**Day 282** **A Level Maths: C Tier 10-a-day: Model Solutions**

## 1 Transforming a point on a graph (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The point P(−4, 2) lies on the curve y = f(x).
Write down the coordinates of the image of P on
(a) y = f(x − 1) (b) y = f(3x)

(a) y = f(x − 1) adds 1 to x, so P maps to (−3, 2).

(b) y = f(3x) divides x by 3, so P maps to $(-\frac{4}{3}, 2)$.

**Answer: (a) (−3, 2) (b) $(-\frac{4}{3}, 2)$**

## 2 Natural logs and e^x (All boards)

Solve 2 ln x = 6.
Give your answer to 3 significant figures.

ln x = 3

$x = e^3 = 20.1$

**Answer: x = 20.1**

## 3 Standard deviation from summary data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

For 8 values, $\Sigma x = 136$ and $\Sigma x^2 = 2456$.
Find the mean and the standard deviation.

Mean = 136 ÷ 8 = 17

Variance = $\frac{2456}{8} - 17^2 = 307 - 289 = 18$

Standard deviation = $\sqrt{18}$

**Answer: mean = 17, standard deviation = 4.24**

## 4 Parametric equations: finding points (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

A curve has parametric equations
$x = 4t + 2$, $y = 2t^2 - 5$.
Find the coordinates of the point where t = −3.

$x = 4 \times (-3) + 2 = -10$

$y = 2 \times (-3)^2 - 5 = 13$

**Answer: (−10, 13)**

## 5 Two-stage motion: acceleration then constant speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A train starts from rest and accelerates uniformly at 1 m $s^{-2}$ for 4 s, then travels at constant speed for a further 15 s. Find the total distance travelled.

Speed reached: $v = 1 \times 4 = 4$ m $s^{-1}$

Stage 1: $s = \frac{1}{2} \times 4 \times 4 = 8$

Stage 2: $s = 4 \times 15 = 60$

**Answer: 68 m**

## 6 Angle between vectors (scalar product) (CIE)

$\mathbf{a} = 2\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$.
Find the angle between a and b, to 1 decimal place.

a.b = (2)(2) + (4)(−3) + (2)(4) = 0

$|\mathbf{a}| = \sqrt{24}$, $|\mathbf{b}| = \sqrt{29}$

$\cos\theta = \frac{0}{\sqrt{24} \times \sqrt{29}}$, so θ = 90.0°

**Answer: 90.0°**

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## 7 Catching up: constant speed against acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Car P passes a point O at constant speed 7 m $s^{-1}$.

At that instant car Q starts from rest at O with constant acceleration 2 m $s^{-2}$ in the same direction. Find the time when Q catches up P.

Distances equal: $7t = \frac{1}{2} \times 2 \times t^2$

$t(7 - 1t) = 0$, so $t = 0$ or $t = 7 \div 1$

**Answer: 7 s**

## 8 Box plots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The box plot summarises the delivery times, in minutes, of a pizza company.

Find the range and the interquartile range.

Range = $65 - 25 = 40$

IQR = $60 - 35 = 25$

**Answer: range = 40, IQR = 25**

## 9 Parallel vectors (All boards)

$\mathbf{a} = 5\mathbf{i} + 2\mathbf{j}$ and $\mathbf{b} = \frac{5}{2}\mathbf{i} + k\mathbf{j}$, where k is a constant.

Given that a and b are parallel, find the value of k.

Parallel: $\mathbf{b} = \lambda\mathbf{a}$, so $\frac{5}{2} = \lambda \times 5$, giving $\lambda = \frac{1}{2}$

$k = \lambda \times 2 = 1$

**Answer: k = 1**

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

The line $y = 2x + k$ is a tangent to the curve

$y = x^2 + 6x + 5$.

Find the value of k.

$x^2 + 6x + 5 = 2x + k$

$x^2 + 4x + (5 - k) = 0$

A tangent touches once: discriminant = 0

$(4)^2 - 4(5 - k) = 0$

**Answer: k = 1**