



Oxford Cambridge and RSA

Level 3 Alternative Academic Qualification Cambridge Advanced National in Human Biology

H049/H149 Unit F170: Fundamentals of human biology

Sample Assessment Material (SAM)

Time allowed: 1 hour 15 minutes

XXX/XXXX

You must have:

- a ruler (cm/mm)

You can use:

- a scientific or graphical calculator

Please write clearly in black ink. Do not write in the barcodes.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

First name(s)

Last name

Date of birth

D	D	M	M	Y	Y	Y	Y
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INSTRUCTIONS

- Use black ink.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- In the live exam there might be lined pages at the end of the question paper for you to use if you need extra space. Remember, you must clearly show the question numbers.
- Answer **all** the questions.

INFORMATION

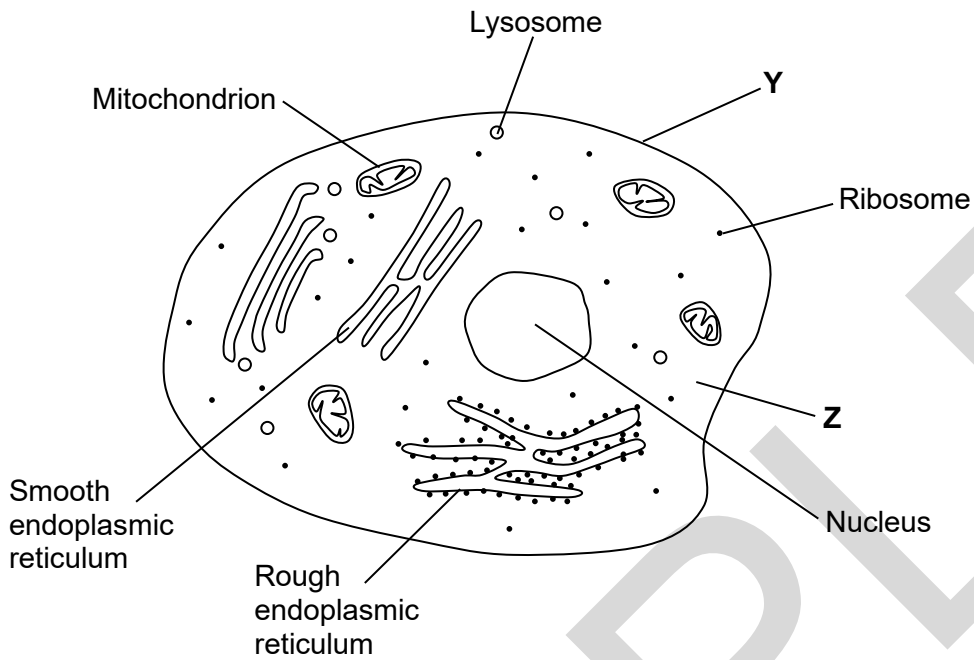
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- This document consists of **16** pages.

ADVICE

- Read each question carefully before you start your answer.

Answer **all** the questions.

- 1 The diagram below shows a generalised model of a human cell. The diagram is **not** drawn to scale and two of the labels are incomplete.



(a)

- (i) Identify Y and Z from the diagram.

Y

Z

[2]

- (ii) Outline **two** ways the smooth endoplasmic reticulum supports the production of organelles in the cell.

1

.....

2

.....

[2]

- (iii) Ribosomes are found freely throughout the human cell and are attached to the rough endoplasmic reticulum.

The diagram does **not** show the other location of ribosomes.

Which structure is also known to contain ribosomes?

Tick (✓) **one** box.

Lysosome

Mitochondrion

Nucleus

Smooth endoplasmic reticulum

[1]

- (b) Many cells are highly specialised. These cells often originate from stem cells found in different locations in the adult human body. One location is in bone marrow.

- (i) State **one other** location for stem cells in the adult human body.

..... [1]

- (ii) Outline **two** advantages of using adult stem cells to produce new red blood cells in a laboratory.

1

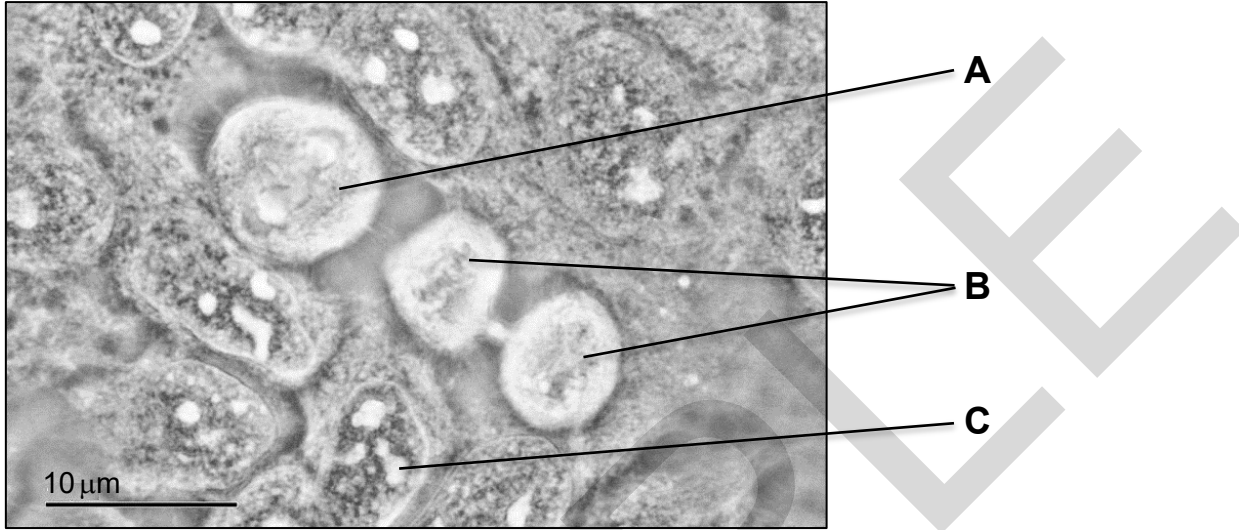
2 [2]

