

Questions

Q1.

A student investigated mitosis in the root tip of a garlic plant.

(i) Explain why the student used the tip of the root.

(2)

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(ii) The student squashed the root tip on a microscope slide to spread out the cells.

The slide was placed on the stage of a microscope.

Describe how to use the microscope to obtain a clear image of the cells.

(2)

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(iii) The student could not see the chromosomes inside the cells.

State what can be added to the root tip squash to make the chromosomes visible.

(1)

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(Total for question = 5 marks)

Q2.

There is a shortage of kidneys for organ transplants.

Scientists are investigating how to grow kidneys using genetically modified pig embryos.

Figure 5 shows this process.

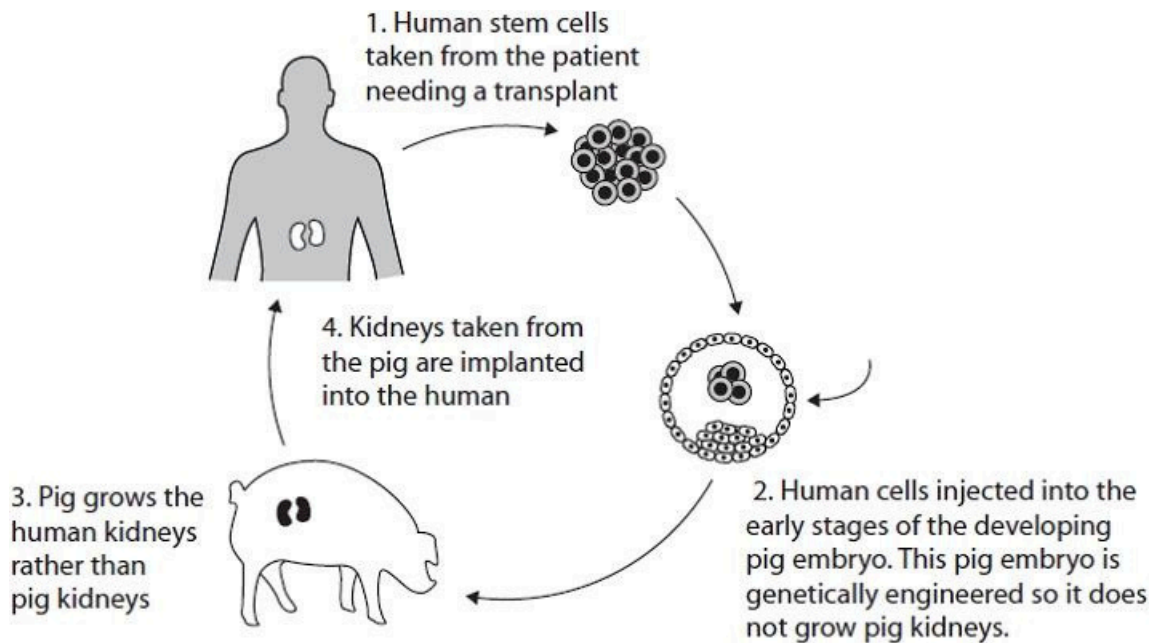


Figure 5

(i) State why the embryo of the pig must be engineered so it does not grow pig kidneys.

(1)

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(ii) Explain why human stem cells are used for this process.

(2)

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(Total for question = 3 marks)

Q3.

Figure 8 shows how alcohol consumption increases the risk of developing liver cancer.

Someone who does not drink alcohol has a 1.0 risk of developing liver cancer.

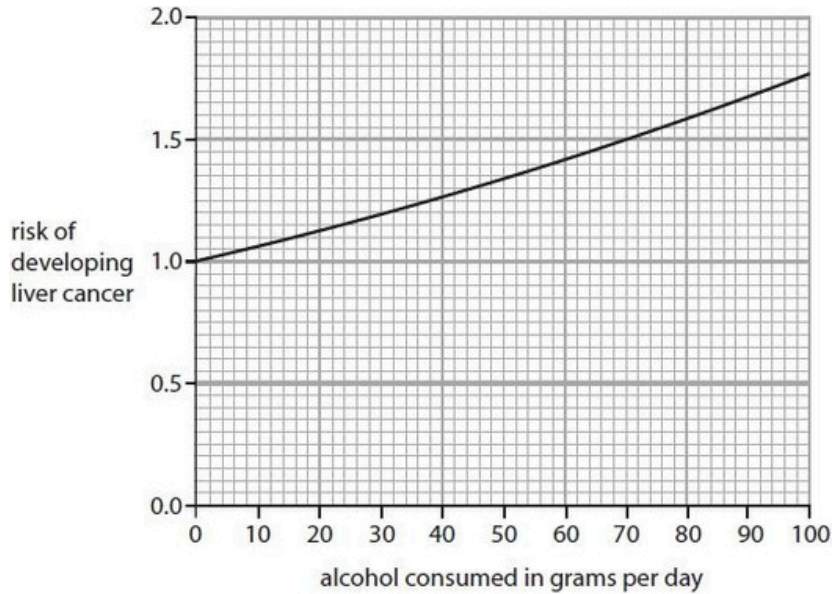


Figure 8

(i) One unit of alcohol contains 8 grams of alcohol.

Calculate the risk of developing liver cancer for someone who consumes 4 units of alcohol a day.

(2)

..... risk of developing liver cancer

(ii) Describe how cancer develops in the liver.

