \text{ g} \times 1 = 25 \text{ g} \times d$

$d = \frac{30 \times 1}{25}$

Answer: 1.2 m from the pivot

3 Transforming a point on a graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The point P(−5, −6) lies on the curve y = f(x).
Write down the coordinates of the image of P on
(a) y = f(4x) (b) y = −f(x)

(a) y = f(4x) divides x by 4, so P maps to $(-\frac{5}{4}, -6)$.

(b) y = −f(x) changes the sign of y, so P maps to (−5, 6).

Answer: (a) $(-\frac{5}{4}, -6)$ (b) (−5, 6)

4 Differentiate tan, sec, cosec, cot (AQA, Edexcel, OCR, MEI, Eduqas)

Differentiate y = cosec 5x with respect to x.

Use the standard result: d/dx(cosec kx) = −k cosec kx cot kx

Answer: dy/dx = −5 cosec 5x cot 5x

5 Composite functions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

f(x) = 3x − 6 and $g(x) = x^2 - 1$.
Find (a) fg(x), (b) gf(x).

$fg(x) = f(x^2 - 1) = 3x^2 - 9$

$gf(x) = (3x - 6)^2 - 1 = 9x^2 - 36x + 35$

Answer: (a) $3x^2 - 9$ (b) $9x^2 - 36x + 35$

6 Binomial: mean and variance (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(60, 0.2). Find E(X) and Var(X).

E(X) = np = 60 × 0.2 = 12

Var(X) = npq = 60 × 0.2 × 0.8

Answer: E(X) = 12, Var(X) = 9.6

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

$x^2 + kx + 16 = 0$ has equal roots.
Find the possible values of k.

Equal roots: $b^2 - 4ac = 0$

$k^2 - 4 \times 1 \times 16 = 0$, so $k^2 = 64$

Answer: k = ±8

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8 Integration by substitution (All boards)

Use the substitution u = sin x to find

$\int \cos x \sin^4 x \, dx$.

u = sin x, so du = cos x dx

$\int 1\, u^4 \, du = \frac{1\, u^5}{5}$

Replace u by sin x

Answer: $\frac{1 \sin^5 x}{5} + c$

9 Power of an engine: driving force (CIE)

A lorry's engine works at a constant rate of 75 kW. Find the driving force when the vehicle is moving at 25 m s^{-1}.

P = Fv

75000 = F × 25

Answer: 3000 N

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

12 pairs of data on daily mean temperature and sunshine hours have r = 0.58.

Test, at the 5% significance level, for evidence of positive correlation. The critical value is 0.4973.

H_0: ρ = 0, H_1: ρ > 0

r = 0.58 is beyond the critical value 0.4973

Reject H_0

Answer: Reject H_0: there is evidence of positive correlation