Cambridge Assessment International Education

Specimen Paper Answers

Paper 2: Theory

Cambridge O Level Biology

5090

For examination from 2023

Version 1

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge O Level Biology 5090, and to show examples of very good answers.

In this booklet, we have provided answers for all questions with examiner comments. These exercises require candidates to answer short-answer and structured questions and candidates are awarded maximum of 80 marks for this paper and the mark scheme provides the answers required to gain the marks.

Each question and answer is followed by an examiner comment on the candidate's answer. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could improve their answers and avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at **www.cambridgeinternational.org./support**

2023 Specimen Paper 2 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub www.cambridgeinternational.org/support

Assessment at a glance

The syllabus for Cambridge O Level Biology 5090 is available at www.cambridgeinternational.org

All candidates take three papers. Candidates will be eligible for grades A* to E.

Paper 1: Multiple Choice		And	Paper 2: Theory	
1 hour			1 hour 45 minutes	
40 Marks	30%		80 Marks	50%
40 four-option multiple-choice questions			Short-answer and structured questions	
Externally assessed			Externally assessed	

Practical assessment

Paper 3: Practical Test		Or	Paper 4: Alternative to Practical	
1 hour 30 minutes			1 hour	
40 Marks	20%		40 Marks	20%
Questions will be based on the experimental skills in Section 4			Questions will be based on the experimental skills in Section 4	
Externally assessed			Externally assessed	

Question 1

Question 1(a)

1 Digestion in the human digestive system is carried out by the action of enzymes.

(a) The diagrams each represent the action of a specific enzyme to break down a substrate into one or more end products.

Fig. 1.1 has been completed for you.

Complete Fig. 1.2 and Fig. 1.3.

