Day 87	A Level Maths: S Tier 10-a-day
1 Solve $\log_2(x + 1) + \log_2(x - 13) = 5$, justifying clearly any root that you reject.	
2 A data set has lower quartile 20 and upper quartile 36. An outlier is a value more than 1 × IQR beyond the nearest quartile. (a) Find the range of values that are not outliers. (b) 8 observations have mean 29. The largest is 57, an outlier, and it is removed. Find the new mean.	
3 Express $\frac{-6 - 2\sqrt{2}}{1 - 2\sqrt{2}}$ in the form $p + q\sqrt{2}$, where p and q are rational numbers.	
4 Data pairs (x, y) are coded by $u = x - 4$ and $v = \frac{y}{5}$. The regression line of v on u is $v = 5.8 + 0.1u$. (a) Find the regression line of y on x in the form $y = a + bx$. (b) Use it to estimate y when x = 12.	
5 A curve has parametric equations $x = \ln t$, $y = 3t^2 + 3t$, $t > 0$. Find the equation of the tangent where t = 1, in the form $y = mx + c$.	

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6 A particle P moves with constant acceleration. At t = 0 seconds P is at $(-2\mathbf{i} + 2\mathbf{j})$ m with velocity $(9\mathbf{i} + 7\mathbf{j})$ m s^{-1}. At t = 6, P has velocity $(-15\mathbf{i} - 17\mathbf{j})$ m s^{-1}. Find (a) the acceleration of P, (b) the time at which P moves parallel to $(\mathbf{i} - \mathbf{j})$, (c) the position vector of P at that time.	
7 $f(x) = \frac{kx + 3}{x - 5}$ for $x \neq 5$. Given that f is self-inverse, find k, and hence solve f(x) = x.	
8 (a) Expand $(25 - x)^{-\frac{1}{2}}$ up to and including the term in x^2. (b) Use x = 0.05 to estimate $\frac{1}{\sqrt{24.95}}$ to 5 decimal places.	
9 Two drones P and Q move so that, t seconds after launch, their position vectors in metres are $\mathbf{r}_P = \begin{pmatrix} -5 \\ 1 \\ -2 \end{pmatrix} + t\begin{pmatrix} 1 \\ 3 \\ 3 \end{pmatrix}$ and $\mathbf{r}_Q = \begin{pmatrix} 8 \\ -10 \\ -10 \end{pmatrix} + t\begin{pmatrix} -2 \\ 6 \\ 5 \end{pmatrix}$. Find the time at which they are closest and the exact minimum distance between them.	
10 At time t = 0 hours, ship A is at the point with position vector $(21\mathbf{i} + 27\mathbf{j})$ km relative to a port O, and moves with constant velocity $(\mathbf{i} + 6\mathbf{j})$ km h^{-1}. Ship B leaves O at t = 0 with constant speed 17 km h^{-1} and intercepts A. Find (a) the time at which B intercepts A, (b) the velocity of B as a vector.	