2 Human cancer cells divide rapidly by mitosis.

Cancer cells undergoing mitosis can be observed in a tissue sample using a light microscope.

The percentage of cancer cells dividing can be calculated over time to indicate the stage of cancer development.

The photomicrograph shows some cells undergoing mitosis within cancerous tissue.



- (a) (i) Using the photomicrograph, identify **one** advantage and **one** disadvantage of using a light microscope for this observation.

Advantage

.....

Disadvantage

.....

[2]

- (ii) The photomicrograph displays a bar line to represent 10 μm.
Calculate the magnification of the image using this information.

Use the equation: magnification = $\frac{\text{image size}}{\text{actual size}}$

Magnification = × [2]

(b) Identify the stages of mitosis shown at **A** and **B** in the photomicrograph.

Explain **one** reason for each choice.

Stage of mitosis at **A**.....

Explanation

.....

Stage of mitosis at **B**

Explanation

.....

[4]

SAMPLE

- 3** An athlete has broken the radius bone in their arm.
Surgery will be required to hold the two parts of the bone together.

(a)

- (i)** The bone will reform as different components migrate across the adjacent surfaces between the two parts.

Which **two** components must migrate across the adjacent surfaces?

Tick (✓) **two** boxes.

Erythrocytes

Fibrocytes

Hepatocytes

Muscle cells

Osteocytes

[2]

- (ii)** Blood vessels grow between the two parts of the damaged radius bone to deliver essential molecules and ions needed to form new bone tissue.

Complete the sentences.

The blood supply delivers oxygen needed to carry out aerobic respiration.

The reforming bone tissue also needs ions to form the matrix.

Bone growth is energy demanding. The blood supply delivers molecules
as an energy source.

[2]

4 A 6-year-old child has a hole in the septum of their heart between the two ventricles.

This condition is known as a ventricular septal defect (VSD).

(a)

(i) The VSD can be diagnosed by observing a number of symptoms.

Three different physiological tools can be used to aid this diagnosis.

Complete the table to match the physiological tool used to show each of the symptoms of the VSD.

Symptom of the VSD	Physiological tool
Abnormal heartbeat
Hole in the septum between the ventricles of the heart
Rapid breathing

[3]

(ii) Outline **one** potential impact of having a ventral septal defect to health.

..... [1]

(iii) Identify what will happen to the child's pulmonary ventilation rate (PVR) if their breathing rate increases.

..... [1]

(b)

(i) If not treated, a VSD may lead to a higher pressure of blood delivered at the lungs. This results in a condition called pulmonary resistance.

Pulmonary resistance can be measured using a peak flow meter.

The following instructions were provided to patients on a leaflet with the meter.

- Move the marker to the bottom of the numbered scale.
- Take a deep breath to fill your lungs.
- Blow out as hard as you can in a single blow.
- Write down the number you get.
- Repeat the set of steps 2 more times.

Explain **two** improvements that are necessary to ensure an accurate reading is taken.

Improvement 1

Explanation

.....

