15.1 Control & Coordination in Mammals

Question Paper

Course	CIE A Level Biology
Section	15. Control & Coordination
Topic	15.1 Control & Coordination in Mammals
Difficulty	Hard

Time allowed: 60

Score: /44

Percentage: /100

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Question 1a

Fig. 1 shows the events leading to the generation of an action potential in two types of taste buds.
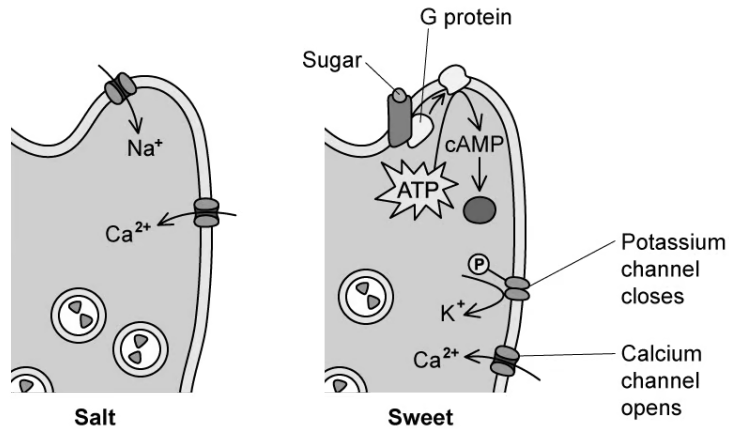

Fig. 1

Explain how an action potential is generated by a taste bud that responds to salty flavour.

[3 marks]

Question 1b

Fig. 1 shows that taste buds responding to sweet flavours make use of the second messenger model.

Use Fig. 1 to suggest how an action potential is generated by a taste bud that responds to sweet flavours.

[3 marks]

Question 1c

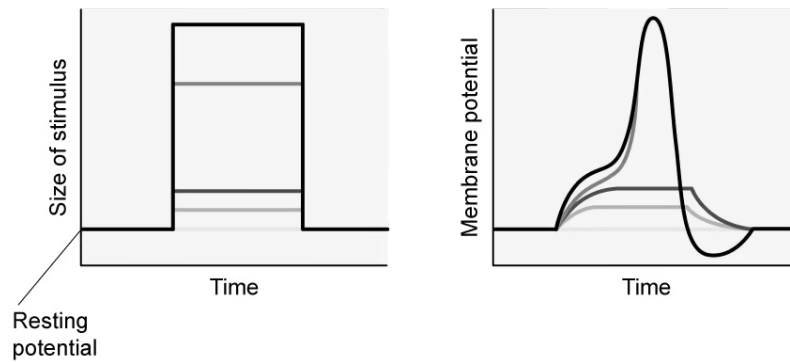Fig. 2 shows the effect of applying different sizes of stimulus on the membrane potential of a receptor cell.

Fig. 2

Describe what Fig. 2 shows about the effect of stimulus size on membrane potential.

[2 marks]

Question 1d

Outline how an action potential generated in a receptor cell is transmitted along an axon.

[3 marks]

Question 2a

Table 1 shows the speed of impulse transmission in neurones of different type and diameter.

Table 1

Neurone source	Myelinated	Axon diameter / μm	Speed of impulse transmission / m s^{-1}
Cat	Yes	5	27
Rabbit	No	7	6
Frog	Yes	16	36
Newt	Yes	7	27

Calculate the percentage increase in impulse transmission speed in myelinated neurones when the axon diameter is increased from 7 μm to 16 μm.

[2 marks]

Question 2b

Describe the effect of myelination on neurones shown in Table 1

[2 marks]

Question 2c

Explain the following from Table 1:

(i)
The effect of myelination on speed of nerve impulse transmission.

[3]

(ii)

The effect of axon diameter on speed of nerve impulse transmission.

[1]

[4 marks]

Question 2d

Scientists investigated the relationship between myelin in brain tissue and the different types of dementia.

