Day 196	A Level Maths: A Tier 10-a-day
1 A, B and C have position vectors $\begin{pmatrix} 5 \\ -4 \\ -3 \end{pmatrix}$, $\begin{pmatrix} 5 \\ -3 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ -1 \\ k \end{pmatrix}$ relative to O, where k is a constant. Given that A, B and C are collinear, find k and the ratio AB : BC.	
2 Show by counter-example that the statement "n! + 1 is prime for all positive integers n" is false.	
3 A ball is projected from a point O on horizontal ground at 49 m s^{-1} at angle α above the horizontal, $\tan \alpha = \frac{4}{3}$, and lands at A. Find (a) the time of flight, (b) the greatest height, (c) OA. Take g = 9.8.	
4 A(−1, −1) and B(−7, 7) are the ends of a diameter of a circle. (a) Find the equation of the circle, in the form $x^2 + y^2 + ax + by + c = 0$. (b) Show that C(−7, −1) lies on the circle.	
5 At one location, the daily maximum gust is modelled by N(20.6, 6^2). (a) Find the probability that on a randomly chosen day the value exceeds 30 knots. (b) Estimate the number of such days in a period of 92 days.	

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6 A curve has parametric equations $x = 3t^2 + 1$, $y = -t(t^2 - 9)$. Find the coordinates of the points where the curve meets the x-axis.	
7 Bulbs are defective with probability 0.25, independently. A pack of 7 bulbs is rejected if it has at least 3 defective. From 10 such packs, find the probability that exactly 2 are rejected (3 s.f.).	
8 Solve $\cos 2x + 2\cos x = -1$ for $0 \leq x \leq 2\pi$.	
9 $g(x) = \frac{1}{18 + 6\sin x + 8\cos x}$ (a) Write $6\sin x + 8\cos x$ in the form $R\sin(x + \alpha)$, with α acute. (b) Find the greatest and least values of g(x) and the smallest positive x at which the greatest value occurs (1 d.p.).	
10 A particle P has position vector $\mathbf{r} = (2t^3 - 5t)\mathbf{i} + (3t^2 - 6t)\mathbf{j}$ metres at time t s. Find (a) the speed of P when t = 3, (b) the value of t when P is moving parallel to $\mathbf{i}$. Give answers to 3 s.f. if not exact.	