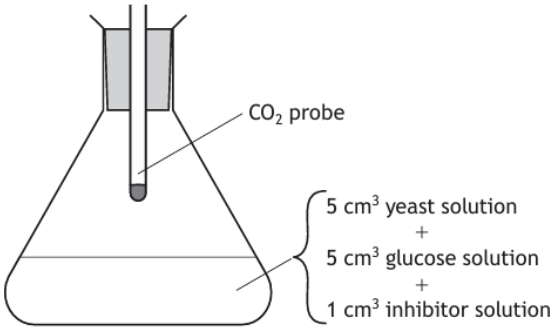
Controls

1. An investigation was carried out into the effect of an enzyme inhibitor's concentration on the rate of respiration in yeast. Five different flasks were set up as shown.



Each flask contained a different concentration of inhibitor. The CO_2 concentration was measured by the probe.

In a suitable control experiment for this investigation the flask should contain

A 5 cm^3 yeast solution and 5 cm^3 glucose solution

B 5 cm^3 yeast solution, 5 cm^3 glucose solution and 1 cm^3 water

C 5 cm^3 water, 5 cm^3 glucose solution and 1 cm^3 inhibitor solution

D 5 cm^3 yeast solution, 5 cm^3 water and 1 cm^3 inhibitor solution.

2. An experiment was carried out to investigate the effectiveness of a sunscreen on the survival of yeast cells.

Yeast was added to a Petri dish containing agar. Sunscreen was spread across the lid before the dish was exposed to UV light.

A valid conclusion, relating to the aim, could be drawn by setting up a control experiment without

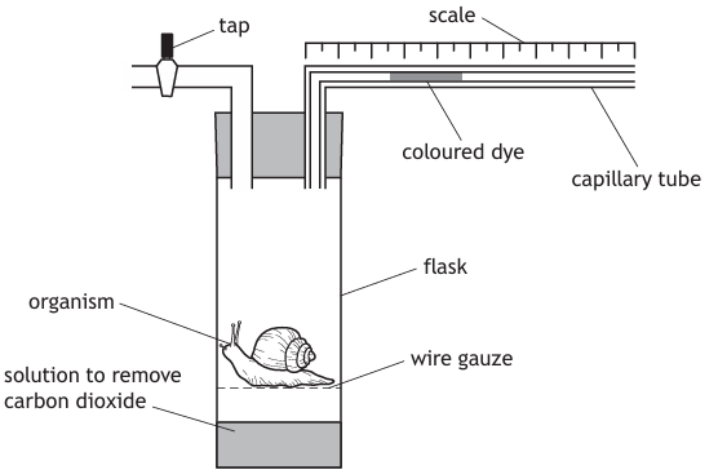
A yeast

B sunscreen

C yeast and no exposure to UV light

D sunscreen and no exposure to UV light.

3. An investigation was carried out to compare the rate of respiration of an organism at different temperatures. The apparatus was set up as shown.



The investigation was repeated at four different temperatures. The organism was left in the apparatus for 30 minutes at each temperature.

A suitable control for this investigation would be to use the same set up with

A more organisms

B a wider range of temperatures

C glass beads in place of organism

D no solution to remove carbon dioxide.

4. A student set up a test tube containing 5 cm^3 of milk and 1 cm^3 of the enzyme trypsin.

The milk became clear and the student concluded that the white milk protein had been broken down by trypsin.

To show that trypsin caused the milk to become clear, a control tube should contain

A 5 cm^3 of milk and 1 cm^3 of distilled water

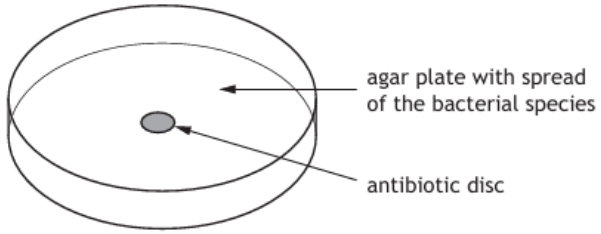
B 5 cm^3 of distilled water and 1 cm^3 of trypsin

C 5 cm^3 of boiled and cooled milk and 1 cm^3 of trypsin

D 5 cm^3 of boiled and cooled milk and 1 cm^3 of distilled water.