(2)

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(Total for question = 4 marks)

Q4.

The student observed 89 cells on the microscope slide.

Figure 6 shows the number of cells at each stage of the cell cycle.

stage of cell cycle	number of cells
Interphase	44
Prophase	12
Metaphase	6
Anaphase	18
Telophase	9

Figure 6

Use this equation to calculate the mitotic index for this slide.

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

Give your answer to three significant figures.

(3)

Mitotic index

(Total for question = 3 marks)

Q5.

The tips of plant roots are where many cells are dividing by mitosis.

(i) Which term describes the area of a root where many cells are dividing by mitosis?

(1)

- A meristem
- B root hair cell
- C xylem
- D phloem

(ii) Plant root cells contain an enzyme that joins glucose molecules together to make starch.
Devise a plan to investigate the effect of pH on the activity of this enzyme.

(3)

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(Total for question = 4 marks)

Q6.

Mitosis and meiosis are processes that produce new cells.

Compare the outcomes of mitosis and meiosis.

(3)

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(Total for question = 3 marks)

Q7.

As we grow, we make new cells by mitosis and meiosis.

(i) The cells that are made can become specialised.

Figure 13 shows a diagram of a sperm cell.

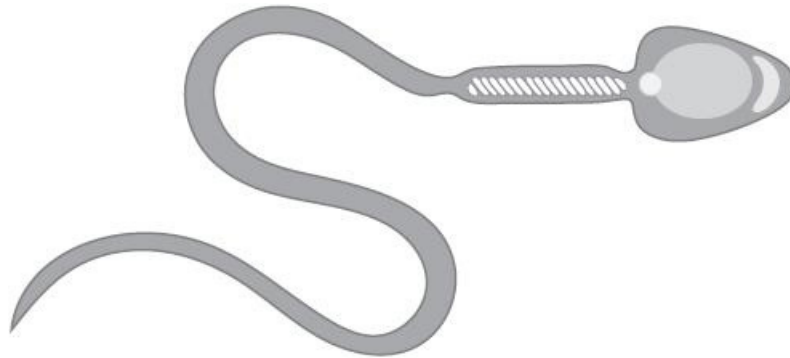


Figure 13

Describe two ways that the sperm cell is specialised.

(2)

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2

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(ii) Complete the table to show the results when a cell divides by mitosis or meiosis in humans.

Human body cells, except gametes, have 23 pairs of chromosomes.

(4)

	mitosis	meiosis
number of daughter cells produced		
number of chromosomes in each daughter cell		

(Total for question = 6 marks)

Q8.

* Figure 8 shows cells undergoing mitosis.

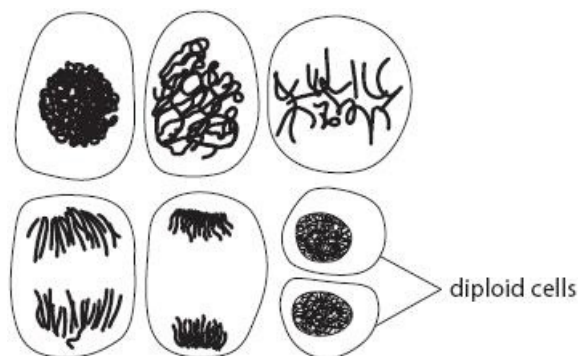


Figure 8

Describe how the stages of mitosis result in the formation of two diploid cells.

(6)

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(Total for question = 6 marks)

Q9.

Human growth hormone (hGH) can be used as a medical treatment.

Before 1980, hGH was extracted from the pituitary glands of humans after they had died.

Since 1980, hGH can be produced by bacteria that have been genetically modified.

(i) Describe the advantages of producing hGH using genetically modified bacteria.

(2)

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Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

(ii) Figure 4 shows a percentile growth chart for the height of girls aged 2 – 20.

