**Q1.**(a)     Explain how the methylation of tumour suppressor genes can lead to cancer.

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**(Extra space)** ................................................................................................

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**(3)**

Scientists investigated a possible relationship between the percentage of fat in the diet and the death rate from breast cancer in women from 10 countries.

Their data is shown in the table below.

|  |  |  |
| --- | --- | --- |
|  | **Percentage of fat in  diet of population** | **Death rate of women  from breast cancer per 100 000 women** |
|  | 9.5 | 1.5 |
|  | 15.0 | 7.0 |
|  | 20.0 | 12.0 |
|  | 25.0 | 9.0 |
|  | 32.0 | 15.0 |
|  | 35.0 | 8.0 |
|  | 35.0 | 20.0 |
|  | 40.5 | 18.0 |
|  | 43.0 | 24.0 |
|  | 45.0 | 26.0 |

(b)     Describe how you would plot a suitable graph of these data. Explain your choice of type of graph.

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**(Extra space)** ................................................................................................

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**(3)**

(c)     What can you conclude from these data?

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**(2)**

**(Total 8 marks)**

**Q2.**(a)     Scientists who investigate disease may look at risk factors. What is a risk factor?

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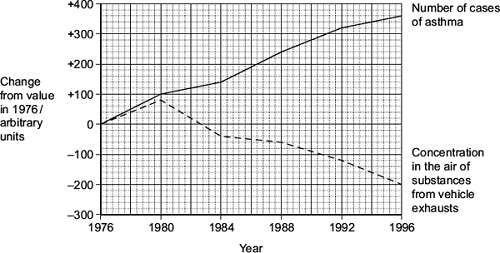
**(1)**

Scientists investigated the link between pollution from vehicle exhausts and the number of cases of asthma. Between 1976 and 1996, the scientists recorded changes in the following

•        the concentration in the air of substances from vehicle exhausts

•        the number of cases of asthma.

The graph shows their results



(b)     Between which years on the graph was there

(i)      a positive correlation between the number of cases of asthma and the concentration in the air of substances from vehicle exhausts

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**(1)**

(ii)     a negative correlation between the number of cases of asthma and the concentration in the air of substances from vehicle exhausts?

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**(1)**

(c)     The scientists concluded that substances in the air from vehicle exhausts did not cause the increase in asthma between 1976 and 1980. Explain why.

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**(3)**

**(Total 6 marks)**

**Q3.**Some people are lactose intolerant. The lactose in milk and milk products, such as cheese, causes digestive discomfort in these people.

Scientists gave 159 adult volunteers, who had dia gnosed themselves as lactose intolerant, a questionnaire to complete. The volunteers were asked,

•        do you eat the food?

•        if you eat the food, do you feel discomfor t after eating it?

The results are shown in the table.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Food** | **Typical lactose content / g per serving** | **Percentage of people who** | | | |
|  | **A** do not eat the food | **B** feel discomfort after eating the food | **C (= A + B)** do not eat the food or feel discomfort after eating the food | **D** feel no discomfort after eating the food |
|  | Hard cheese | 1.2 | 11.1 | 39.9 | 51.0 | 49.0 |
|  | Pizza | 3.0 | 10.4 | 57.8 | 68.2 | 31.8 |
|  | Soft cheese | 3.6 | 25.1 | 53.0 | 78.1 | 21.9 |
|  | Ice cream | 6.0 | 14.6 | 68.2 | 82.8 | 17.2 |
|  | Milk | 9.9 | 27.0 | 67.1 | 94.1 | 5.9 |

(a)     The scientists investigated the relationship between the lactose content of the food and the amount of digestive discomfort.

(i)      The figures in columns **A** and **B** were used to produce those in column **C**.  
The scientists used column **C** rather than column **B** in their analysis. Suggest why.

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**(1)**

(ii)     Describe the relationship between the lactose content of the food and the data in column **C**.

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**(1)**

(iii)    The scientists could **not** conclude that the discomfort was caused by the increase in lactose content of the food. Explain why.

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**(2)**

(b)     Suggest **two** reasons why the data in this table may be unreliable.

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2 .....................................................................................................................