Improvement 2

Explanation

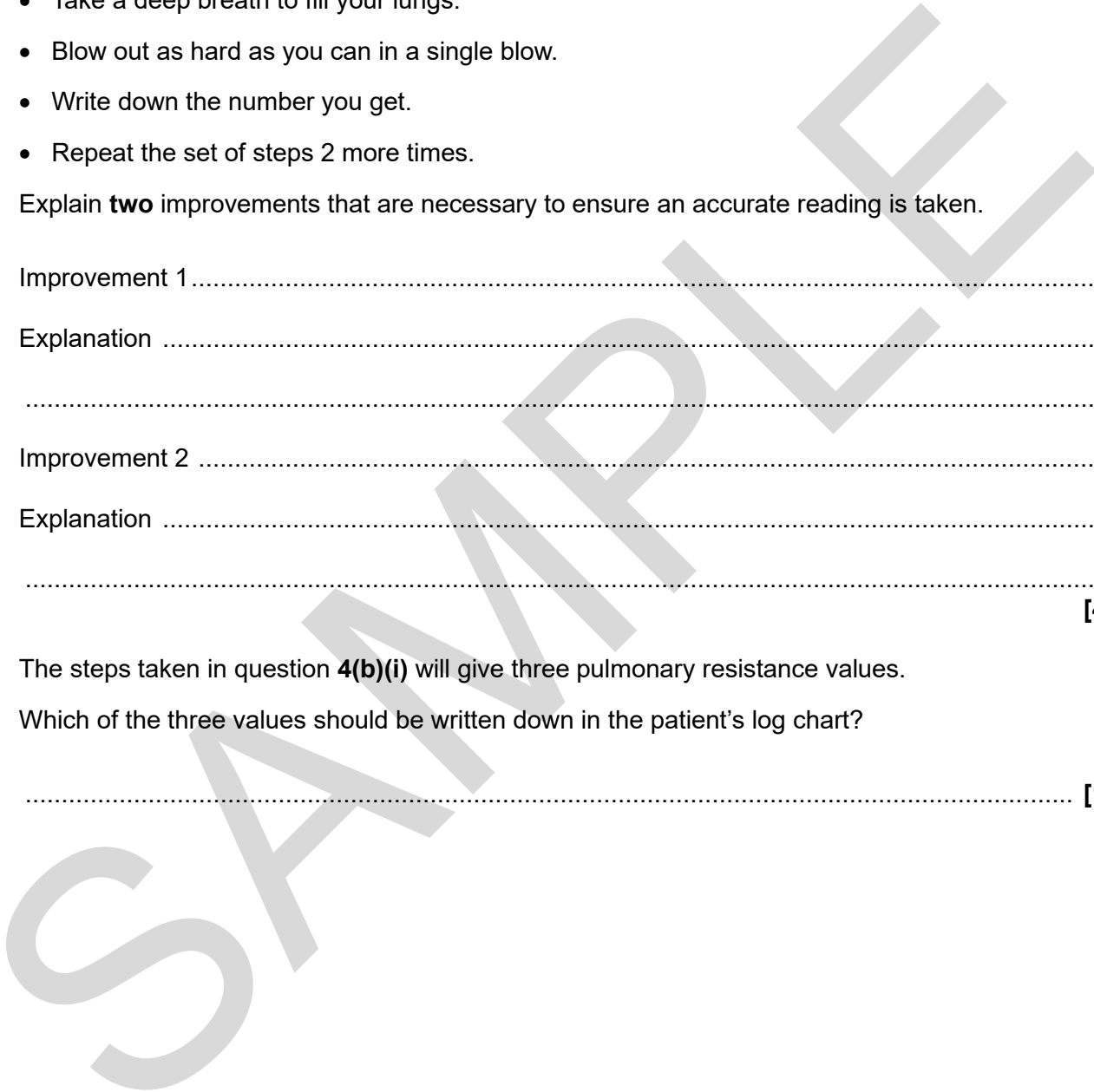
.....

[4]

(ii) The steps taken in question **4(b)(i)** will give three pulmonary resistance values.

Which of the three values should be written down in the patient's log chart?

..... **[1]**



5

(a) Hormones are produced in endocrine glands.

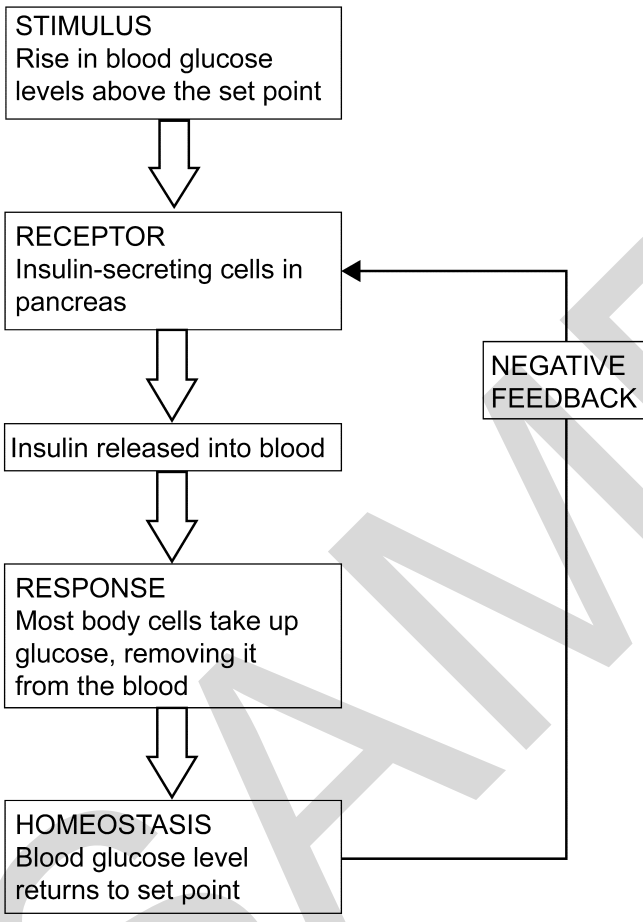
Describe how hormones control different parts of the body.

.....

.....

..... [2]

(b) The homeostasis model summarises the steps involved in the regulation of glucose.



(i) Using the model above, explain how negative feedback affects the release of insulin from the insulin-secreting cells.

.....

.....

.....

..... [2]

(ii) Outline why negative feedback is an essential part of glucose regulation.

.....
 [1]

(c)

(i) The table below shows the classification of non-diabetic, pre-diabetic and type 2 diabetic patients based on their blood glucose levels.

