Day 177	A Level Maths: S Tier 10-a-day
1 A particle P moves with constant acceleration. At t = 0 seconds P is at $(3\mathbf{i} - 5\mathbf{j})$ m with velocity $(-3\mathbf{i})$ m s^{-1}. At t = 10, P has velocity $(17\mathbf{i} + 10\mathbf{j})$ m s^{-1}. Find (a) the acceleration of P, (b) the time at which P moves parallel to $(\mathbf{i} + 2\mathbf{j})$, (c) the position vector of P at that time.	
2 Find the exact gradient of the curve $y = 3^{3x + 2}$ at the point where x = 0.	
3 Solve $x^{\frac{2}{3}} + x^{\frac{1}{3}} - 2 = 0$.	
4 A particle of weight W N is on a rough plane inclined at α to the horizontal, where $\sin\alpha = \frac{4}{5}$. A force P N acts up a line of greatest slope; the particle stays at rest for $32.5 \leq P \leq 47.5$. Find (a) W, (b) the coefficient of friction, (c) the acceleration when P = 95. Take g = 9.8 m s^{-2}.	
5 The line $12y = 5x + k$ is a tangent to the circle $(x + 3)^2 + (y + 1)^2 = 1$. Find the two possible values of k.	

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6 For n = 15 pairs of values: $\Sigma x = 150$, $\Sigma y = 750$, $\Sigma x^2 = 1649$, $\Sigma xy = 7798$. (a) Find the equation of the regression line of y on x. (b) The x values lie between 6 and 15. Estimate y when x = 14 and comment on its reliability.	
7 The curve C has equation $x e^y + 3y = 1$. Find the equation of the normal to C at the point (1, 0), in the form $ax + by + c = 0$ with integers a, b, c.	
8 A biased spinner lands on 'win' with the same unknown probability p each time. It is used 7 times in round 1 and 6 times in round 2. Given that exactly 9 wins occur altogether, find the probability that exactly 6 of them were in round 1.	
9 $f(\theta) = \frac{4}{33 + 20 \sin\theta + 21 \cos\theta}$ (a) Write $20 \sin\theta + 21 \cos\theta$ as $R \sin(\theta + \alpha)$, $R > 0$, $0 < \alpha < 90°$. (b) Find the greatest and least values of $f(\theta)$, and the smallest positive θ at which the greatest value occurs, to 1 d.p.	
10 The function f is defined by $f(x) = 4x^2 - 16x + 23$ for $x \geq k$. Given that k is the least value for which f is one-one, find k, $f^{-1}(x)$, and the domain of f^{-1}.	