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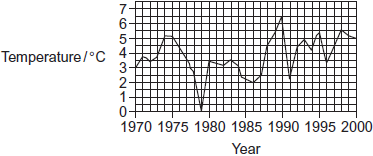
**(2)**

**(Total 6 marks)**

**Q4.**During the last 50 years, there have been changes in the climate of the UK. One of the main changes is temperature. The data in the following resources all relate to southern England.

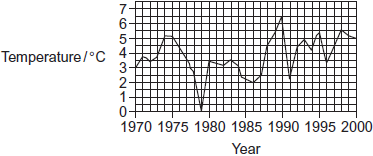
**Figure 1** shows the mean temperatures for January and February combined.

**Figure 1**



**Figure 2** shows the mean temperatures for March.

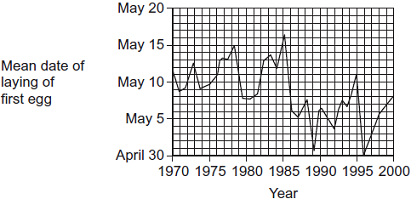
**Figure 2**



Birds, such as chaffinches, have been recorded as breeding earlier. Chaffinches build nests. When the nest is complete, the female lays eggs until she has produced a full clutch of 4 to 6 eggs. After the eggs hatch, the parent birds feed the young on insects.

**Figure 3** shows the mean date on which chaffinches laid their first egg.

**Figure 3**

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The data from which this graph was drawn were collected by volunteers. They used standard record cards. The volunteers used one record card for each nest they found. Each card was used to record

•        the geographical location

•        the habitat in which the nest site was situated

•        the date of each visit to the nest by the volunteer

•        the number of eggs present in the nest at each visit.

Visits were made to the nests at least once every 5 days.

(a)     Do the data in **Figure 1** and **Figure 2** support the idea that there has been a rise in the mean temperatures in southern England between 1970 and 2000? Explain your answer.

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**(2)**

(b)     Describe briefly how you would use a statistical test to find whether there is a significant correlation between mean March temperature and the date when chaffinches laid their first egg.

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(Extra space) .................................................................................................

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**(3)**

(c)     In chaffinches, the date of laying the first egg is determined by a number of factors. These include day length and temperature. What is the advantage to the bird of egglaying being determined by

(i)      daylength

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**(2)**

(ii)     temperature?

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**(2)**

(d)     Scientists found that there was a correlation between mean annual temperature and the date when chaffinches laid the first egg. Can you conclude that higher temperatures cause earlier laying of the first egg?  
Explain your answer.

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**(2)**

(e)     How does the way in which the data were collected affect the conclusions which can be drawn from **Figure 3**?

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**(2)**

**(Total 13 marks)**

**Q5.**Australian scientists investigated one aspect of competition between wheat and ryegrass.

•        They crushed up some wheat plants and mixed the crushed plants with distilled water.

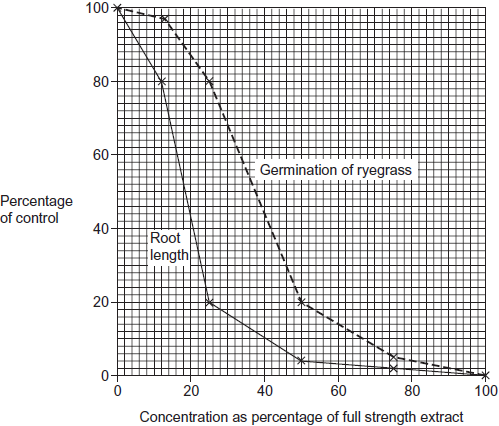
•        Water-soluble substances in the crushed plants dissolved in the distilled water. The scientists called this solution the *full-strength* extract.

•        The scientists then made a series of dilutions of the full-strength extract.

•        They put ryegrass seeds into each dilution and recorded how many seeds germinated (started to grow). If the seeds germinated, they measured the lengths of the roots of the seedlings.

•        They presented their results as percentages of a control experiment.

The graph shows the effects of different concentrations of the extract on the germination of ryegrass and on the length of the roots of the seedlings that grew from them.



(a)     Describe the control that the scientists set up in this investigation.

