Day 259 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Modulus equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $|x + 2| < 1$.

$-1 < x + 2 < 1$

Add -2 to each part.

Answer: $-3 < x < -1$

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

$X \sim B(20, 0.25)$. Find E(X) and Var(X).

$E(X) = np = 20 \times 0.25 = 5$

$Var(X) = npq = 20 \times 0.25 \times 0.75$

Answer: E(X) = 5, Var(X) = 3.75

3 Chain rule: gradient at a point (All boards)

Find the gradient of the curve $y = (3x + 2)^4$
at the point where $x = 1$.

Use the chain rule: $dy/dx = 3 \times 4(3x + 2)^3$

At $x = 1$: $dy/dx = 1500$

Answer: 1500

4 Constant acceleration: finding the initial speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moving in a straight line with constant acceleration 4 m s^{-2} travels 243 m in 9 s.
Find its initial speed.

$s = ut + \frac{1}{2}at^2$

$243 = 9\,u + \frac{1}{2} \times 4 \times 9^2$

$9\,u = 81$

Answer: 9 m s^{-1}

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

Solve $16^x = 8$.

$16 = 2^4$ and $8 = 2^3$

$2^{4x} = 2^3$, so $4x = 3$

Answer: $x = \frac{3}{4}$

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

Find $\int \sin(2x + 1)\,dx$.

$\int \sin(ax + b)\,dx = -\frac{1}{a}\cos(ax + b)$

Here $a = 2$

Answer: $-\frac{1}{2}\cos(2x + 1) + c$

7 Resultant force as vectors and acceleration (AQA, Edexcel, OCR, MEI, Eduqas)

Two forces $(\mathbf{i} - 3\mathbf{j})$ N and $(5\mathbf{i} + 5\mathbf{j})$ N act on a particle of mass 2 kg. No other horizontal forces act. Find the acceleration of the particle as a vector in terms of $\mathbf{i}$ and $\mathbf{j}$.

Resultant $= (\mathbf{i} - 3\mathbf{j}) + (5\mathbf{i} + 5\mathbf{j})$

$= (6\mathbf{i} + 2\mathbf{j})$ N

$F = ma$: $a = \frac{1}{2}(6\mathbf{i} + 2\mathbf{j})$

Answer: $(3\mathbf{i} + \mathbf{j})$ m s^{-2}

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

Solve the simultaneous equations:

$y = x^2 - 2x - 2$, $y = x - 2$.

$x^2 - 2x - 2 = x - 2$

$x^2 - 3x = 0$

$(x + 0)(x - 3) = 0$

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

Answer: $x = 0$, $y = -2$ and $x = 3$, $y = 1$

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

8 pairs of data on daily mean temperature and sunshine hours have $r = 0.53$.

Test, at the 5% significance level, for evidence of positive correlation. The critical value is 0.6215.

$H_0: \rho = 0$, $H_1: \rho > 0$

$r = 0.53$ is not beyond the critical value 0.6215

Do not reject H_0

Answer: Do not reject H_0: there is not enough evidence of positive correlation

10 Small angle approximations (AQA, Edexcel, OCR, MEI, Eduqas)

θ is small and measured in radians.

Use the small angle approximations to find an approximation for $\cos\theta + \theta \sin 6\theta$.

$\cos\theta \approx 1 - \frac{\theta^2}{2}$, $\theta \sin 6\theta \approx 6\theta^2$

So $\cos\theta + \theta \sin 6\theta \approx 1 + \frac{11\,\theta^2}{2}$

Answer: $1 + \frac{11\,\theta^2}{2}$