Day 250 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

The histogram shows the times, t minutes, taken by some people to complete a puzzle.
Find the number of people who took between 5 and 25 minutes.

Frequency = frequency density × class width
$5 \leq t < 15$: $3 \times 10 = 30$
$15 \leq t < 25$: $1 \times 10 = 10$
Total = 30 + 10
Answer: 40

2 Arc length and perimeter of a sector (All boards)

A sector has radius 12 cm and angle $\frac{\pi}{2}$ radians.

Find the arc length, leaving π in your answer, and the perimeter.

Arc length = $r\theta = 12 \times \frac{\pi}{2} = 6\pi$ cm

Perimeter = arc + 2r = $6\pi + 24$ cm
Answer: Arc 6π cm; perimeter $(6\pi + 24)$ cm

3 Velocity-time: constant deceleration to rest (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A car decelerates uniformly from 8 m s^{-1} to rest in 8 s. Find (a) the deceleration, (b) the distance travelled while decelerating.

(a) $a = \frac{v - u}{t} = \frac{0 - 8}{8}$

(b) $s = \frac{(u + v)}{2} t = 4 \times 8$

Answer: (a) 1 m s^{-2} (b) 32 m

4 Reciprocal trig functions: exact values (All boards)

Write down the exact values of
(a) sec 210° (b) cot 300°

(a) $\sec 210° = \frac{1}{\cos 210°} = \frac{1}{-\frac{\sqrt{3}}{2}} = -\frac{2\sqrt{3}}{3}$

(b) $\cot 300° = \frac{1}{\tan 300°} = \frac{1}{-\sqrt{3}} = -\frac{\sqrt{3}}{3}$

Answer: (a) $-\frac{2\sqrt{3}}{3}$ (b) $-\frac{\sqrt{3}}{3}$

5 Inverse functions (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = -5x - 4$.
Find $f^{-1}(x)$.

$y = -5x - 4$, so $y + 4 = -5x$
$x = \frac{y + 4}{-5}$

Answer: $f^{-1}(x) = \frac{x + 4}{-5}$

6 Equilibrium of a particle under three forces (diagram) (All boards)

A particle is in equilibrium under the three forces shown. $\cos \alpha = \frac{3}{5}$. Find P and Q.

Horizontally: $P = 10 \cos \alpha = 10 \times \frac{3}{5}$

Vertically: $Q = 10 \sin \alpha = 10 \times \frac{4}{5}$

Answer: P = 6, Q = 8

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7 The factor theorem and factorising (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = x^3 - 6x^2 + 5x + 12$
(a) Show that $(x + 1)$ is a factor of $f(x)$.
(b) Factorise $f(x)$ completely.

$f(-1) = (-1) + (-6) + (-5) + 12 = 0$, so $(x + 1)$ is a factor.
$f(x) = (x + 1)(x^2 - 7x + 12)$
$x^2 - 7x + 12 = (x - 3)(x - 4)$
Answer: (b) $f(x) = (x + 1)(x - 3)(x - 4)$

8 Quotient rule (All boards)

Use the quotient rule to find the derivative of

$y = \frac{x^2}{x + 4}$.

Quotient rule: if $y = \frac{u}{v}$ then $dy/dx = \frac{u'v - uv'}{v^2}$

Differentiate the numerator and denominator, then substitute and simplify.

Answer: $dy/dx = \frac{x(x + 8)}{(x + 4)^2}$

9 Selection without replacement (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A bag has 5 red and 3 blue sweets. Two are taken at random without replacement.
Find the probability that they are both the same colour.

$P(RR) = \frac{5}{8} \times \frac{4}{7}$, $P(BB) = \frac{3}{8} \times \frac{2}{7}$

Add: $\frac{5}{14} + \frac{3}{28}$

Answer: $\frac{13}{28}$

10 Position of a point relative to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x + 2)^2 + (y + 3)^2 = 49$.
Determine whether the point P(3, 8) is inside, outside or on the circle.

Distance^2 from the centre $(-2, -3)$ to P:
$(3 - (-2))^2 + (8 - (-3))^2 = 25 + 121 = 146$
$r^2 = 49$, and $146 > 49$.
Answer: P is outside the circle