Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2A2B Human Biological Science 2014 /35

**Scientific Method Quantitative Test**

**1.** A researcher working for a pharmaceutical company has developed an adrenaline related compound called DRUG X which has shown promise as a bronchodialator in the treatment of asthma. Bronchodialators are substances which cause the muscular walls of the airways to relax during an asthma attack thus making breathing easier. Since one of the side effects of adrenaline can be to increase heart rate, which can be undesirable, it was decided to run a clinical trial on a group of volunteers.

100 people were chosen at random, they were then randomly allocated into one of 2 subgroups, Group A and Group B.

All volunteers in both groups were asked to rest for 15 minutes before their heart rate was measured and recorded by the researcher.

Group A were then given an intravenous injection of 5ml saline solution. Saline solution is a placebo as it is known to have no effect on heart rate. Half an hour later their heart rate was measured again

Group B were given an intravenous injection containing 5ml of DRUG X. Half an hour later their heart rate was measured and recorded again.

Using the above experiment, answer the following questions.

a) Write a possible hypothesis for the experiment.

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(2 marks)

b) Name the independent variable.

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(1 mark)

c) Name the dependent variable.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(1 mark)

d) Name TWO controlled variables.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(2 mark)

e) Describe two ways experimental error could be reduced in this experiment.

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(2 marks)

f) Describe what a placebo is. Explain why it was used in the experiment.

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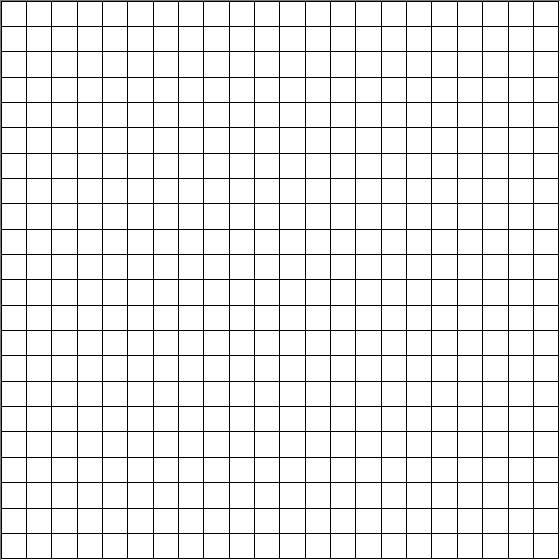
(4 marks)

**2.** An investigator was examining possible factors which might contribute to traffic accidents. One of the factors examined was the effect of sleep deprivation (lack of sleep) on people’s reaction times.

The table below shows the average reaction times of a group of people after they had been awake for a certain number of hours

|  |  |
| --- | --- |
| **Hours since last sleep** | **Average reaction time (ms)** |
| 12 | 250 |
| 16 | 265 |
| 18 | 312 |
| 20 | 364 |
| 22 | 422 |

a) Graph this data on the grid below. (5 marks)



b) What conclusions can the investigator make from these results? How can this be applied to traffic accidents?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(2 marks)

c) Using your graph, predict the reaction time of a person who had been awake for:

(i) 14 hours \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii) 24 hours \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(2 marks)

d) Which of your predictions in the question above are you more confident about? Explain why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(2 marks)

e) List THREE factors the scientist would have needed to consider when selecting the volunteers for the experiment so that the results could be regarded as valid.

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(3 marks)

f) The reaction time is listed in the table as an average. Give TWO reasons why this was necessary.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(2 marks)

**3.** A poultry feed chemist (a scientist who creates food for chickens) wanted to see if he could increase the mass of chickens faster by using Growth Hormone. Eight chickens were raised in a laboratory. Four chickens were fed food containing Growth Hormone supplement in their normal food and four others were fed with normal poultry food only. The hormone treatment began when the chickens were two weeks old.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Chicken # | Mass (g)  2 weeks after hatching | Mass (g)  8 weeks after hatching |
| Growth Hormone in food | 1  2  3  4 | 100  90  100  110 | 450  560  460  600 |
| Normal food only | 5  6  7  8 | 90  100  100  110 | 400  450  460  410 |

a) Explain what a control group is

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(1 mark)

b) List the chickens in the control group (1 mark)

c) Has this experiment produced reliable results? Why/Why not?

