

1(a).

- (i) Mia has an eye disease that weakens the fibres that hold her cornea in place.

Her cornea has become damaged causing its shape to change.

What is the role of the cornea and how will damage to the shape affect Mia's sight?

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----- [2]

- (ii) Scientists are now using stem cells to repair damage to corneas.

What is a stem cell?

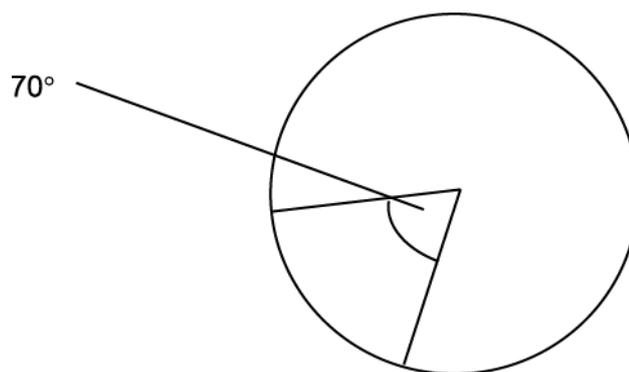
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----- [1]

- (iii) Stem cells can be obtained from embryos.

Why are some people against using embryos as a source of stem cells?

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----- [1]

(b). New body cells are created as part of the cell cycle. This is represented in the diagram below.



In this example, the whole cell cycle takes 141 minutes.

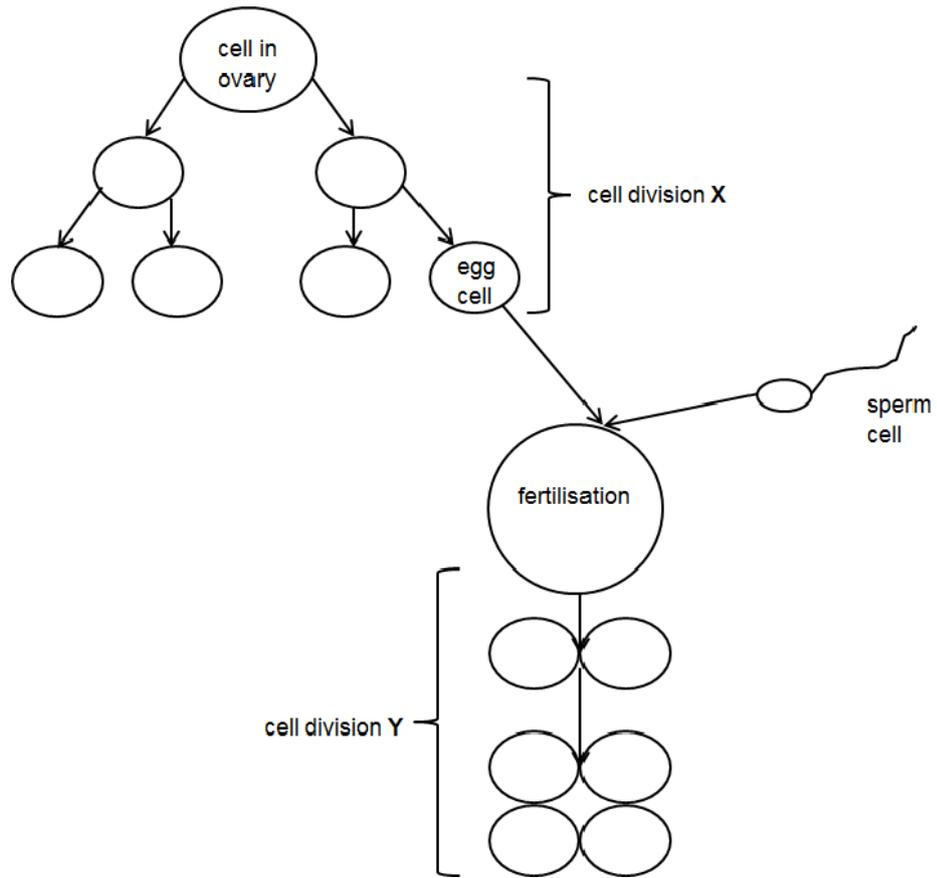
Calculate the time spent in mitosis.