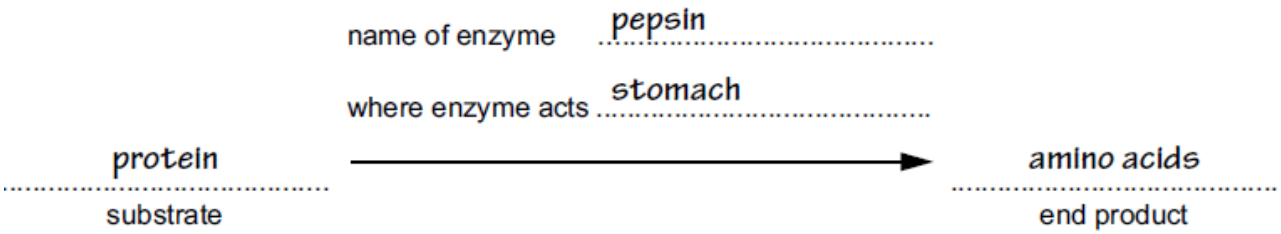

Fig. 1.1

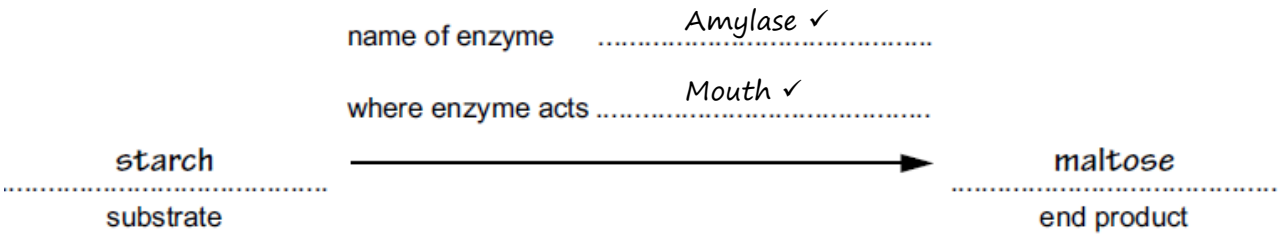

Fig. 1.2

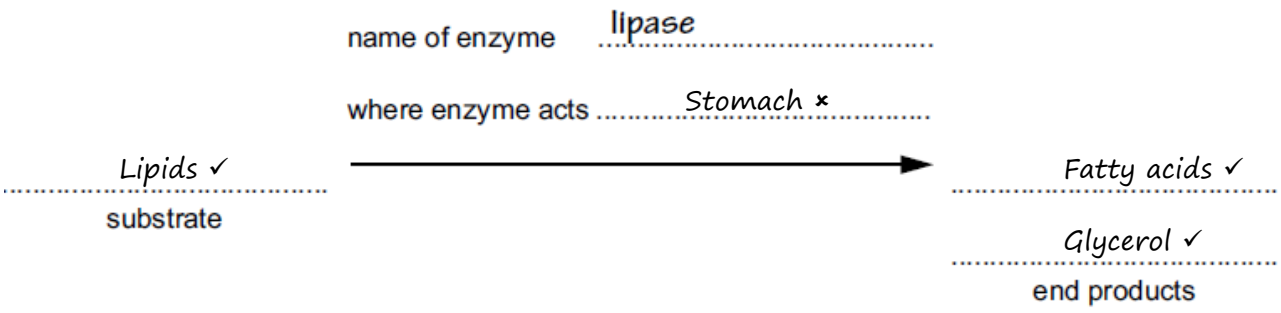

Fig. 1.3

Mark awarded = 5 out of 6

Examiner comment

The candidate has a good understanding of digestive enzymes and has been awarded 5/6 marks. The only mark not awarded is for stating that lipase acts in the stomach whereas it actually acts in the small intestine.

Common mistakes

Candidates commonly know the enzymes, their substrates and products but confuse their sites of action.

Question 1(b)

(b) Amino acids are the end products of protein digestion.

Describe what happens to these amino acids after digestion until they reach the liver.

After digestion the amino acids must be absorbed ✓ into the bloodstream ✓ so they can be transported around the body. The small intestine is lined with villi which increase the surface area for absorption into the capillaries ✓.

[4]

Mark awarded = 3 out of 4

Examiner comment

The candidate has clearly explained the absorption of amino acids and has been awarded 3 marks. Full marks would have been awarded if the candidate stated that amino acids diffuse into the capillaries or that amino acids are transported to the liver via the hepatic portal vein.

Common mistakes

Some candidates explain that amino acids are joined together to make proteins and then explain the roles of proteins. These answers cannot be credited because the question asks about what happens to amino acids after digestion until they reach the liver.

Total mark awarded = 8 out of 10

Question 2

Question 2(a)(i)

2 Fig. 2.1 shows the effect on crop yield (amount harvested) of using nitrogen-containing fertilisers.

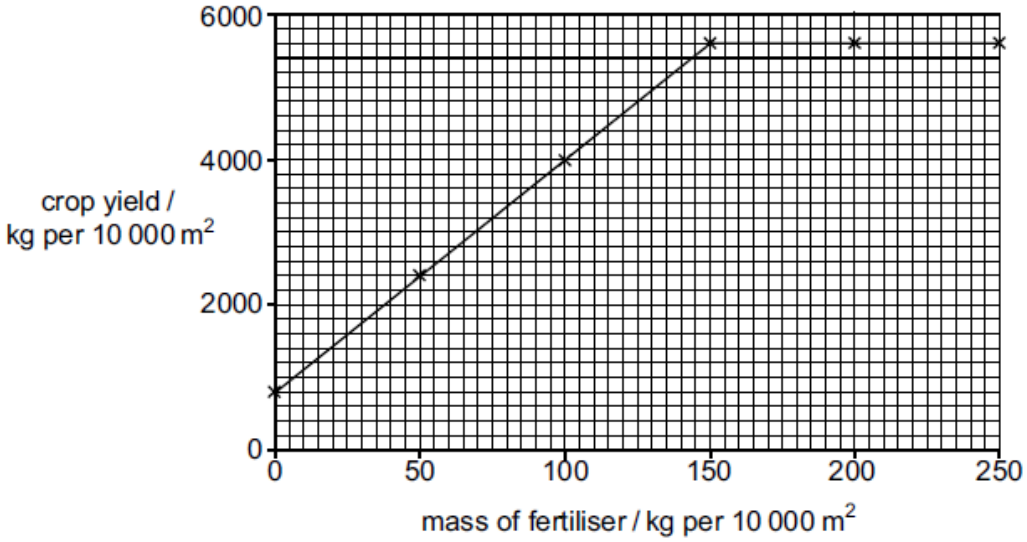

Fig. 2.1

(a) (i) Using the information in Fig. 2.1, describe the effect on crop yield of using an increasing mass of fertiliser.

As the mass of fertiliser increases, the crop yield increases ✓ proportionally.

After 150 kg / 10 000 m² ✓ the crop yield does not increase ✓ any further.

[3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has written a well-structured response and has used specific data quotes to illustrate their answers. The candidate has been awarded full marks but a useful addition would be to state that with no fertiliser the crop yield was 800 kg / 10 000 m².

