

1 A virus called RSV causes severe respiratory disease.

(a) Suggest **two** precautions that a person with RSV could take to reduce the spread of the virus to other people.

1. _____

2. _____

(2)

(b) One treatment for RSV uses monoclonal antibodies which can be injected into the patient.

Scientists can produce monoclonal antibodies using mice.

The first step is to inject the virus into a mouse.

Describe the remaining steps in the procedure to produce monoclonal antibodies.

(3)

(c) Describe how injecting a monoclonal antibody for RSV helps to treat a patient suffering with the disease.

(2)

A trial was carried out to assess the effectiveness of using monoclonal antibodies to treat patients with RSV.

Some patients were given a placebo.

(d) Why were some patients given a placebo?

(1)

A number of patients had to be admitted to hospital as they became so ill with RSV.

The results are shown in the table below.

Treatment received by patient	% of patients within each group admitted to hospital with RSV
Group A: Monoclonal antibody for RSV	4.8
Group B: Placebo	10.4

The trial involved 1 500 patients.

- Half of the patients (group A) were given the monoclonal antibodies.
- Half of the patients (group B) were given the placebo.

(e) Calculate the total number of patients admitted to hospital with RSV during the trial.

Total number of patients admitted to hospital = _____

(2)

(f) Evaluate how well the data in the table above supports the conclusion:

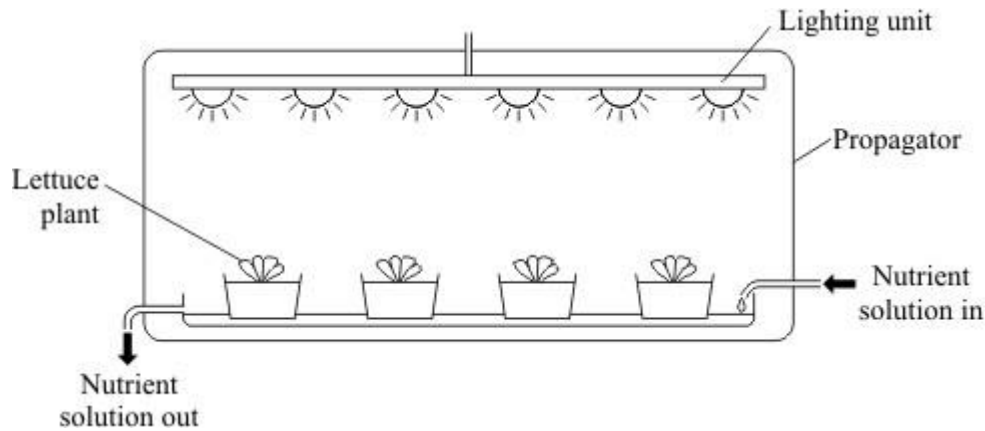
‘monoclonal antibodies are more effective at treating RSV than a placebo’.

(2)

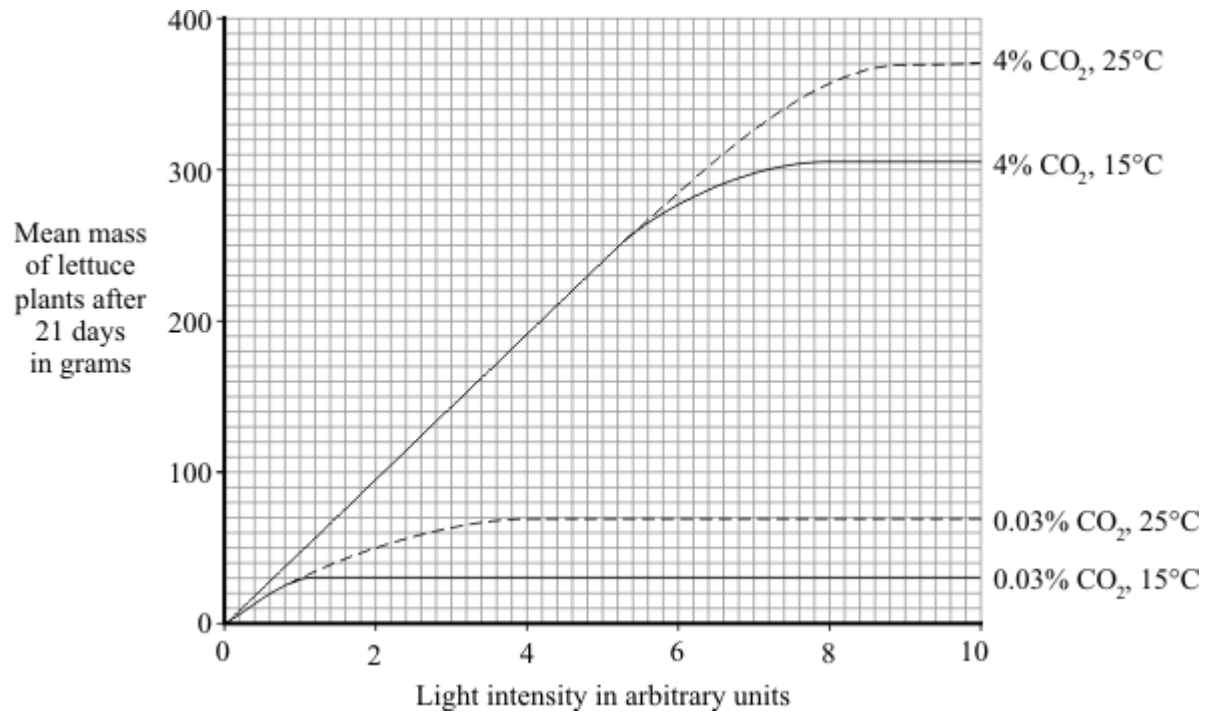
(Total 12 marks)