The scientists measured the mean myelin content in brain tissue samples from 3 different groups:

- A control group of 15 people without dementia
- 22 people with vascular dementia (VD)
- 18 people with Alzheimer's dementia (AD)

Their results are shown in Fig. 1 below. The smaller vertical bars represent standard deviation.
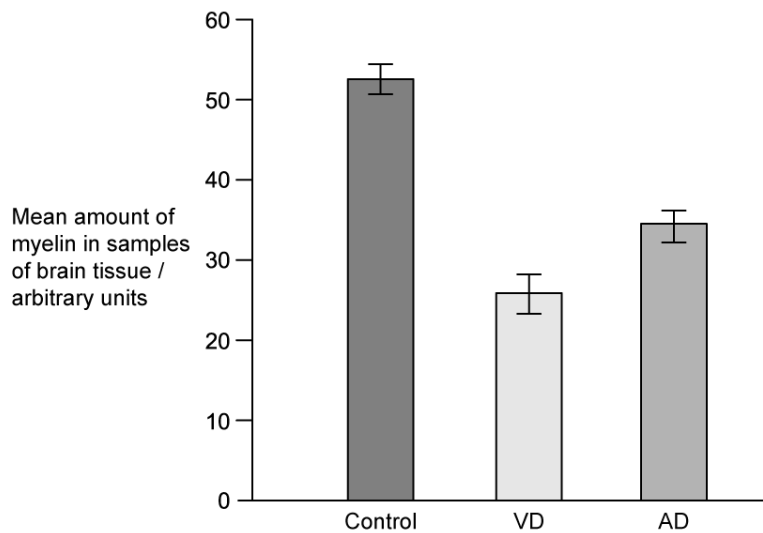

Fig. 1

A research assistant reviewing Fig. 1 concluded that there was a relationship between the concentration of myelin present in an individual's brain and the likelihood of dementia.

Evaluate this conclusion.

[4 marks]

Question 3a

A group of six students carried out an experiment to determine their reaction times using a ruler.

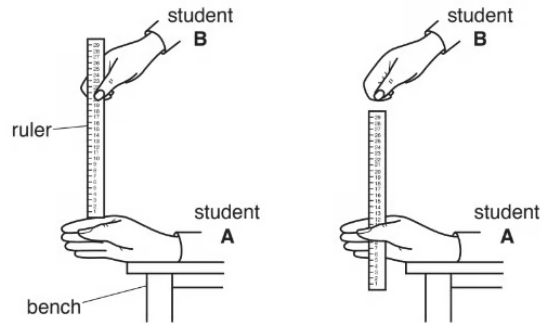Fig. 1 shows the basic procedure used for the experiment.

Fig. 1

The students worked in pairs.

- Student **A** rested their hand on a bench.
- Student **B** then dropped a ruler from a set height.
- Student **A** had to catch the ruler as quickly as possible.
- The distance the ruler had dropped was measured and recorded.
- The students calculated their reaction times.

The formula for calculating reaction time in seconds is shown in Fig. 2.

$$\text{reaction time} = \sqrt{\frac{2 \times D}{g}}$$

D = distance ruler had dropped in metres
$g = 9.8 \, \text{m s}^{-2}$

Fig. 2

Table 1 shows the results for the six students.

Table 1

Student	Distance ruler had dropped / m	Reaction time / s
1	0.17	0.19
2	0.10	0.14
3	0.16	0.18
4	0.08	
5	0.16	0.18
6	0.35	0.27

(i)

Use the formula in Fig. 2 to complete Table 1.

[1]

(ii)

Predict what would happen to the reaction time if the ruler was held higher than the original set height.

[1]

[2 marks]

Question 3b

There was some background noise in the classroom when the students carried out their experiment. The students thought that this noise might have affected their reaction times. They decided to modify their original experiment to find out if the presence or absence of background noise affects reaction time.

(i)
Identify the dependent variable in this investigation.

[1]

(ii)

Using the procedure shown in Fig. 1, describe a method that the students could use to find out if the presence or absence of background noise affects reaction time.

Your method should be set out in a logical order and be detailed enough for another person to follow.

