Day 305	A Level Maths: S Tier 10-a-day
1 A lift of mass M kg, carrying a passenger of mass 90 kg, hangs from a vertical cable. The tension in the cable is 4840 N and the floor exerts a force of 990 N on the passenger. Find (a) the acceleration of the lift, with its direction, (b) the value of M. Take g = 9.8 m s^{-2}.	
2 The curve $y = 2x^2 + 5x + 2$ is translated by $\begin{pmatrix} 3 \\ 3 \end{pmatrix}$ and then a stretch, scale factor 2, parallel to the x-axis. Find the equation of the resulting curve in the form $y = ax^2 + bx + c$.	
3 A school has 60 students in Year 10, 120 in Year 11 and 120 in the sixth form. A stratified sample of 40 students is taken. (a) Find the number sampled from each group. (b) Two students are chosen at random from the sample. Find the probability they are from the same group.	
4 $f(x) = \frac{10}{x^2 + 4x + 8}$ for all real x. Find the greatest value of f(x), the value of x at which it occurs, and the range of f.	
5 X ~ B(10, p). It is given that $P(X = 2) = \frac{9}{10} \times P(X = 1)$. (a) Find the value of p. (b) Find P(X = 0), correct to 3 significant figures.	

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6 A curve is given by $x = y^3 + 2y^2 - 2y$. Find dy/dx and d^2y/dx^2 when $y = -1$.	
7 A circle passes through P(13, 1), Q(−11, −9) and R(6, −16). Find its equation.	
8 Use the substitution $u = x^2 + 2$ to find the exact value of $\int_0^1 x(x^2 + 2)^4 \, dx$	
9 At time t = 0 hours, ship A is at the point with position vector $(32\mathbf{i} - 60\mathbf{j})$ km relative to a port O, and moves with constant velocity $(-3\mathbf{i} + 3\mathbf{j})$ km h^{-1}. Ship B leaves O at t = 0 with constant speed 13 km h^{-1} and intercepts A. Find (a) the time at which B intercepts A, (b) the velocity of B as a vector.	
10 Two drones P and Q move so that, t seconds after launch, their position vectors in metres are $\mathbf{r}_P = \begin{pmatrix} -5 \\ 3 \\ 4 \end{pmatrix} + t\begin{pmatrix} 1 \\ 0 \\ -3 \end{pmatrix}$ and $\mathbf{r}_Q = \begin{pmatrix} 2 \\ 0 \\ 9 \end{pmatrix} + t\begin{pmatrix} -1 \\ 1 \\ -5 \end{pmatrix}$. Find the time at which they are closest and the exact minimum distance between them.	