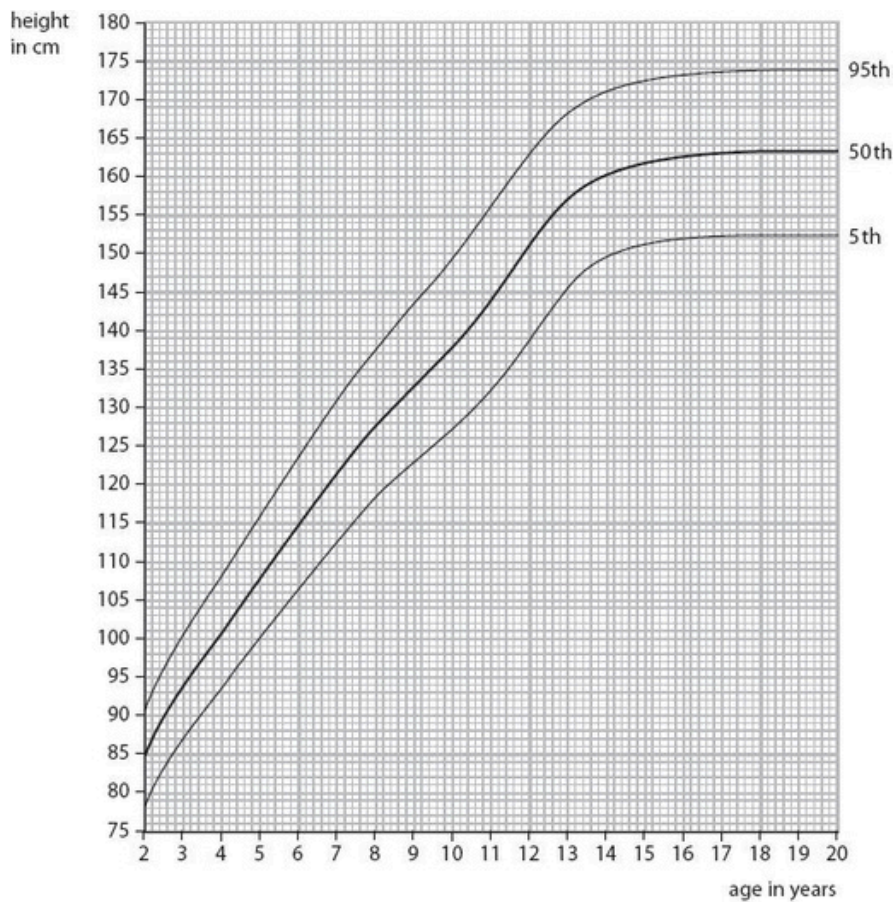


Figure 4

Which girl is most likely to need to be treated with human growth hormone?

(1)

- A a 7 year old who is 125 cm tall
- B a 9 year old who is 135 cm tall
- C a 10 year old who is 145 cm tall
- D a 12 year old who is 128 cm tall

(Total for question = 3 marks)

Q10.

Figure 14 shows a banana plantation.



Figure 14

After the bananas have been harvested, the old plants are cut down. The suckers then develop into mature plants producing the next crop of bananas. The tip of each sucker contains a group of cells called a meristem.

(i) Describe the function of a meristem in the growth of a plant.

(2)

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(ii) A student took a sample of cells from a meristem to view under a light microscope. Describe how the student would prepare a microscope slide using these cells.

(3)

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(Total for question = 5 marks)

Q11.

In 2012, two scientists were awarded the Nobel prize for their research on stem cells.

They showed that adult cells could be reprogrammed to become cells with the properties of embryonic stem cells.

Describe the possible benefits of this research.

(3)

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(Total for question = 3 marks)

Q12.

Describe what is produced when a single cell divides by mitosis.

(3)

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(Total for question = 3 marks)

Q13.

Arthritis is a condition that occurs when cells in joints get damaged or destroyed.

Stem cell therapy can be used to treat arthritis.

Discuss the benefits and risks of using stem cell therapy to treat arthritis.

(4)

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(Total for question = 4 marks)

Q14.

Macular degeneration is a defect of the eye that occurs when some cells of the retina begin to break down.

Embryonic stem cell therapy has been used to improve the vision of some patients with macular degeneration.

Explain how embryonic stem cells could be used to treat macular degeneration.

(2)

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(Total for question = 2 marks)

Q15.

Cell division processes are used to produce body cells and gametes.

Figure 9 shows the development of a human embryo from a fertilised egg.

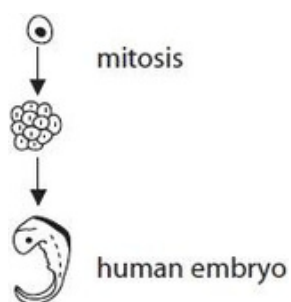


Figure 9

(i) Explain how many cells are produced from one fertilised egg, after two cell divisions by mitosis.

(2)

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(ii) Which process occurs causing the divided cells to become specialised?

(1)

- A meiosis
- B cloning
- C differentiation
- D cytokinesis

(Total for question = 3 marks)

Q16.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Figure 3 shows a cell from an onion root tip.

This cell is dividing by mitosis.

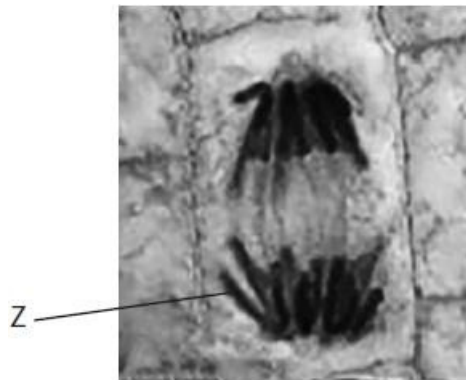


Figure 3

(i) Which structure is labelled Z?

(1)

- A allele
- B chromosome
- C spindle
- D nuclear membrane

(ii) Mitosis produces new cells.

Give two reasons why mitosis is important in living things.

(2)

1

.....

2

.....

(iii) Draw one straight line from each stage of the cell cycle to its description.

(2)

stage of cell cycle	description
interphase	the nuclear membrane breaks down
	two nuclei are formed
	the cell divides in two
cytokinesis	a spindle is formed
	DNA is copied

(Total for question = 5 marks)

Q17.

Some diseases can cause irreversible damage to the nervous system.

Give reasons why stem cells could be used to treat these neurological diseases.

