Day 172	A Level Maths: S Tier 10-a-day
1 A particle P moves in a plane. At time t seconds its position vector relative to a fixed origin O is r metres, where $\mathbf{r} = (-t^2 + 7t)\mathbf{i} + (-1.5t^2 + 8t)\mathbf{j}$. Find (a) the value of t at which P is moving parallel to $(\mathbf{i} + \mathbf{j})$, (b) the speed of P at this time (3 s.f. if not exact).	
2 Use the trapezium rule with 5 strips to estimate $\int_1^2 \sqrt{4 - x^2}\, dx$, to 4 s.f. Is it an overestimate or an underestimate? Explain.	
3 For 8 pairs of values, $S_{xx} = 144$, $S_{yy} = 441$ and $S_{xy} = 160$. (a) Calculate the product moment correlation coefficient r. (b) The critical value for a two-tailed test at the 5% level with n = 8 is 0.7067. Carry out the test of H_0: $\rho = 0$ against H_1: $\rho \neq 0$.	
4 (a) Express $5\cos\theta + 12\sin\theta$ in the form $R\cos(\theta - \alpha)$, where $R > 0$ and $0 < \alpha < 90°$. Give α to 1 d.p. (b) Hence solve $5\cos\theta + 12\sin\theta = 2$ for $0 \leq \theta < 360°$, giving answers to 1 d.p.	
5 Find the set of values of x for which both $x^2 + 4x - 5 \leq 0$ and $-x - 1 > 3$.	

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6 For events A and B, P(A) = 0.5, P(B) = 0.6 and P(A | B) = 0.4. (a) Find P(A ∩ B). (b) Find P(A′ | B′).	
7 Solve simultaneously: $x - 2y = -3$ $x^2 - 2xy + y^2 = 16$	
8 A box of weight 180 N is pulled at constant speed up a line of greatest slope of a rough plane ($\tan\alpha = \frac{12}{5}$, $\mu = \frac{5}{12}$) by a force P N at angle β above the plane. (a) Find P when $\tan\beta = \frac{5}{12}$. (b) Find the least possible value of P as β varies.	
9 A and B are acute angles with $\tan A = \frac{1}{9}$ and $\tan B = \frac{4}{5}$. Find tan(A + B) and hence show that $A + B = \frac{\pi}{4}$.	
10 $u_{n+1} = -\frac{1}{3}u_n + 8$, $u_1 = -14$. (a) Find the limit L of the sequence. (b) Find the least n such that $\lvert u_n - L\rvert < 0.01$.	