**4.** The manager of a company making ice cream believes that the proportions of people in the population who prefer vanilla, chocolate, strawberry and other are in the ratio 10 : 5 : 2 : 3

The manager takes a random sample of 400 customers and records their age and favourite ice cream flavour. The results are shown in the table below.

| | | Ice cream flavour | | | | |
|---|---|---|---|---|---|---|
| | | Vanilla | Chocolate | Strawberry | Other | Total |
| **Age** | Child | 95 | 25 | 13 | 25 | 158 |
| | Teenager | 57 | 20 | 17 | 36 | 130 |
| | Adult | 36 | 50 | 10 | 16 | 112 |
| | Total | 188 | 95 | 40 | 77 | 400 |

(a) Use the data in the table to test, at the 5% level of significance, the manager's belief. You should state your hypotheses, test statistic, critical value and conclusion clearly.

**(8)**

A researcher wants to investigate whether or not there is a relationship between the age of a customer and their favourite ice cream flavour. In order to test whether favourite ice cream flavour and age are related, the researcher plans to carry out a $\chi^2$ test.

(b) Use the table to calculate expected frequencies for the group

(i) teenagers whose favourite ice cream flavour is vanilla,

(ii) adults whose favourite ice cream flavour is chocolate.

**(2)**

(c) Write down the number of degrees of freedom for this $\chi^2$ test.

**(1)**

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**Question 4 continued**

**(Total for Question 4 is 11 marks)**