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**(1)**

(b)     The scientists found a positive correlation between the inhibition of germination and the concentration of the extract.

(i)      Describe how they could find out whether this correlation was significant.

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**(2)**

(ii)      Explain why a correlation does **not** mean that the extract caused inhibition of germination.

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**(1)**

(c)     The scientists concluded that wheat plants produce substances that help them to compete with ryegrass.

(i)      Give evidence from the investigation to support this conclusion.

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**(2)**

(ii)     Why might their conclusion **not** be valid?

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**(3)**

**(Total 9 marks)**

**M1.**(a)      1.      Methylation prevents transcription of gene;

2.      Protein not produced that prevents cell division / causes cell death / apoptosis;

3.      No control of mitosis.

**3**

(b)     1.      Scatter graph;

2.      Fat on *x* axis and death rate on *y* axis;

3.      (Because) looking at relationship between two discrete / independent variables.

**3**

(c)     1.      (Trend) shows positive correlation / shows the more fat in diet, the higher death rate from breast cancer;

2.      But number of points off line / anomalies.

**2**

**[8]**

**M2.**(a)     Something that increases chance / increases probability / makes it more likely;

**1**

(b)     (i)      1976 - / to / and 1980;

**1**

(ii)     1980 - / to / and 1996;

**1**

(c)     1.      Correlation does not mean that there is a causal relationship;

*1. Do not accept casual*

2.      May be some other factor / named factor associated with vehicles and asthma / producing rise in both;

3.      (After 1980) asthma continues to rise but exhaust concentration falls / negative correlation (after 1980);

**3**

**[6]**

**M3.**(a)     (i)      Assumed that did not eat due to discomfort in the past;

**1**

(ii)     Positive correlation / as lactose concentration increases the data in column C increases / percentage who do not eat the food or feel discomfort after eating the food increases;

**1**

(iii)    Correlation does not mean that there is a causal relationship;

May be due to some other factor / example of factor;

*Do not accept casual*

**2**

(b)     1.      People self-diagnosed lactose intolerant condition;

2.      Discomfort may be due to other factor / infection / other component of diet / is subjective;

3.      Large variation in lactose content of specific food items / e.g. variation in lactose content of different soft cheeses;

4.      Amount in a serving may vary;

5.      Untruthful responses / demand characteristics;

*Sample size = neutral.*

**2 max**

**[6]**

**M4.**(a)     Shows trend of mean temperature rise;  
Higher temperatures more frequent since 1984 (in January and February);  
Considerable variation in temperature from year to year;  
Which may be due to chance;

*No mark for yes or no Do not penalise candidates who state there is no trend*

**2 max**

(b)     Construct null nypothesis;  
Use Spearman rank (and calculate test statistic);  
Look up in table (to find critical value of P = 0.05 / 5 %);  
Use figure (in table) to accept or reject null hypothesis;

**3 max**

(c)     (i)      (Particular daylength) always occurs at same time of year / valid example;  
Birds do not start laying eggs when period of warm weather occurs early in year;  
Synchronises breeding behaviour;  
Sufficient foraging time for food collection for young;

**2 max**

(ii)     Birds able to respond to changing climate;  
Food availability (mainly) determined by temperature;  
As insect / invertebrate development temperature-dependent;

**2 max**

(d)     A correlation does not indicate a causal relationship;  
As may be due to another factor / named factor;

**2**

(e)     Visits could be up to 5 days apart;  
Date of egg-laying may be inaccurate by 5+ days;

**2**

**[13]**

**M5.**(a)     Same number of ryegrass seedlings in distilled water;

**1**

(b)     (i)      Produce null hypothesis;

Carry out Spearman Rank correlation test / find correlation coefficient;

Use values to show P < critical value / find probability of results being due to chance;

*Accept valid example*

*E.g. There is no correlation between inhibition of germination and the concentration of the extract.*

**2 max**

(ii)     May be another factor / named factor (that also inhibits germination);

*e.g. amount of water in extract*

**1**

(c)     (i)      Extract inhibits ryegrass germination / extract stops ryegrass starting to grow;

Inhibition of root length / causes ryegrass to have shorter roots;