Classification	Blood glucose levels 2 hours after food (mg/dl of blood)	Blood glucose levels 12 hours after food (mg/dl of blood)
Non-diabetic	70-99	<140
Pre-diabetic	100-125	140-199
Type 2 diabetes	126	200

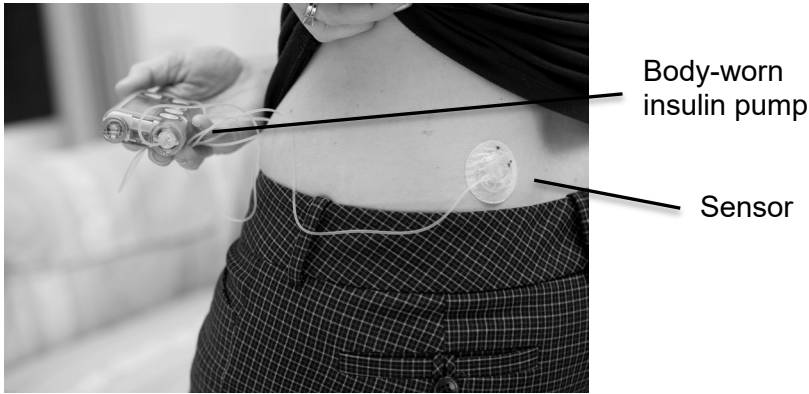
A patient has their blood glucose measurement taken. Their blood glucose levels 2 hours after food is 105 (mg/dl of blood).

Calculate the percentage by which this patient's blood glucose concentration 2 hours after food is higher than the upper limit for normal concentration.

Give your answer to an appropriate number of significant figures.

..... [2]

- (ii) Research has led to the production of an automated tool, commonly called the artificial pancreas, to regulate **type 1** diabetes. The tool uses a hybrid closed loop system, as shown in the image.



- A sensor is attached to the body of the patient to monitor blood glucose levels.
- The 'set point' for the patient is programmed into a body-worn insulin pump.
- The sensor transmits data to the pump.
- The data is used to calculate how much insulin is needed by the patient.
- The pump is charged by a battery cell and delivers insulin into the patient's blood.

Explain **one** advantage of using an artificial pancreas.

.....

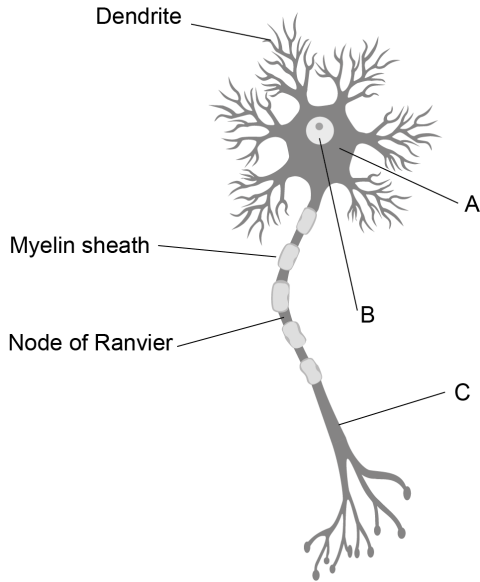
.....

..... [2]

6 A trainee doctor is studying multiple sclerosis (MS).

The trainee is already aware that this condition involves a change in the structure and function of neurons in the body.

(a) The course tutor shows the trainee a diagram of a motor neuron affected by MS.



(i) Identify structures **A**, **B** and **C** in the diagram.

A

B

C [3]

(ii) Outline the changes to the myelin sheath causing MS.

.....

.....

..... [2]

(iii) State the impact of the changes to the myelin sheath on the transmission of impulses along the motor neuron.

.....

..... [1]

(b) The trainee is exploring the overall effect of MS on the spinal reflex arc.

State **one other** type of neuron commonly found in the spinal reflex arc, **not** including the motor neuron.

..... [1]

7 A team of research scientists are culturing bacteria extracted from the large intestine of a patient.

(a) Explain **two** roles of a Bunsen burner when culturing bacteria.

1

.....

