1. The probability distribution of the random variable X is given by the formula

$$P(X = r) = k(r^2 - 1) \text{ for } r = 2, 3, 4, 5.$$

i. Show the probability distribution in a table, and find the value of k.

[3]

2. The probability distribution for the discrete random variable X is shown in Fig. 3.

x	0	1	2	3	4
$P(X = x)$	$0.4a$	$0.5a$	$0.3a$	$0.2a$	$0.1a$

Fig. 3

(a) Calculate the value of the constant a. [2]

(b) Calculate $P(X \geq 2)$. [2]

[1]

3. The probability distribution of the discrete random variable X is given in Fig. 4.

r	0	1	2	3	4
$P(X = r)$	0.2	0.15	0.3	k	0.25

Fig. 4

(a) Find the value of k. [2]

X_1 and X_2 are two independent values of X.

(b) Find $P(X_1 + X_2 = 6)$. [3]

4. The discrete random variable X takes the values $r = 0,1,2,3,4$ with probabilities

$$P(X = r) = k(r + 1)(r + 2).$$

(a) Calculate the value of the constant k. [2]

(b) Calculate $P(X < 3)$, giving your answer as a fraction in its lowest terms. [2]

5. Roxanne is employed by an employment agency called Supertemps. In any given week she may be required to work up to a maximum of 5 days.

Both Roxanne and her partner, Alex, suggest ways in which the number of days, X, Roxanne is required to work in a week may be modelled.

- Roxanne thinks that X may be modelled using the discrete uniform distribution.
- Alex suggests the following formula to model the probability distribution of X.

$$P(X = x) = k(2x - 5)^2 \text{ for } x = 0, 1, 2, 3, 4, 5.$$

(a) Calculate the value of k for Alex's model. [2]

Alex and Roxanne record the number of days Roxanne is required to work in each of the first 42 weeks of her employment. The results are summarised in Fig. 9.

Number of days	0	1	2	3	4	5
Frequency	13	7	1	0	7	14

Fig. 9

[6]

(b) Investigate how well each model fits the data.

END OF QUESTION paper

Mark scheme

Question			Answer/Indicative content	Marks	Part marks and guidance	
1		i	r: 2, 3, 4, 5; $P(X=r)$: $3k$, $8k$, $15k$, $24k$	B1	For correct table (ito k or correct probabilities 0.06, 0.16, 0.30, 0.48)	
		i	$3k + 8k + 15k + 24k = 1$	M1		For their four multiples of k added and = 1.
		i	$k = 0.02$	A1	or $k = 1/50$ (with or without working) **Examiner's Comments** Nearly all candidates were able to calculate the correct coefficients of k and sum the terms to get $50k$. Work was generally neatly presented and well structured. Only a very few candidates failed to get the correct answer of 1/50. A small number of candidates did not show the probabilities in a table, thus losing 1 mark.	Allow M1A1 even if done in part **(ii)** – link part **(ii)** to part **(i)**
			Total	3		
2		a	$0.4a + 0.5a + 0.3a + 0.2a + 0.1a = 1$ soi $a = \frac{2}{3}$	M1(AO1.1b) A1(AO1.1b) [2]		
		b	$\frac{2}{3}(0.3 + 0.2 + 0.1)$	M1(AO1.1b)	*their* $\frac{2}{3}$	

			0.4	A1(AO1.1b) [2]		
		c	positive skew	B1(AO1.2) [1]		
			Total	2		
3		a	$0.2 + 0.15 + 0.3 + k + 0.25 = 1$ oe $k = 0.1$	M1(AO1.1) A1(AO1.1) [2]	**Examiner's Comments** Candidates generally did this correctly, with many showing exactly the working given in the mark scheme.	
		b	k^2 seen $0.3\times0.25\times2 + k^2$ 0.16	M1(AO3.1a) M1(AO1.1) A1(AO1.1) [3]	Or $0.3\times0.25\times2$ seen Allow slip eg omission of 2; or insertion of 2 Ft k from (a) for M1M1	

					Examiner's Comments This part caused considerable difficulty, with some candidates omitting it, others drawing a possibility space with equally likely outcomes, and others copying information from the table given in the question. Candidates who realised that a total of 6 could be made either from 3 and 3 or else from 2 and 4 sometimes did not realise that 4 and 2 is also possible; others thought the probability of 3 and 3 had to be counted twice.	
			Total	5		
4		a	$k(1\times2 + 2\times3 + 3\times4 + 4\times5 + 5\times6) = 1$ $k = \frac{1}{70}$	M1 (AO1.1) A1 (AO1.1) [2]		
		b	$\frac{2+6+12}{70}$ $= \frac{2}{7}$	M1 (AO1.1) A1 (AO1.1) [2]	FT their k / Allow 1. $P(X \le 3)$ method	
			Total	4		
5		a	$k(25 + 9 + 1 + 1 + 9 + 25) = 1$ $k = \frac{1}{70}$	M1 (AO 3.3) A1(AO 1.1) [2]		
		b	Roxannes model <table><tr><td>day s</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr></table>			

				Marks	Guidance	
			<table><tr><td>f_e</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td></tr></table> Correct for 1 and 4 days, but otherwise a poor fit Alexs model <table><tr><td>days</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>f_e</td><td>15</td><td>5.4</td><td>0.6</td><td>0.6</td><td>5.4</td><td>15</td></tr></table> The expected frequencies are all within 2 of the observed frequencies, so Alex's model appears to be a good fit.	B1 (AO 3.4) B1(AO 3.5a) M1(AO 3.4) A1(AO 1.1) B1(AO 2.4) B1(AO 3.5a) [6]	A0 if expected frequencies are rounded to nearest integer	
			Total	8		