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(3 marks)

d) How could reliability be improved?

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(2 marks)

**SOLUTIONS** /35

**Scientific Method Quantitative Test**

1. A researcher working for a pharmaceutical company has developed an adrenaline related compound called DRUG X which has shown promise as a bronchodialator in the treatment of asthma. Bronchodialators are substances which cause the muscular walls of the airways to relax during an asthma attack thus making breathing easier. Since one of the side effects of adrenaline can be to increase heart rate it was decided to run a clinical trial on a group of volunteers.

100 people were chosen at random, they were then randomly allocated into one of 2 subgroups, group A and group B.

All volunteers in both groups were asked to rest for 15 minutes before their heart rate was measured and recorded by the researcher.

Group A were then given an intravenous injection of 5ml saline solution. Saline solution is a placebo as it is known to have no effect on heart rate. Half an hour later their heart rate was measured again

Group B were given an intravenous injection containing 5ml of DRUG X. Half an hour later their heart rate was measured and recorded again.

Using the above experiment, answer the following questions.

a) Write a possible hypothesis for the experiment.

Drug X will increase the heart rate of an individual (must mention ind and dep var)

(2 marks)

b) Name the independent variable.

Drug X

(1 mark)

c) Name the dependent variable.

Heart rate

(1 mark)

d) Name TWO controlled variables.

Both groups 15 min rest – 5ml injection each – ½ hour wait after injection

Any 2 (2 mark)

e) Describe two ways experimental error could be reduced in this experiment.

Repeat experiment (1)

Increase sample size (1) (2 marks)

f) Describe what a placebo is. Explain why it was used in the experiment.

1 resembles drug

1 no active component /ind var

1 reduces psychological effect

1 allows comparison (4 marks)

2. An investigator was examining possible factors which might contribute to traffic accidents. One of the factors examined was the effect of sleep deprivation on people’s reaction times.

The table below shows the average reaction times of a group of people after they had been awake for a certain number of hours

|  |  |
| --- | --- |
| Hours since last sleep | Average reaction time (ms) |
| 12 | 250 |
| 16 | 265 |
| 18 | 312 |
| 20 | 364 |
| 22 | 422 |

a) Graph this data on the graph paper provided. (5 marks)

minus one mark for any of the following:

not neat

no ruler

not line graph

no suitable title

mmissing units

no suitable axis labels

ind var on horizontal

b) What conclusions can the investigator make from these results? How can this be applied to traffic accidents?

Increased waking hours increases reaction time

More accidents when people have been awake for a long time / are driving tired (2 marks)

c) Using your graph, predict the reaction time of a person who had been awake for:

(i) 14 hours 260ms +-5 must state units

(ii) 24 hours 475ms +-5 must state units

(2 marks)

d) Which of your predictions in the question above are you more confident about? Explain why.

14 is interpolation, you have data on either side

Not extrapolation (2 marks)

e) List THREE considerations the investigator would have needed to make in selecting the volunteers for his experiment so that his results could be regarded as valid.

Eyesight all good any 3

All physically able

No drugs etc

Gender

Age (3 marks)

f) The reaction time is listed in the table as an average. Give TWO reasons why this was necessary.

Reduce error

Increase accuracy

Lower individual effect any 2

Detection of outliers

(2 marks)

3. A poultry feed chemist (a scientist who creates food for chickens) wanted to see if he could increase the mass of chickens faster by using Growth Hormone. Eight chickens were raised in a laboratory. Four chickens were fed food containing Growth Hormone supplement in their normal food and four others were fed with normal poultry food only. The hormone treatment began when the chickens were two weeks old.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Chicken # | Mass (g)  2 weeks after hatching | Mass (g)  8 weeks after hatching |
| Growth Hormone in food | 1  2  3  4 | 100  90  100  110 | 450  560  460  600 |
| Normal food | 5  6  7  8 | 90  100  100  110 | 400  450  460  410 |

a) Explain what a control group is and list the chickens in the control group.

A sample that is the same as the test group in all ways except the ind var (1 mark)

5,6,7,8 (1 mark)

b) Has this experiment produced reliable results? Why/Why not?

No – one mark

Small sample size any 2

Not repeated

½ chickens in sample showed same growth as control (3 marks)

c) How could reliability be improved?

Increase sample size

Repeat

Continue for longer (2 marks)