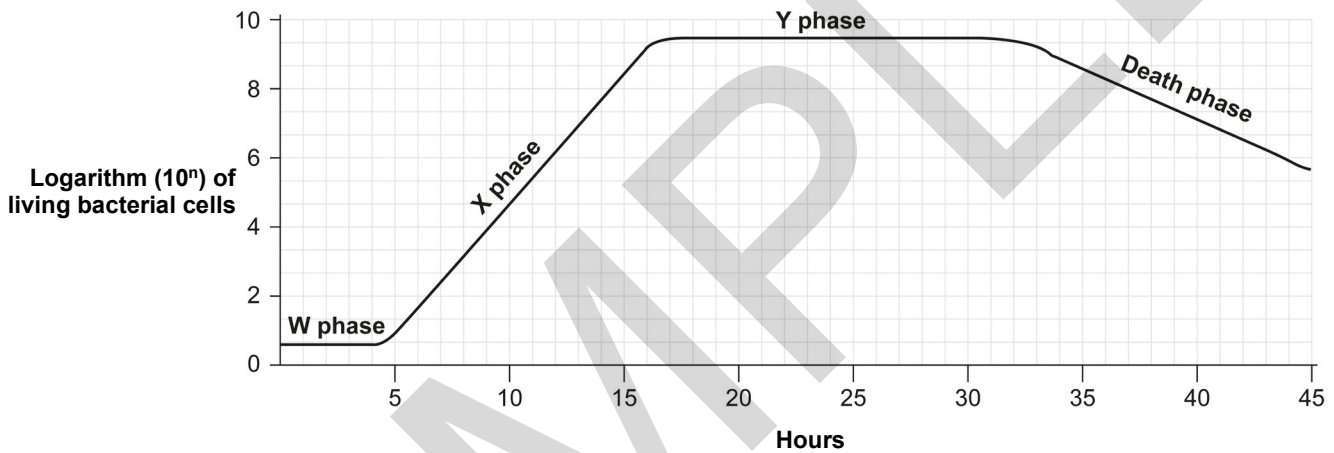
2

.....

[2]

(b) A specific type of bacteria in the sample is cultured in a container of nutrient broth. Changes in the bacteria population are recorded over a period of 45 hours.

The results of the study are shown in the graph.



(i) What is the increase in logarithm (10ⁿ) of living bacterial cells recorded between phases **W** and **Y**?

Increase in logarithm (10ⁿ) of living cells = [1]

(ii) State the names of the **W** phase and **Y** phase.

W phase

Y phase

[2]

(iii) Under optimum conditions in the phase labelled **X** on the diagram, bacteria in the container reproduce rapidly by binary fission.

Calculate the rate of change during the **X** phase.

rate of change = [2]

(c)

- (i) The research scientists have shown that many of the bacteria found in the large intestine are beneficial to human health and wellbeing.

The beneficial bacteria can produce antimicrobial peptides (AMP) or proteins, which disrupt the cell walls of disease-causing bacteria.

Explain how bacteria in the biome carry out their beneficial activities.

.....

.....

.....

.....

.....

.....

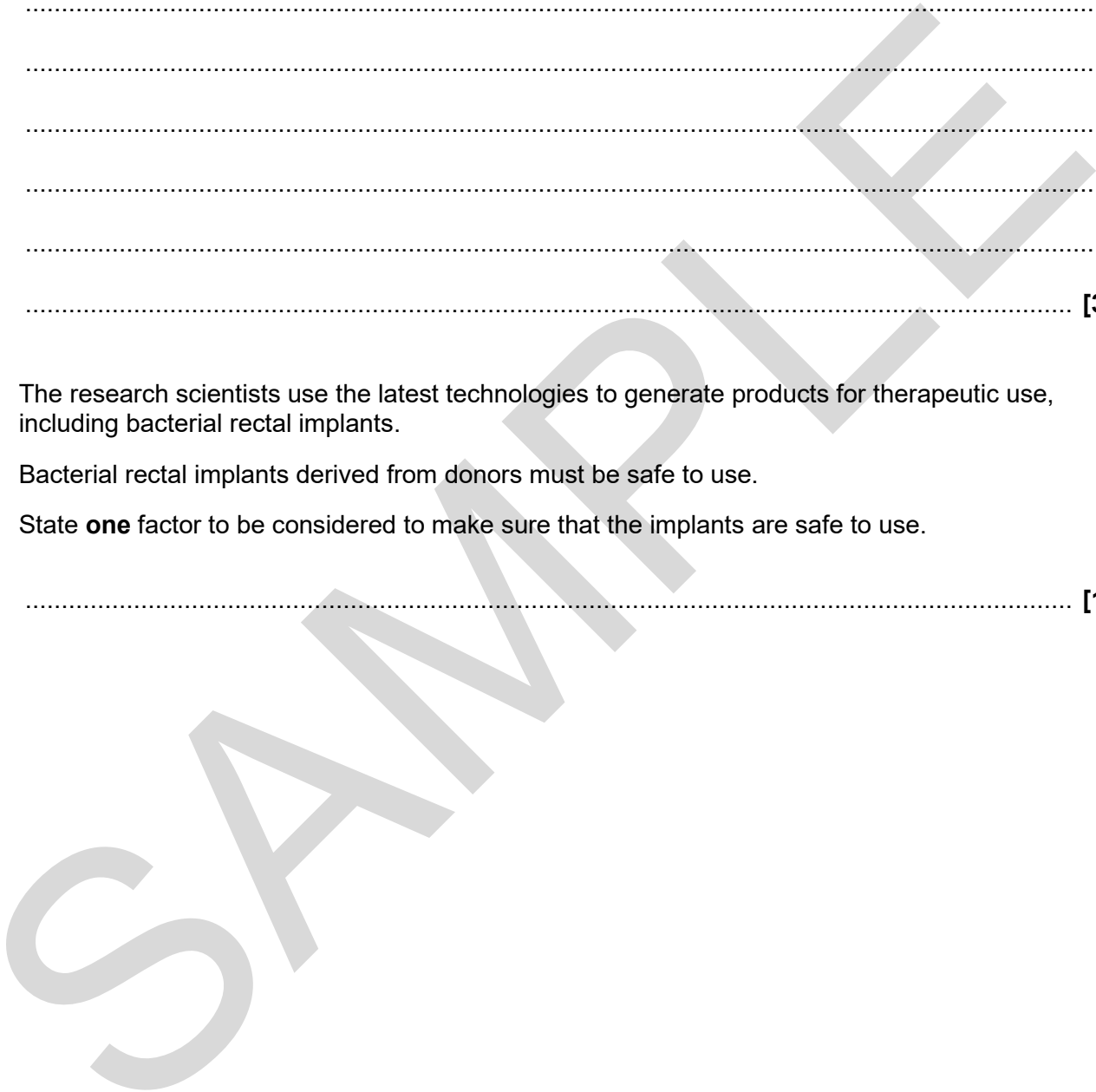
..... [3]

- (ii) The research scientists use the latest technologies to generate products for therapeutic use, including bacterial rectal implants.