Question 2(a)(ii)

(ii) The nitrogen in the fertiliser is in the form of nitrate ions.

Describe how the nitrogen in the fertiliser is absorbed by crop plants and used to give an increased crop yield.

Nitrate ions in the fertiliser are actively taken up by root hair cells ✓. Active transport ✓ uses energy from respiration and occurs up a concentration gradient. The nitrate ions are used to make amino acids ✓ which are then made into proteins.

..... [3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has clearly answered the question and been awarded full marks. The candidate did not link proteins to yield so a useful addition would be to state that increased proteins allow for increased cell division and growth.

Common mistakes

Candidates often read too quickly and miss parts of the question. This question asks for a description of absorption and how nitrogen gives an increased yield. Both aspects must be covered in a well-rounded answer.

Question 2(a)(iii)

(iii) Explain why a farmer may decide to use a mass of fertiliser per 10 000 m^2 which is less than that needed for a maximum crop yield.

Fertiliser is expensive ✓ and it may not be worth adding too much fertiliser if the crop isn't of much value ✓.

..... [3]

Mark awarded = 2 out of 3

Examiner comment

The candidate has been awarded 2 marks but has missed the opportunity of discussing the effect of fertilisers on the environment. Full marks could have been awarded for stating that fertilisers can run-off the land and cause eutrophication of lakes.

Common mistakes

Candidates should always take note of the number of marks. This question has 3 marks available and therefore 3 points must be made to be awarded full marks. This candidate has only made two points so cannot achieve full marks.

Question 2(b)

(b) State **one** type of mineral ion, other than nitrate, that is required by a plant and explain its importance to the plant.

type of mineral ion *magnesium* ✓

importance to plant *used to make chloroplasts* ×

[2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded 1 mark for recalling that magnesium ions are required by plants. The second mark could not be awarded because magnesium is needed to make chlorophyll not chloroplasts.

Common mistakes

Candidates should always take care with terminology, particularly when using similar terms such as chlorophyll and chloroplasts.

Total mark awarded = 9 out of 11

Question 3

Question 3(a)

3 DNA controls cell function by controlling the production of proteins.

These proteins determine the phenotype of an organism, including blood group in humans.

(a) Describe the structure of a DNA molecule.

DNA is a double stranded ✓ molecule. Each strand is made from nucleotides ✓ joined together. Nucleotides contain bases called A, G, C and T ✓.

[4]

Mark awarded = 3 out of 4

Examiner comment

The candidate has scored 3 but has not mentioned some important points that would have allowed full credit to be awarded. For instance, DNA is a double helix , bases in each strand pair with bases on the other strand and bases always pair the same way – A with T and C with G.

Common mistakes

Some candidates state that DNA is made from alleles or genes. These candidates have confused DNA structure with the role of DNA in gene expression.

Question 3(b)(i)

(b) One parent of a child has blood group B and the other parent has blood group A. The child has blood group O.

The parents decide to have another child.

(i) Complete the genetic diagram in Fig. 3.1 to show the possible blood groups for the second child of these parents.

genotypes of parents I^BI^O x I^AI^O ✓

gametes I^B I^O I^A I^O ✓

possible genotypes of child I^AI^B I^BI^O I^AI^O I^OI^O ✓

possible blood groups of child AB B A O ✓

[4]

Fig. 3.1

Mark awarded = 4 out of 4

Examiner comment

The candidate has fully understood the codominant inheritance of human blood groups.

Common mistakes

Candidates often use different symbols for the inheritance of blood groups and this makes it far more challenging when interpreting the genotypes. When answering questions on blood groups candidates should write the alleles as I^B, I^O, I^A and I^O.

Question 3(b)(ii)

(ii) State the probability that the second child of these parents:

has the same sex as the first child 50% ✓

has the same blood group as the first child 25% ✓

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has understood that inheritance is random and independent of previous results.

Common mistakes

Candidates often state 33% for the blood groups because they consider A, B and AB but forget about O.

Total mark awarded = 9 out of 10

Question 4

Question 4(a)(i)

4 Fig. 4.1 shows a photomicrograph of a pollen grain with a pollen tube growing from it.

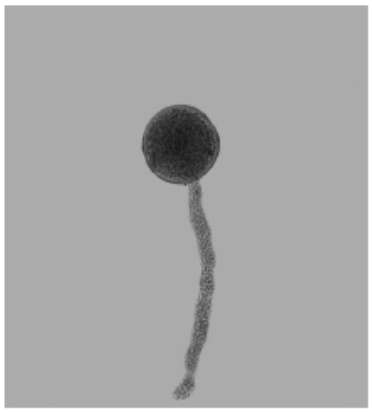

Fig. 4.1

A student placed pollen grains from the same type of plant in sucrose solutions of different concentrations for a fixed amount of time. After this time, the student used a microscope to examine the grains and tubes.

