| Day 179 | A Level Maths: S Tier 10-a-day |
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| **1** A stone is thrown vertically upwards with speed 5 m $s^{-1}$ from the top of a cliff. The top of the cliff is 97.5 m above the sea.<br>Find (a) the time taken for the stone to reach the sea, (b) the total distance travelled by the stone, to 3 s.f. Take g = 9.8 m $s^{-2}$. | |
| **2** Solve $\log_2(x + 10) + \log_2(x - 5) = 4$,<br>justifying clearly any root that you reject. | |
| **3** $f(x) = x^3 - 5x^2 + 12x - 8$.<br>Show that $(x - 1)$ is a factor of f(x), and that the equation f(x) = 0 has exactly one real root. | |
| **4** A ball is thrown vertically upwards from ground level with speed 68.6 m $s^{-1}$.<br>Find the length of time for which the ball is more than 220.5 m above the ground, and the greatest height it reaches. Take g = 9.8 m $s^{-2}$. | |
| **5** A data set has lower quartile 27 and upper quartile 38. An outlier is a value more than 2 × IQR beyond the nearest quartile.<br>(a) Find the range of values that are not outliers.<br>(b) 10 observations have mean 31. The largest is 63, an outlier, and it is removed. Find the new mean. | |

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**6** The line $12y = 5x + k$ is a tangent to the circle $(x + 1)^2 + (y + 1)^2 = 4$.
Find the two possible values of k.

**7** Line $l_1$: $\mathbf{r} = \begin{pmatrix} -7 \\ -9 \\ -1 \end{pmatrix} + s\begin{pmatrix} 2 \\ 3 \\ 1 \end{pmatrix}$,
line $l_2$: $\mathbf{r} = \begin{pmatrix} -7 \\ 1 \\ 4 \end{pmatrix} + t\begin{pmatrix} -3 \\ 0 \\ 1 \end{pmatrix}$.
Show whether the lines meet, giving the point of intersection if they do, and find the acute angle between them to 1 d.p.

**8** The function f is defined by $f(x) = 2x^2 - 4x - 4$ for $x \leq k$. Given that k is the greatest value for which
f is one-one, find k, $f^{-1}(x)$, and the domain of $f^{-1}$.

**9** Two fair 12-sided dice, numbered 1 to 12, are rolled. M is the larger of the two scores.
(a) Show that $P(M = m) = \frac{(2m - 1)}{144}$ for m = 1, 2, ..., 12.
(b) Find P(M = 9) and E(M).

**10** $\frac{dy}{dx} = -2xy$, and y = 5 when x = 0.
Solve the differential equation and find y when x = 2.