Day 172	A Level Maths: A Tier 10-a-day
1 A(3, −9) and B(3, 1) are the ends of a diameter of a circle. (a) Find the equation of the circle, in the form $x^2 + y^2 + ax + by + c = 0$. (b) Show that C(0, 0) lies on the circle.	
2 A ball is thrown vertically upwards at 9.8 m s^{-1} from a point h m above horizontal ground, and hits the ground 4 s later. Find (a) h, (b) the greatest height above the ground. Take g = 9.8.	
3 $f(x) = e^x - 4x - 11$. Show that the equation f(x) = 0 has a root α in the interval [3, 4].	
4 The 76 items in a list are numbered 1 to 76. A systematic sample of 19 items is taken, starting with a random item among the first few. The first item selected is number 2. Find the sampling interval and the number of the last item selected.	
5 The equation $e^x = 3x + 8$ has a root α. Use the iteration $x_{n+1} = \ln(3x + 8)$ with $x_0 = 2$ to find x_1, x_2 and x_3 to 4 d.p., and hence the value of α to 2 d.p. (continue until the 2 d.p. value is settled).	

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6 The line $-3x + 4y = k$ is a tangent to the circle $(x - 1)^2 + (y + 2)^2 = 25$. Find the two possible values of k.	
7 The mean fill volume of bottles (ml) is normally distributed with standard deviation 10; it was previously 30. A random sample of 9 has mean 21.3. Test, at the 10% level, whether the mean has changed.	
8 Solve $\|x + 1\| > \|-2x + 6\|$.	
9 A ball is projected from the ground at 16 m s^{-1} at angle α above the horizontal, $\tan\alpha = \frac{15}{8}$. At time T s, while in flight, it is moving perpendicular to its initial direction. Find (a) T, (b) the height of the ball then. Take g = 9.8. Give answers to 3 s.f. if not exact.	
10 A curve has equation $3x^2y + 2y^3 + 2x = 16$. Find $\frac{dy}{dx}$ in terms of x and y, and the gradient of the normal at (0, 2).	