Chapter 1 Science investigation skills

Chapter review questions

1 Resolution of a microscope refers to the smallest distance between two points which can be distinguished as separate objects. The higher the resolution of a microscope, the more detail of an object can be observed; what seems to be one object may be discernable as two objects as the resolution increases. Magnification of a microscope refers to the amount an object has been amplified or enlarged for viewing. Magnifying an object by 100 times increases the size of the object but does not show you extra details.

2 One would expect that preliminary data showed that the vaccine produces an immune response and now scientists need to determine whether any harmful side effects occur following inoculation (vaccination). To start with, the research question could be: Do the test vaccines cause harmful side effects in ferrets following injection? A possible hypothesis could be: Vaccinations administered to ferrets may cause adverse side effects to the animals.

3 Independent variables are variables that are controlled in the experiment so an outcome can be observed. In this experiment, the independent variable would be the vaccine itself. The concentration, the amount of substances in the solution and the volume would need to be controlled before being administered to the ferrets. The dependent variable is the observed effects due to the administration of the vaccine, including the presence or absence of harmful side effects, such as as a fever, and the level of inflammation.

4 A control group of ferrets that are injected with an innocuous sample (a solution that does not illicit an immune response) is essential so that the experimental findings can be attributed to the vaccine alone.

5 This experiment would generate both qualitative and quantitative data. The qualitative data would include physical symptoms such as the presence of a fever, paralysis or lethargy. These symptoms would be further investigated to determine the level of inflammation and the level of immune response (antibodies), which would be quantitative data.

6 Three variables that need to be controlled in these initial experiments would be that the ferrets would need to be of the same breed, the amount of vaccine administered would need to be kept the same, and the injection schedule would need to be the same for all animals and trials.

7 Reliability of an experiment is the term given when a protocol produces similar results following consistent and repeated testing. Reliability can be achieved by repetition and replication. This includes conducting multiple trials on separate occasions, or allow the same protocol to be used by a different group. Reliability can also be improved by using a larger test sample size.

8 The validity of the experiment refers to whether the results observed are aligned to the hypothesis or intention of the experiment. For this experiment, the intention is to produce an effective vaccine with no harmful side effects. One approach that could make the data more valid is to check that variables are carefully measured and controlled so the results can be related to the aim/hypothesis of the experiment. These leaves no doubt that the data collected

result from the vaccine that was administered. Another way to make the experiment more valid is, once the results are obtained, to see what changes are needed to make the experiment aligned to the hypothesis. For example, if harmful side effects were observed, the following experiments could include changes to the dose of the vaccine given, which may change the result.

9 A histogram graph would be best to represent quantitative data. The two test groups could be compared with each other and to the control group. The different groups would be plotted on the *x* axis and as an example the levels of inflammation (dependent variable) would plotted on the *y* axis.

10 For every experiment, an assessment needs to be conducted to determine the possible risks. This includes the risks to you and other people, how likely it is there will be an injury and if there was an injury what the consequences would be. In this instance as the experiment involves the use of a highly contagious and deadly viral disease, the likelihood of harm would exist, and it could lead to catastrophic consequences, so the term or rank would be an 'extreme risk'.

11 Scientists adhere to the three Rs, which are reduction, refinement and replacement, when using animals in their experimentation. Reduction refers to minimising the number of animals to a sample size where you would obtain the same data as a larger group. Refinement refers to the modification of methods to alleviate or minimise potential pain and distress of animals. Replacement refers to using alternative models that do not involve the use of animals at all, or to replacing animals that have a nervous system with those that don't.

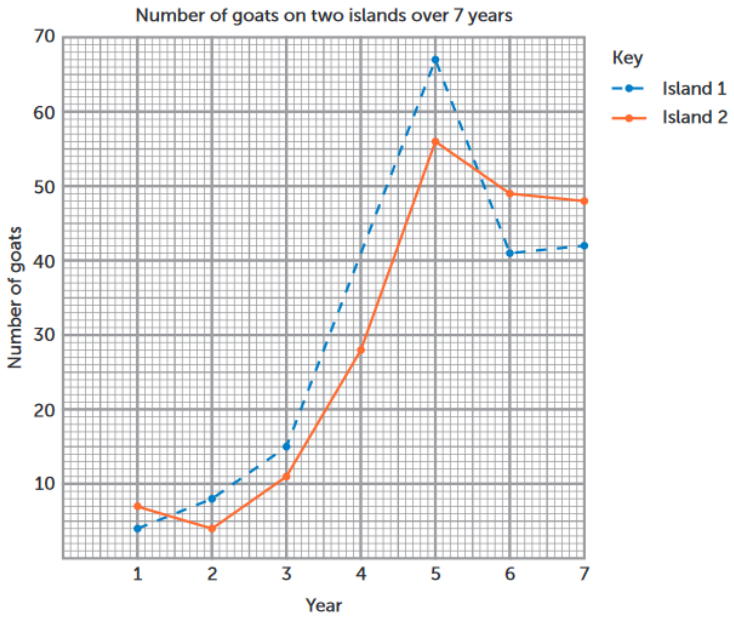
Practice exam questions

1 D

2 A

3 C

4 **a**



b i 42 (accept any answer in the range 41–43)

ii Births = 20; deaths = 38.
Population size at the end of Year 8 = (48 + 20) – 38
= 68 – 38
= 30

c i 8 ÷ 500 = 0.016 goats/ha (must show units to get the mark)

ii Island 1: 42 ÷ 500 = 0.084 goats/ha

Island 2: 48 ÷ 800 = 0.06 goats/ha

(must show units to get the mark)

5 a Dependent variable: Number of wild dogs killed/affected by baiting. This is the variable that will be affected by the experiment/measured during the experiment/that depends on the independent variable.

b Independent variable: Baiting. This is the variable that will be manipulated/altered in the experiment/upon which the results of the experiment depend.