**Day 328** **A Level Maths: C Tier 10-a-day: Model Solutions**

## 1 Transforming a graph with a labelled turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve y = f(x). The maximum point is shown. Write down the coordinates of the maximum point on the curve with equation
(a) y = f(x) − 1 (b) y = −f(x)

(a) y = f(x) − 1: the maximum point moves to (−3, 1).
(b) y = −f(x): the point moves (it becomes a minimum) to (−3, −2).
**Answer: (a) (−3, 1) (b) (−3, −2)**

## 2 Find a and b in y = ab^x (All boards)

The curve $y = ab^x$ passes through (0, 6) and (4, 96).
Find the values of a and b.

x = 0: $y = a \times b^0 = a$, so a = 6
x = 4: $6 \times b^4 = 96$, so $b^4 = 16$
b = 2
**Answer: a = 6, b = 2**

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

Here are 7 values: 11, 2, 4, 10, 6, 3, 10
Find the mean and the standard deviation, to 3 s.f.

$\Sigma x = 46$, $\Sigma x^2 = 386$, n = 7
Mean = 46 ÷ 7 = 6.571
Variance = $\frac{386}{7} - (6.571)^2 = 11.96$
Standard deviation = $\sqrt{11.96}$
**Answer: mean = 6.57, standard deviation = 3.46**

## 4 F = ma: find the force or the mass (All boards)

A resultant force of 40 N gives a body an acceleration of 2 m $s^{-2}$. Find the mass of the body.

F = ma
40 = m × 2
**Answer: 20 kg**

## 5 Collinear points using vectors (All boards)

A(0, 2), B(2, 4) and C(7, 9).
Show that A, B and C are collinear and find AB : BC.

AB = $\begin{pmatrix}2\\2\end{pmatrix}$ and BC = $\begin{pmatrix}5\\5\end{pmatrix}$
AB = $2\begin{pmatrix}1\\1\end{pmatrix}$ and BC = $5\begin{pmatrix}1\\1\end{pmatrix}$, so AB and BC are parallel with common point B
Hence A, B, C are collinear and AB : BC = 2 : 5
**Answer: collinear; AB : BC = 2 : 5**

## 6 Car towing a caravan (All boards)

A car of mass 800 kg tows a caravan of mass 500 kg on a level road with acceleration 0.25 m $s^{-2}$. Resistances: 400 N on the car, 150 N on the caravan. Find the driving force and the tow bar tension.

Whole system: D − 400 − 150 = 1300 × 0.25
Caravan: T − 150 = 500 × 0.25
**Answer: D = 875 N, T = 275 N**

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## 7 Newton-Raphson: one or two steps (AQA, Edexcel, OCR, MEI, Eduqas)

$f(x) = x^3 - x - 4$.

Use the Newton-Raphson method with $x_0 = 3$ to find $x_1$, giving your answer to 3 decimal places.

$f'(x) = 3x^2 - 1$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$x_1 = 3 - \frac{20.00}{26.00} = 2.2308$$

**Answer: $x_1 = 2.231$**

## 8 Combining two inequalities (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of x satisfying both $2x + 5 > -3$ and $x^2 + 9x + 18 < 0$.

$2x + 5 > -3$ gives $x > -4$.

$x^2 + 9x + 18 < 0$: $(x + 6)(x + 3) < 0$, so $-6 < x < -3$.

Both are true where the two ranges overlap.

**Answer: $-4 < x < -3$**

## 9 Independent events (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$P(A) = 0.2$, $P(B) = 0.3$ and $P(A \cap B) = 0.03$.

(a) Find $P(A \mid B)$.

(b) Are A and B independent? Give a reason.

(a) $P(A \mid B) = P(A \cap B) \div P(B) = 0.03 \div 0.3 = 0.1$

(b) $P(A) \times P(B) = 0.2 \times 0.3 = 0.06$

This does not equal $P(A \cap B) = 0.03$, so A and B are not independent

**Answer: (a) 0.1 (b) not independent, as $P(A) \times P(B) \neq P(A \cap B)$**

## 10 Finding a quadratic from its turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a sketch of a quadratic curve.

Find its equation in the form $y = a(x - p)^2 + q$.

The turning point is $(3, -2)$, so $y = a(x - 3)^2 - 2$.

The curve passes through $(0, 25)$:

$25 = a(-3)^2 - 2$, so $27 = 9a$

$a = 3$

**Answer: $y = 3(x - 3)^2 - 2$**