chi squared *[54 marks]*

As part of a study into healthy lifestyles, Jing visited Surrey Hills University. Jing recorded a person's position in the university and how frequently they ate a salad. Results are shown in the table.

	Salad meals per week			
	0	**1–2**	**3–4**	**>4**
Students	45	26	18	6
Professors	15	8	5	12
Staff and Administration	16	13	10	6

Jing conducted a χ^2 test for independence at a 5 % level of significance.

1a. State the null hypothesis. *[1 mark]*

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1b. Calculate the p-value for this test. *[2 marks]*

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1c. State, giving a reason, whether the null hypothesis should be accepted. *[2 marks]*

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Manny and Annabelle, mathematics teachers at Burnham High School, give their students the same examination. A random sample of the examination scores were collected from each of their classes.

Examination scores from Manny's class	76	77	82	84	88	90	91	98
Examination scores from Annabelle's class	68	79	81	89	91	92	92	95

Annabelle uses these scores to conduct a two-tailed t-test to compare the means of the two classes, at the 5% level of significance. It is assumed the examination scores for both classes have the same variance and are normally distributed.

The null hypothesis is $\mu_1 = \mu_2$, where μ_1 is the mean examination score from Manny's class and μ_2 is the mean examination score from Annabelle's class.

2a. Write down the alternative hypothesis. *[1 mark]*

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2b. Find the p-value for this test. Give your answer correct to five decimal places. *[2 marks]*

Annabelle concludes there is insufficient evidence to reject the null hypothesis.

2c. State whether Annabelle's conclusion is correct. Give a reason for your answer. *[2 marks]*

A group of 1280 students were asked which electronic device they preferred. The results per age group are given in the following table.

	Age			
Preferred device	**11–13**	**14–16**	**17–18**	**Total**
Laptop	143	160	153	456
Tablet	205	224	131	560
Mobile phone	72	128	64	264
Total	420	512	348	1280

A student from the group is chosen at random. Calculate the probability that the student

3a. prefers a tablet. *[2 marks]*

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3b. is $11–13$ years old and prefers a mobile phone. *[2 marks]*

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3c. prefers a laptop **given that** they are $17–18$ years old. *[2 marks]*

3d. prefers a tablet or is $14–16$ years old. *[3 marks]*

A χ^2 test for independence was performed on the collected data at the 1% significance level. The critical value for the test is 13.277.

3e. State the null and alternative hypotheses. *[1 mark]*

3f. Write down the number of degrees of freedom. *[1 mark]*

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3g. Write down the χ^2 test statistic. *[2 marks]*

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3h. Write down the p-value. *[1 mark]*

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3i. State the conclusion for the test in context. Give a reason for your answer. *[2 marks]*

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Casanova restaurant offers a set menu where a customer chooses **one** of the following meals: pasta, fish or shrimp.

The manager surveyed 150 customers and recorded the customer's age and chosen meal. The data is shown in the following table.

	Pasta	Fish	Shrimp	Total
Adults	24	25	32	81
Children	20	14	35	69
Total	44	39	67	150

A χ^2 test was performed at the 10% significance level. The critical value for this test is 4.605.

4a. State H_0, the null hypothesis for this test. *[1 mark]*

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4b. Write down the number of degrees of freedom. *[1 mark]*

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4c. Show that the expected number of children who chose shrimp is 31, correct to two significant figures. *[2 marks]*

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Write down

4d. the χ_2 statistic. *[2 marks]*

4e. the p-value. *[1 mark]*

4f. State the conclusion for this test. Give a reason for your answer. *[2 marks]*

A customer is selected at random.

4g. Calculate the probability that the customer is an adult. *[2 marks]*

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4h. Calculate the probability that the customer is an adult or that the customer chose shrimp. *[2 marks]*

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4i. Given that the customer is a child, calculate the probability that they chose pasta or fish. *[2 marks]*

A survey was conducted on a group of people. The first question asked how many pets they each own. The results are summarized in the following table.

Number of pets owned	0	1	2	3	4	5
Number of people	20	45	40	30	20	5

5a. Write down the total number of people, from this group, who are **pet owners**. *[1 mark]*

5b. Write down the modal number of pets. *[1 mark]*

5c. For these data, write down the median number of pets. *[1 mark]*

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5d. For these data, write down the lower quartile. *[1 mark]*

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5e. For these data, write down the upper quartile. *[1 mark]*

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The second question asked each member of the group to state their age and preferred pet. The data obtained is organized in the following table.

	Age	
Preferred pet	**Teenager**	**Non-teenager**
cat	23	32
dog	35	23
bird	16	13
other	11	7

5f. Write down the ratio of teenagers to non-teenagers in its simplest form. *[1 mark]*

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A χ^2 test is carried out at the 10 % significance level.

5g. State the null hypothesis. *[1 mark]*

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5h. State the alternative hypothesis. *[1 mark]*

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5i. Write down the number of degrees of freedom for this test. *[1 mark]*

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5j. Calculate the expected number of teenagers that prefer cats. *[2 marks]*

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5k. State the conclusion for this test. Give a reason for your answer. *[2 marks]*

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