Day 120	A Level Maths: B Tier 10-a-day
1 A stone is projected from ground level with initial velocity components 31 m s^{-1} horizontally and 19.6 m s^{-1} vertically upwards. Take g = 9.8 m s^{-2}. Find (a) the greatest height, (b) the speed at the greatest height.	
2 The vector $\mathbf{a} = \begin{pmatrix} -4 \\ -4 \\ 7 \end{pmatrix}$. Find |a| and a unit vector in the direction of a.	
3 A radio-controlled car moves with constant velocity $(-2\mathbf{i} - 2\mathbf{j})$ m s^{-1}. At time t = 0 its position vector relative to a fixed origin O is $(-7\mathbf{i} + 4\mathbf{j})$ m. Find (a) its position vector when t = 6, (b) the value of t when it crosses the line through O in the direction of $\mathbf{i}$.	
4 Large data set: maximum relative humidity (%) at Hurn has mean 88, sd 7. Outliers are more than 3 sd from the mean. Are the values 111 and 69 outliers?	
5 A curve has equation $x^2 + xy + 4x + 3y^2 - 2y = 45$. Find $\frac{dy}{dx}$ in terms of x and y, and the gradient at (3, −3).	

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6 The continuous random variable X has pdf f(x) $= \frac{3x^2}{216}$ for $0 \leq x \leq 6$, and 0 otherwise. (a) Find P(X > 4). (b) Find the median of X, to 3 significant figures.	
7 Solve $4x^2 + 10x < -4$.	
8 Line l_1: $\mathbf{r} = \begin{pmatrix}8\\3\\4\end{pmatrix} + \lambda\begin{pmatrix}2\\0\\3\end{pmatrix}$. Line l_2: $\mathbf{r} = \begin{pmatrix}4\\0\\-5\end{pmatrix} + \mu\begin{pmatrix}0\\1\\1\end{pmatrix}$. Show that l_1 and l_2 intersect and find the point.	
9 Prove by contradiction that there are no integers x and y such that $x^2 - y^2 = 10$.	
10 $f(x) = \frac{-3x + 2}{x - 3}$ for $x \in \mathbb{R}$, $x \neq 3$. (a) Find $f^{-1}(x)$. (b) State the domain of f^{-1}.	