(2)

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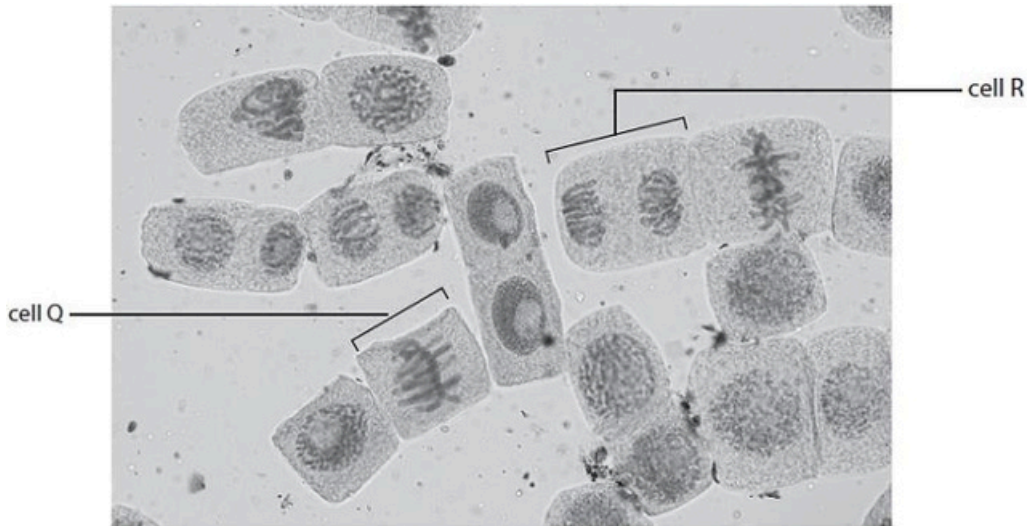
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(Total for question = 2 marks)

Q18.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Figure 4 shows cells from an onion root tip as seen using a light microscope.



(Source: © Rattiya Thongdumhyu/Shutterstock)

Figure 4

(i) Identify the stages of mitosis shown in cell Q and cell R.

(1)

	cell Q	cell R
<input type="checkbox"/> A	metaphase	anaphase
<input type="checkbox"/> B	telophase	anaphase
<input type="checkbox"/> C	metaphase	interphase
<input type="checkbox"/> D	telophase	interphase

(ii) Describe two processes that occur in cells during prophase.

(2)

- 1
- 2

(iii) State the term used to describe the process which occurs after mitosis, when the cell divides into two.

(1)

.....

(iv) The diameter of one cell in Figure 4 is 0.075 mm.

Which is this diameter in μm ?

(1)

- A 0.75 μm
- B 75 μm
- C 750 μm
- D 75 000 μm

(Total for question = 5 marks)

Q19.

Figure 7 shows mitosis occurring in some plant cells.



Figure 7

(i) The cells in Figure 7 were taken from a rapidly growing part of a plant.

Which part of a plant has rapidly dividing cells?

(1)

- A chloroplast
- B epithelium
- C meristem
- D vacuole

(ii) Which stage of mitosis is shown in cell R?

(1)

- A prophase
- B metaphase
- C anaphase
- D telophase

(iii) Describe two genetic similarities of the new cells that would be produced by cell Q in Figure 7.

(2)

1

2

(iv) The cells in Figure 7 were heated in hydrochloric acid.

State two safety precautions that should be taken when heating hydrochloric acid.

(2)

1

2

(Total for question = 6 marks)

Q20.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Figure 7 shows a height percentile chart for boys.

The numbers on the right-hand side of the graph show the percentiles of the population for each growth curve.

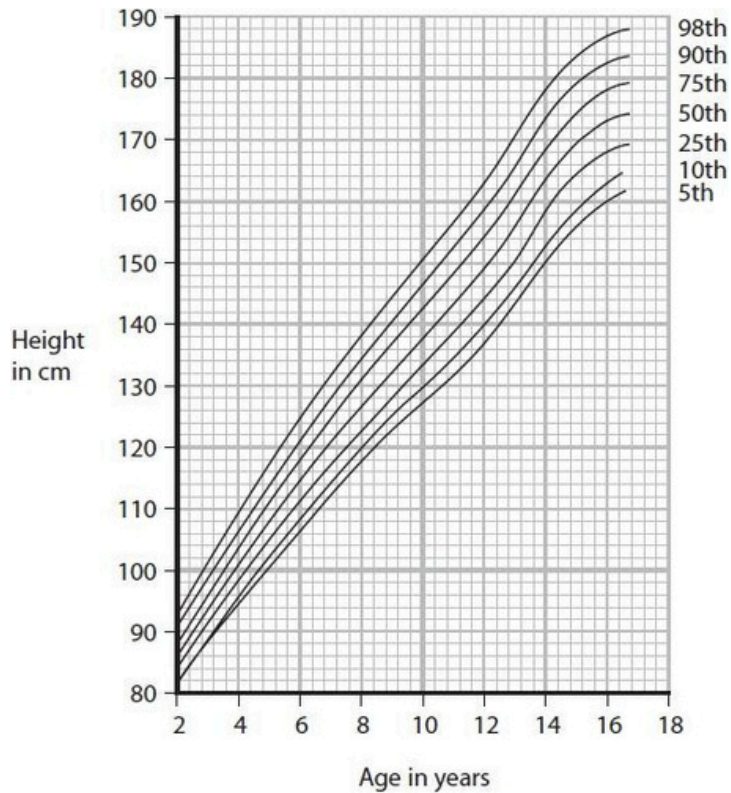


Figure 7

(i) A 10-year-old boy has a height of 140 cm.

Which is the percentile range for height for this boy?

- A 10th to 25th
- B 25th to 50th
- C 50th to 75th
- D 75th to 90th

(1)

(ii) State how percentile charts are used.

(1)

.....

(Total for question = 2 marks)

Q21.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Figure 1 shows a root cell in a stage of mitosis.

