Day 191 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 F = ma: find the force or the mass (All boards)

A particle of mass 6 kg has acceleration 1 m s^{-2}. Find the magnitude of the resultant force acting on it.

F = ma
F = 6 × 1
Answer: 6 N

2 Integrate standard functions (All boards)

Find
(a) $\int 4\sec^2 2x\,dx$
(b) $\int 4\sin 2x\,dx$

Use the standard integrals and divide by the coefficient of x where needed.
(a) = 2 tan 2x + c
(b) = −2 cos 2x + c
Answer: (a) 2 tan 2x + c (b) −2 cos 2x + c

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

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

Put 2x − 2 = 0: x = 1
Remainder = f(1) = (−3) + (−5) + (−1) + (−5)
= −14
Answer: −14

4 Counting: arrangements and selections (CIE)

In how many ways can a team of 2 be chosen from 11 students?

$^{11}C_2 = \frac{11\times10}{2\times1}$
Answer: 55

5 Reciprocal graphs and asymptotes (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = \frac{-1}{x-3} - 4$.

Write down the equations of the asymptotes and the coordinates where the curve meets the axes.

Asymptotes: x = 3 and y = −4.
y = 0: $\frac{-1}{x-3} = 4$, so $x = \frac{11}{4}$
x = 0: $y = \frac{-1}{-3} - 4 = -\frac{11}{3}$
Answer: x = 3, y = −4 ; $(\frac{11}{4}, 0)$, $(0, -\frac{11}{3})$

6 Newton-Raphson: one or two steps (AQA, Edexcel, OCR, MEI, Eduqas)

$f(x) = x^3 - 4x - 4$.
Use the Newton-Raphson method with $x_0 = 2$ to find x_1,
giving your answer to 3 decimal places.

$f'(x) = 3x^2 - 4$
$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$
$x_1 = 2 - \frac{-4.000}{8.000} = 2.5000$
Answer: $x_1 = 2.500$

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7 Sampling: advantages (AQA, Edexcel, OCR, MEI, Eduqas)

A researcher wants to find out the opinions of the staff at a company.
Give one advantage and one disadvantage of using systematic sampling.

Advantage: it is quick and easy and spreads the sample evenly through the list.
Disadvantage: a repeating pattern in the list could cause bias, and a list is needed.
Answer: Advantage: quick and evenly spread. Disadvantage: a pattern in the list may bias

8 Rough slope: limiting equilibrium or sliding (All boards)

A crate is on the point of sliding down a rough plane inclined at α to the horizontal, where $\tan\alpha = \frac{7}{24}$. Find the coefficient of friction.

Perpendicular: $R = mg\cos\alpha$
Parallel (limiting): $F = mg\sin\alpha$
$\mu = \frac{F}{R} = \tan\alpha$
Answer: $\frac{7}{24}$

9 Iteration $x_{n+1} = g(x_n)$ (All boards)

$x_{n+1} = \frac{5}{x_n^2 + 1} + 1$, with $x_0 = 1$.
Find x_1, x_2 and x_3 to 3 decimal places.

$x_1 = 3.5000$
$x_2 = 1.3774$
$x_3 = 2.7259$
Answer: $x_1 = 3.500$, $x_2 = 1.377$, $x_3 = 2.726$

10 Parametric equations: finding points (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A curve has parametric equations
$x = 2t + 4$, $y = 2t^2 - 2$.
The point P has y-coordinate 6 and positive t.
Find the coordinates of P.

$2t^2 - 2 = 6$, so $t^2 = 4$, giving $t = 2$ ($t > 0$)
$x = 2 \times 2 + 4 = 8$
Answer: (8, 6)