Table 4.1 shows the results of the investigation.

Table 4.1

% sucrose concentration	% of pollen grains germinated	mean pollen tube length / mm
1	6	0.005
2	13	0.008
4	25	0.015
8	56	0.040
10	31	0.030
20	25	0.018
40	13	0.006

(a) (i) A total of 12 pollen grains were placed in the 20% sucrose solution.

Using the information in Table 4.1, calculate the number of pollen grains that germinated to produce a pollen tube in the 20% sucrose solution.

In 20% sucrose 25% germinated so

25/100 x 12 = 3 ✓ ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly read the data and found that 25% of pollen grains germinated in 20% sucrose. They then calculated that 3 of the 12 would germinate.

Question 4(a)(ii)

(ii) Suggest why the **mean** pollen tube length was calculated for each sucrose concentration.

Calculating an average allows samples to be compared because it removes individual differences in growth. ✓ [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has realised that average values allow valid comparisons.

Common mistakes

Some candidates find it difficult to explain why averages are taken. In this experiment, the pollen tubes will grow to different lengths so taking an average gives a single value that is representative of the entire sample and allows comparison with other samples.

Question 4(a)(iii)

(iii) Using the information in Table 4.1, identify the optimum (best) concentration of sucrose solution for pollen grain germination and pollen tube growth.

8 ✓% [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has correctly found the sucrose concentration that has the highest percentage germination and the greatest mean pollen tube length.

Question 4(a)(iv)

(iv) Explain how you used the information in Table 4.1 to answer **(a)(iii)**.

The optimum sucrose concentration is the one that produces the highest percentage germination ✓ *and the greatest mean pollen tube length.* ✓ [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has clearly explained how they found the optimum concentration.

Common mistakes

Some candidates select the correct concentration in (a)(iii) and explain that they either use the percentage germination or the mean pollen tube length, rather than both as is asked in the question.

Question 4(a)(v)

(v) The germination of a pollen grain requires the movement of water into the pollen grain to form a pollen tube.

Suggest why placing a pollen grain in a solution with a higher sucrose concentration than in your answer to **(a)(iii)** may result in a lower percentage of germination.

If the sucrose concentration is too high, water will move out ✓ of the pollen grain so the cells will become flaccid.

[3]

Mark awarded = 1 out of 3

Examiner comment

The candidate has made a basic explanation but has missed some important details. For instance, they could have stated that water moves out by osmosis and that the water moves down a water potential gradient.

Common mistakes

Candidates often understand what a question is asking but miss the key points that allow marks to be awarded. Careful use of scientific terminology is always beneficial.

Question 4(b)

(b) Describe the route taken by a growing pollen tube in a plant **and** explain the importance of this route in plant reproduction.

The pollen lands on the sticky stigma ✓ and the pollen tube grows down to the ovary ✓. This allows fertilisation ✓ to occur.

[4]

Mark awarded = 3 out of 4

Examiner comment

The candidate has been awarded 3 marks but has missed some important points that would have given a much stronger answer. For instance, the pollen tube grows down through the style, growth brings the male and female gametes close together and this allows fusion of the gametes.

Common mistakes

Questions worth several marks often have two aspects that must be discussed. In this question, candidates must describe the route and explain the importance if they are to gain full marks.

Total mark awarded = 9 out of 12

Question 5

Question 5(a)

5 Compare each of the following processes:

(a) aerobic respiration and anaerobic respiration

Aerobic and anaerobic respiration both use glucose ✓ to release energy. Aerobic uses oxygen. Anaerobic produces less energy ✓ than aerobic.

[3]

Mark awarded = 2 out of 3

Examiner comment

The candidate has been careful to make two direct comparisons and has been awarded 2 marks. However, they did not state that anaerobic does not use oxygen so could not be awarded a third mark despite knowing that aerobic respiration uses oxygen. The candidate uses the phrase 'energy is produced', this should be avoided and would be much better stated as 'energy is released'.