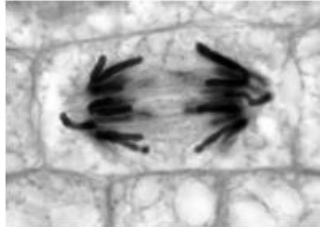


Figure 1

(i) Which stage of mitosis is shown in Figure 1?

(1)

- A prophase
- B metaphase
- C anaphase
- D telophase

(ii) Describe what is happening in Figure 1.

(3)

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(Total for question = 4 marks)

Q22.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

The tips of plant roots are where many cells are dividing by mitosis.

(i) Which term describes the area of a root where many cells are dividing by mitosis?

(1)

- A meristem
- B root hair cell
- C xylem
- D phloem

(ii) Plant root cells contain an enzyme that joins glucose molecules together to make starch.

Devise a plan to investigate the effect of pH on the activity of this enzyme.

(3)

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(Total for question = 4 marks)

Q23.

Figure 15 shows a method of producing plants.

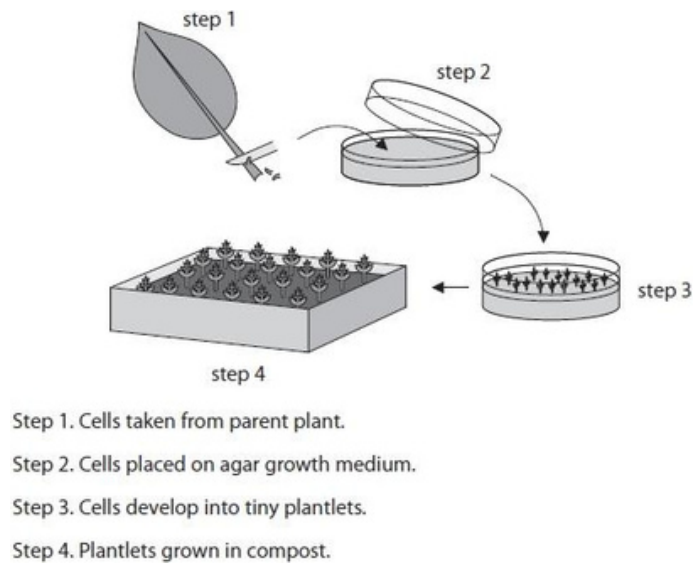


Figure 15

(i) Some cells in each plantlet develop into root cells.

Name the process occurring as these cells develop into root cells.

(1)

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(ii) Describe the advantages of producing plants by the method shown in Figure 15.

(2)

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(iii) An autoclave is used to prepare the agar growth medium used in Step 2.

Explain why the agar growth medium is autoclaved.

(2)

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(iv) One of the plantlets had different coloured leaves.

Give one reason why this plantlet had different coloured leaves.

(1)

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(Total for question = 6 marks)

Q24.

Eye tests can detect some brain tumours.

(i) State one other way that brain tumours can be detected.

(1)

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(ii) Describe why a brain tumour is difficult to treat.

(2)

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(Total for question = 3 marks)

Q25.

The mitotic index is often used in the diagnosis of cancer.

State the effect of cancer on cell division.

(1)

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(Total for question = 1 mark)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	An answer including: <ul style="list-style-type: none"> • (the root tip) contains {meristem / dividing} cells (1) • for growth (1) 	reject meiosis	(2) AO1 1

Question number	Answer	Additional guidance	Mark
(ii)	An answer combining: <ul style="list-style-type: none"> • switch the lamp on • start with the lowest objective lens / look through the eyepiece lens (1) • use the (focusing) wheel to obtain a clear image (1) 	accept adjust the mirror accept start with x4 / x10 objective lens	(2) AO1 2

Question number	Answer	Additional guidance	Mark
2(a)(iii)	use a stain / named stain	accept dye / iodine	(1) AO3 3b

Q2.

Question number	Answer	Additional guidance	Mark
(i)	Any one from: <ul style="list-style-type: none"> • pig kidneys cannot be used in humans (1) • pig kidneys would be rejected (by humans) (1) • to prevent competition between the pig and the human organ (1) • so the human kidneys form properly (1) 	ignore so it grows human kidneys accept so there is room for the human kidneys	(1) A02 1

Question number	Answer	Mark
(ii)	An explanation linking two from: <ul style="list-style-type: none"> • stem cells {are undifferentiated / are unspecialised / can differentiate / become specialised / form any type of cell} (1) • so can produce the {kidney / kidney cells / kidney tissue} (1) • that won't be rejected (when transplanted) (1) 	(2) A01 1

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	(8 x 4) = 32 (grams of alcohol) (1) 1.2 / 1.20 (x risk)	award full marks for the correct answer with no workings	(2) A03

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer including two from:</p> <ul style="list-style-type: none"> • mutations in DNA (1) • cell division is uncontrolled (1) • leading to the formation of a tumour / growth / mass of cells (1) 	<p>accept change in the gene/cell mutates</p> <p>accept {rapid / continuous} cell division</p>	<p>(2)</p> <p>AO2 1</p>

Q4.

Question number	Answer	Additional guidance	Mark
	<p>Select 45 cells in mitosis (1)</p> <p>$(45) \div 89 \times 100 = 50.561$ (1)</p> <p>50.6</p>	<p>Award full marks for correct answer with no working</p> <p>ecf for workings that show the use of an incorrect number of cells up to and including 89 cells</p> <p>ecf if the workings show their answer to 3 s.f.</p>	<p>(3)</p> <p>A03 2ab</p>

Q5.