2 Changing the conditions in which plants grow affects how fast they grow.

The diagram shows a propagator in which scientists can control temperature, light intensity and carbon dioxide concentration.



The graph shows the effects of changing the temperature, light intensity and carbon dioxide concentration on the growth of lettuce plants.



- (a) Describe and explain the effect of increasing light intensity on the mean mass of lettuce plants at 4% carbon dioxide and 15 °C.

(3)

- (b) Growers wish to make maximum profits from their lettuces.

What do they need to consider before making decisions about the growing conditions for their lettuces?

(2)

(c) The nutrient solution contains nitrate ions and magnesium ions.

Complete the table to show the functions of these ions in plants and their deficiency symptoms.

Ion	Function in plants	Deficiency symptoms
Nitrate	_____	_____
	_____	_____
	_____	_____
Magnesium	_____	_____
	_____	_____
	_____	_____

(4)

(Total 9 marks)

3

A gardener is looking at the plants in his greenhouse.

(a) Some of the plants have a disease.

Give **two** ways the gardener could identify the pathogen infecting the plants.

1. _____

2. _____

(2)

(b) Plants can become unhealthy if they do not have essential mineral ions.

Describe the appearance of plants with:

- **nitrate** deficiency
- **magnesium** deficiency.

Nitrate deficiency _____

Magnesium deficiency _____

(2)

(c) Plants need other mineral ions.

- Potassium ions are needed for healthy root growth.
- Phosphate ions are needed for healthy flowers and fruits.

The gardener makes his own garden compost.

The percentage (%) of minerals in his compost was compared with two fertilisers he could buy.

The data are shown in the table below.

	Percentage (%) mineral content			
	Nitrate ions	Phosphate ions	Potassium ions	Cost in £ / kg
Garden compost	0.5	0.3	0.8	0.00
Fertiliser S	5.0	1.3	6.6	4.99
Fertiliser T	3.0	12.0	6.0	9.99

The gardener buys Fertiliser **S**.

Explain why he chose Fertiliser **S**.

(4)
(Total 8 marks)

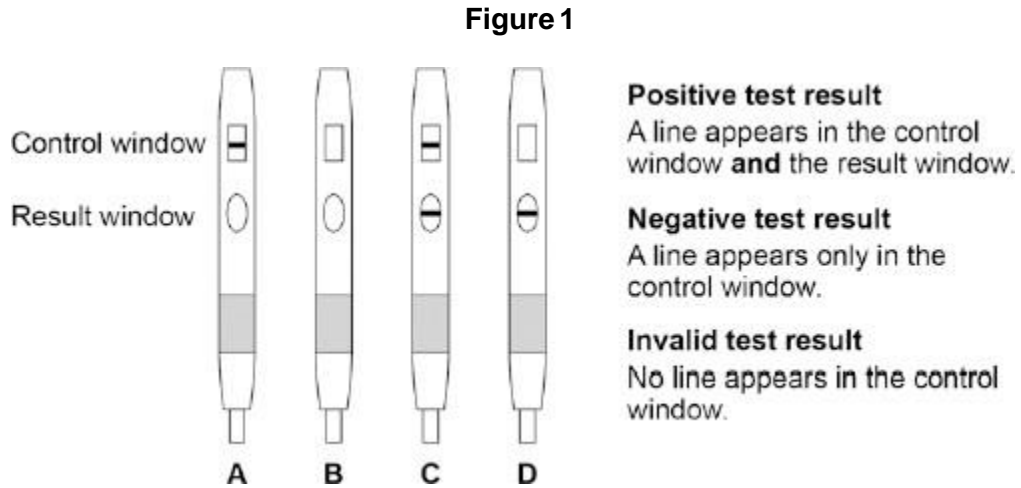
4

Monoclonal antibodies are used to measure the levels of hormones in the blood.

Pregnant women produce the hormone HCG.

