Day 207	A Level Maths: S Tier 10-a-day
1 A particle is projected at 10 m s^{-1} up a line of greatest slope of a rough plane inclined at α to the horizontal, where $\sin\alpha = \frac{4}{5}$ and $\mu = 0.65$. Find (a) the distance it travels up the plane, to 3 s.f., (b) its speed on returning to its starting point. Take g = 9.8 m s^{-2}.	
2 Find the exact value of $\int_0^{\pi/2} \frac{\cos x}{4 + \sin x}\, dx$	
3 A binomial random variable X has mean 3 and variance 2.25. (a) Find n and p. (b) Find P(X = 5), correct to 3 significant figures.	
4 The points A, B, C have coordinates (1, 4, −2), (−2, 0, −1), (3, 0, 1). Find angle ABC to 1 d.p., and the exact area of triangle ABC.	
5 A data set has lower quartile 28 and upper quartile 37. An outlier is a value more than 2 × IQR beyond the nearest quartile. (a) Find the range of values that are not outliers. (b) 12 observations have mean 29. The largest is 58, an outlier, and it is removed. Find the new mean.	

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6 The first row of a theatre has 8 seats. Each row has 4 more seats than the row in front. Find
(a) the number of seats in row 41,
(b) the least number of rows for at least 1229 seats.

7 Use the substitution $u = x^2 + 3$ to find the exact value of

$$\int_0^1 x(x^2 + 3)^4 \, dx$$

8 Express $\frac{6x^2 - 37x + 54}{(x - 2)(x - 4)^2}$ in the form $\frac{A}{(x - 2)} + \frac{B}{(x - 4)} + \frac{C}{(x - 4)^2}$.

9 A plank of mass 4 kg lies on a smooth horizontal table, with a block of mass 4 kg on it ($\mu = 0.4$ between them). A horizontal force P N acts on the block.
(a) Find the greatest P for which the block does not slip. (b) Find the accelerations of block and plank when P = 78.4. Take g = 9.8 m s^{-2}.

10 The curve C has equation $y = \frac{3x - 18}{x - 3}$.
(a) Write down the equations of the asymptotes of C.
(b) The line $y = x + k$ is a tangent to C.
Find the possible values of k.