**2**

(ii)     Scientists crushed plants to get extract;

Plants might not secrete substances in the extract into the soil;

These substances might get broken down in the soil;

Wheat and ryegrass might not grow at the same time / wheat plants might not produce substance when ryegrass is growing;

Concentration of extract in the soil might be different from that in solution;

**3 max**

**[9]**

**E2.**(a)     An encouraging number of students correctly suggested that a risk factor would increase the likelihood or chance of an event occurring. Where errors occurred, they usually involved incorrectly referring to risk factors causing, or being a side effect of, specific diseases. Defining a risk factor as a factor which affects risk was considered to be insufficient to gain credit.

(b)     Most students correctly distinguished between positive and negative correlation although there were those who explained either in their answers to part (b) (ii) or part (c) that negative correlation meant no correlation.

(c)     The better students had clearly examined the data presented in the question and referred to correlation not necessarily meaning causation and to the negative correlation from 1980 onwards. These students sometimes suggested that other factors such as population increase could explain the rise in both the number of cases of asthma and of the concentration of substances from vehicle exhausts. It was clear that many students took refuge in set responses that might have been relevant to previous questions but did not apply to the data here. Such responses included poor diagnosis and factors that might have explained the increase in asthma cases but had little bearing on the increase in the concentration of substances from vehicle exhausts. There were also a number of answers along the "we do not know" theme. Answers to questions of this nature should be based on the material that has been provided. "We do not know" is generally an inappropriate response.

**E3.**(a)     (i)      Only better candidates clearly understood the idea that some individuals did not eat the food due to discomfort from eating it in the past.

(ii)     Most candidates clearly described a positive correlation in one form or another. Candidates failing to gain this mark often provided only part of the information in the column heading C.

(iii)    Better candidates had little difficulty explaining that correlation does not mean that there is a causal relationship and that some other factor may be involved. However, many candidates only provided part of this explanation for one mark or provided answers that bore little relevance to the wording of the question.

(b)     Many candidates gained both marks in this question, often for understanding that self-diagnosis and subjectivity of ‘discomfort’ could make the data unreliable. The idea of untruthful responses was also often credited.

**E4.**(a)     Candidates recognised that temperatures were generally higher and also suggested that the temperature fluctuated. This question was usually marked at the correct level. It was less common for candidates to identify that the trend in the data may have been due to chance.

(b)     This was well understood with the vast majority scoring two or more marks. It was marked at the correct level by most centres. Most commonly the null hypothesis was absent in responses. Many accounts provided extensive unnecessary detail about calculating the test statistic. This was often incorrectly given credit.

(c)     (i)      Only a very small number of candidates established valid links between egg-laying and daylength. Very few candidates realised that daylength was related to a particular time of year. Too many answers which did not correspond to points on the marking guidelines were credited by centres. Credit was also often incorrectly given for synchronising egg-laying rather than breeding behaviour.

(ii)     Candidates had more success with the relationship of egg-laying and temperature. They established links with availability of food and an increase in insect numbers. Many candidates, however, discussed body temperature and survival of young and this was incorrectly credited by some centres. Others answered in terms of temperature affecting egg hatching.

(d)     This was well answered by the vast majority and marked at the correct level.

(e)     Many candidates were able to use the data supplied to suggest that the date of egg-laying would be imprecise. Many answers were linked to the collection of data by volunteers, candidates considering that as a consequence the data were unreliable and the conclusions that could be drawn were debatable. Again answers not meeting the requirements of those in the marking guidelines, such as ‘don’t know when the eggs were laid’, were credited.

**E5.**(a)     Almost all candidates referred to carrying out the procedure using distilled water but very few indicated that the same number of ryegrass seedlings would be required.

(b)     Maximum credit was usually scored in part (a) with candidates correctly choosing the Spearman rank correlation test and indicating either that they would use this to test a null hypothesis or determine the probability of obtaining results by chance. Part (b) was, almost without exception, answered correctly.

(c)     Most candidates scored at least one of the two available marks for part (a) by identifying either the reduced germination of ryegrass or the reduced root growth. There were few convincing answers to part (b), however, and most candidates approached this question by unjustified criticism of the experimental approach.