HCG is excreted in urine.

Figure 1 shows four pregnancy test strips.



(a) Which test strip shows a negative test result?

Tick **one** box.

A **B** **C** **D**

(1)

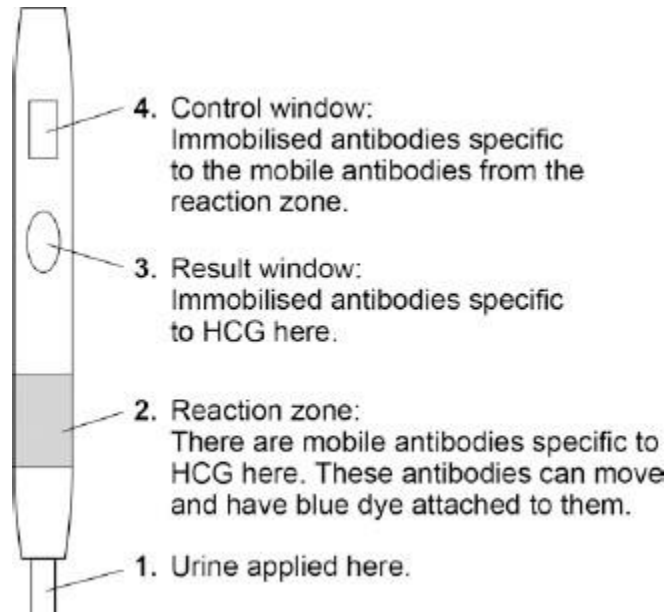
(b) Monoclonal antibodies are used for pregnancy testing.

Give **one other** use of monoclonal antibodies.

(1)

(c) **Figure 2** shows the parts of a pregnancy test strip.

Figure 2



The pregnancy test strip will show a positive test result when a woman is pregnant.

Explain how the pregnancy test strip works to show a positive result.

(6)
(Total 8 marks)

5

Some students investigated the effect of pH on the growth of one species of bacterium.

They transferred samples of bacteria from a culture of this species to each of eight flasks. Each flask contained a solution of nutrients but at a different pH.

After 24 hours, the students measured the amount of bacterial growth.

- (a) It was important that the flasks in which the bacteria grew were not contaminated with other microorganisms.

Describe **two** precautions the students should have taken to prevent this contamination.

1. _____

2. _____

(2)

- (b) To see the effect of pH on the growth of the bacteria, other conditions should be kept constant.

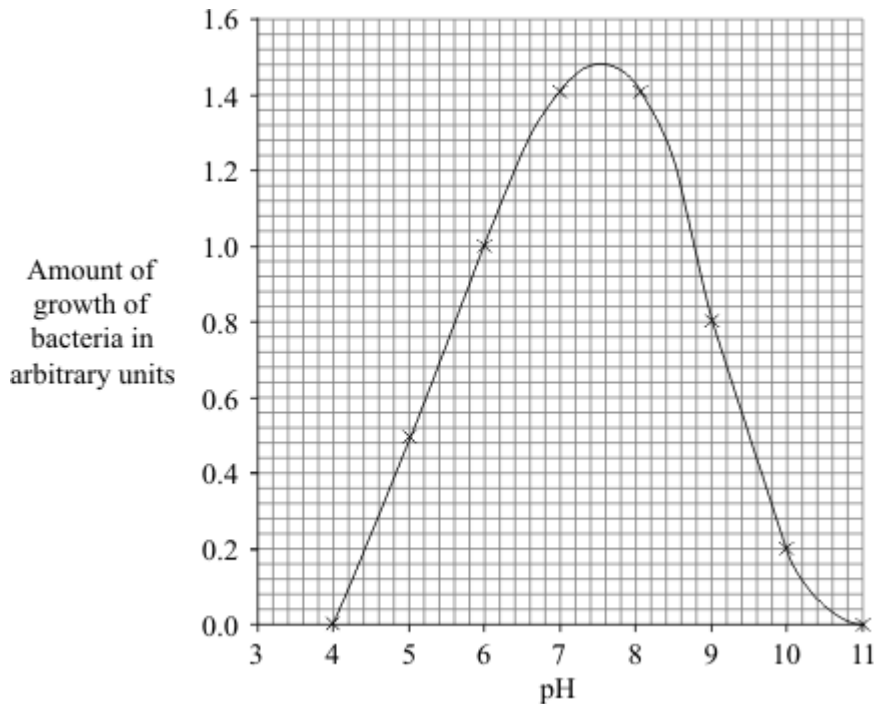
Suggest **two** conditions which should have been kept constant for all eight flasks.

1. _____

2. _____

(2)

- (c) The graph shows the results of the investigation.



The students wanted to find the best pH for the growth of this species of bacterium.

