



S11-test Experimental Design: Test Pack

EDEXCEL 1ST0 · Calculator allowed · about 15 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A researcher wants to find out whether adding fertiliser increases the height that tomato plants grow to.

(a) State what is meant by a hypothesis. (1)

(b) Write a suitable hypothesis for this investigation. (1)

(Total for Question 1 is 2 marks)

- 2** A student is investigating how the length of a pendulum affects the time for one swing. For a pendulum of length 40 cm, she repeats her timing 3 times, shown in the table.

Repeat	1	2	3
Time (seconds)	1.28	1.42	1.25

(a) Work out the mean time for one swing at this length, giving your answer to 3 significant figures. (2)

(b) Give one reason why taking repeated timings and calculating a mean gives a more reliable result than using a single timing. (1)

(c) State one further change the student could make to her investigation to improve its reliability even more. (1)

(Total for Question 2 is 4 marks)

3 A student investigates whether listening to music improves memory. She asks for volunteers, then lets them choose whether to join the 'music' group or the 'no music' group. All volunteers in the music group complete the memory test in the morning; all volunteers in the no-music group complete it in the afternoon. Each volunteer attempts the test only once.

- (a) Identify one weakness in how the volunteers are placed into groups, and explain the problem this could cause. (2)
- (b) Identify one weakness in how the test is timed, and explain the problem this could cause. (2)
- (c) Suggest one change, relating to the number of times each volunteer attempts the test, that would make the experiment more reliable. (1)

(Total for Question 3 is 5 marks)

4 A pharmaceutical trial for a new painkiller measures the percentage of volunteers reporting reduced pain after treatment, for trials of different sizes.

Trial size (volunteers)	20	200	2000
% reporting reduced pain	75%	61%	60%

- (a) State which trial size is likely to give the most reliable estimate of the true percentage of people helped by the painkiller, giving a reason. (2)
- (b) Give a reason why the trial with only 20 volunteers might give a result that does not reflect how the drug performs in the wider population. (1)

(Total for Question 4 is 3 marks)

Mark scheme · S11-test Experimental Design: Test Pack

Question 1

- (a) **B1** a statement that can be tested/investigated and predicts a relationship between two variables, oe
- (a) **Answer: A hypothesis is a statement that can be tested by an investigation, which predicts a relationship between two variables.**
- (b) **B1** a testable statement linking fertiliser and plant height, e.g. 'plants given fertiliser grow taller than plants not given fertiliser', oe
- (b) **Answer: Tomato plants given fertiliser will grow taller than tomato plants not given fertiliser.**

Question 2

- (a) **M1** $(1.28 + 1.42 + 1.25) / 3$, oe
- (a) **A1** 1.32 (seconds) cao, awrt
- (a) **Answer: 1.32 seconds**
- (b) **B1** reduces the effect of random error/an unusual anomalous timing in any one individual reading, oe
- (b) **Answer: It reduces the effect of random error, so an unusually fast or slow individual timing has less effect on the overall result.**
- (c) **B1** any valid improvement, e.g. increase the number of repeats, or test more pendulum lengths, oe
- (c) **Answer: e.g. take more repeat timings at each length.**

Question 3

- (a) **B1** volunteers are not randomly allocated to groups (they self-select)
- (a) **B1** this could introduce bias, e.g. people who already enjoy/respond well to music opting into the music group, an extraneous variable other than music that could affect memory
- (a) **Answer: The volunteers were not randomly allocated; they chose their own group. This could introduce bias, since the kind of person who chooses the music group (e.g. someone who already concentrates well with music) might have performed better on the memory test anyway.**
- (b) **B1** time of day is not kept constant between groups (morning vs afternoon), an extraneous variable
- (b) **B1** memory performance may naturally differ by time of day, so time of day (rather than music) could explain any difference between the groups, oe
- (b) **Answer: Time of day is not kept the same: one group is tested in the morning, the other in the afternoon. Memory performance can naturally vary through the day, so any difference between the groups could be caused by the time of day rather than by the music.**
- (c) **B1** repeat the test / give each volunteer several attempts and use a mean, oe
- (c) **Answer: Give each volunteer several attempts at the test and use their mean score, rather than a single attempt.**

Question 4

- (a) **B1** 2000 cao
- (a) **B1** larger sample sizes are less affected by chance/random variation, so the result is more likely to be close to the true population percentage, oe
- (a) **Answer: The trial of 2000 volunteers. Larger samples are less affected by chance variation, so its result is more likely to be close to the true percentage for the whole population.**
- (b) **B1** small samples are more affected by random/chance variation, so an unusual result is more likely to occur by chance, oe
- (b) **Answer: With only 20 volunteers, chance variation has a much bigger effect, so an unusually high or low result is more likely to occur just by chance.**