Day 107 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Coding (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The values x are coded using $y = (x - 50) \div 5$.

The coded values have mean $\bar{y} = 0.9$ and standard deviation 0.7.
Find the mean and standard deviation of x.

$x = 50 + 5y$
Mean: $50 + 5 \times 0.9 = 54.5$
Standard deviation: $5 \times 0.7 = 3.5$ (adding 50 has no effect)
Answer: mean = 54.5, standard deviation = 3.5

2 Natural logs and e^x (All boards)

Solve $e^{5x+2} = 20$.
Give your answer to 3 significant figures.

Take natural logs: $5x + 2 = \ln 20 = 2.996$
$x = 0.199$
Answer: x = 0.199

3 Composite functions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = 4x + 4$ and $g(x) = 5x + 4$.
Solve $fg(x) = 0$.

$fg(x) = f(5x + 4) = 20x + 20$
$20x + 20 = 0$
Answer: x = −1

4 Braking: deceleration and time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car travelling at 30 m s^{-1} brakes uniformly and comes to rest after travelling 75 m.
(a) Find the deceleration.
(b) Find the time taken to stop.

(a) $v^2 = u^2 + 2as$: $0 = 30^2 + 2 \times a \times 75$
so $a = -6$, a deceleration of 6

(b) $s = \frac{(u + v)}{2} t$: $75 = 15\,t$

Answer: (a) 6 m s^{-2} (b) 5 s

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

Sketch $y = \frac{5}{x - 3} - 4$.

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

Asymptotes: $x = 3$ and $y = -4$.
$y = 0$: $\frac{5}{x - 3} = 4$, so $x = \frac{17}{4}$
$x = 0$: $y = \frac{5}{-3} - 4 = -\frac{17}{3}$

Answer: x = 3, y = −4 ; $(\frac{17}{4}, 0)$, $(0, -\frac{17}{3})$

6 Factorised trig equation (All boards)

Solve $(\cos x - 1)(2 \cos x - 1) = 0$ for $0° \leq x \leq 360°$.

Either $\cos x - 1 = 0$ or $2 \cos x - 1 = 0$
$\cos x = 1$: $x = 0°, 360°$
$\cos x = \frac{1}{2}$: $x = 60°, 300°$
Answer: x = 0°, 60°, 300°, 360°

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7 Smooth inclined plane: acceleration and speed (All boards)

A particle of mass 3 kg slides from rest down a smooth plane inclined at angle α to the horizontal, where $\sin\alpha = \frac{3}{5}$. Take $g = 9.8$ m s^{-2}.
Find (a) its acceleration, (b) its speed after 4 s.

(a) Parallel to slope: $mg\sin\alpha = ma$

$a = 9.8 \times \frac{3}{5}$

(b) $v = u + at = 0 + 5.88 \times 4$

Answer: (a) 5.88 m s^{-2} (b) 23.52 m s^{-1}

8 Normal approximation to the binomial (CIE)

$X \sim B(150, 0.4)$. Use a normal approximation to find $P(X \geq 54)$, to 3 s.f.

$np = 60$ and $npq = 36$, so use $Y \sim N(60, 36)$
Continuity correction: $P(Y > 53.5)$

$z = (53.5 - 60) \div \sqrt{36}$

Answer: 0.861

9 Tangent condition for a line and a curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The line $y = 2x + k$ is a tangent to the curve
$y = x^2 + 6x - 2$.
Find the value of k.

$x^2 + 6x - 2 = 2x + k$

$x^2 + 4x + (-2 - k) = 0$

A tangent touches once: discriminant = 0

$(4)^2 - 4(-2 - k) = 0$

Answer: $k = -6$

10 Integration by substitution (All boards)

Use the substitution $u = x^2 + 2$ to find
$\int 2x\,(x^2 + 2)^2\,dx$.

$u = x^2 + 2$, so $du = 2x\,dx$

$\int 1\,u^2\,du = \frac{1\,u^3}{3}$

Replace u: the answer below

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