Bacterial rectal implants derived from donors must be safe to use.

State **one** factor to be considered to make sure that the implants are safe to use.

..... [1]



8 Fungi live in many different locations, including inside the human body.

(a) A number of fungal species form branching hyphae, called a mycelium.

The septum in the fungal hypha contains tiny holes or perforations.

What is the function of hyphae?

..... [1]

(b) Outline how parasitic fungi, such as *Aspergillus*, infect body tissues.

.....
..... [2]

END OF QUESTION PAPER

SAMPLE

This is sample assessment material for our specification. It is to help show how the live assessment materials will look. During the lifetime of the qualification you might see small adjustments to the assessment materials. This is part of continuous improvement, designed to help you and your students. We recommend you look at the most recent set of past papers where available.



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**Level 3 Alternative Academic Qualification Cambridge
Advanced Nationals in Human Biology**

Unit F170: Fundamentals of human biology

Sample Assessment Material (SAM)

Mark Scheme

This document has **12** pages.

SAMPLE

MARKING INSTRUCTIONS

Crossed-out answers

If a student has crossed out an answer and written a clear alternative, do **not** mark the crossed-out answer.

If a student has crossed out an answer and **not** written a clear alternative, give the student the benefit of the doubt and mark the crossed-out answer if it's readable.

Multiple choice question answers

When a multiple choice question has only one correct answer and a student has written two or more answers (even if one of these answers is correct), you should **not** award a mark.

When a student writes more than one answer

1. Questions that ask for a set number (including 1) of short answers or points

If a question asks for a set number of short answers or points (e.g. **two** reasons for something), mark only the **first set number** of answers/points.

First mark the answers/points against any printed numbers on the answer lines, marking the **first** answer/point written against each printed number. **Then**, if students have not followed the printed numbers, mark the answers/points from left to right on each line and **then** line by line until the set number of answers/points have been marked. Do **not** mark the remaining answers/points.

2. Questions that ask for a single developed answer

If a student has written two or more answers to a question that only requires a single (developed) answer, and has **not** crossed out unintended answers, mark only the first answer.

3. Contradictory answers in points-based questions

When a student has written contradictory answers, do **not** award any marks, even if one of the answers is correct.

Levels of Response marking

1. To determine the level start at the highest level and work down until you reach the level that best describes the answer

2. To determine the mark within the level, consider the following:

Quality of the answer	Award mark
Consistently meets the criteria for this level	At the top of the level (6 and 9 mark questions)
Meets the criteria but with some inconsistency	At the middle of the level (9 mark questions)
On the borderline of this level and the one below	At the bottom of the level (6 and 9 mark questions)

MARK SCHEME

1 (a) (i)	
Max mark	2 (PO1)
Answer	Y = Cell (surface) membrane (1) Z = Cytoplasm/cytosol (1)
Guidance	1 mark for each correct answer.

1 (a) (ii)	
Max mark	2 (PO1)
Answer	Up to two marks for points about how the smooth endoplasmic reticulum supports the production of organelles in the cell: <ul style="list-style-type: none"> • Production of phospholipids (1) for the membranes (1) • Stores and releases calcium ions (1) • Attachment of receptors on to cell membrane proteins (1) • Synthesis of cholesterol for the cell membrane (1)
Guidance	1 mark for each correct point. Function with use in organelles only for 1 mark Do not accept: <ul style="list-style-type: none"> • responses referring to RER, e.g. protein synthesis

1 (a) (iii)	
Max mark	1 (PO1)
Answer	<ul style="list-style-type: none"> • Mitochondrion (1)
Guidance	Correct answer only.

1 (b) (i)	
Max mark	1 (PO1)
Answer	One mark for location of stem cell stated: <ul style="list-style-type: none"> • Lungs (1) • Liver (1) • Cartilage (1) • Muscle (1) • Skin/epidermis (1) <p>Credit any other appropriate response</p>
Guidance	1 mark for each correct answer. Do not accept: <ul style="list-style-type: none"> • Bone marrow

1 (b) (ii)	
Max mark	2 (PO1)
Answer	Any two from: <ul style="list-style-type: none"> • Avoids ethical concerns of using embryonic stem cells (1) • Reduced risk of rejection from donor (as identical) (1) • Easier to access/extract (1) • Don't need to wait for a donor (1) <p>Credit any other appropriate response</p>
Guidance	Correct answers only.

