Day 190 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows temperature and ice cream sales for a group.
Describe the correlation.

The points lie close to a line with positive gradient.
As temperature increases, ice cream sales tends to increase.
Answer: strong positive correlation

2 Horizontal projection from a cliff (AQA, Edexcel, OCR, MEI)

A ball is thrown horizontally at 4 m s^{-1} from the top of a vertical cliff of height 44.1 m above the sea. Take g = 9.8 m s^{-2}.
Find (a) the time taken to reach the sea, (b) the horizontal distance of the landing point from the cliff.

(a) Vertically: u = 0, s = 44.1, a = 9.8

$44.1 = \frac{1}{2} \times 9.8 \times t^2$, so $t^2 = 9$

(b) Horizontal distance = speed × time = 4 × 3
Answer: (a) 3 s (b) 12 m

3 Normal distribution: probabilities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(150, 5^2)$. Find $P(X > 142.5)$, giving your answer to 3 s.f.

$z = (142.5 - 150) \div 5 = -1.5$
$P(X > 142.5) = P(Z > -1.5)$
Answer: 0.933

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

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

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

$a = 9.8 \times \frac{4}{5}$

(b) $v = u + at = 0 + 7.84 \times 2$
Answer: (a) 7.84 m s^{-2} (b) 15.68 m s^{-1}

5 Discriminant: equal roots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The equation $3x^2 + 6x + c = 0$ has equal roots.
Find the value of c.

Equal roots: $b^2 - 4ac = 0$
$6^2 - 4 \times 3 \times c = 0$
$36 = 12c$
Answer: c = 3

6 Exact trigonometric values (All boards)

Write down the exact value of cos 330°.

cos 330° has the same size as cos 30°, and the sign comes from the quadrant (CAST).

$\cos 30° = \frac{\sqrt{3}}{2}$, so $\cos 330° = \frac{\sqrt{3}}{2}$

Answer: $\frac{\sqrt{3}}{2}$

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7 Combining two inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of x satisfying both
$3x - 4 > -13$ and $x^2 - x - 20 < 0$.

$3x - 4 > -13$ gives $x > -3$.
$x^2 - x - 20 < 0$: $(x + 4)(x - 5) < 0$, so $-4 < x < 5$.
Both are true where the two ranges overlap.
Answer: $-3 < x < 5$

8 Integrate using partial fractions (All boards)

$\frac{4x + 10}{(x + 3)(x + 2)} \equiv \frac{A}{x + 3} + \frac{B}{x + 2}$.

Find A and B, and hence find $\int \frac{4x + 10}{(x + 3)(x + 2)}\, dx$.

$4x + 10 \equiv A(x + 2) + B(x + 3)$
$x = -3$ gives $A = 2$; $x = -2$ gives $B = 2$
$\int \left(\frac{2}{x + 3} + \frac{2}{x + 2}\right) dx = 2 \ln |x + 3| + 2 \ln |x + 2| + c$
Answer: $A = 2, B = 2$; $2 \ln |x + 3| + 2 \ln |x + 2| + c$

9 Expanding brackets with surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Expand and simplify $(4 + \sqrt{3})(4 - \sqrt{3})$.

$= 4^2 - (\sqrt{3})^2$
$= 16 - 3$
Answer: 13

10 Separable differential equations (All boards)

Given that $dy/dx = 20x^3$ and $y = 0$ when $x = 0$,
find y in terms of x.

$y = \int 20x^3\, dx = 5x^4 + c$
$x = 0$, $y = 0$: $c = 0$
Answer: $y = 5x^4$