Day 66	A Level Maths: S Tier 10-a-day
1 θ is small and measured in radians. Use small angle approximations to find the value that $\frac{\cos 3\theta - \cos 1\theta}{\theta^2}$ approaches as $\theta \to 0$.	
2 A ball is projected from a point O on horizontal ground with speed 49 m s^{-1} at an angle θ above the horizontal, where $\tan\theta = \frac{3}{4}$. Find the horizontal distance between the two points at which the ball is 39.2 m above the ground. Take g = 9.8 m s^{-2}.	
3 Prove that n(n + 7)(n + 14)(n + 21) + 2401 is a perfect square for every integer n.	
4 The equation $x^3 = 2x + 2$ has a root α. (a) Show that the equation can be written as $x = \sqrt[3]{(2x + 2)}$. (b) Use $x_{n+1} = \sqrt[3]{(2x_n + 2)}$ with $x_0 = 1$ to find x_1, x_2, x_3 to 4 d.p., and hence state α to 3 d.p.	
5 $X \sim B(14, \frac{1}{4})$. (a) Show that $P(X = r + 1) \div P(X = r) = \frac{14 - r}{r + 1} \times \frac{1}{3}$. (b) Find the most likely value of X and its probability (3 s.f.).	

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6 Given that $\sin 3\theta \equiv 3\sin\theta - 4\sin^3\theta$, solve $\sin 3\theta = 2\sin\theta$ for $0 < \theta < 2\pi$, in terms of π.	
7 Two fair 6-sided dice, numbered 1 to 6, are rolled. M is the smaller of the two scores. (a) Show that $P(M = m) = \frac{(13 - 2m)}{36}$ for m = 1, 2, ..., 6. (b) Find P(M = 2) and E(M).	
8 The roots of $x^2 + kx + 24 = 0$ differ by 5. Find the possible values of k.	
9 A particle P moves on a straight line. At time t seconds, where $t \geq 0$, its velocity is v m s^{-1}, where $v = 25\sqrt{t} - 5t$. Find (a) the greatest speed of P, (b) the greatest displacement of P from its starting point.	
10 A geometric series has first term 3 and common ratio 4. Find the least n for which $S_n > 73515$.	