Day 158	A Level Maths: S Tier 10-a-day
1 A non-uniform rod AB of length 5 m and mass 6 kg rests on supports at C and D, where AC = 1 m and AD = 4 m, with $R_C = 3R_D$. Find (a) the distance of the centre of mass from A. A particle of mass m kg at B puts the rod on the point of tilting about D. (b) Find m.	
2 A population of bacteria is modelled by $P = P_0e^{kt}$, t in hours. Initially P = 50 and after 2 hours P = 80. Find k, and the time for the population to reach 500, to 3 s.f.	
3 Find the set of values of x for which both $x^2 - 2x - 15 \leq 0$ and $-x - 5 < -5$.	
4 Three forces $(-3\mathbf{j})$ N, $(6\mathbf{i} + k\mathbf{j})$ N and $(-3\mathbf{i} + 6\mathbf{j})$ N act on a particle of mass 5 kg. The resultant is parallel to $(3\mathbf{i} + 4\mathbf{j})$. Find (a) the value of k, (b) the magnitude of the acceleration of the particle, to 3 s.f.	
5 The tangent to $y = x\sqrt{4x + 12}$ at the point where x = 1 meets the axes at A and B. Find the exact area of triangle OAB, where O is the origin.	

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6 A manufacturer says that 20% of its screens have no flaws. A sample of 25 screens is checked, and 7 have no flaws. Test, at the 1% significance level, the claim that the proportion is higher. Give your conclusion in context.	
7 $f(x) = 2x^3 + ax^2 + bx - 4$, where a and b are constants. $(x + 2)$ is a factor of $f(x)$, and $f(x)$ leaves remainder 80 when divided by $(x - 3)$. Find a and b, and hence solve $f(x) = 0$.	
8 A and B are acute angles with $\tan A = \frac{1}{12}$ and $\tan B = \frac{11}{13}$. Find $\tan(A + B)$ and hence show that $A + B = \frac{\pi}{4}$.	
9 A geometric series has first term 7 and common ratio $\frac{4}{5}$. Find the least n for which S_n exceeds 99% of the sum to infinity.	
10 $X \sim B(28, \frac{1}{5})$. (a) Show that $P(X = r + 1) \div P(X = r) = \frac{28 - r}{r + 1} \times \frac{1}{4}$. (b) Find the most likely value of X and its probability (3 s.f.).	