Give your answer to two decimal places.

Time spent in mitosis = ..... minutes [2]

2(a). There are two types of cell division.

Human egg cells are produced by one type of cell division. The other type is used for growth of new cells.



Identify the two types of cell division shown in the diagram above.

Cell division X \_\_\_\_\_

Cell division Y \_\_\_\_\_

[2]

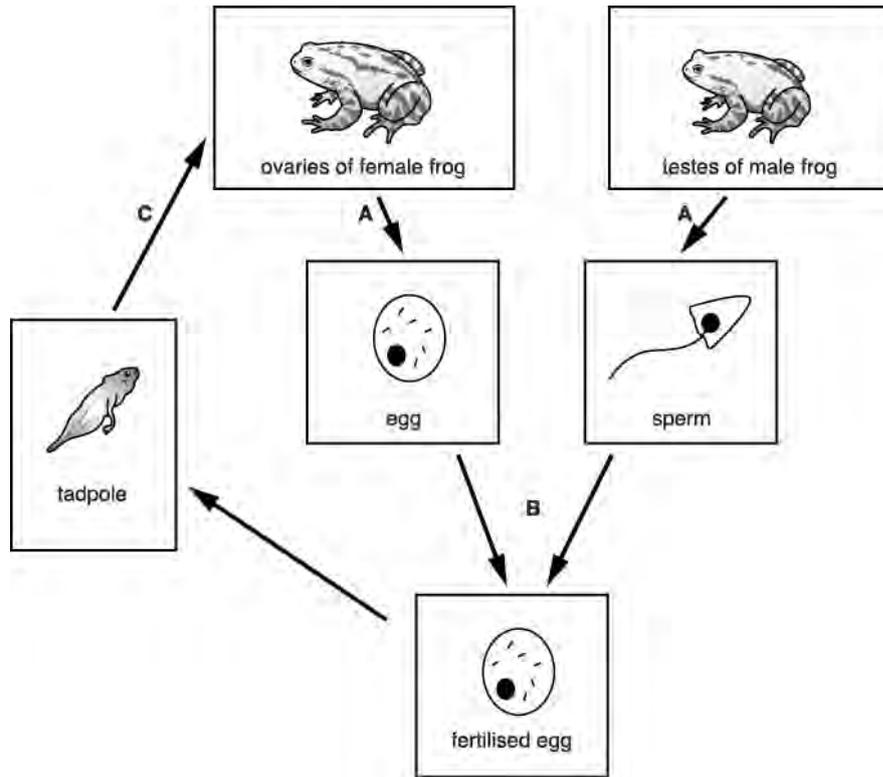
(b). After cells divide they become specialised to form tissues with different functions.

Explain what happens during this process of specialisation.

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[4]

3. The diagram below shows the life cycle of a frog.



Three stages of the life cycle have been labelled A, B and C.

Identify the **two** stages at which cell division takes place. Describe the similarities and differences between the cell division at these two stages.

[6]



*The quality of written communication will be assessed in your answer.*

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[6]

4(a). Jean grows geranium plants. Her favourite plant has purple flowers.

She takes a cutting from her favourite plant.

After 10 days, roots start to develop.

Explain why Jean takes a cutting from the geranium and does not grow the plant from a seed.

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[3]

(b). Name the plant cells that divide to form unspecialised cells.

----- [1]

(c). As Jean's cutting grows, unspecialised cells become specialised.

These specialised cells form different tissues and organs.

Give **one** example of a plant tissue and **one** example of a plant organ.

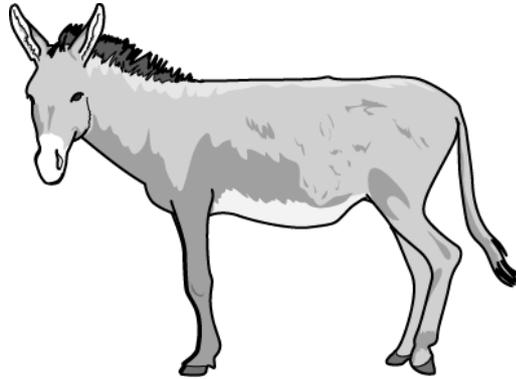
Tissue -----  
Organ -----

[2]

5(a). Name the type of cell division that produces gametes.

