Day 69	A Level Maths: S Tier 10-a-day
1 A car of mass 1200 kg tows a trailer of mass 400 kg along a horizontal road, with driving force 1760 N. Resistances are 800 N on the car and 320 N on the trailer. (a) Find the tension in the tow bar. At 4.8 m s^{-1} the tow bar breaks. (b) Find the distance between car and trailer when the trailer stops.	
2 A sequence is defined by $u_1 = \frac{3}{2}$ and $u_{n+1} = \frac{1}{1 - u_n}$. Show that the sequence is periodic and find $\sum_{r=1}^{99} u_r$.	
3 A stone is thrown vertically upwards with speed 11 m s^{-1} from the top of a cliff. The top of the cliff is 67.5 m above the sea. Find (a) the time taken for the stone to reach the sea, (b) the total distance travelled by the stone, to 3 s.f. Take g = 9.8 m s^{-2}.	
4 Each shot Amira takes scores with probability $\frac{3}{5}$, independently. (a) Find the probability that her third score comes on shot number 9. (b) Find the probability that her third score comes on or before shot number 9.	
5 Solve $\sqrt{x + 7} = x + 5$.	

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6 Data pairs (x, y) are coded by $u = x - 5$ and $v = \frac{y}{10}$. The regression line of v on u is $v = 14.5 + 1.8u$. (a) Find the regression line of y on x in the form $y = a + bx$. (b) Use it to estimate y when $x = 9$.	
7 Use the substitution $u = 1 + \ln x$ to find the exact value of $\int_1^{e^4} \frac{1}{x(1 + \ln x)}\, dx$	
8 A curve has parametric equations $x = 3t^2$, $y = 2t(3 - t)$, for $0 \leq t \leq 3$. The curve meets the x-axis at O and at A. Find the area enclosed between the curve and the x-axis.	
9 A geometric series has first term 6 and common ratio 2. Find the least n for which $S_n > 81260$.	
10 The line l has equation $\mathbf{r} = \begin{pmatrix} 0 \\ 7 \\ 3 \end{pmatrix} + t\begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix}$. The point P has coordinates $(-1, 0, 5)$. Find the coordinates of the foot F of the perpendicular from P to l, and the exact distance PF.	