Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ /37

**Scientific Method Quantitative Test**

1. Lance Armstong had his Tour De France medals taken from him as he was convicted of taking performance enhancing drugs and blood doping. Blood doping is the removal of an athlete’s own blood weeks prior to the event then returning it to the athlete’s blood just before the even to increase the number of oxygen carrying red blood cells.

Researchers wanted to determine how much of an advantage this gave athletes. 10 different professional athletes were each timed doing three different activities twice each. Equal and adequate rest days were given between each activity.

The activities were 100km mountain biking, 5 km swimming and a 42km marathon.

Before completing each activity for a second time each athlete received a transfusion. They were not told if it was a saline solution, which has no effect on the body, or if it was their own blood which had been removed from every athlete weeks prior.

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.

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(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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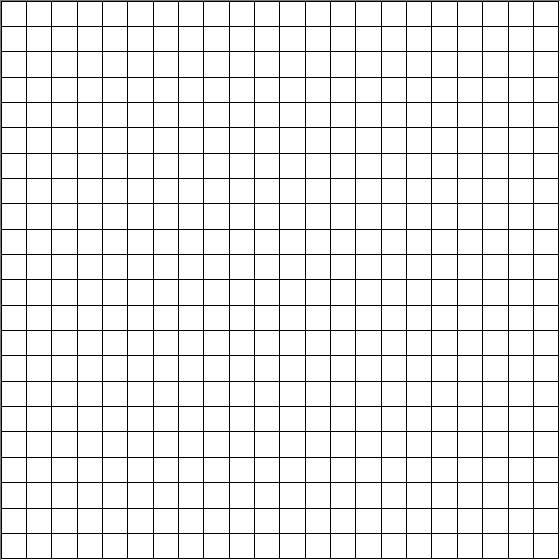
(4 marks)

**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 paediatrician (doctor for children) was trialling a new vitamin drink which he hoped would increase growth in children who were small for their age. He trialled eight 7 year old children who were a variety of heights. He gave each a drink each day for 6 months. Children numbered 1 - 4 were given the vitamin drink, children numbered 5 – 8 were given a placebo.

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Child number | Height before (cm) | Height after (cm) |
| Given Vitamin Drink | 1  2  3  4 | 100  105  106  96 | 100  106  108  100 |
| Given Placebo | 5  6  7  8 | 105  102  95  107 | 106  103  100  109 |

a) Explain what a control group is

(1 mark)

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

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

(3 marks)

d) How could reliability be improved?

(2 marks)

e) What conclusion could the paediatrician make based on these results?

(2 marks)

**SOLUTIONS** /35

**Scientific Method Quantitative Test**

1. 1. Lance Armstong had his Tour De France medals taken from him as he was convicted of taking performance enhancing drugs and blood doping. Blood doping is the removal of an athlete’s own blood weeks prior to the event then returning it to the athlete’s blood just before the even to increase the number of oxygen carrying red blood cells.

Researchers wanted to determine how much of an advantage this gave athletes during different activities. 10 different professional athletes were each timed doing three different activities twice each. Equal and adequate rest days were given between each activity.

The activities were 100km mountain biking, 5 km swimming and a 42km marathon.

Before each activity each athlete received a transfusion. They were not told if it was a saline solution, which has no effect on the body, or if it was their own blood.

Using the above experiment, answer the following questions.

a) Write a possible hypothesis for the experiment.

Blood doping will decrease the time taken to complete athletic activity (must mention ind and dep var)

(2 marks)

b) Name the independent variable.

Blood doping / additional red blood cells

(1 mark)

c) Name the dependent variable.

Time taken to complete athletic activity

(1 mark)

d) Name TWO controlled variables.

All receive intravenous transfusion, all do same activities, equal rest between activities, all prof athletes

Any 2 (2 mark)

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

Repeat experiment Verification by other scientists

Increase sample size 1 mark each – any 2 (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 paediatrician (doctor for children) was trialling a new vitamin drink which he hoped would increase growth in children who were small for their age. He trialled eight 7 year old children who were a variety of heights. He gave each a drink each day for 6 months. Children numbered 1 - 4 were given the vitamin drink, children numbered 5 – 8 were given a placebo.

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Child number | Height before (cm) | Height after (cm) |
| Given Vitamin Drink | 1  2  3  4 | 100  105  106  96 | 100  106  108  100 |
| Given Placebo | 5  6  7  8 | 105  102  95  107 | 106  103  100  109 |

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 (3 marks)

c) How could reliability be improved?

Increase sample size

Repeat

Continue for longer (2 marks)

e) What conclusion could the paediatrician make based on these results?

Vitamin drink ineffective in increasing growth in 7 year old children within 6 months (2 marks)