Day 26 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

A sector of a circle has radius 12 cm and angle 1.5 radians.
Find (a) the arc length, (b) the perimeter of the sector.

(a) Arc length = $r\theta = 12 \times 1.5 = 18.0$ cm
(b) Perimeter = arc + 2r = 18.0 + 24 = 42.0 cm
Answer: (a) 18.0 cm (b) 42.0 cm

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

The scatter diagram shows age of a car and value of the car for a group.
Describe the correlation.

The points show no pattern: as age of a car increases, value of the car shows no consistent trend.
Answer: no correlation

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

A car decelerates uniformly from 12 m s^{-1} to rest in 10 s. Find (a) the deceleration, (b) the distance travelled while decelerating.

(a) $a = \frac{v - u}{t} = \frac{0 - 12}{10}$

(b) $s = \frac{(u + v)}{2} t = 6 \times 10$

Answer: (a) 1.2 m s^{-2} (b) 60 m

4 Trapezium rule from a table (AQA, Edexcel, OCR, MEI, Eduqas)

The table shows values of y = f(x).
x: 2 3 4 5 6
y: 4.3 7.9 7.7 3.8 2.6
Use the trapezium rule to estimate the area under the curve between x = 2 and x = 6.

h = 1 with 4 strips

Area $\approx \frac{1}{2}[4.3 + 2.6 + 2(7.9 + 7.7 + 3.8)]$

$= \frac{1}{2} \times 45.7$

= 22.85
Answer: 22.85

5 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 $x = -1$, 2 and 3.
$f(x) = k(x + 1)(x - 2)(x - 3)$
At $(0, -6)$: $k \times 1 \times (-2) \times (-3) = -6$
$k = -1$
Answer: $f(x) = -(x + 1)(x - 2)(x - 3)$

6 Particle on a smooth table connected to a hanging particle (All boards)

A 7 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 3 kg particle, as shown. The system is released from rest. Take g = 9.8 m s^{-2}. Find the tension.

Table particle: $T = 7a$
Hanging particle: $3 \times 9.8 - T = 3a$
Adding: $29.4 = 10a$
Answer: 20.58 N

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

Solve the simultaneous equations:

$y = x^2 - 15$, $y = x + 5$.

$x^2 - 15 = x + 5$

$x^2 - x - 20 = 0$

$(x - 5)(x + 4) = 0$

Use $y = x + 5$ to find each y.

Answer: $x = -4$, $y = 1$ and $x = 5$, $y = 10$

8 Reciprocal trig functions: exact values (All boards)

Write down the exact values of

(a) cosec 120° (b) sec 135°

(a) $\text{cosec } 120° = \frac{1}{\sin 120°} = \frac{1}{\frac{\sqrt{3}}{2}} = \frac{2\sqrt{3}}{3}$

(b) $\sec 135° = \frac{1}{\cos 135°} = \frac{1}{-\frac{\sqrt{2}}{2}} = -\sqrt{2}$

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

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

The line $y = 4x + k$ is a tangent to the curve

$y = x^2 + 10x - 4$.

Find the value of k.

$x^2 + 10x - 4 = 4x + k$

$x^2 + 6x + (-4 - k) = 0$

A tangent touches once: discriminant = 0

$(6)^2 - 4(-4 - k) = 0$

Answer: $k = -13$

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

The values x are coded using $y = (x - 20) \div 5$.

The coded values have mean $\bar{y} = 3.9$ and standard deviation 2.4.

Find the mean and standard deviation of x.

$x = 20 + 5y$

Mean: $20 + 5 \times 3.9 = 39.5$

Standard deviation: $5 \times 2.4 = 12$ (adding 20 has no effect)

Answer: mean = 39.5, standard deviation = 12