Question number	Answer	Mark
(i)	<p>A meristem</p> <p>The only correct answer is A</p> <p><i>B is incorrect because root hair cells are not the area of the root where many cells are dividing by mitosis.</i></p> <p><i>C is incorrect because xylem is not the area of the root where many cells are dividing by mitosis.</i></p> <p><i>D is incorrect because phloem is not the area of the root where many cells are dividing by mitosis.</i></p>	<p>(1)</p> <p>A01 1</p>

Question number	Answer	Additional guidance	Mark
(ii)	<p>An answer including three of the following</p> <ul style="list-style-type: none"> • add {enzyme (solution) / plant root cells} to glucose (solution) (1) • test for presence of starch (1) • test {each minute / at set time intervals} / time until a positive result for starch (1) • repeat at more than one pH / (in buffers) of different pH values (1) • reference to controlling one variable, e.g. same volume of solutions / same temperature (1) 	<p>accept use iodine</p>	<p>(3)</p> <p>A03 3a</p>

Q6.

Question number	Answer	Additional Guidance	Mark
	<p>Any three from:</p> <ul style="list-style-type: none"> • mitosis produces 2 cells and meiosis produces 4 cells (1) • mitosis produces genetically identical cells and meiosis produces genetically different cells (1) • mitosis produces diploid cells and meiosis produces haploid cells (1) • mitosis produces body cells and meiosis produces {gametes /sex cells} (1) 	<p>accept offspring for cells</p> <p>mitosis is involved in asexual reproduction and meiosis is involved in sexual reproduction (1)</p>	<p>AO1 1 (3)</p>

Q7.

Question number	Answer	Additional guidance	Mark
(i)	<p>A description including any two from:</p> <ul style="list-style-type: none"> • tail / flagellum (1) • acrosome / sac with enzymes (1) • (many) mitochondria (1) • streamlined (1) • haploid / has 23 chromosomes (1) 	accept has enzymes to digest the membrane around the egg	(2) A01 1

Question number	Answer	Mark									
(ii)	<p>Award one mark for each correct square in the table.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>mitosis</th> <th>meiosis</th> </tr> </thead> <tbody> <tr> <th>number of daughter cells produced</th> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> </tr> <tr> <th>number of chromosomes in each daughter cell</th> <td style="text-align: center;">46 / <u>23 pairs</u></td> <td style="text-align: center;">23</td> </tr> </tbody> </table> <p>For mitosis (number of chromosomes) ignore 23 on its own, must be qualified as 23 pairs</p>		mitosis	meiosis	number of daughter cells produced	2	4	number of chromosomes in each daughter cell	46 / <u>23 pairs</u>	23	(4) A01 1
	mitosis	meiosis									
number of daughter cells produced	2	4									
number of chromosomes in each daughter cell	46 / <u>23 pairs</u>	23									

Q8.

Question number	Answer	Mark
Expert	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>Prophase</p> <ul style="list-style-type: none"> • the nuclear membrane disappears • the DNA unwinds and condenses into chromosomes / chromatids • spindle fibres become visible <p>Metaphase</p> <ul style="list-style-type: none"> • the chromosomes line up along the centre / equator of the cell • spindle fibres attach to chromosomes at the centromere <p>Anaphase</p> <ul style="list-style-type: none"> • chromatids are pulled to the edges of the cell • by the spindle fibres <p>Telophase</p> <ul style="list-style-type: none"> • a nuclear membrane forms around each of the sets of chromosomes • separating them from one another <p>Cytokinesis occurs Splitting the cytoplasm to create two separate diploid cells each with identical chromosomes</p>	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> • Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	<ul style="list-style-type: none"> • Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	<ul style="list-style-type: none"> • Demonstrates accurate and relevant biological understanding throughout. Understanding of scientific, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Q9.

Question number	Answer	Additional guidance	Mark
(i)	<p>An answer that combines two of the following points of application of knowledge and understanding to provide a logical description:</p> <ul style="list-style-type: none"> • more hGH can be produced / hGH can be obtained quickly /hGH is easier to produce (1) • hGH sample is pure/less likely to be contaminated/ less chance of {transfer of pathogens/infections} (1) • hGH more effective/ hGH less likely to be rejected (1) 	<p>accept more people can be treated</p> <p>accept hGH doesn't carry a disease ignore safer/cleaner</p> <p>ignore idea of waiting until someone dies ignore references to costs or religious beliefs</p>	(2)

Question number	Answer	Mark
(ii)	D a 12 year old who is 128 cm tall	(1)

Q10.

Question number	Answer	Additional guidance	Mark
(i)	<p>Two from:</p> <ul style="list-style-type: none"> • (meristem cells) are undifferentiated (1) • (meristem cells) divide / produce more cells (1) • by mitosis (1) 	<p>accept are stem cells</p> <p>accept (the cells produced) can differentiate /become specialised/elongate (1)</p>	(2) AO1 1

Question number	Answer	Additional guidance	Mark
(ii)	<p>An answer including</p> <ul style="list-style-type: none"> • use a thin section of {cells/meristem} (1) • add a stain / named stain (1) • place a cover slip on top of the sample (1) 	<p>accept add a sample of the cells to the microscope slide</p> <p>accept a description of a coverslip</p>	<p>(3) AO1 2</p>

Q11.

