Day 111	A Level Maths: S Tier 10-a-day
1 A ball is dropped from a height of 6 m. After each bounce it rises to $\frac{1}{2}$ of its previous height. (a) Find the total distance it travels before it stops. (b) After how many bounces does it rise less than 0.01 m?	
2 P(X = x) = k(x + 4) for x = 1, 2, 3, and 0 otherwise. (a) Show that k = $\frac{1}{18}$. (b) Find E(X) and Var(X). (c) Find Var(2X + 2).	
3 Three forces $(-2\mathbf{i} - 2\mathbf{j})$ N, $(-3\mathbf{i} + k\mathbf{j})$ N and $(-5\mathbf{i} - 5\mathbf{j})$ N act on a particle of mass 4 kg. The resultant is parallel to $(-5\mathbf{i} - \mathbf{j})$. Find (a) the value of k, (b) the magnitude of the acceleration of the particle, to 3 s.f.	
4 The function f is defined by $f(x) = 2x^2 - 12x + 24$ 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}.	
5 Find the exact value of $\int_0^1 \frac{x}{x^2 + 3}\, dx$	

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6 The circle $x^2 + y^2 + 2x - 6y - 90 = 0$ passes through P$(-7, -5)$. The tangent at P meets the axes at A and B. Find the area of triangle OAB.	
7 Given that $\sin 3\theta \equiv 3\sin\theta - 4\sin^3\theta$, solve $\sin 3\theta = -\sin\theta$ for $0 < \theta < 2\pi$, in terms of π.	
8 A car of mass 1500 kg, with engine power 9.88 kW, climbs a straight road with $\sin\alpha = \frac{1}{25}$ against a constant resistance of 400 N. Find (a) the greatest steady speed up the hill, (b) the acceleration at 5 m s^{-1}. Take g = 9.8 m s^{-2}.	
9 X and Y are independent, X ~ Po(6) and Y ~ Po(2). (a) State the distribution of X + Y. (b) Given that X + Y = 5, find the probability that X = 3.	
10 Find the coordinates of the points of inflection of $y = \frac{3}{x^2 + 12}$.	