**Day 308** **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 9 cm and angle 0.5 radians.
Find (a) the arc length, (b) the perimeter of the sector.

(a) Arc length = $r\theta = 9 \times 0.5 = 4.50$ cm
(b) Perimeter = arc + 2r = 4.50 + 18 = 22.5 cm
**Answer: (a) 4.50 cm (b) 22.5 cm**

## 2 Mean from a frequency table (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The table summarises the number of pets owned by 25 people.
Pets, x: 0, 1, 2, 3, 4
Frequency, f: 3, 5, 2, 7, 8
Find the mean.

$\Sigma fx = 3\times0 + 5\times1 + 2\times2 + 7\times3 + 8\times4 = 62$
Mean = $\Sigma fx \div \Sigma f = 62 \div 25$
**Answer: 2.48**

## 3 Geometric series: sum of n terms (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the sum of the first 9 terms of the geometric series 6 + 30 + 150 + ...

$a = 6$, $r = 5$, $n = 9$

$$S_n = \frac{a(r^n - 1)}{r - 1} = \frac{6(5^9 - 1)}{5 - 1}$$

$= 2929686$
**Answer: 2929686**

## 4 Iteration $x_{n+1} = g(x_n)$ (All boards)

$x_{n+1} = \sqrt{2x_n + 1}$, with $x_0 = 2$.
Find $x_1$, $x_2$ and $x_3$ to 3 decimal places.

$x_1 = 2.2361$
$x_2 = 2.3393$
$x_3 = 2.3830$
**Answer: $x_1 = 2.236$, $x_2 = 2.339$, $x_3 = 2.383$**

## 5 Modulus graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Sketch $y = |x^2 - 25|$. Write down the coordinates where the graph meets the axes and the coordinates of the local maximum point.

$y = 0$: $x^2 = 25$, so $x = \pm5$
$x = 0$: $y = |-25| = 25$. The part of $x^2 - 25$ below the x-axis is reflected in it.
The local maximum is at $x = 0$.
**Answer: (5, 0), (−5, 0), (0, 25) ; maximum (0, 25)**

## 6 Moments: reactions on a uniform beam (AQA, Edexcel, OCR, MEI)

A uniform beam AB of mass 30 kg and length 5 m rests horizontally on supports at A and B. A load of mass 5 kg is placed on the beam 3.75 m from A. Take $g = 9.8$ m s$^{-2}$. Find the reaction at B.

Moments about A:
$R_B \times 5 = 30 \times 9.8 \times 2.5 + 5 \times 9.8 \times 3.75$
$R_B \times 5 = 918.75$
**Answer: 183.75 N**

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## 7 Finding an unknown using the factor theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$(x - 2)$ is a factor of $x^3 + kx^2 - 2x$.
Find the value of k.

Let $f(x) = x^3 + kx^2 - 2x$. Then $f(2) = 0$:
$8 + 4k - 4 = 0$
$4k = -4$
**Answer: $k = -1$**

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

A 2 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 5 kg particle, as shown. The system is released from rest. Take $g = 9.8$ m s$^{-2}$. Find the tension.

Table particle: $T = 2a$
Hanging particle: $5 \times 9.8 - T = 5a$
Adding: $49 = 7a$
**Answer: 14 N**

## 9 Rearrange and iterate (All boards)

(a) Show that $x^2 - x - 2 = 0$ can be rearranged to $x = \sqrt{x + 2}$.
(b) Use $x_{n+1}$ = this formula with $x_0 = 3$ to find $x_1$, $x_2$ to 3 d.p.

(a) $x^2 = x + 2$, so $x = \sqrt{x + 2}$ $(x > 0)$
(b) $x_1 = 2.2361$, $x_2 = 2.0582$
**Answer: (a) shown (b) $x_1 = 2.236$, $x_2 = 2.058$**

## 10 Normal approximation to the binomial (CIE)

$X \sim B(120, 0.2)$. Use a normal approximation to find $P(X \leq 24)$, to 3 s.f.

$np = 24$ and $npq = 19.2$, so use $Y \sim N(24, 19.2)$
Continuity correction: $P(Y < 24.5)$
$z = (24.5 - 24) \div \sqrt{19.2}$
**Answer: 0.545**