Day 343 **A Level Maths: S Tier 10-a-day**

1 Two fair 8-sided dice, numbered 1 to 8, are rolled. M is the smaller of the two scores.

(a) Show that $P(M = m) = \frac{(17 - 2m)}{64}$ for m = 1, 2, ..., 8.

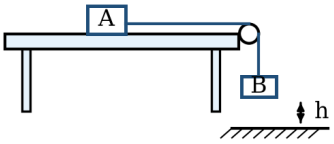
(b) Find P(M = 3) and E(M).

2 Solve $\cos 2\theta - \cos \theta = 0$ for $0 \leq \theta < 360°$.

3 Express $\frac{6 + 3\sqrt{7}}{3 + \sqrt{7}}$ in the form $p + q\sqrt{7}$, where p and q are rational numbers.

4 Particles A (3 kg) and B (3 kg) are joined by a light string over a smooth pulley (see diagram). A lies on a rough table with $\mu = 0.5$, and B is 0.9 m above the floor.

The system is released from rest. Find the total distance A moves before coming to rest (A does not reach the pulley).



5 A drink cools according to $\theta = 20 + Ae^{-kt}$, where θ °C is the temperature after t minutes. Initially $\theta = 95$, and after 6 minutes $\theta = 70$.

Find A and k, then find when $\theta = 47$ (3 s.f.).

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6 A rare allele is present in 1% of a population. A test is positive for 90% of those with it and for 8% of those without it. Find P(positive) and P(has it | positive).	
7 Express $\frac{3x^3 - 19x^2 + 40x - 31}{(x-2)(x-3)}$ in the form $ax + b + \frac{C}{(x-2)} + \frac{D}{(x-3)}$.	
8 $u_{n+1} = u_n + n - 1$, $u_1 = -1$. (a) Show that $u_n = an^2 + bn + c$ and find a, b, c. (b) Find the least n for which $u_n > 506$.	
9 A plank of mass 2 kg lies on a smooth horizontal table, with a block of mass 2 kg on it ($\mu = 0.3$ between them). A horizontal force P N acts on the plank. (a) Find the greatest P for which the block does not slip. (b) Find the accelerations of block and plank when P = 35.28. Take g = 9.8 m s^{-2}.	
10 Line l_1: $\mathbf{r} = \begin{pmatrix} 7 \\ 4 \\ -3 \end{pmatrix} + s\begin{pmatrix} 3 \\ 2 \\ 0 \end{pmatrix}$, line l_2: $\mathbf{r} = \begin{pmatrix} -2 \\ 8 \\ 3 \end{pmatrix} + t\begin{pmatrix} 2 \\ -2 \\ -2 \end{pmatrix}$. Show whether the lines meet, giving the point of intersection if they do, and find the acute angle between them to 1 d.p.	