Controls

5. The effect of an antibiotic on a bacterial species was tested by spreading a culture of each of the bacterial species on agar plates and adding a disc of absorbent paper soaked in the antibiotic, as shown in the diagram below.



The plate was incubated for 24 hours at 30 °C and the growth examined.

Which of the following would be a suitable control for this experiment?

Repeat the experiment exactly but

A with no bacteria

B incubate at human body temperature

C use a disc with no antibiotic

D use a disc with a different antibiotic.

6 An investigation was carried out into the effect of dodder on blueberry yield. Blueberries from two fields, one of which was infected with dodder, were harvested and yields recorded.

The results are shown in the table.

Treatment	Average blueberry yield (kg per hectare)
Infected	18 000
Uninfected	22 500

Explain why the uninfected field is included as a control in this investigation. **1**

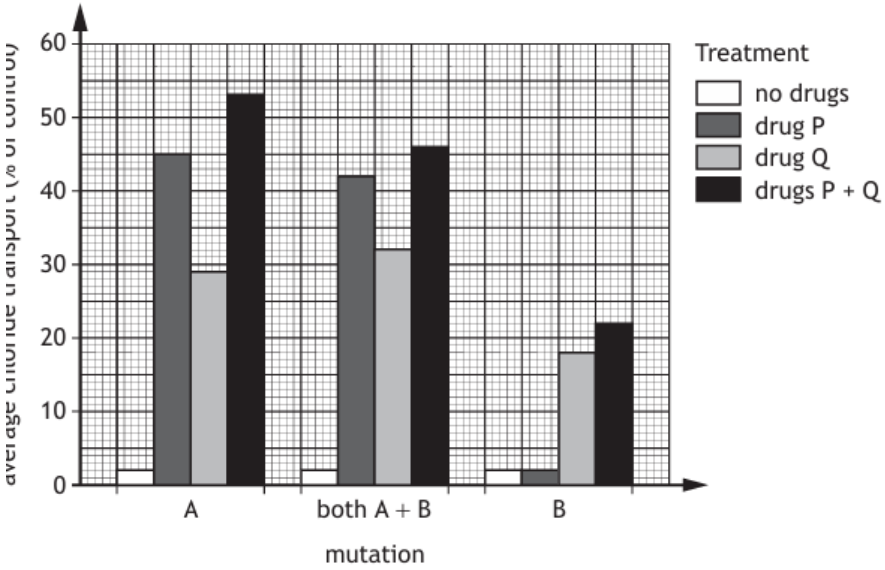
7 Cystic fibrosis in humans is caused by mutations in a gene that reduces chloride transport across the cell membrane.

An investigation was carried out to determine the effectiveness of two drugs, P and Q, on improving chloride transport in individuals with cystic fibrosis. Individuals with different mutations, A, B, and both A and B, were treated as follows.

- No drugs
- Drug P alone
- Drug Q alone
- Drug P and drug Q combined

Chloride transport across cell membranes was measured and compared to the chloride transport in a control group with no mutations in the gene.

The results are shown in the graph.



State the purpose of including a control group in this investigation. **1**

Controls

8 Cancer is a disease in which cell division is uncontrolled. Some anticancer drugs inhibit protein synthesis.

An experiment was carried out to compare the effect of two drugs, Y and Z, on protein synthesis in human cells.

Two different human cell cultures, HeLa and HL-60, were incubated with drugs Y and Z in liquid growth media at 35 °C.

HeLa cells + drug Y

HL-60 cells + drug Z

A range of concentrations of each drug were used and protein synthesis was measured.

The results are shown in the table.