- (i) Use the graph to estimate the pH at which the bacteria would grow best.

pH _____

(1)

- (ii) What could the students do to find a more accurate value for the best pH for growth of the bacteria?

(1)

(Total 6 marks)

Mark schemes

- 1** (a) any **two** from:
- regular hand washing
 - **or**
use hand sanitiser / alcohol gel
 - cover nose / mouth when coughing / sneezing
allow wear a face mask
 - put used tissues (straight) in the bin
 - don't kiss uninfected people
allow isolate patient from others
- or**
- don't share cutlery / cups / drinks with uninfected people
- clean / disinfect / sterilise surfaces regularly
ignore responses referring to infected people
- 2
- (b) any **three** from:
- stimulate (mouse) lymphocytes to produce antibody
for marking points 1 and 2 lymphocyte must be used at least once
 - combine (mouse) lymphocyte with tumour cell
- or**
- (create a) hybridoma
- clone (hybridoma) cell
 - (hybridoma) divides rapidly **and** produces the antibody
- 3
- (c) any **two** from:
- (monoclonal) antibody binds to virus **or** antibody binds to antigen on surface of virus
 - (monoclonal) antibody is complementary (in shape) / specific to antigen (on surface of virus)
 - white blood cells / phagocytes kill / engulf the virus(es)
- 2
- (d) as a control
- or**
- to see / compare the effects of the treatment (vs. no treatment)
- 1
- (e) $(4.8 + 10.4) \div 2 \div 100 \times 1500$
- or**
- $(4.8 \div 100 \times 750) + (10.4 \div 100 \times 750)$
- 1
- 114
- an answer of 114 scores 2 marks*
- allow 228 for 1 mark*
- 1

- (f) **(supports the conclusion because)**
over double the number / % of patients (in the trial) were hospitalised with the placebo
(compared to MAB)

1

(does not support the conclusion because)

no information on patients not hospitalised / still unwell at home

or

other factors may have affected those admitted to hospital

allow correct named factor e.g. age / gender / other illness

or

don't know if it was a double blind trial

1

[12]

2

- (a) any **three** from:

- ((mean) mass) increases up to 7 / 8 units (of light) then levels off
- light limiting factor up to 7 / 8 units
- for photosynthesis
must be in correct context
- other factor / temperature limiting above 7 / 8 units

3

- (b) any **two** from:

- cost of providing conditions / heat / light / CO₂
- effect of treatment on profit
allow too much of factor is wasteful
- relevant use of data from graph eg limiting factors
- named other factors eg fertiliser / pest control / weeds / density of planting
allow taste / appearance

2

(c) **nitrate function**

produce amino acids / proteins / enzymes

ignore DNA

do not allow chlorophyll

1

nitrate deficiency

stunted growth

allow description

ignore plant dies

1

magnesium function

produce chlorophyll

ignore chloroplasts

1

magnesium deficiency

yellow leaves / plant

ignore plant dies

1

[9]

3

(a) compare them to (pictures in) a gardening manual / website

1

send to laboratory (for testing)

1

(b) (nitrate) stunted growth

1

(magnesium) yellowing of leaves

allow chlorosis

1

(c) (fertiliser **S**)

has most nitrogen for good growth

*if no other marks awarded allow 1 mark for (fertiliser **s**) has more minerals than compost*

1

(and) has high(est) potassium content for stronger roots

1

(it is also) cheaper than fertiliser **T**

1

(however) has less phosphate than fertiliser **T** (although more than compost) so flowers / fruit perhaps less important for the gardener

1

[8]

4 (a) **A**

1

(b) any **one** from:

- identify / locate specific molecules / other hormones
- locate blood clots
- diagnose / treat some cancers

1

(c) (as) urine passes through reaction zone

1

HCG hormone binds to the mobile HCG antibody (in the reaction zone)

1

(passes up the stick) HCG hormone binds to the immobilised HCG antibodies in the results zone

1

(the other) antibodies which do not attach to HCG

1

bind to antibodies in control zone

1

blue dye appears in both control and results zones (to show positive result)

1

[8]

5 (a) any **two** from:

- sterilise / kill microorganisms
ignore 'cleaning' / 'disinfect'
ignore 'germs'
- method of sterilisation eg apparatus / media sterilised in oven / autoclave
allow pressure cooker / boiling water
- pass flask mouth / pipette tip / loop / test tube mouth through flame
- work near a flame
- minimise opening of flask / test tube **or** hold non-vertical
*allow idea of sealing / covering **or** prevent entry of air*

2

(b) any **two** from:

- temperature
ignore references to time / type of bacterium
- concentration / amount of nutrients / ions
- type of nutrient
- volume / amount of solution
- amount of bacteria added
- agitation **or** amount of oxygen

2

(c) (i) 7.5

accept in range 7.4 – 7.6

1

(ii) use more pH values around / close to pH 7.5 / between 7 and 8

1

[6]