2 (a) (i)	
Max mark	2 (PO2)
Answer	Up to one mark for one advantage of using a LM from the photomicrograph Up to one mark for one disadvantage of using a LM from the photomicrograph One mark for identifying an advantage of LM from the photomicrograph. <ul style="list-style-type: none"> • Dividing cells A and B can be distinguished from non-dividing cells like cell C and surrounding cells (1) • Relative abundance of cells undergoing interphase (not mitosis) in the cells surrounding A and B is reinforced (1) One mark for identifying a disadvantage of LM from the photomicrograph. <ul style="list-style-type: none"> • Low magnification means that details of centromeres are not visible (1) • Presence of nuclear envelope cannot be confirmed due to the resolution/magnification of this image (1) <p>Credit any other appropriate response.</p>
Guidance	Maximum one advantage and one disadvantage. Do not accept: LMs are cheap/quick to use

2 (a) (ii)	
Max mark	2 (PO2)
Answer	Magnification = image size ÷ actual size 25 mm ÷ 10 µm 25 000 µm ÷ 10 µm (1) = (×) 2500 (1)
Guidance	Look for the correct answer first . If the correct answer is present, award full marks and ignore anything else that is written in the answer space. Otherwise: 1 mark for 25 000 µm ÷ 10 µm

2 (b)	
Max mark	4 (PO2)
Answer	<p>Up to two marks for each stage: One mark for identifying the stage of mitosis shown in the photomicrograph. One mark for explanation using the photomicrograph</p> <p>Stage of mitosis at A</p> <ul style="list-style-type: none"> • Metaphase (1) <p>Explanation</p> <ul style="list-style-type: none"> • Clusters of chromosomes at the equator / centre of spindle arrangement (1) <p>Stage of mitosis at B</p> <ul style="list-style-type: none"> • Telophase (1) <p>Explanation</p> <ul style="list-style-type: none"> • Clusters of chromatids/new chromosomes at the opposite poles/newly forming cells (1) • Cytoplasmic streaming/cytokinesis taking place (1) <p>Credit any other appropriate response.</p>
Guidance	<p>Up to two marks for each stage identified.</p> <p>Maximum two stages.</p>

3 (a) (i)	
Max mark	2 (PO1)
Answer	<ul style="list-style-type: none"> • Fibrocytes (1) • Osteocytes (1)
Guidance	<p>Correct answers only</p> <p>If a student ticks more than two boxes, award 0 marks for the whole question.</p>

3 (a) (ii)	
Max mark	2 (PO1)
Answer	<ul style="list-style-type: none"> • Calcium /Phosphate/Sodium/Magnesium (1) • Glucose (1)
Guidance	<p>1 mark for each correct answer.</p> <p>Accept incorrect spellings if the word is recognisable.</p>

4 (a) (i)		
Max mark	3 (PO1)	
Answer	Symptom of the VSD	Physiological tool
	Abnormal heartbeat	Electrocardiogram / ECG (1)
	Hole in the septum between the ventricles of the heart	Ultrasound scanner (1)
	Rapid breathing	Spirometer (1)
Guidance	1 mark for each correct answer. Correct answers only.	

4 (a) (ii)		
Max mark	1 (PO1)	
Answer	One mark for potential impact of having a ventral septal defect to health outlined:	
	<ul style="list-style-type: none"> • None if the hole is very small (1) • Risk of endocarditis/infection (1) • Aortic valve leakage (1) • Heart strain/enlargement/difficulty breathing/fatigue (all same point) (1) • Arrhythmia (1) • Stroke (1) 	
Guidance	Credit any other appropriate response 1 mark for a correct answer.	

4 (a) (iii)		
Max mark	1 (PO2)	
Answer	<ul style="list-style-type: none"> • PVR will increase (1) 	
	Credit any other appropriate response	
Guidance	1 mark for a correct answer.	

4 (b) (i)	
Max mark	4 (PO1)
Answer	<p>Up to two marks for each improvement. One mark for identifying the improvement. One mark for explaining how each improvement will ensure an accurate reading is taken e.g.:</p> <p>Improvement: stand up straight/sit comfortably (1) Explanation: ensures sufficient exhale/reading reflects maximum airflow/consistency with measurements (1)</p> <p>Improvement: ensure peak flow meter is clean and dry (1) Explanation: dirt/debris can interfere with movement of indicator/reduces damage to internal components (1)</p> <p>Improvement: close your lips tightly around the mouthpiece (1) Explanation: prevent air leaks/maximise effort or flow of air through the meter/consistent measurement (1)</p> <p>Improvement: take peak flow readings at same time each day (1) Explanation: minimise impact of natural lung function variations (e.g, body temp, activity level, impacts of medication) for consistency (1)</p> <p>Credit any other appropriate response.</p>
Guidance	Up to two marks for each valid [factor] identified. Maximum two factors.

4 (b) (ii)	
Max mark	1 (PO1)
Answer	<ul style="list-style-type: none"> • Highest reading/value (1) <p>Credit any other appropriate response</p>
Guidance	

5 (a)	
Max mark	2 (PO1)
Answer	<p>Any two from:</p> <ul style="list-style-type: none"> • Secreted/released from glands/endocrine cells (1) • Travel in blood (stream) (1) • Affect target organs/cells (1) <p>Credit any other appropriate response.</p>
Guidance	1 mark for each correct answer.