Drug concentration (nM)	Protein synthesis (% of control)	
	Drug Y	Drug Z
0 (Control)	100	100
10	100	85
50	56	35
75	32	14
100	7	0

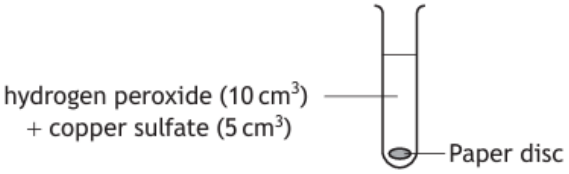
Drugs Y and Z were dissolved in a solvent before being added to the growth media.

Explain why this solvent would also have to be added to the control cultures. **1**

9 Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water. Paper discs soaked in catalase sink when placed into hydrogen peroxide solution. The discs rise to the surface when oxygen is produced. The time taken for the discs to rise can be used to measure catalase activity.

An experiment was set up to investigate the effect of copper sulfate concentration on catalase activity.

Six tubes were set up, each containing 10 cm^3 of hydrogen peroxide and 5 cm^3 of a different concentration of copper sulfate. One paper disc was then placed into each test tube as shown in the diagram. The time taken for each paper disc to rise to the surface was recorded.



The results are shown in the table.

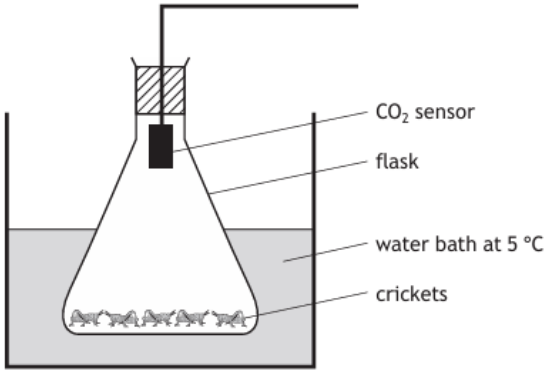
Concentration of copper sulfate solution (mol l^{-1})	*Time taken for paper disc to rise* (seconds)
0·2	8
0·3	12
0·4	15
0·6	18
0·8	19
1·0	20

Describe a suitable control for this experiment. **1**

Controls

10 An investigation was carried out to compare the rate of metabolism in a species of cricket, *Gryllus assimilis*, at different temperatures.

Five crickets were placed in a sealed flask which was fitted with a carbon dioxide (CO_2) sensor as shown in the diagram below.



The flask was placed in a water bath at 5 °C and left for 10 minutes.

The CO_2 produced per minute was then measured. This procedure was repeated at 10, 15, 20 and 30 °C.

The results are shown in the table below.

Temperature (°C)	*Rate of CO_2 production* (units per minute)
5	300
10	500
15	800
20	1200
30	1600

A control flask should be included in this investigation.

Describe the control and explain its purpose in the investigation. **2**

Description _____

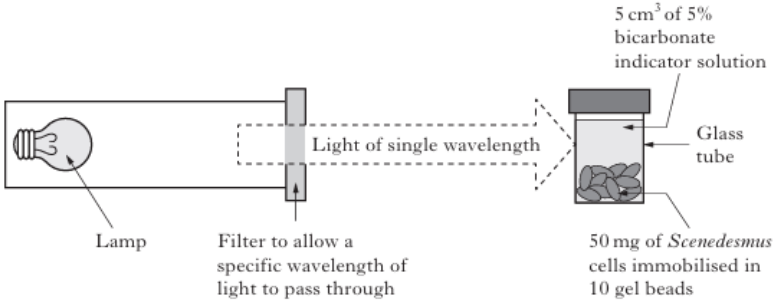
_____

Explanation _____

_____

11. Photosynthesis in algal cells can be measured by immersing them in bicarbonate indicator solution. The indicator solution gradually changes colour as carbon dioxide is removed from it by photosynthesis. This colour change can be measured by placing the solution in a colorimeter. The higher the rate of photosynthesis, the higher the reading on the colorimeter.

