Day 244	A Level Maths: S Tier 10-a-day
1 $f(x) = \frac{-5x + 1}{(1 - 3x)(1 - x)}$. (a) Express f(x) in partial fractions. (b) Hence expand f(x) in ascending powers of x up to x^3, stating the range of validity.	
2 Use the trapezium rule with 6 strips to estimate $\int_0^1 \ln(1 + x^2)\,dx$, to 4 s.f. Is it an overestimate or an underestimate? Explain.	
3 An arrow is projected from a point O on horizontal ground with speed 49 m s^{-1} at an angle α above the horizontal, where $\tan\alpha = \frac{4}{3}$. Find the horizontal distance between the two points at which the arrow is 58.8 m above the ground. Take g = 9.8 m s^{-2}.	
4 $u_{n+1} = u_n + 3n + 3$, $u_1 = -4$. (a) Show that $u_n = an^2 + bn + c$ and find a, b, c. (b) Find the least n for which $u_n > 713$.	
5 12 recorded times (seconds) have mean 23 and standard deviation 3. One value was recorded as 14 but should have been 5. Find the correct mean and the correct standard deviation.	

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6 A colony of 200 cells grows by 5% each day. Find the least whole number of days for the colony to exceed 400 cells.	
7 At time t = 0 hours, ship A is at the point with position vector $(52\mathbf{i} + 40\mathbf{j})$ km relative to a port O, and moves with constant velocity $(2\mathbf{i} - 2\mathbf{j})$ 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.	
8 Solve $\frac{5}{(x-1)} < \frac{4}{(x-3)}$.	
9 $y = e^{2x} \sin 3x$. Show that $dy/dx = e^{2x}(2 \sin 3x + 3 \cos 3x)$. Find the x coordinate of the stationary point with the smallest positive x (3 s.f.), and its nature.	
10 X ~ B(200, 0.45). (a) State why a normal approximation is suitable for X. (b) Use a normal approximation to estimate $P(X \leq 82)$, to 3 significant figures.	