| Day 226 | A Level Maths: S Tier 10-a-day |
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| **1** The curve $y = ax^n$ passes through (1, 5) and (9, 15).<br>Find the values of a and n. | |
| **2** A ball is dropped from a height of 5 m. After each bounce it rises to $\frac{3}{4}$ of its previous height.<br>(a) Find the total distance it travels before it stops.<br>(b) After how many bounces does it rise less than 0.1 m? | |
| **3** $X \sim B(25, \frac{2}{5})$.<br>(a) Show that $P(X = r + 1) \div P(X = r) = \frac{25 - r}{r + 1} \times \frac{2}{3}$.<br>(b) Find the most likely value of X and its probability (3 s.f.). | |
| **4** A geometric series has sum to infinity 8 and second term $-6$. Find the possible values of the common ratio r and the first term a in each case. | |
| **5** Given that $\sin 3\theta \equiv 3 \sin \theta - 4 \sin^3\theta$, solve $\sin 3\theta = 2 \sin \theta$ for $0 < \theta < 360°$. | |

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| **6** A river is 80 m wide and flows at 10 m $s^{-1}$. A boat has speed 6 m $s^{-1}$ in still water and crosses the river heading so that it is carried as little distance downstream as possible.<br>Find the least possible distance downstream between the starting point and the landing point. | |
| **7** Each shot Amira takes scores with probability $\frac{1}{3}$, independently.<br>(a) Find the probability that her fourth score comes on shot number 10.<br>(b) Find the probability that her fourth score comes on or before shot number 10. | |
| **8** A and B are acute angles with $\tan A = \frac{1}{7}$ and $\tan B = \frac{3}{4}$.<br>Find $\tan(A + B)$ and hence show that $A + B = \frac{\pi}{4}$. | |
| **9** A particle is projected at 9 m $s^{-1}$ up a line of greatest slope of a rough plane inclined at $\alpha$ to the horizontal, where $\sin \alpha = \frac{3}{5}$ and $\mu = 0.35$.<br>Find (a) the distance it travels up the plane, to 3 s.f., (b) its speed on returning to its starting point. Take g = 9.8 m $s^{-2}$. | |
| **10** Sam claims that $n^2 + n + 17$ is prime for every positive integer n.<br>Show that Sam is wrong by finding the smallest value of n that is a counter-example. | |