Day 352	A Level Maths: S Tier 10-a-day
1 Given that $\sum_{r=1}^{n}(2r + 5) = 247$, find n.	
2 Solve $\cos(3\theta + 10°) = \frac{\sqrt{2}}{2}$ for $0° \leq \theta \leq 360°$.	
3 A ball is thrown vertically upwards from ground level. It is more than 117.6 m above the ground for 10 s. Find the speed of projection and the greatest height reached. Take g = 9.8 m s^{-2}.	
4 Prove that $n^2 + 1$ is never a multiple of 8, for any integer n.	
5 For events A and B, P(A) = 0.6, P(B) = 0.2 and P(A | B) = 0.5. (a) Find $P(A \cap B)$. (b) Find $P(A \mid B')$.	

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6 Use the substitution u = sin x to find the exact value of $\int_0^{\pi/4} \cos x \sin^4 x \, dx$	
7 The curve C has parametric equations $x = 2t$, $y = t^2$. The line $y = 2x - 3$ meets C at A and B. Find the exact length AB.	
8 A particle P moves on a line. Its displacement from a fixed point O at time t seconds is s metres, where $s = 12 \sin \frac{t}{2} + 5 \cos \frac{t}{2}$. Find (a) the greatest distance of P from O, (b) the greatest speed of P, (c) the first time P is at its greatest distance from O (3 s.f.).	
9 $X \sim N(\mu, 81)$. H_0: $\mu = 31$ is tested against H_1: $\mu < 31$ using the mean of a sample of size 16 at the 1% level. (a) Find the critical region for the sample mean. (b) Find the probability of a Type II error when $\mu = 27.5$.	
10 Two boats P and Q move so that, t hours after noon, their position vectors in km are $\mathbf{r}_P = \begin{pmatrix} -5 \\ -1 \end{pmatrix} + t\begin{pmatrix} -3 \\ -2 \end{pmatrix}$ and $\mathbf{r}_Q = \begin{pmatrix} -14 \\ -8 \end{pmatrix} + t\begin{pmatrix} -1 \\ 1 \end{pmatrix}$. Find the time at which they are closest and the exact minimum distance between them.	