A Level Biology B

H422/03 Practical skills in biology

Question Set 9

1. (a) (i) The Mantoux test is used to check if a person is immune to tuberculosis (TB) to decide whether they need a BCG vaccination.

A red inflamed lump (induration) may appear three days after the injection of tuberculin.

A person is considered to be immune to TB if they develop an induration that has a diameter of at least 10 mm.

For an induration of 10 mm the percentage error is 10%.

Explain how this percentage error could lead to incorrect decisions about whether a BCG vaccination is needed.

[2]

(a) (ii) A health professional measures the diameter of the induration using a ruler marked in millimetres.

Suggest one way this method for measuring indurations could be improved.

Explain your answer.

[2]

(b)* The Mantoux test requires:

- a solution of tuberculin kept away from the light between 2 °C and 8 °C
- a sterile needle and a sterile syringe.

An alternative to the Mantoux test is a more accurate antibody test called ELISA which requires:

- a fresh blood sample
- full laboratory facilities.

The Mantoux test was used on a sample of 89 people and was followed up with an ELISA.

The results are shown in Table 4.1

	Number of people		
	ELISA positive	**ELISA negative**	**Total**
Mantoux positive	22	6	28
Mantoux negative	18	43	61
Total	40	49	89

Table 4.1

Evaluate the use of the Mantoux test and ELISA for testing whether people are immune to TB.

In your answer you should refer to the data in Table 4.1.

[6]

(c) **(i)** Ten patients were studied to determine whether the age at BCG vaccination affected the length of time that immunity against TB was effective.

Any correlation was tested using Spearman's rank correlation coefficient:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

The data collected are shown in Table 4.2.

Patient	Age at vaccination	Rank	Time immune (years)	Rank	d	d^2
A	13		16			
B	12		17			
C	14		18			
D	1		22			
E	30		4			
F	35		1			
G	15		18			
H	14		17			
I	0		23			
J	13		16			
					Total	

Table 4.2

Calculate the Spearman's rank correlation coefficient for these data.

You may complete Table 4.2 to help you with your working.

Give your answer to **four decimal places**.

[3]

(c) (ii) The null hypothesis used in the study was:

"There is no negative correlation between age at vaccination and length of time immunity was effective."

Table 4.3 shows the critical values for Spearman's rank correlation coefficient.

	Critical values for r_s	
Degrees of freedom	**p = 0.05**	**p = 0.01**
8	0.6429	0.8333
10	0.5636	0.7455
18	0.4014	0.5501
20	0.3805	0.5218

Table 4.3

Use Table 4.3 to decide if the null hypothesis was correct.

[3]

Total Marks for Question Set 9: 16

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