Day 140	A Level Maths: S Tier 10-a-day
1 A drug dose of 80 mg decays by 12% each hour. Find the first whole number of hours after which less than 5 mg remains.	
2 $f(x) = \frac{12}{x^2 - 2x + 2}$ for all real x. Find the greatest value of f(x), the value of x at which it occurs, and the range of f.	
3 The equation $e^x = 4x + 8$ has a root α. (a) Show that the equation can be written as $x = \ln(4x + 8)$. (b) Use $x_{n+1} = \ln(4x_n + 8)$ with $x_0 = 3$ to find x_1, x_2, x_3 to 4 d.p., and hence state α to 3 d.p.	
4 Given that $\sqrt{6}$ is irrational, prove by contradiction that $\sqrt{2} + \sqrt{3}$ is irrational.	
5 Particles A and B are projected from a point O at the same instant, with initial velocities $(\mathbf{i} + 37\mathbf{j})$ m s^{-1} and $(9\mathbf{i} + 22\mathbf{j})$ m s^{-1} respectively (i horizontal, j vertically upwards). Both are still in flight after 2 s. Find (a) the distance AB at this time, (b) the angle AB makes with the horizontal, to 1 d.p.	

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6 A school has 200 students in Year 10, 80 in Year 11 and 120 in the sixth form. A stratified sample of 40 students is taken. (a) Find the number sampled from each group. (b) Two students are chosen at random from the sample. Find the probability they are from the same group.	
7 A box of weight 78 N is pulled at constant speed along rough horizontal ground ($\mu = \frac{5}{12}$) by a force P N at angle θ above the horizontal. (a) Find P when $\tan\theta = \frac{12}{5}$. (b) Find the least possible value of P as θ varies, and the corresponding θ to 1 d.p.	
8 (a) Write $\frac{2x+11}{(x+4)^2}$ in the form $\frac{A}{x+4} + \frac{B}{(x+4)^2}$. (b) Find the exact value of $\int_0^2 \frac{2x+11}{(x+4)^2}\,dx$.	
9 A and B take turns, A first, to score; the first to score wins. P(A scores) = $\frac{1}{6}$, P(B scores) = $\frac{1}{3}$ each attempt. Find P(A wins (a) on attempt 1 or 2, (b) overall).	
10 $f(x) = \frac{2x-4}{(1+2x)(1-3x)}$. (a) Express f(x) in partial fractions. (b) Hence expand f(x) in ascending powers of x up to x^3, stating the range of validity.	