The effect of different wavelengths of light on rate of photosynthesis in *Scenedesmus*, an algal species which grows near the surface layers of fresh water lochs, was measured. The apparatus shown below was set up in a darkened room.



After one hour, the bicarbonate indicator was removed from the tube, placed in a colorimeter and a reading taken.

The experiment was carried out seven times using different filters, each of which allowed a single wavelength of light to pass through.

The results are shown in the table below.

Filter	*Wavelength of light passing through* (nanometres)	*Colorimeter reading* (units)
1	400	0·48
2	450	0·74
3	500	0·36
4	550	0·32
5	600	0·24
6	650	0·96
7	700	0·26

A control tube would be required for each wavelength of light being investigated.

Describe the contents of a suitable control tube.

_____

_____ **1**

Controls

12 An investigation was carried out into the effect of background rock music on the ability to recall words in a list.

Students of the same age were arranged into two groups of 20. At the same time of day, each group listened to a list of 10 words being read aloud.

While the words were being read out, one group was played rock music. After the words were read out the music was stopped, and each student was asked to write down the words they had heard.

The other group was a control group.

The results are shown in the tables.

Rock music group	
Position of word in list	**Number of students recalling word**
1	19
2	18
3	15
4	9
5	5
6	3
7	3
8	12
9	17
10	19

Control group	
Position of word in list	**Number of students recalling word**
1	20
2	19
3	17
4	12
5	7
6	6
7	6
8	14
9	19
10	20

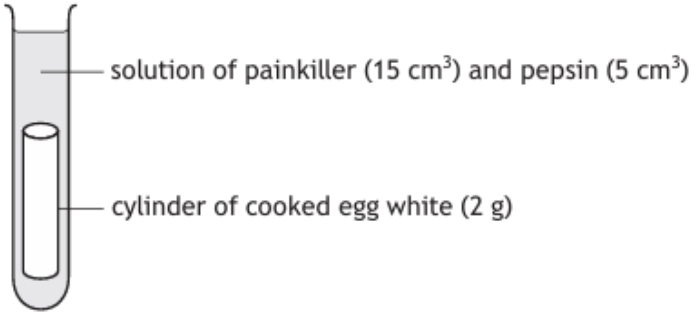
Describe the control that was set up for this investigation.

13 Some painkillers are recommended to be taken after a meal. However, painkillers can inhibit the action of digestive enzymes.

An investigation was carried out into the effect of different painkillers on the inhibition of the digestive enzyme, pepsin.

Cooked egg white is composed of protein, which can be broken down by pepsin.

Test tubes containing different painkiller solutions were set up as shown. A control test tube was also set up.



The test tubes were left for 24 hours at 37 °C and then the mass of egg white broken down was calculated.

The table shows the results of the investigation.

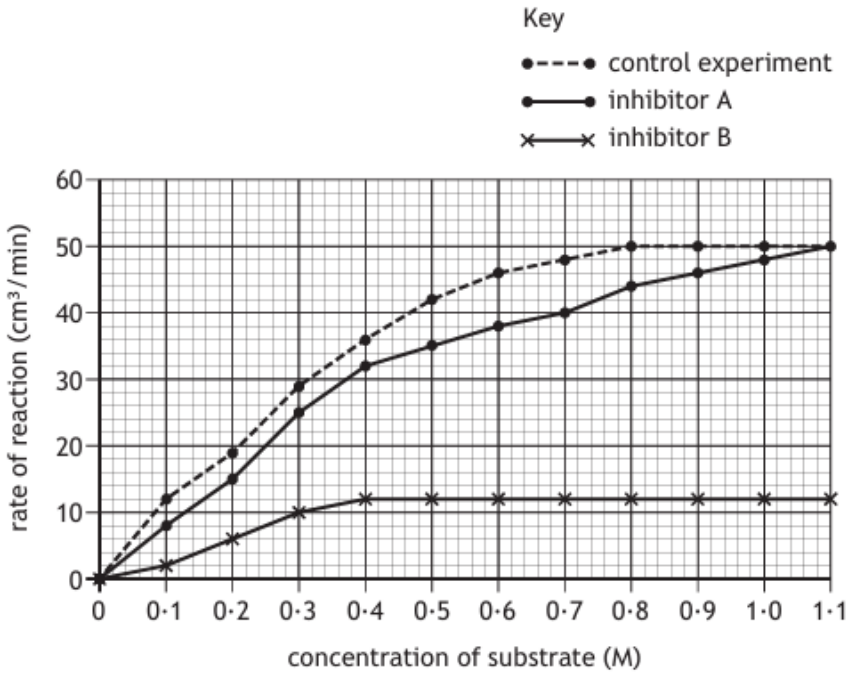
Painkiller	Mass of egg white broken down (g)
Paracetamol	1.4
Aspirin	1.1
Ibuprofen	1.3