----- [1]

(b). The offspring of a male donkey and a female horse is called a mule.



A horse has 64 chromosomes in each body cell. A donkey has 62 chromosomes in each body cell.

Complete the boxes below to show how many chromosomes would be found in the gametes (sex cells) in these two species.

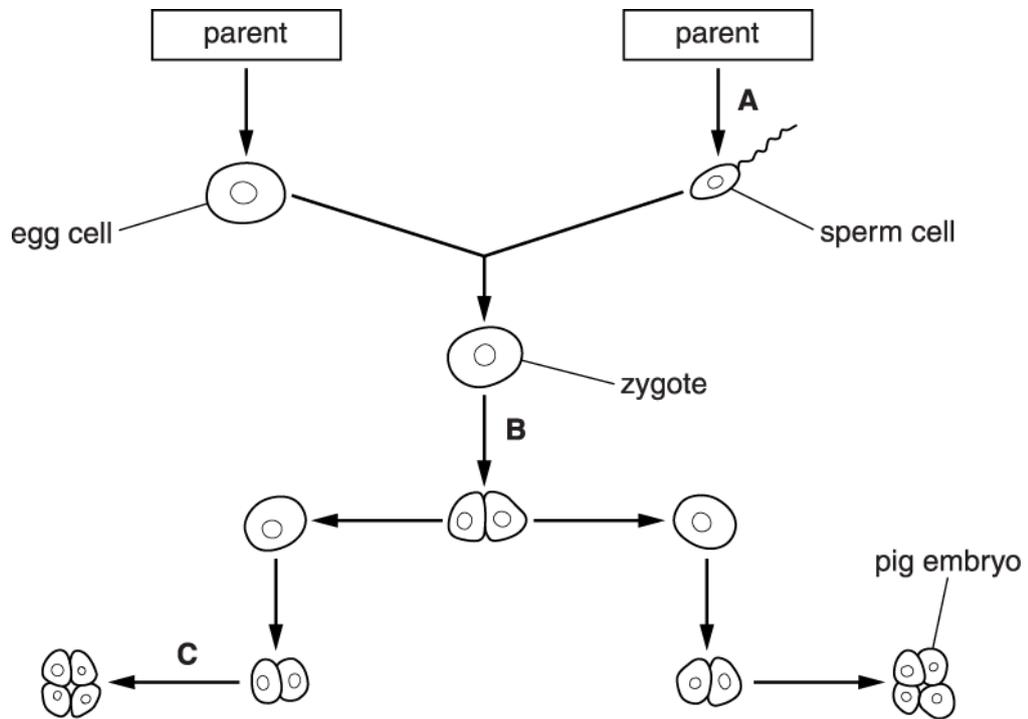
	Female horse	Male donkey
Gametes		

[1]

6(a). A scientist is studying growth and development in identical twin piglets.

The piglets are formed from the division of a zygote (fertilised egg).

The diagram shows the stages involved in the formation of the piglets.



(i) Name the types of cell division at stages A, B and C.

Write the correct answer in the box next to each letter.

A	
B	
C	

[1]

(ii) The scientist observes that the piglets are **different** from their parents, but are **identical** to each other.

Explain why.

Use information from the diagram in your answer.

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[3]

(b). Muscle cells and skin cells are sampled from one of the piglets.

The muscle cells contain the protein actin, whereas skin cells contain the protein keratin.

(i) How can cells in the same piglet produce different proteins?

Put ticks (✓) in the boxes next to the correct answers.

All of the genes are switched on.

Different cell types contain different genes.

Cells only produce the specific proteins they need.

Only the genes needed for the cell are switched on.

Some of the genes are lost from cells during their development.

[2]

(ii) A cell is taken from a pig embryo just after stage C in the diagram.

Explain why this cell can be used to make both skin cells and muscle cells.

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----- [2]

(iii) Cells can also be taken from human embryos for experiments.

