Day 12	A Level Maths: A Tier 10-a-day
1 Ball A is dropped from rest 98 m above the ground. At the same instant ball B is projected upwards at 24.5 m s^{-1} from the ground directly below A. Find (a) the time when they collide, (b) the height of the collision. Take g = 9.8.	
2 X ~ B(13, 0.2). Find, to 3 significant figures: (a) P(2 ≤ X ≤ 4) (b) P(X > 2)	
3 A lift of mass 250 kg carries a person of mass 60 kg. The cable tension is 2852 N and the lift is accelerating. Find (a) the magnitude and direction of the acceleration, (b) the force of the floor on the person. Take g = 9.8.	
4 Prove that $n^3 - n$ is divisible by 6 for every positive integer n.	
5 The vectors $\begin{pmatrix} k \\ k \\ -2 \end{pmatrix}$ and $\begin{pmatrix} k \\ 3 \\ 2 \end{pmatrix}$ are perpendicular. Find the possible values of k and, for the larger value, the exact length of the first vector.	

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6 $f(x) = 3x^2 - 5, x \geq 0$. Find $f^{-1}(x)$ and state its domain.	
7 A curve has parametric equations $x = (t - \sin t)$, $y = (1 - \cos t)$. Find $\frac{dy}{dx}$ in terms of t and the exact equation of the tangent at the point where $t = \frac{\pi}{2}$, in the form $y = mx + c$.	
8 A sequence is defined by $u_1 = k$ and $u_{n+1} = -u_n + 6$. Given that $u_3 = 7$, find (a) the value of k, (b) $\sum_{r=1}^{4} u_r$.	
9 Use integration by parts twice to find the exact value of $\int_0^3 x^2 e^x \, dx$.	
10 Faults are reported at random at an average of 2 per hour. Find the probability that in a 45-minute period there are (a) zero events (b) at least 2. (c) Find the probability that at least one occurs in each of two separate 45-minute periods.	