Day 18	A Level Maths: S Tier 10-a-day
1 Solve the simultaneous equations $\log_3 x - \log_3 y = 2$ $x + y = 70$	
2 Sam claims that $n^2 + n + 41$ is prime for every positive integer n. Show that Sam is wrong by finding the smallest value of n that is a counter-example.	
3 θ is small and measured in radians. Use small angle approximations to find the value that $\frac{1 - \cos 3\theta}{\theta \tan 3\theta}$ approaches as $\theta \to 0$.	
4 Particles A and B are projected from a point O at the same instant, with initial velocities $(17\mathbf{i} + 34\mathbf{j})$ m s^{-1} and $(11\mathbf{i} + 26\mathbf{j})$ m s^{-1} respectively (i horizontal, j vertically upwards). Both are still in flight after 3 s. Find (a) the distance AB at this time, (b) the angle AB makes with the horizontal, to 1 d.p.	
5 A school has 240 students in Year 10, 160 in Year 11 and 80 in the sixth form. A stratified sample of 24 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.	

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6 The curves $y = e^x$ and $y = 4e^{-x}$ meet at the point P.
Find the exact area of the region bounded by the two curves
and the y-axis.

7 (a) Expand $(9 + x)^{\frac{1}{2}}$ up to and including the term in x^2.
(b) Use $x = 0.04$ to estimate $\sqrt{9.04}$ to 5 decimal places.

8 A particle P of mass 3 kg moves under a single force F N, where $\mathbf{F} = (12t - 3)\mathbf{i} + (18t^2 - 15)\mathbf{j}$ and t is the time in seconds. At t = 0, P is at the origin with velocity $(\mathbf{i} - 3\mathbf{j})$ m s^{-1}.
Find (a) the velocity of P at t = 3, (b) the position vector of P at t = 3.

9 $X \sim N(\mu, 64)$. H_0: $\mu = 43$ is tested against H_1: $\mu > 43$ using the mean of a sample of size 25 at the 5% level.
(a) Find the critical region for the sample mean.
(b) Find the probability of a Type II error when $\mu = 46$.

10 In the diagram, line l_1 passes through A and B. Line l_2 is perpendicular to l_1 at B and meets the x-axis at C. Find the coordinates of C and the area of triangle ABC.