[7]

[8 marks]

Question 3c

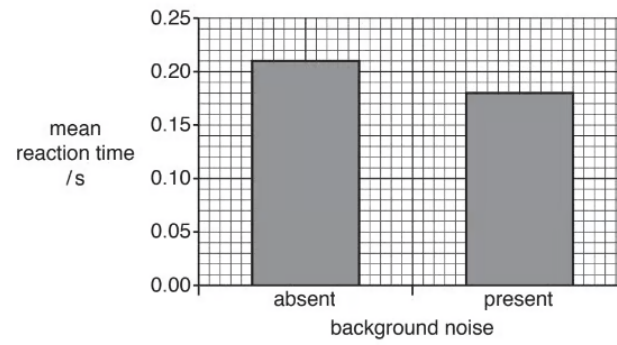Fig. 3 shows some results for a reaction time test that the students found on the internet.

Fig. 3

State why a bar chart is a suitable way to show the data.

[1 mark]

Question 3d

(i)

Suggest **one** conclusion the students could have made based on these results.

[1]

(ii)

The students decided to carry out a *t*-test to find out if the difference in reaction time was significant.

State why a *t*-test is suitable for these data.

[1]

(iii)

State a null hypothesis for this test.

[1]

Table 2 shows some probability values of *t*.

Table 2

degrees of freedom	10	12	14	16	18	20	22	24	26	28	30	40	50	60
probability 0.05	2.23	2.18	2.14	2.12	2.10	2.09	2.07	2.06	2.06	2.05	2.04	2.02	2.01	2.00

(iv)

The students used 16 degrees of freedom and calculated *t* = 2.05.

State **and** explain what the value of *t* indicates about the difference in mean reaction times shown in Fig. 3.

[1]

[4 marks]

Question 3e

Another student, when carrying out the ruler experiment shown in Fig. 1, noticed that the more repetitions carried out, the faster the reaction time became.

The student decided to carry out a different experiment to investigate the effect of repetition on the accuracy of carrying out a task.

Five students, **V, W, X, Y** and **Z** were tested.

- Each student was given a picture of a star, as shown in Fig. 4.
- Each student sat at a desk so that the star was only visible in a mirror, as shown in Fig. 5.
- Each student was asked to draw between the double lines of the star when looking at it **only** in the mirror. Fig. 6 shows a star diagram completed by a student.
- The students recorded the number of times their lines went outside the double line of the star.
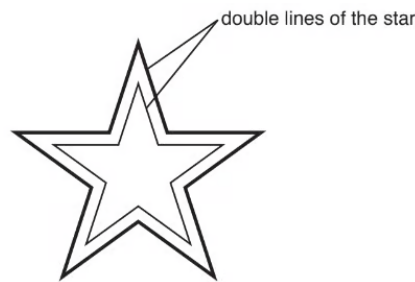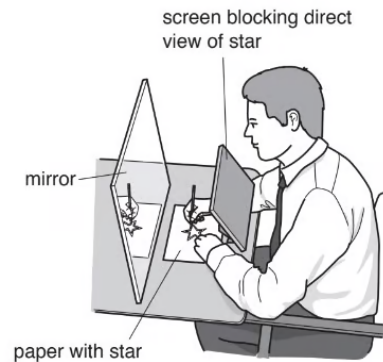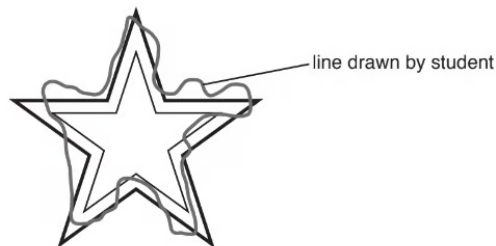

Fig. 4

Fig. 5

Fig. 6

Each student repeated the task nine times on the same day. The results are shown in Table 3.

Table 3

student	number of times the students' lines went outside the double lines of the star								
	1	2	3	4	5	6	7	8	9
V	48	48	46	44	42	40	41	41	41
W	45	42	43	40	38	35	36	35	35
X	38	37	34	32	31	30	28	38	28
Y	31	30	31	29	44	28	26	25	25
Z	41	40	38	37	35	35	33	33	32

(i)
Identify the independent variable in this experiment.

[1]

(ii)

Suggest the hypothesis that was tested in this experiment.

[1]

(iii)

A person walked into the room and started talking to one of the students who was carrying out the test.

Circle the result in Table 3 that was affected by this.

[1]

(iv)

One of the students had previously carried out a similar task.

Identify this student **and** give a reason for your answer.

[1]

[4 marks]

Question 3f

State **two** conclusions based on the data in Table 3.

[2 marks]