Suggest one ethical reason against this work.

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----- [1]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a	i	Cornea – responsible for bending the light ✓ Light rays will no longer meet on the retina so sight will be poor ✓	2	ALLOW reference to blindness
		ii	An unspecialised cell which can become any cell type ✓	1	
		iii	Any one from Embryos killed in the process ✓ Embryos could be a life ✓	1	
	b		<b>FIRST CHECK THE ANSWER ON THE ANSWER LINE IF</b> answer = 27.42 award 2 marks  (141 ÷ 360) × 70 ✓ 27.42 (minutes) ✓	2	
			<b>Total</b>	<b>6</b>	
2	a		Cell division X: meiosis Cell division Y: mitosis	2	<b>DO NOT ALLOW</b> ambiguous spelling e.g. meiotis
	b		Some genes are switched off ✓ Some genes are switched on ✓ These makes proteins ✓ For specific cell types ✓	4	
			<b>Total</b>	<b>6</b>	
3			<b>Level 3 (5-6 marks)</b> Correct identification of the two stages where cell division occurs, AND comparison of the two types of cell division to include both similarities AND differences Quality of written communication does not impede communication of the science at this level  <b>Level 2 (3-4 marks)</b> Correct identification of the two stages where cell division occurs AND identifies characteristics of the two types of cell division Quality of written communication partly impedes communication of the science at this level  <b>Level 1 (1-2marks)</b>	6	<b>This question is targeted at grades up to A</b>  <b>Indicative scientific points may include</b>  <b>Correct identification of the cell division at stages in the frogs life cycle:</b>  <ul style="list-style-type: none"> <li>• Stage A – meiosis</li> <li>• Stage C – mitosis</li> </ul> If Stage B is identified as meiosis or mitosis, alongside A or C, then do not credit A or C (as appropriate).  <b>Comparison of two forms of cell division:</b>  <b>Similarities</b>

Question	Answer/Indicative content	Marks	Guidance												
	<p>Correct identification of the stages where cell division occurs. Quality of written communication impedes communication of the science at this level</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit</p>		<ul style="list-style-type: none"> <li>• idea that <b>both</b> require DNA replication</li> <li>• idea that <b>both</b> require doubling / copying / duplication of chromosomes</li> <li>• cells in <b>both</b> will require a growth phase</li> <li>• during growth phase, more organelles will be produced</li> </ul> <p><b>Differences</b></p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;"><u>Mitosis</u></td> <td style="text-align: center;"><u>Meiosis</u></td> </tr> <tr> <td style="text-align: center;">One division</td> <td style="text-align: center;">Two divisions</td> </tr> <tr> <td style="text-align: center;">Idea of 2 daughter cells</td> <td style="text-align: center;">Idea of 4 daughter cells</td> </tr> <tr> <td style="text-align: center;">Idea that daughter cells genetically identical</td> <td style="text-align: center;">Idea that daughter cells non - identical</td> </tr> <tr> <td style="text-align: center;">Idea that daughter cells are diploid/2n/ same number of chromosomes as adult / same amount of DNA as adult</td> <td style="text-align: center;">Idea that daughter cells are haploid/2n/ half number of chromosomes as adult / half amount of DNA as adult</td> </tr> <tr> <td style="text-align: center;">produces somatic/body cells</td> <td style="text-align: center;">produces gametes</td> </tr> </table> <p><b>ignore</b> mention of locations in which mitosis and meiosis take place</p> <p><b>Examiner's Comments</b></p> <p>Over one third of candidates scored zero on this question, suggesting a lack of knowledge of meiosis and mitosis, and/or a lack of knowledge of where they take place and what their purpose is within a living organism. Having to apply their knowledge to a non-human context may also have</p>	<u>Mitosis</u>	<u>Meiosis</u>	One division	Two divisions	Idea of 2 daughter cells	Idea of 4 daughter cells	Idea that daughter cells genetically identical	Idea that daughter cells non - identical	Idea that daughter cells are diploid/2n/ same number of chromosomes as adult / same amount of DNA as adult	Idea that daughter cells are haploid/2n/ half number of chromosomes as adult / half amount of DNA as adult	produces somatic/body cells	produces gametes
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Question			Answer/Indicative content	Marks	Guidance
					<p>been problematic.</p> <p>Of those who scored, responses were very variable with marks spread relatively evenly across the range. A large proportion of candidates identified B (rather than C) as a process of cell division, usually alongside A. Some candidates forgot to name the stages. Some candidates mixed meiosis with mitosis, e.g. stating that mitosis makes gametes, or showed other signs of confusion, e.g. sperm cells dividing before fertilisation. Explicit comparisons were quite rare, being recognised in about 25% of responses, although primarily focused on differences rather than similarities. Most candidates described aspects of each process without explicit comparison (usually talking about chromosome number, genetically identical/different, number of divisions, and number of cells produced), and in some cases they also forgot to name the types of cell division. Many candidates appeared not to understand the difference between fertilisation and meiosis, with many describing fertilisation as meiosis. A fairly common error was also to describe meiosis as happening in the gametes, rather than producing them. Candidates should try to ensure that they spell meiosis and mitosis sufficiently well that an Examiner can distinguish between them.</p>
			<b>Total</b>	<b>6</b>	