Describe the contents of the solution in the control tube. **1**

Controls

14 An investigation was carried out to show the effect of two different inhibitors on the rate of a reaction, catalysed by an enzyme.

The graph shows the results of this investigation.



(a) Name the substances present in the control experiment. **1**

15 Statins are drugs which reduce the production of cholesterol in the liver. A year-long trial was carried out to investigate the effects of taking a newly-developed statin on blood cholesterol levels.

Sixty individuals with raised blood cholesterol levels were selected and divided into two groups of thirty.

Individuals in Group 1 were prescribed a capsule, containing 20 mg of the statin, to take each day. Individuals in Group 2 were the control group. At two-monthly intervals, blood samples were taken from all individuals and their blood cholesterol levels measured.

The results are shown in the table below.

	Average blood cholesterol level (mmol/l)	
Month of trial	Group 1	Group 2
0	6·3	6·3
2	6·3	6·3
4	6·3	6·1
6	6·3	6·3
8	5·6	6·1
10	5·3	6·2
12	5·1	6·1

Suggest what was prescribed to the individuals in Group 2 during this trial. **1**

Controls

16. An investigation was carried out to determine the effects of a distraction task on the ability to recall words in a list.

A group of 20 students listened to a list of words being read aloud.

Immediately after the last word had been read out, the students were distracted by being asked to recite the alphabet backwards from Z to A.

They were then asked to write down all the words from the list that they could remember.

The results of this investigation are shown in the table below.

Position of word in list	*Number of students remembering word*	*Position of word in list*	*Number of students remembering word*
1	20	11	2
2	19	12	3
3	18	13	4
4	17	14	2
5	15	15	3
6	10	16	4
7	8	17	3
8	6	18	3
9	4	19	2
10	3	20	3

A control group of students should have been used in this investigation.

Describe how the procedure used with the control group should differ from the procedure outlined.

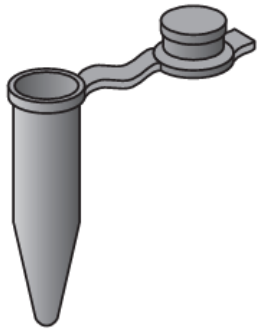
_____

_____ **1**

17. The diagram shows the contents of a tube used in PCR.

Contents of tube

— DNA
— DNA nucleotides
— primers
— enzyme and buffer



Describe the contents of a suitable control tube designed to show that primers are needed in the reaction. **1**

_____

_____

Controls Answers

1. B
2. B
3. C
4. A
5. C
6. To prove dodder affects blueberry yield.
7. To prove the drugs affect chloride transport.
8. To prove the solvent did not affect protein synthesis OR to prove only the drugs affected protein synthesis
9. Exact same set up but no copper sulfate and replace with same volume of water
10. Exact same set up but replace with dead crickets/glass beads

    To prove crickets affected the rate of metabolism
11. exact same set up but in the dark/no light
12. Exact same setup but no background music
13. Exact same setup but replace painkiller solution with same volume o f water
14. Enzyme + substrate + water
15. Exact same capsule but missing the statin active ingredient
16. Exact same set up but no distraction task
17. Exact same setup but no primers and replace with same volume of water.