Day 142	A Level Maths: S Tier 10-a-day
1 X ~ B(100, 0.02). (a) Explain why a Poisson approximation is suitable and state its distribution. (b) Use it to estimate P(X > 3), to 4 s.f. (c) Find the exact value of P(X > 3), to 4 s.f.	
2 The sum of the first n terms of a sequence is $S_n = 2n^2 + n$. (a) Find an expression for u_n. (b) Find the least n for which $u_n > 162$.	
3 A chord AB of a circle, centre O and radius 6 cm, subtends an angle of $\frac{2\pi}{3}$ at O. Find the exact area and the exact perimeter of the minor segment cut off by AB.	
4 Three forces $(-4\mathbf{i} + 4\mathbf{j})$ N, $(5\mathbf{i} + k\mathbf{j})$ N and $(4\mathbf{i} + 3\mathbf{j})$ N act on a particle of mass 5 kg. The resultant is parallel to $(5\mathbf{i} - \mathbf{j})$. Find (a) the value of k, (b) the magnitude of the acceleration of the particle, to 3 s.f.	
5 $g(x) = x^2 - 4$. Also $fg(x) = -3x^2 + 16$, where f is a linear function. (a) Find f(x). (b) Solve gf(x) = 165.	

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6 A bag has 4 red, 6 blue and 3 green counters. A player takes two without replacement. Two reds win £5, two blues win £7, anything else wins nothing.
(a) Find the expected winnings.
(b) The player pays £1 to play. Find the expected profit.

7 A car of mass 1000 kg, with engine power 7.9 kW, climbs a straight road with $\sin\alpha = \frac{1}{20}$ against a constant resistance of 300 N.
Find (a) the greatest steady speed up the hill, (b) the acceleration at 2.5 m s^{-1}. Take g = 9.8 m s^{-2}.

8 $f(\theta) = \frac{1}{20 + 8\sin\theta + 15\cos\theta}$
(a) Write $8\sin\theta + 15\cos\theta$ as $R\sin(\theta + \alpha)$, $R > 0$, $0 < \alpha < 90°$.
(b) Find the greatest and least values of $f(\theta)$, and the smallest positive θ at which the greatest value occurs, to 1 d.p.

9 Solve simultaneously:
$x - y = -1$
$2x^2 - 2xy + y^2 = 37$

10 Two drones P and Q move so that, t seconds after launch, their position vectors in metres are $\mathbf{r}_P = \begin{pmatrix}-4\\2\\-3\end{pmatrix} + t\begin{pmatrix}0\\1\\-2\end{pmatrix}$ and $\mathbf{r}_Q = \begin{pmatrix}-11\\-1\\10\end{pmatrix} + t\begin{pmatrix}2\\2\\-5\end{pmatrix}$.
Find the time at which they are closest and the exact minimum distance between them.