Common mistakes

Candidates often write about aerobic respiration and then write about anaerobic respiration. This style of answer is unlikely to be awarded high marks as the question requires a comparison to be made.

Question 5(b)

(b) anaerobic respiration in muscles and anaerobic respiration in yeast

Both use glucose ✓ to release energy. Both do not use oxygen. In muscles carbon dioxide × and water is formed whereas in yeast alcohol ✓ is formed.

[3]

Mark awarded = 2 out of 3

Examiner comment

The candidate has incorrectly stated that carbon dioxide is formed during anaerobic respiration in muscles. The correct product is lactic acid. To achieve full marks the candidate could have added that anaerobic respiration in yeast produces carbon dioxide gas or that anaerobic respiration in muscles builds up an oxygen debt.

Common mistakes

The types of respiration are commonly confused by candidates. It may benefit candidates to write the word, or chemical, equations in their answers as it may help focus their response.

Question 5(c)

(c) photosynthesis and phototropism.

Photosynthesis uses light whereas phototropism detects light. Photosynthesis uses chlorophyll whereas phototropism uses auxin ✓. Photosynthesis makes glucose ✓ whereas phototropism causes cells to grow.

[4]

Mark awarded = 2 out of 4

Examiner comment

The candidate has made some good points but has missed details that would have been awarded additional marks. Phototropism isn't just detecting light, it is growth in response to light. Phototropism causes cells to elongate and the stem to grow towards (or away from) the light, both growth and direction are required to be awarded a mark.

Common mistakes

Candidates often miss low-demand marks because they overlook them. In this question, the candidate didn't state that both processes occur in plants.

Candidates often find describing the effect of auxin challenging. In a stem which is positively phototropic, auxin causes cells on the shaded side of the stem to elongate and hence stem growth is towards the light.

Total mark awarded = 6 out of 10

Question 6

Question 6

6 The statements **E** to **K** relate to the process of reproduction.

E produces genetically identical offspring

F produces more individuals of the same species

G always involves only one parent

H involves fusion of nuclei

I requires gametes

J forms a diploid zygote

K involves only cell division by mitosis

Table 6.1 shows a comparison of sexual and asexual reproduction.

Complete Table 6.1 by writing each letter in the correct box to match it to sexual reproduction only, asexual reproduction only, or to both.

The first letter has been written in the correct box for you. Use each letter **once** only.

Table 6.1

sexual reproduction only	asexual reproduction only	both sexual and asexual reproduction
H✓ I ✓ J ✓	E E ✓ G ✓ F × K ✓	

[6]

Mark awarded = 5 out of 6

Examiner comment

The candidate has put statement F into the asexual reproduction only category, perhaps confusing 'producing more individuals' with 'producing more identical individuals'.

Common mistakes

When completing tables, it is essential that the headings are read carefully. Occasionally candidates write their answers in the wrong column and cannot be credited.

Total mark awarded = 5 out of 6

Question 7

Question 7(a)

7 Organisms can be classified into groups by the features they share.

(a) State **two** features used to classify humans as mammals.

1 *hair* ✓

2 *mammary glands* ✓

[2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded full marks. Other suitable characteristics include warm blooded or a four-chambered heart.

Common mistakes

In classification questions it is important to check if they question specifies internal or external features. This question doesn't specify so both internal and external features can be stated.

Question 7(b)

(b) The scientific name for humans is *Homo sapiens*.

State the level of classification referred to by each part of the scientific name:

Homo *family* ×

sapiens *species* ✓

[2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded 1 mark because they incorrectly stated that *Homo* is the family name rather than the genus name.

Common mistakes

Candidates often know the terms genus and species but reverse them when applying them to a named species.

Question 7(c)

(c) Humans may be infected with pathogens such as viruses.

State the **two** main features of a virus.

1 *cell wall* ×

2 *plasmids* ×

[2]

Mark awarded = 0 out of 2

Examiner comment

The candidate has confused viruses with bacteria and has stated two correct features of bacteria rather than viruses. Suitable features of viruses include protein coat and genetic material.

Common mistakes

The candidate has displayed they know the features of organisms but has mistakenly stated bacterial features rather than viral. At the end of the examination it's always beneficial reading through answers to check for simple mistakes such as this.

Question 7(d)(i)

(d) Fig. 7.1 shows a sample of human blood as seen under a microscope.

In Fig. 7.1 one cell is labelled **X**. Cells of this type produce antibodies.

