Day 250	A Level Maths: A Tier 10-a-day
1 Car A passes P at constant speed 7 m s^{-1}. 7 s later car B leaves P from rest, in the same direction, with acceleration 1.5 m s^{-2}. B overtakes A at Q. Find (a) the time B takes to reach Q, (b) PQ, (c) the speed of B at Q.	
2 The vectors $\begin{pmatrix} k \\ k \\ -2 \end{pmatrix}$ and $\begin{pmatrix} k \\ 1 \\ 1 \end{pmatrix}$ are perpendicular. Find the possible values of k and, for the larger value, the exact length of the first vector.	
3 A charity raises £600 in its first year and in each later year raises £50 more than in the previous year. (a) How much does it raise in year 15? (b) In which year does the total raised first exceed £5000?	
4 A particle of mass 2 kg is acted on by forces $F_1 = (-18\mathbf{i} + 11\mathbf{j})$ N and F_2. Its acceleration is $(3\mathbf{i} + 2\mathbf{j})$ m s^{-2}. Find (a) F_2, (b) the angle between F_2 and $\mathbf{i}$, to 1 d.p.	
5 The line $y = 3x - 3$ meets the curve $y = x^2 + 2x - 15$ at A and B. (a) Find the coordinates of A and B. (b) Find the exact length AB.	

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6 $f(x) = x^2 - 5$. Show that the Newton-Raphson formula gives $x_{n+1} = \frac{1}{2}(x_n + \frac{5}{x_n})$, and use it with $x_0 = \frac{3}{2}$ to find x_2 as an approximation to $\sqrt{5}$, to 4 d.p.	
7 Faults are reported at random at an average of 6 per hour. Find the probability that in a 20-minute period there are (a) zero events (b) at least 1. (c) Find the probability that at least one occurs in each of two separate 20-minute periods.	
8 Expand $(2 - 2x)^{-1}$ in ascending powers of x, up to and including x^2. State the range of x for which the expansion is valid.	
9 For n = 8 pairs of (x, y): $\Sigma x = 132$, $\Sigma y = 467$, $\Sigma x^2 = 2484$, $\Sigma y^2 = 30407$, $\Sigma xy = 8651$. Calculate the product moment correlation coefficient, and describe the correlation.	
10 The equation $x^2 = x + 9$ has a root α. Use the iteration $x_{n+1} = \sqrt{x + 9}$ with $x_0 = 2$ to find x_1, x_2 and x_3 to 4 d.p., and hence the value of α to 2 d.p. (continue until the 2 d.p. value is settled).	