Day 78	A Level Maths: S Tier 10-a-day
1 Use the substitution $u = e^x + 1$ to find the exact value of $\int_0^{\ln 7} \frac{e^x}{e^x + 1}\,dx$	
2 A ball is thrown vertically upwards from ground level. It is more than 132.3 m above the ground for 6 s. Find the speed of projection and the greatest height reached. Take $g = 9.8$ m s^{-2}.	
3 The curve $y = ax^n$ passes through (2, 2) and (4, 1). Find the values of a and n.	
4 Data pairs (x, y) are coded by $u = x - 3$ and $v = \frac{y}{4}$. The regression line of v on u is $v = 6 + 0.5u$. (a) Find the regression line of y on x in the form $y = a + bx$. (b) Use it to estimate y when x = 11.	
5 A geometric series has first term 7 and common ratio $\frac{9}{10}$. Find the least n for which S_n exceeds 99% of the sum to infinity.	

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6 Find the exact coordinates of the stationary point of $y = x^2 \ln x$ for $x > 0$, and determine its nature.	
7 Evaluate $\sum_{r=5}^{12}(3 \times 2^r + 2r)$.	
8 Solve simultaneously: $x - y = -6$ $x^2 + 2y^2 = 27$	
9 A and B take turns, A first, to score; the first to score wins. P(A scores) = $\frac{1}{3}$, P(B scores) = $\frac{1}{2}$ each attempt. Find P(A wins (a) on attempt 1 or 2, (b) overall).	
10 Two ships A and B move with constant velocities. At time t = 0 hours, A is at $(\mathbf{i} - 4\mathbf{j})$ km relative to a fixed origin and B is at $(-15\mathbf{i} - 17\mathbf{j})$ km. A has velocity $(-2\mathbf{i} - 2\mathbf{j})$ km h^{-1} and B has velocity $(4\mathbf{i} + 6\mathbf{j})$ km h^{-1}. Find (a) the time at which the ships are closest together, (b) the least distance between them.	