Day 67	A Level Maths: A Tier 10-a-day
1 Of 35 students, 12 study Maths (M), 16 Physics (P) and 16 Chemistry (C). 2 study M and P, 6 study M and C, 6 study P and C, and 1 study all three. One student is chosen at random. Given that a student studies Chemistry, find the probability that they study all three.	
2 $f(x) = -2x^2 + 20x - 46$. (a) Write f(x) in the form $a(x + p)^2 + q$. (b) State the maximum value of f(x) and the value of x at which it occurs. (c) Solve f(x) = 0, giving surds in simplest form.	
3 Solve $2\sin^2\theta - 4\cos\theta + 4 = 0$ for $0° \leq \theta \leq 360°$.	
4 $f(x) = 3x^2 - 6x + 9$, $x \geq 1$. Find $f^{-1}(x)$ and state its domain.	
5 A ball is projected from a point O on horizontal ground at 17 m s^{-1} at angle α above the horizontal, $\tan\alpha = \frac{5}{12}$, and lands at A. Find (a) the time of flight, (b) the greatest height, (c) OA. Take g = 9.8. Give answers to 3 s.f. if not exact.	

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6 The random variable X has $P(X = x) = k(x^2 + 1)$ for $x = 0, 1, 2, 3$. (a) Show that $k = \frac{1}{18}$. (b) Find E(X) and Var(X). (c) Find $P(X \geq 1)$.	
7 Find the coefficient of x^8 in the expansion of $(2x^3 - \frac{3}{x})^8$.	
8 A drink at 75°C is left in a room at 15°C. Its temperature θ °C satisfies $\frac{d\theta}{dt} = -k(\theta - 15)$. After 15 minutes the temperature is 55°C. Find k, then the time for it to reach 25°C, to 3 s.f.	
9 At 12:00 ship P has position $(-\mathbf{i} + 3\mathbf{j})$ km and velocity $(3\mathbf{i} + \mathbf{j})$ km h^{-1}; ship Q has position $(-7\mathbf{i} - 9\mathbf{j})$ km and velocity $(5\mathbf{i} + 5\mathbf{j})$ km h^{-1}. Show that the ships collide and find the time and position vector of the collision.	
10 l_1: $\mathbf{r} = \begin{pmatrix} 12 \\ -3 \\ 8 \end{pmatrix} + \lambda \begin{pmatrix} -3 \\ 2 \\ -3 \end{pmatrix}$ l_2: $\mathbf{r} = \begin{pmatrix} 3 \\ 3 \\ -1 \end{pmatrix} + \mu \begin{pmatrix} -1 \\ 3 \\ 3 \end{pmatrix}$ Determine whether l_1 and l_2 intersect. If they do, find the point of intersection.	