Day 323	A Level Maths: S Tier 10-a-day
1 θ is small and measured in radians. Use small angle approximations to find the value that $\frac{\sin 1\theta \tan 2\theta}{1 - \cos 4\theta}$ approaches as $\theta \to 0$.	
2 A train accelerates uniformly from rest at 0.6 m s^{-2} to a speed of V m s^{-1}, travels at this speed, then decelerates uniformly at 0.75 m s^{-2} to rest. The journey takes 88 s and covers 840 m. Find V and the time spent at constant speed.	
3 Given that $\sqrt{3}$ is irrational, prove by contradiction that $1 + 8\sqrt{3}$ is irrational.	
4 Data pairs (x, y) are coded by $u = x - 2$ and $v = \frac{y}{2}$. The regression line of v on u is $v = 37 + 0.75u$. (a) Find the regression line of y on x in the form $y = a + bx$. (b) Use it to estimate y when $x = 4$.	
5 The tangent to $y = \frac{x^2 + 2}{x + 1}$ at the point where $x = 1$ meets the axes at A and B. Find the exact area of triangle OAB, where O is the origin.	

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6 Two ships A and B move with constant velocities. At time t = 0 hours, A is at $(-8\mathbf{i} + 7\mathbf{j})$ km relative to a fixed origin and B is at $(-9\mathbf{i})$ km. A has velocity $(-4\mathbf{j})$ km h^{-1} and B has velocity $(4\mathbf{i} - \mathbf{j})$ km h^{-1}. Find (a) the time at which the ships are closest together, (b) the least distance between them.	
7 Express $\frac{-33x^2 + 85x - 55}{(x-4)(3x-3)^2}$ in the form $\frac{A}{(x-4)} + \frac{B}{(3x-3)} + \frac{C}{(3x-3)^2}$.	
8 A curve has parametric equations $x = 2\sin t$, $y = 3\cos 2t$. Find y in terms of x.	
9 Line l_1: $\mathbf{r} = \begin{pmatrix} 6 \\ -4 \\ -8 \end{pmatrix} + s\begin{pmatrix} -1 \\ 3 \\ 2 \end{pmatrix}$, line l_2: $\mathbf{r} = \begin{pmatrix} 5 \\ 8 \\ 0 \end{pmatrix} + t\begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}$. Show whether the lines meet, giving the point of intersection if they do, and find the acute angle between them to 1 d.p.	
10 $X \sim N(\mu, 16)$. H_0: $\mu = 46$ is tested against H_1: $\mu > 46$ using the mean of a sample of size 9 at the 1% level. (a) Find the critical region for the sample mean. (b) Find the probability of a Type II error when $\mu = 48$.	