Day 89 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Sampling: advantages (AQA, Edexcel, OCR, MEI, Eduqas)

A researcher wants to find out the opinions of the staff at a company.
Give one advantage and one disadvantage of using quota sampling.

Advantage: no sampling frame is needed and each group is guaranteed to be represented.
Disadvantage: it is not random, so the interviewer may introduce bias.
Answer: Advantage: no sampling frame needed. Disadvantage: not random, interviewer bias

2 Straight line through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find an equation of the line through A(−1, −5) and B(2, 2), in the form ax + by + c = 0, where a, b and c are integers.

Gradient = $\frac{2-(-5)}{2-(-1)} = \frac{7}{3}$

$y - (-5) = \frac{7}{3}(x - (-1))$

Multiply out and rearrange to integer coefficients.
Answer: $7x - 3y - 8 = 0$

3 Find the angle of a sector (All boards)

A sector has radius 4 cm and arc length 4.80 cm.
Find the angle of the sector in radians and the area of the sector.

$\theta = \frac{\text{arc length}}{r} = \frac{4.80}{4} = 1.2$

Area = $\frac{1}{2}r^2\theta = \frac{1}{2} \times 4^2 \times 1.2 = 9.60\ \text{cm}^2$

Answer: $\theta = 1.2$ radians; area 9.60 cm^2

4 Velocity at time t with constant acceleration (vectors) (AQA, Edexcel, OCR, MEI, Eduqas)

A particle has initial velocity $(3\mathbf{i} - 4\mathbf{j})$ m s^{-1} and constant acceleration $(3\mathbf{i} - \mathbf{j})$ m s^{-2}.
Find its velocity after 3 s.

$v = u + at$
$v = (3\mathbf{i} - 4\mathbf{j}) + 3(3\mathbf{i} - \mathbf{j})$
$= (3\mathbf{i} - 4\mathbf{j}) + (9\mathbf{i} - 3\mathbf{j})$
Answer: $(12\mathbf{i} - 7\mathbf{j})$ m s^{-1}

5 Domain and range (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = (x - 1)^2 + 4$, $x \geq 0$.
Find the range of f.

The minimum of $(x - 1)^2$ is 0 at x = 1, which is allowed since $1 \geq 0$.
So $f(x) \geq 4$.
Answer: $f(x) \geq 4$

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

A 4 kg particle on a smooth horizontal table is joined by a light string over a smooth pulley to a hanging 6 kg particle, as shown. The system is released from rest. Take g = 9.8 m s^{-2}. Find the tension.

Table particle: $T = 4a$
Hanging particle: $6 \times 9.8 - T = 6a$
Adding: $58.8 = 10a$
Answer: 23.52 N

7 Area between a line and a curve (All boards)

The curve $y = 9x - x^2$ and the line $y = 3x$ meet at the origin and at P.
Find the area enclosed between them.

$9x - x^2 = 3x$ gives $6x - x^2 = 0$, so $x = 0$ or $x = 6$

Area $= \int_0^6 (6x - x^2)\,dx = \left[\frac{6x^2}{2} - \frac{x^3}{3}\right]$ from 0 to 6

$= \frac{6^3}{2} - \frac{6^3}{3} = 36$

Answer: 36

8 Frequency density (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

In a histogram, the class 0 to 5 has frequency 15 and is drawn with a bar of height 3 cm.
The class 5 to 15 has frequency 50. Find the height of its bar.

Frequency density = frequency ÷ class width
First bar: 15 ÷ 5 = 3, so 3 cm represents 3
Second bar: 50 ÷ 10 = 5

Height $= 3 \times \frac{5}{3}$

Answer: 5 cm

9 Equation of a circle from a diagram (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a circle with the centre marked.
The circle touches the x-axis. Find the equation of the circle.

The circle touches the x-axis, so the radius equals the y-coordinate of the centre: r = 5.

Centre (4, 5): $(x - a)^2 + (y - b)^2 = r^2$

Answer: $(x - 4)^2 + (y - 5)^2 = 25$

10 Identity then solve (sin² to cos) (All boards)

Solve $-4\cos^2 x + 2\sin x + 2 = 0$
for $0° \le x \le 360°$.

Use $\cos^2 x = 1 - \sin^2 x$: $4\sin^2 x + 2\sin x - 2 = 0$

Factorise and solve: $\sin x = -1$ or $\sin x = \frac{1}{2}$

$x = 30°, 150°, 270°$

Answer: x = 30°, 150°, 270°