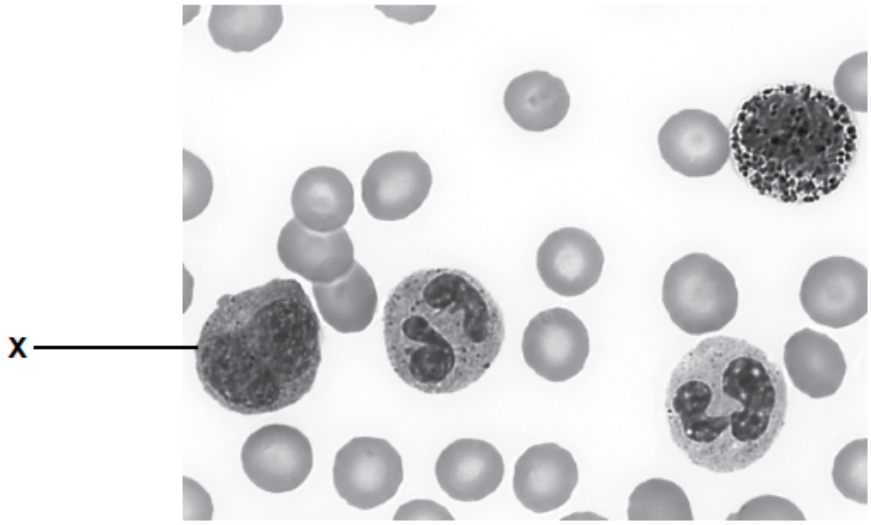

Fig. 7.1

(i) Outline how the type of cell labelled **X** defends the body against infection by a pathogen.

Cell X is a white blood cell. Pathogens have antigens ✓ on their surface that are recognised as being foreign. Antibodies bind to the antigens ✓ and mark the pathogen for phagocytosis ✓.

[4]

Mark awarded = 3 out of 4

Examiner comment

The candidate clearly understands this immune response. Cell X was referred to as a white blood cell, which is correct, but the term lymphocyte is much more precise and would have been credited with a mark. Stating that each type of antibody is specific to a particular antigen due to the complementary binding of antigen-antibody would also have been credited.

Common mistakes

Candidates often understand the general details of an immune response but do not include sufficient detail in their answers or use incorrect terminology. For instance, saying that antibodies attack pathogens isn't accurate enough to be credited. Stating that, antibodies bind to sites on pathogens called antigens, this binding is specific due to the complementary shape of the antibody and antigen, would gain 3 marks.

Question 7(d)(ii)

(ii) Infection causes the type of cell labelled **X** to produce antibodies.

State **one** other cause of antibody production.

Being given a vaccination ✓ ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate understands that being given a vaccine, which is part of the pathogen or a weakened form of the pathogen, causes antibody production.

Total mark awarded = 7 out of 11

Question 8

Question 8(a)

8 (a) Explain the concept of control by negative feedback.

Negative feedback is a process that attempts to reverse ✓ a change. For instance, if body temperature ✓ increases this is detected ✓ by the hypothalamus ✓ which in turn causes the body to lower the temperature by sweating or vasodilation. ✓

[4]

Mark awarded = 4 out of 4

Examiner comment

The candidate has made 5 points that would gain credit so scores a maximum mark. Credit could also have been gained from stating that communication, such as nervous impulses or hormones, must occur. Stating that homeostasis aims to keep conditions stable or at a set level, would have been another good way of describing homeostasis.

Common mistakes

Candidates often describe an example of negative feedback rather than explaining the concept. This frequently means they will gain partial marks but rarely full marks. An ideal answer would explain the general concept and illustrate it with specific examples.

Question 8(a)

(b) Describe how **two named** components of the skin are involved in regulating body temperature in **hot** conditions.

Fur ✓ insulates the body by trapping air. When the body is too warm the erector muscles relax and cause fur to lay down ✓, releasing air and trapping less heat ✓. Blood vessels near the surface of the skin dilate ✓ and this takes more blood ✓ to the skin so heat ✓ can be lost. [6]

Mark awarded = 6 out of 6

Examiner comment

The candidate has chosen two suitable components and described how they lower body temperature. The quality of the response could have been improved by adding additional details. For instance, stating that the blood vessels are capillaries or that heat radiates from the skin would have ensured full credit.

Common mistakes

Candidates often write general descriptions of how the body can cool down in hot conditions but miss the fact that the question asks for how two named components regulate temperature.

Total mark awarded = 10 out of 10

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554
e: info@cambridgeinternational.org www.cambridgeinternational.org