Day 157	A Level Maths: S Tier 10-a-day
1 $f(\theta) = \frac{3}{14 + 12\sin\theta + 5\cos\theta}$ (a) Write $12\sin\theta + 5\cos\theta$ as $R\sin(\theta + \alpha)$, $R > 0$, $0 < \alpha < 90°$. (b) Find the greatest and least values of $f(\theta)$, and the smallest positive θ at which the greatest value occurs, to 1 d.p.	
2 A ball is dropped from a height of 3 m. After each bounce it rises to $\frac{1}{2}$ of its previous height. (a) Find the total distance it travels before it stops. (b) After how many bounces does it rise less than 0.01 m?	
3 A stone is thrown vertically upwards with speed 9 m s^{-1} from the top of a cliff. The top of the cliff is 122.4 m above the sea. 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}.	
4 $X \sim B(60, 0.2)$. (a) State why a normal approximation is suitable for X. (b) Use a normal approximation to estimate $P(X \leq 12)$, to 3 significant figures.	
5 The equation $e^x = 3x + 4$ has a root α. (a) Show that the equation can be written as $x = \ln(3x + 4)$. (b) Use $x_{n+1} = \ln(3x_n + 4)$ with $x_0 = 1$ to find x_1, x_2, x_3 to 4 d.p., and hence state α to 3 d.p.	

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6 A uniform plank AB of length 10 m and mass 30 kg rests on supports at C and D, where AC = 3 m and DB = 3 m. A girl of mass 50 kg stands on it at distance x m from A. Find the range of x for which the plank stays in equilibrium on both supports.	
7 P(X = x) = kx(6 − x) for x = 1, 2, ..., 5, and 0 otherwise. (a) Show that k = $\frac{1}{35}$. (b) Find E(X) and Var(X). (c) Find Var(2X + 4).	
8 A geometric series has sum to infinity 25 and second term 4. Find the possible values of the common ratio r and the first term a in each case.	
9 The region bounded by y = $\frac{6}{x+1}$, the x-axis and the lines x = 0 and x = 1 is rotated through 2π about the x-axis. Find the exact volume of the solid formed.	
10 A geometric series has first term 9 and common ratio $\frac{4}{5}$. Find the least n for which S_n exceeds 99% of the sum to infinity.	