Day 207	A Level Maths: B Tier 10-a-day
1 A remote-control car moves with constant velocity $(-10\mathbf{i} - 24\mathbf{j})$ m s^{-1}, where $\mathbf{i}$ and $\mathbf{j}$ are unit vectors east and north. Find its speed and the acute angle its direction makes with $\mathbf{i}$, to 1 d.p.	
2 Prove that if n is odd then $n^2 + n + 7$ is odd.	
3 A particle is in equilibrium under three forces: P N at angle θ above the positive x-axis, a force of 6 N in the negative x-direction and a force of Q N in the negative y-direction. $\cos\theta = \frac{3}{5}$. Find P and Q.	
4 Points A, B and C have position vectors $\begin{pmatrix} 0 \\ 2 \\ -1 \end{pmatrix}$, $\begin{pmatrix} 0 \\ -1 \\ 2 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 5 \\ r \end{pmatrix}$ respectively. Given that A, B, C are collinear, find r.	
5 Faults occur at random in a cable at an average rate of 3 per hour of operation. Find the probability that in 20 minutes there are at least 2 (3 s.f.).	

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6 Find y in terms of x, given that $\frac{dy}{dx} = 4y^2e^x$ and y = 0.25 when x = 0.	
7 Given that each trap catches a rabbit independently with probability 0.25, find the least number of traps needed for the probability of at least one success to exceed 0.999.	
8 Find the set of values of x for which $4x - 2 > 2$ and $x^2 - 5x + 4 \leq 0$.	
9 Line l_1: $\mathbf{r} = \begin{pmatrix}3\\1\\6\end{pmatrix} + \lambda\begin{pmatrix}1\\3\\2\end{pmatrix}$. Line l_2: $\mathbf{r} = \begin{pmatrix}-2\\-2\\6\end{pmatrix} + \mu\begin{pmatrix}2\\0\\-1\end{pmatrix}$. Show that l_1 and l_2 intersect and find the point.	
10 Prove by contradiction that there are no integers m and n such that 15m + 10n = 62.	