Day 190	A Level Maths: S Tier 10-a-day
1 A ball is projected from a point O on horizontal ground at 45° to the horizontal. The ball just passes over the top of a vertical wall of height 10.8 m, at a horizontal distance of 27 m from O. Find (a) the speed of projection, (b) the greatest height of the ball above the ground, to 3 s.f. Take g = 9.8 m s^{-2}.	
2 Find the coefficient of x^2 in the expansion of $(x + 3)(1 + 2x)^8$.	
3 The equation $e^x = 5x + 2$ has a root α. (a) Show that the equation can be written as $x = \ln(5x + 2)$. (b) Use $x_{n+1} = \ln(5x_n + 2)$ with $x_0 = 2$ to find x_1, x_2, x_3 to 4 d.p., and hence state α to 3 d.p.	
4 Solve $5^{2x} - 6 \times 5^x + 5 = 0$.	
5 $f(x) = x^3 + 5x - 4$. (a) Show that $f(x) = 0$ has a root α with $0 < \alpha < 1$. (b) Use Newton-Raphson with $x_0 = 0$ to find x_1 and x_2 to 4 decimal places.	

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6 $f(x) = \frac{24}{x^2 + 8x + 20}$ for all real x. Find the greatest value of f(x), the value of x at which it occurs, and the range of f.	
7 The points A, B, C have coordinates $(-2, 0, -1)$, $(5, -3, 3)$, $(-3, -1, -3)$. Find angle ABC to 1 d.p., and the exact area of triangle ABC.	
8 The pdf of X is $f(x) = a + bx$ for $0 \leq x \leq 4$, and 0 otherwise, where a and b are constants. $E(X) = \frac{38}{15}$. (a) Find a and b. (b) Find $P(X < 2)$.	
9 A particle starts from rest at the top of a rough slope of length 6 m ($\sin\alpha = \frac{4}{5}$, $\mu = 0.6$), then slides along rough horizontal ground with the same μ. Use energy to find (a) its speed at the foot of the slope (3 s.f.), (b) the distance it slides on the ground. Take $g = 9.8$ m s^{-2}.	
10 X takes values 0, 1, 2, 3 with $P(X = x) = k(x + 1)$. X_1 and X_2 are independent copies of X. (a) Find k. (b) Find $P(X_1 + X_2 = 2)$. (c) Find $P(X_1 = X_2)$ and $E(X_1 + X_2)$.	