Day 307 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Evaluating fractional and negative indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Evaluate $25^{\frac{1}{2}}$.

$25^{\frac{1}{2}} = (25^{\frac{1}{2}})^1$

$25^{\frac{1}{2}} = 5$

$(5)^1 = 5$

Answer: 5

2 Integrate standard functions (All boards)

Find

(a) $\int 9 \cos 3x \, dx$

(b) $\int 9 e^{3x} \, dx$

Use the standard integrals and divide by the coefficient of x where needed.

(a) = $3 \sin 3x + c$

(b) = $3 e^{3x} + c$

Answer: (a) $3 \sin 3x + c$ (b) $3 e^{3x} + c$

3 Regression: prediction and reliability (AQA, Edexcel, OCR, MEI, Eduqas)

For 7 data pairs, with hours of revision from 8 to 16, the regression line is E = 4 + 9h.

Estimate exam score when h = 24 and comment on the reliability.

$E = 4 + 9 \times 24 = 220$

24 is outside the range 8 to 16, so this is extrapolation.

Answer: E = 220; estimate is unreliable, as 24 is outside the data range (extrapolation)

4 Area enclosed by a parabola (diagram) (All boards)

The diagram shows the curve $y = 3x(3 - x)$.

Find the area of the shaded region, between the curve and the x-axis.

The curve meets the x-axis where x = 0 and x = 3

Area = $\int_0^3 3(3x - x^2) \, dx = [3(\frac{3x^2}{2} - \frac{x^3}{3})]$ from 0 to 3

$= 3(\frac{3^3}{2} - \frac{3^3}{3})$

$= \frac{27}{2}$

Answer: $\frac{27}{2}$

5 The factor theorem and factorising (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = 2x^3 - 18x^2 + 46x - 30$

(a) Show that $(x - 1)$ is a factor of f(x).

(b) Factorise f(x) completely.

$f(1) = 2 + (-18) + 46 + (-30) = 0$, so $(x - 1)$ is a factor.

$f(x) = (x - 1)(2x^2 - 16x + 30)$

$2x^2 - 16x + 30 = 2(x - 3)(x - 5)$

Answer: (b) $f(x) = 2(x - 1)(x - 3)(x - 5)$

6 Moments: reactions on a uniform beam (AQA, Edexcel, OCR, MEI)

A uniform beam AB of mass 30 kg and length 2 m rests horizontally on supports at A and B. A load of mass 25 kg is placed on the beam 1 m from A. Take g = 9.8 m s^{-2}. Find the reaction at B.

Moments about A:

$R_B \times 2 = 30 \times 9.8 \times 1 + 25 \times 9.8 \times 1$

$R_B \times 2 = 539$

Answer: 269.5 N

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

A company says that the probability a customer buys a ticket is 0.2.
A researcher thinks that the probability is different. Let p be the probability that customer buys a ticket.
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: $p = 0.2$, H_1: $p \neq 0.2$

8 Equation of a transformed curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The curve C has equation $y = x^3 + 4x^2 + 3x + 1$.
C is reflected in the y-axis. Find the equation of the image.

Reflection in the y-axis: replace x by $-x$.

$y = -x^3 + 4x^2 - 3x + 1$

Answer: $y = -x^3 + 4x^2 - 3x + 1$

9 Two objects moving towards each other (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Two cyclists start at the same time from points A and B, 153 m apart, and cycle directly towards each other at constant speeds of 10 m s^{-1} and 7 m s^{-1}. Find the time until they meet.

Closing speed = $10 + 7 = 17$ m s^{-1}

Time = $\frac{153}{17}$

Answer: 9 s

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

Solve $\sin x = -\frac{1}{2}$ for $0 \leq x \leq 2\pi$.

Give your answers in terms of π.

Reference angle: $\frac{\pi}{6}$

sin is negative in the third and fourth quadrants.

$x = \frac{7\pi}{6}, \frac{11\pi}{6}$

Answer: $x = \frac{7\pi}{6}, \frac{11\pi}{6}$