Question Number	Answer	Additional guidance	Mark
	<p>Any three from:</p> <ul style="list-style-type: none"> • have the potential to produce any cell type (1) • no need to use embryonic stem cells (1) • less chance of patient rejecting their own cells (1) • used to treat conditions which are currently incurable / used for cell transplants /used to replace faulty cells (1) 	<p>accept can turn into many cell types /pluripotent /totipotent</p> <p>accept embryos do not need to be killed</p> <p>accept named conditions e.g Parkinson's / diabetes</p> <p>ignore references to cloning body parts / replace organs / treat cancer unless qualified</p>	<p>(3) AO 2 1</p>

Q12.

Question number	Answer	Additional guidance	Mark
	<p>A description including three from:</p> <ul style="list-style-type: none"> • two cells (1) • diploid cells / same number of chromosomes as parent cell (1) • genetically identical cells (1) • body cells (1) 	<p>accept 23 pairs of chromosomes / 46 chromosomes</p> <p>accept cells for growth / repair</p>	<p>(3)</p> <p>A01 1</p>

Q13.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer including four from:</p> <p>Benefits (maximum 2 marks):</p> <ul style="list-style-type: none"> • stem cells can differentiate / become specialised (1) • replace (damage) cells (1) • reduce symptoms of arthritis (1) <p>Risks (maximum 2 marks):</p> <ul style="list-style-type: none"> • new cells do not function correctly (1) • stem cells continue to divide (1) • risk of side effects / symptoms worsen / rejecting cells (1) 	<p>accept can become {joint cells / any type of cell}</p> <p>accept repair damaged joints</p> <p>accept cell division could develop into cancer</p> <p>accept may have to take medication to prevent rejection / suppress immune system</p>	<p>(4)</p> <p>AO2 1</p>

Q14.

Question number	Answer	Mark
	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): <ul style="list-style-type: none"> embryonic stem cells can be stimulated to produce cells of the retina (1) which can be transplanted into a patient’s eye to replace the damaged cells (1) 	(2)

Q15.

Question number	Answer	Mark
(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): <ul style="list-style-type: none"> one cell produces two daughter cells for every division by mitosis (1) two cell division steps produces four cells (1) 	(2)

Question number	Answer	Mark
(ii)	C	(1)

Q16.

Question Number	Answer	Mark
(i)	B chromosome The only correct answer is B <i>A is not correct because Z is not an allele</i> <i>C is not correct because Z is not the spindle</i> <i>D is not correct because Z is not the nuclear membrane</i>	(1) AO1 1

Edexcel Biology GCSE - Cell Division and Growth

Question Number	Answer	Mark
(ii)	Any two from: <ul style="list-style-type: none"> • for growth (1) • for repair (of tissues / organs) (1) • for asexual reproduction (1) 	(2) AO1 1

Question Number	Answer	Mark
(iii)	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>stage of cell cycle</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">interphase</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">cytokinesis</div> </div> </div> <div style="text-align: center;"> <p>description</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">the nuclear membrane breaks down</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">two nuclei are formed</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">the cell divides in two</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">a spindle is formed</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: 100px; text-align: center;">DNA is copied</div> </div> </div> </div> <p>Do not award mark if two lines are drawn from interphase box Do not award mark if two lines are drawn from cytokinesis box</p>	(2) AO1 1

Q17.

Question number	Answer	Mark
	An explanation that combines identification – amplification of knowledge (1 mark) and reasoning / justification – application of understanding (1 mark): <ul style="list-style-type: none"> • stem cells can develop into specific cells / stem cells are undifferentiated / stem cells are unspecialised (1) • used to replace damaged cells (which don't otherwise regrow) (1) 	(2)

Q18.

Question Number	Answer	Mark
(i)	A metaphase anaphase The only correct answer is A <i>B is not correct because cell Q is not telophase</i> <i>C is not correct because cell R is not interphase</i> <i>D is not correct because cell R is not interphase</i>	(1) AO2 1

Question Number	Answer	Additional Guidance	Mark
(ii)	A description including two from: <ul style="list-style-type: none"> • chromatids condense (1) • identical chromatids are joined (1) • nuclear membrane breaks down (1) 	accept chromosomes condense / coil up / become visible accept chromosomes join accept nucleus breaks down accept spindle fibres form (1)	(2) AO1 1

Question Number	Answer	Mark
(iii)	cytokinesis	(1) AO1 1

Question Number	Answer	Mark
(iv)	<p>B 75 μm</p> <p>The only correct answer is B</p> <p><i>A is not correct because 0.75 μm is 0.00075 mm</i></p> <p><i>C is not correct because 750 μm is 0.75mm</i></p> <p><i>D is not correct because 75 000 μm is 75 mm</i></p>	<p>(1)</p> <p>AO1 1</p>

Q19.

