Day 331 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Solving equations with indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $25^x = 15625$.

$25 = 5^2$ and $15625 = 5^6$

$5^{2x} = 5^6$, so $2x = 6$

Answer: $x = 3$

2 Driving force and resistance (All boards)

A car of mass 1500 kg is driven along a straight horizontal road by a driving force of 1150 N against a constant resistance of 400 N.

Find the acceleration of the car.

Resultant force = $1150 - 400 = 750$ N

F = ma: $750 = 1500\,a$

Answer: 0.5 m s^{-2}

3 Solve a logarithmic equation (one log) (All boards)

Solve $\log_x 256 = 4$.

$x^4 = 256$

$x = 4$

Answer: $x = 4$

4 Finding a cubic from its graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve y = f(x), where f(x) is a cubic. Find f(x) in the form $k(x - a)(x - b)(x - c)$.

The curve crosses the x-axis at $x = -4$, -2 and 1.

$f(x) = k(x + 4)(x + 2)(x - 1)$

At $(0, -8)$: $k \times 4 \times 2 \times (-1) = -8$

$k = 1$

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

5 Parametric differentiation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

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

Find dy/dx in terms of t, and its value when t = 1.

$dx/dt = 4t$, $dy/dt = 9t^2 - 1$

$$dy/dx = \frac{dy}{dt \div dx/dt} = \frac{9t^2 - 1}{4t}$$

At t = 1: dy/dx = 2

Answer: $dy/dx = \frac{9t^2 - 1}{4t}$; 2

6 Maximum speed from calculus (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line. Its velocity at time t seconds ($0 \le t \le 2$) is $v = (-3t^2 + 6t)$ m s^{-1}. Find the maximum velocity and the time at which it occurs.

$$a = \frac{dv}{dt} = 6 - 6t$$

Maximum when $a = 0$: $t = \frac{6}{6} = 1$

$v = 6 \times 1 - 3 \times 1^2$

Answer: 3 m s^{-1} at $t = 1$

7 Geometric distribution (CIE)

Seeds are planted one at a time until one grows, with probability 0.3333333333 each time. X is the number planted.

Find P(X = 3), to 3 s.f.

$$P(X = 3) = (1 - p)^2 \times p = (\frac{2}{3})^2 \times \frac{1}{3}$$

Answer: 0.148

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8 Finding a quadratic from its turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a sketch of a quadratic curve.

Find its equation in the form $y = a(x - p)^2 + q$.

The turning point is $(-3, 1)$, so $y = a(x + 3)^2 + 1$.

The curve passes through $(0, -17)$:

$-17 = a(3)^2 + 1$, so $-18 = 9a$

$a = -2$

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

9 Normal approximation to the binomial (CIE)

$X \sim B(50, 0.25)$. Use a normal approximation to find $P(X \leq 14)$, to 3 s.f.

$np = 12.5$ and $npq = 9.375$, so use $Y \sim N(12.5, 9.375)$

Continuity correction: $P(Y < 14.5)$

$z = (14.5 - 12.5) \div \sqrt{9.375}$

Answer: 0.743

10 Natural logs and e^x (All boards)

Solve (a) $e^x = 50$ (b) $\ln x = 1.5$

Give answers to 3 significant figures.

(a) $x = \ln 50 = 3.91$

(b) $x = e^{1.5} = 4.48$

Answer: (a) x = 3.91 (b) x = 4.48