Day 54	A Level Maths: S Tier 10-a-day
1 Prove that $5k = n^2 + 2$ has no integer solutions (k and n integers).	
2 A cone with its vertex downwards and semi-vertical angle α, where $\tan\alpha = \frac{1}{2}$, is filled at 3π cm^3s^{-1}. Find the rate at which the depth h is rising when h = 2 cm. ($V = \frac{1}{3}\pi r^2 h$)	
3 A ball is thrown vertically upwards from ground level. It is more than 73.5 m above the ground for 2 s. Find the speed of projection and the greatest height reached. Take g = 9.8 m s^{-2}.	
4 A population of bacteria is modelled by $P = P_0e^{kt}$, t in hours. Initially P = 400 and after 4 hours P = 1200. Find k, and the time for the population to reach 2400, to 3 s.f.	
5 Each year Jo pays £1000 into an account on 1 January. Interest of 3% is added each 31 December. Find the first year-end at which the balance exceeds £8,000.	

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6 Each battery is faulty with probability 0.2, independently. Find the least number n of batterys that must be tested so that the probability of finding at least two faulty is greater than 0.99.	
7 Particles of mass 9 kg and 3 kg hang on a light string over a smooth fixed pulley. The 9 kg particle is 0.5 m above the ground; the 3 kg one is on the ground. Released from rest, find (a) the tension, (b) the greatest height reached by the 3 kg particle. Take $g = 9.8\ \text{m s}^{-2}$.	
8 For n = 10 pairs of values: $\Sigma x = 110$, $\Sigma y = 350$, $\Sigma x^2 = 1365$, $\Sigma xy = 3726$. (a) Find the equation of the regression line of y on x. (b) The x values lie between 7 and 16. Estimate y when x = 17 and comment on its reliability.	
9 Solve $\frac{x+2}{-x+4} > -2$.	
10 Solve $8\sec^2\theta + 10\tan\theta - 6 = 0$ for $0 \leq \theta < 360°$, giving answers to 1 d.p.	