Day 4	A Level Maths: A Tier 10-a-day
1 Particles A (8 kg) and B (2 kg) move in the same direction on a smooth horizontal line at 3 m s^{-1} and 8 m s^{-1}. They collide and coalesce. Find (a) the speed of the combined particle, (b) the kinetic energy lost in the collision.	
2 A college has 216 students: 96 Arts, 48 Science and 72 Humanities. A stratified sample of size 18 is taken. Find the number of students sampled from each group.	
3 A 8 kg particle rests on a rough plane inclined at α, $\tan\alpha = \frac{4}{3}$, $\mu = 0.25$. A force of P N acts up a line of greatest slope and the particle stays at rest. Find the range of values of P. Take g = 9.8.	
4 The 4th term of an arithmetic sequence is 27 and the 12th term is 67. Find the first term and common difference, and the sum of the first 25 terms.	
5 $y = \sec(2x)$. Find $\frac{dy}{dx}$ and its exact value at $x = \frac{\pi}{8}$.	

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6 Of 37 students, 17 study Maths (M), 17 Physics (P) and 18 Chemistry (C). 9 study M and P, 10 study M and C, 9 study P and C, and 5 study all three. One student is chosen at random. Given that a student studies exactly two subjects, find the probability that they study Physics.	
7 A curve has equation $4x^2 - 2xy + 2y^2 = 112$. Find the coordinates of the points where the tangent is parallel to the x-axis.	
8 In the expansion of $(1 + kx)^n$, where n is a positive integer, the coefficient of x is 24 and the coefficient of x^2 is 252. Find n and k.	
9 Prove by contradiction that there are no integers m and n such that $10m + 15n = 31$.	
10 Use integration by parts to find the exact value of $\int_0^{\frac{\pi}{6}} x \sin 3x \, dx$.	