Day 103 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

The table shows values of y = f(x).
x: 2 2.25 2.5 2.75 3 3.25
y: 7.2 8.1 5 5.9 7.3 7.7
Use the trapezium rule to estimate the area under the curve between x = 2 and x = 3.25.

h = 0.25 with 5 strips

Area $\approx \frac{0.25}{2}[7.2 + 7.7 + 2(8.1 + 5 + 5.9 + 7.3)]$

$= \frac{0.25}{2} \times 67.5$

$= 8.4375$

Answer: 8.4375

2 Poisson distribution (CIE)

The number of events in one interval has a Poisson distribution with mean 0.5.
Find the probability of at least 1 in one such interval, to 3 s.f.

$P(X \geq 1) = 1 - P(X \leq 0)$
$P(X \leq 0) = 0.6065$
Answer: 0.393

3 Braking: deceleration and time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A cyclist travelling at 24 m s^{-1} brakes uniformly and comes to rest after travelling 96 m.
(a) Find the deceleration.
(b) Find the time taken to stop.

(a) $v^2 = u^2 + 2as$: $0 = 24^2 + 2 \times a \times 96$
so $a = -3$, a deceleration of 3

(b) $s = \frac{(u + v)}{2} t$: $96 = 12 t$

Answer: (a) 3 m s^{-2} (b) 8 s

4 Recurrence relations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A sequence is defined by $u_{n+2} = u_{n+1} + u_n$, with
$u_1 = 2$ and $u_2 = 2$. Find u_6.

$u_3 = 2 + 2 = 4$
$u_4 = 4 + 2 = 6$, $u_5 = 6 + 4 = 10$
$u_6 = 10 + 6 = 16$
Answer: $u_6 = 16$

5 Grouped data: estimated median (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The table shows grouped data.
Class: $0 \leq x < 5$; $5 \leq x < 10$; $10 \leq x < 15$; $15 \leq x < 20$
Frequency: 3, 7, 14, 6
Estimate the median, to 3 s.f.

n = 30, so the median is the 15 th value, in class $10 \leq x < 15$
Cumulative frequency before this class = 10

Median $\approx 10 + \frac{(15 - 10)}{14} \times 5$

Answer: 11.8

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6 Connected rates of change (All boards)

Water fills a tank with a square base of side 10 m.
The depth h m increases at 0.2 m/min. Find the rate of increase of volume.

$V = 10^2h = 100h$, so $\frac{dV}{dh} = 100$

$\frac{dV}{dt} = \frac{dV}{dh} \times \frac{dh}{dt} = 100 \times 0.2$

Answer: 20 m³/min

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

A circle has equation $x^2 + (y + 2)^2 = 49$.
Determine whether the point P(−7, −2) is inside, outside or on the circle.

Distance^2 from the centre (0, −2) to P:

$(-7 - 0)^2 + (-2 - (-2))^2 = 49 + 0 = 49$

$r^2 = 49$, and $49 = 49$.

Answer: P is on the circle

8 Vector geometry with a diagram (OAB) (All boards)

In the diagram, OA = **a**, OB = **b**, and P lies on AB with AP : PB = 1 : 3.
Find AB and AP in terms of **a** and **b**.

$\text{AB} = \text{OB} - \text{OA} = \mathbf{b} - \mathbf{a}$

$\text{AP} = \frac{1}{4}\text{AB} = \frac{1}{4}(\mathbf{b} - \mathbf{a})$

Answer: AB = b − a; AP = $\frac{1}{4}$(b − a)

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

A circle has centre (0, −4) and passes through the point
(1, −6). Find the equation of the circle.

$r^2 = (1 - 0)^2 + (-6 - (-4))^2$

$= 1 + 4 = 5$

Equation: $(x - a)^2 + (y - b)^2 = r^2$

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

10 Power of an engine: driving force (CIE)

A train's engine works at a constant rate of 15 kW. Find the driving force when the vehicle is moving at 15 m s^{-1}.

$P = Fv$

$15000 = F \times 15$

Answer: 1000 N