Day 184	A Level Maths: S Tier 10-a-day
1 Ball A is projected vertically upwards from ground level with speed 23 m s^{-1}. At the same instant, ball B is released from rest 23 m directly above A. The balls collide. Find (a) the height above the ground at which they collide, (b) the velocity of A just before the collision. Take g = 9.8 m s^{-2}.	
2 Use the trapezium rule with 8 strips to estimate $\int_1^2 \frac{\ln x}{x}\,dx$, to 4 s.f. Is it an overestimate or an underestimate? Explain.	
3 The curve $y = 2x^2 - x + 4$ is translated by $\begin{pmatrix}3\\1\end{pmatrix}$ and then a stretch, scale factor 3, parallel to the y-axis. Find the equation of the resulting curve in the form $y = ax^2 + bx + c$.	
4 P(X = x) = k(x + 2) for x = 1, 2, 3, and 0 otherwise. (a) Show that $k = \frac{1}{12}$. (b) Find E(X) and Var(X). (c) Find Var(4X + 3).	
5 A lift of mass 250 kg, carrying a passenger of mass 70 kg, is supported by a vertical cable. The lift is moving upwards and decelerating at 1.2 m s^{-2}. Find (a) the force the floor exerts on the passenger, (b) the tension in the cable. Take g = 9.8 m s^{-2}.	

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6 The volume of a sphere increases at a constant rate of 36π cm^3s^{-1}. When the radius is 3 cm, find the rate of increase of (a) the radius, (b) the surface area. Volume = $\frac{4}{3}\pi r^3$.	
7 The function f is defined by $f(x) = x^2 - 6x + 10$ for $x \leq k$. Given that k is the greatest value for which f is one-one, find k, $f^{-1}(x)$, and the domain of f^{-1}.	
8 A curve has parametric equations $x = 2 + 4\cos t$, $y = 4 + 4\sin t$. Find its Cartesian equation.	
9 The region bounded by $y = \sqrt{x}e^x$, the x-axis and the lines $x = 0$ and $x = 1$ is rotated through 2π about the x-axis. Find the exact volume of the solid formed.	
10 Faults in a cable occur at random at a mean rate of 3 per day. After a modification, 8 faults are found in 1 day. Test at the 10% level whether the rate of faults has increased.	