Question Number	Answer	Mark
(i)	<p>C meristem</p> <p>1. The only correct answer is C</p> <p><i>A is not correct because a chloroplast does not have rapidly dividing cells</i></p> <p><i>B is not correct because epithelium does not have rapidly dividing cells</i></p> <p><i>D is not correct because a vacuole does not have rapidly dividing cells</i></p>	<p>(1)</p> <p>AO 1 1</p>

Question Number	Answer	Mark
(ii)	<p>B metaphase</p> <p>1. The only correct answer is B</p> <p><i>A is not correct because the stage of mitosis shown in cell R is not prophase</i></p> <p><i>C is not correct because the stage of mitosis shown in cell R is not anaphase</i></p> <p><i>D is not correct because the stage of mitosis shown in cell R is not telophase</i></p>	<p>(1)</p> <p>AO 3 2a</p>

Question Number	Answer	Additional guidance	Mark
(iii)	<ul style="list-style-type: none"> • same genes/ DNA/ chromosomes/ alleles (1) • diploid (1) 	<p>accept they are (genetically) identical</p> <p>accept 2n/ same number of chromosomes</p>	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
(iv)	<p>Any two from:</p> <ul style="list-style-type: none"> • wear goggles (1) • avoid contact with acid/wear gloves (1) • use a water bath to heat acid (1) 	<p>accept do not boil/overheat acid (1)</p> <p>accept heat in fume cupboard (1)</p>	(2) AO 3 2a

Q20.

Question number	Answer	Mark
(i)	<p>C 50th to 75th</p> <p>The only correct answer is C</p> <p><i>A is incorrect because his height percentile is 50 – 75</i></p> <p><i>B is incorrect because his height percentile is 50 – 75</i></p> <p><i>D is incorrect because his height percentile is 50 – 75</i></p>	(1) AO3 1a

Question number	Answer	Mark
(ii)	<p>Any one from:</p> <ul style="list-style-type: none"> • to monitor height / growth (over time) (1) • to compare the growth of an individual against the standard growth pattern (1) 	(1) AO1 1

Q21.

Question number	Answer	Mark
(i)	<p>C anaphase</p> <p>i The only correct answer is C</p> <p><i>A is not correct because the chromosomes are arranged differently in prophase</i></p> <p><i>B is not correct because the chromosomes are arranged differently in metaphase</i></p> <p><i>D is not correct because the chromosomes are arranged differently in telophase</i></p>	<p>(1)</p> <p>AO1 1</p>

Question	Answer	Additional guidance	Mark
(ii)	<p>A description including:</p> <ul style="list-style-type: none"> • spindle (fibres) (1) • are pulling the chromosomes (1) • to either side of the cell / poles (1) 	<p>accept chromatids</p>	<p>(3)</p> <p>AO1 1</p>

Q22.

Question number	Answer	Mark
(i)	<p>A meristem</p> <p>The only correct answer is A</p> <p><i>B is incorrect because root hair cells are not the area of the root where many cells are dividing by mitosis.</i></p> <p><i>C is incorrect because xylem is not the area of the root where many cells are dividing by mitosis.</i></p> <p><i>D is incorrect because phloem is not the area of the root where many cells are dividing by mitosis.</i></p>	<p>(1)</p> <p>AO1 1</p>

Question number	Answer	Additional guidance	Mark
(ii)	<p>An answer including three of the following</p> <ul style="list-style-type: none"> • add {enzyme (solution) / plant root cells} to glucose (solution) (1) • test for presence of starch (1) • test {each minute / at set time intervals} / time until a positive result for starch (1) • repeat at more than one pH / (in buffers) of different pH values (1) • reference to controlling one variable, e.g., same volume of solutions / same temperature (1) 	<p>accept use iodine</p>	<p>(3)</p> <p>AO3 3a</p>

Q23.

Question Number	Answer	additional guidance	Mark
(i)	differentiation (1)	accept specialisation	<p>(1)</p> <p>AO 2 1</p>

Question Number	Answer	additional guidance	Mark
(ii)	<p>A logical description including two of the following:</p> <ul style="list-style-type: none"> many plants produced (1) quicker than sexual reproduction (1) genetically identical/ clones produced (1) with the desired characteristics (1) plants from endangered/rare plants (1) 	<p>accept gives more of that plant/higher yield of that plant</p> <p>ignore plants grow faster</p> <p>obtain plants difficult to grow from seed (1)</p>	<p>(2)</p> <p>AO 1 1</p>

Question Number	Answer	Additional guidance	Mark
(iii)	<p>Any two from:</p> <ul style="list-style-type: none"> sterilises agar growth medium (1) destroys unwanted {bacteria /pathogens/fungi/microorganisms/viruses} /there is no contamination (1) so microorganisms don't {affect growth of plantlets / don't compete with plantlets/ don't use nutrients needed by plantlets} (1) 	<p>ignore prevents microorganisms getting in</p> <p>accept only the plantlets grow</p>	<p>(2)</p> <p>AO 2 2</p>

Question Number	Answer	Additional guidance	Mark
(iv)	<ul style="list-style-type: none"> mutation / disease 	<p>accept different alleles/ genotypes/genetic variation</p>	<p>(1)</p> <p>AO 2 1</p>

Q24.

Question Number	Answer	Additional Guidance	Mark
(i)	{CT / PET} scanning	accept MRI / X-ray	(1) A01 1

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>A description including two from:</p> <ul style="list-style-type: none"> • brain is protected by skull (1) • it is difficult to access (1) • nerves do not {repair / regenerate} (1) • the risk of damage to the brain (1) 	<p>accept bone for skull</p> <p>accept must not damage healthy cells/can cause side effects</p>	(2) A01 1

Q25.

Question number	Answer	Additional Guidance	Mark
	(makes cell division) uncontrolled	<p>accept idea of cell division being rapid / increased</p> <p>ignore references to mutation / tumour</p>	(1) A01 1