Day 158 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Integrate (ax + b)^n and related (All boards)

Find $\int e^{2x+3}\,dx$.

$\int e^{ax+b}\,dx = \frac{1}{a}e^{ax+b}$

Here a = 2

Answer: $\frac{1}{2}e^{2x+3} + c$

2 Midpoint and length of a line segment (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A is (−3, −5) and B is (−7, −3).
Find (a) the midpoint of AB,
(b) the length of AB, as a surd in simplest form.

(a) Midpoint = $(\frac{-3+(-7)}{2}, \frac{-5+(-3)}{2}) = (-5, -4)$

(b) $AB^2 = (-4)^2 + (2)^2 = 16 + 4 = 20$

$AB = \sqrt{20} = 2\sqrt{5}$

Answer: (a) (−5, −4) (b) $2\sqrt{5}$

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

Of 150 people, 93 are women. 42 of the women and 31 of the men play an instrument.
One person is chosen at random.
Given that the person is a woman, find the probability that they play an instrument.

There are 93 women

P = 42 ÷ 93

Answer: $\frac{14}{31}$

4 Velocity-time: constant deceleration to rest (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car decelerates uniformly from 12 m s^{-1} to rest in 6 s. Find (a) the deceleration, (b) the distance travelled while decelerating.

(a) $a = \frac{v-u}{t} = \frac{0-12}{6}$

(b) $s = \frac{(u+v)}{2}t = 6 \times 6$

Answer: (a) 2 m s^{-2} **(b) 36 m**

5 Differentiate tan, sec, cosec, cot (All boards)

Differentiate y = 3 tan x with respect to x.

Use the standard result: $d/dx(\tan x) = \sec^2 x$

Answer: $dy/dx = 3\sec^2 x$

6 Parametric equations to Cartesian form (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A curve has parametric equations
$x = t + 1$, $y = t^2 + 4$.
Find a Cartesian equation of the curve.

From x = t + 1: t = x − 1

Substitute into y: $y = (x-1)^2 + 4$

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

Day 158 **A Level Maths: C Tier 10-a-day: Model Solutions**

7 Resultant of perpendicular forces (All boards)

Two forces of magnitudes 3 N and 4 N act on a small ring at right angles to each other. Find (a) the magnitude of the resultant, (b) the angle it makes with the 3 N force, to 1 d.p.

(a) $R^2 = 3^2 + 4^2 = 25$

$R = \sqrt{25}$

(b) $\tan\theta = \frac{4}{3}$

Answer: (a) 5 N (b) 53.1°

8 Maximum value from R form (All boards)

f(x) = 21 sin x + 20 cos x + 6.

Write f(x) in the form R sin(x + α) + 6, with α in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{21^2 + 20^2} = 29$, $\tan\alpha = \frac{20}{21}$ so $\alpha = 43.6°$

f(x) = 29 sin(x + 43.6°) + 6

sin(x + α) has maximum value 1, so f(max) = 29 + 6

Answer: f(x) = 29 sin(x + 43.6°) + 6; maximum 35

9 Histograms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The histogram shows the times, t minutes, taken by some people to complete a puzzle.

Find the number of people who took between 5 and 10 minutes.

Frequency = frequency density × class width

$5 \leq t < 10$: 4 × 5 = 20

Answer: 20

10 Linear and quadratic simultaneous equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve the simultaneous equations:

$y = x^2 + 3x - 3$, $y = 2x - 1$.

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

$x^2 + x - 2 = 0$

$(x + 2)(x - 1) = 0$

Use $y = 2x - 1$ to find each y.

Answer: x = −2, y = −5 and x = 1, y = 1