5 (b) (i)	
Max mark	2 (PO2)
Answer	Up to two marks for valid explanation using information from the homeostasis model provided <ul style="list-style-type: none"> • Negative feedback is triggered by return of glucose to set point/normal level (1) • Negative feedback causes insulin-secreting/beta cells (acting as receptors) to release less insulin into the blood (1) <p>Credit any other appropriate response.</p>
Guidance	Up to two marks for valid explanation

5 (b) (ii)	
Max mark	1 (PO1)
Answer	<ul style="list-style-type: none"> • (Essential) to avoid excess absorption of glucose (by body cells) from the blood (1) • Avoid hypoglycaemia/low glucose levels in blood (1) <p>Credit any other appropriate response.</p>
Guidance	1 mark for correct answer.

5 (c) (i)	
Max mark	2 (PO2)
Answer	(105-99) / 99 x 100 (1) 6.06(1) / 6.1 (1)
Guidance	Look for the correct answer first . If the correct answer is present, award full marks and ignore anything else that is written in the answer space. Otherwise: <ul style="list-style-type: none"> • 1 mark for seeing a correct unrounded answer e.g. 6.06 • 1 mark for (105-99) / 99 x 100 • 1 mark for 6/99

5 (c) (ii)	
Max mark	2 (PO2)
Answer	<p>Up to two marks for the advantage. Up to one mark for identifying an advantage of using the artificial pancreas Up to one mark for explaining why this is an advantage</p> <ul style="list-style-type: none"> • The sensor calculates how much data is needed (1) so the patient does not need to estimate how much insulin is needed (1) • The sensor calculates how much data is needed (1) so the process is not subjective (1) • The sensor transmits the data (1) so the patient does not need to take blood samples/do finger-prick tests (1) • The body worn insulin pump delivers the insulin (1) so the patient does not need to inject insulin (1) <p>Credit any other appropriate response.</p>
Guidance	Maximum one advantage.

6 (a) (i)	
Max mark	3 (PO2)
Answer	<p>A Cell body/cytoplasm/soma B Nucleus C Axon</p>
Guidance	<p>1 mark for each correct answer. Accept incorrect spellings if the word is recognisable.</p>

6 (a) (ii)	
Max mark	2 (PO1)
Answer	<ul style="list-style-type: none"> • Myelin sheath/Schwann cell breaks down/demyelination occurs (1) • Node of Ranvier is longer/more exposed (1)
Guidance	1 mark for each correct answer.

6 (a) (iii)	
Max mark	1 (PO1)
Answer	<p>Any one from:</p> <ul style="list-style-type: none"> • Rate of nerve impulse transmission slows down (1) • Saltatory response stops (1) <p>Credit any other appropriate response.</p>
Guidance	1 mark for correct answer.

6 (b)	
Max mark	1 (PO1)
Answer	Any one from: <ul style="list-style-type: none"> • Sensory (1) • Relay/internuncial/connector (1) <p>Credit any other appropriate response.</p>
Guidance	1 mark for correct answer. Do not accept: <ul style="list-style-type: none"> • motor neuron

7 (a)	
Max mark	2 (PO1)
Answer	Any two from: <ul style="list-style-type: none"> • Sterilising equipment as the high temperatures kill bacteria (1) • Creating a sterile environment as upward air current carry airborne contaminants away from the work area (1) <p>Credit any other appropriate response</p>
Guidance	1 mark for each correct answer. Accept any appropriate equipment e.g. inoculation loop/forceps/mouth of containers

7 (b) (i)	
Max mark	1 (PO2)
Answer	<ul style="list-style-type: none"> • 8.5 (1)
Guidance	Allow tolerance of +/- 0.5

7 (b) (ii)	
Max mark	2 (PO1)
Answer	W phase: lag (1) Y phase: stationary (1)
Guidance	1 mark for each correct answer.

7 (b) (iii)	
Max mark	2 (PO2)
Answer	$(9.33-0.67)/(16-5)$ (1) = 0.787 (log of living cells/hour) (1)
Guidance	Look for the correct answer first . If the correct answer is present, award full marks and ignore anything else that is written in the answer space. Otherwise: $(9.33-0.67)/(16-5)$ (1) or 8.66/11 (1)

7 (c) (i)	
Max mark	3 (PO1)
Answer	Up to three marks for each valid explanation point: The AMP or proteins are produced by beneficial bacterial cells at their ribosomes (1). The AMP is secreted across the cell surface membrane by active processes (1). When released into the lumen of the intestine, the AMP breaks down the peptidoglycan in the cell wall of disease-causing bacteria (1) Credit any other appropriate response
Guidance	1 mark for each correct answer.

7 (c) (ii)	
Max mark	1 (PO1)
Answer	Any one from: <ul style="list-style-type: none"> • Does not contain pathogens/disease-causing organisms (1) • Does not contain tissues/cells from the donor (1) • Does not contain toxins/poisons (1) Credit any other appropriate response
Guidance	1 mark for a correct answer.

8 (a)	
Max mark	1 (PO1)
Answer	<ul style="list-style-type: none"> • Secretion of digestive enzymes (1) Credit any other appropriate response
Guidance	1 mark for a correct answer

8 (b)	
Max mark	2 (PO1)
Answer	Any two from: <ul style="list-style-type: none">• releases enzymes / toxins (1)• enzymes /toxins break down tissues / cells (1) Credit any other appropriate response
Guidance	1 mark for a correct answer

SAMPLE