11 A die in the form of a dodecahedron has its faces numbered from 1 to 12. The die is biased so that the probability that a score of 12 is achieved is different from any other score. The probability distribution of X, the score on the die, is given in the table in terms of p and k, where $0 < p < 1$ and k is a positive integer.

x	1	2	3	4	5	6	7	8	9	10	11	12
$P(X = x)$	p	p	p	p	p	p	p	p	p	p	p	kp

Sam rolls the die 30 times, Leo rolls the die 60 times and Nina rolls the die 120 times. They each plot their scores on bar line graphs.

(a) Explain whose graph is most likely to give the best representation of the theoretical probability distribution for the score on the die. **[1]**

(b) Find p in terms of k. **[2]**

(c) Determine, in terms of k, the expected number of times Nina rolls a 12. **[3]**

(d) Given that Nina rolls a 12 on 32 occasions, calculate an estimate of the value of k. **[2]**

Nina rolls the die a further 30 times.

(e) Use your answer to part **(d)** to calculate an estimate for the probability that she obtains a 12 exactly 8 times in these 30 rolls. **[2]**