Question		Answer/Indicative content	Marks	Guidance
4	a	<p>idea that colour / flower will be the same / ORA for seeds;</p> <p>ref. to clone / genetically identical; ORA</p> <p>taking a cutting is a faster process / seeds would take longer to grow into a plant;</p>	3	<p>Ignore cost</p> <p><b><u>Examiner's Comments</u></b></p> <p>??The majority of higher level candidates obtained one or two marks for this item. The item overlapped with an item on the foundation paper. Most correctly stated that the cuttings were clones or genetically identical copies of the parent/stock plant and referred to the colour of the flowers produced by the products i.e. purple. The speed of the process was generally not considered by many of the candidates. A common error appeared when candidates stated that the cuttings were clones but then repeated this feature by noting that the products generated by seeds were, effectively, not clones. This type of response could not obtain two marks for this feature. Some candidates erroneously introduced the idea of cost and said that taking cuttings is cheaper.</p>
	b	meristem	1	<p>do not accept stem cell Ignore cambium</p> <p><b><u>Examiner's Comments</u></b></p> <p>A surprising number of candidates did not know the term meristem. Stem cell was frequently given as an answer. Some candidates misread the question as needing to provide a <b>type</b> of cell division so answered <b>mitosis</b>. Cambium was another incorrect answer.</p>

Question		Answer/Indicative content	Marks	Guidance
	c	<p><i>Tissue</i> – phloem / xylem / palisade / spongy mesophyll / epidermis / cambium / meristem;</p> <p><i>Organ</i> – flower / root / leaf / stem / fruit / petal / sepal / stamen / ovary;</p>	2	<p>Accept higher level answers e.g. parenchyma</p> <p><b>Examiner's Comments</b></p> <p>??The majority of candidates were able to identify the organ, such as stem, flower, leaf or root, but struggled to name a type of tissue. Those that did usually chose xylem or phloem. As a result, some candidates responded by writing the names of two different organs and incorrectly used the tissue line to include one of the organ names. Examples of a tissue was not answered well with many poorer candidates listing incorrectly leaf, chlorophyll, cytoplasm, stem as examples of tissues.</p>
		<b>Total</b>	<b>6</b>	

Question		Answer/Indicative content	Marks	Guidance						
5	a	Meiosis	1	<p><b>Examiner's Comments</b></p> <p>Again, the majority of candidates were successful with this item. Relatively few named the cell division as mitosis instead of the correct response of meiosis with many hybrid spellings. Weaker candidates guessed fertilisation, sexual reproduction and other terms associated with reproduction.</p>						
	b	<table border="1"> <thead> <tr> <th></th> <th>Horse</th> <th>Donkey</th> </tr> </thead> <tbody> <tr> <td>Sperm cell</td> <td>32</td> <td>31</td> </tr> </tbody> </table>		Horse	Donkey	Sperm cell	32	31	1	<p><b>NEED BOTH</b></p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates coped well with this item and correctly identified the number of chromosomes for each of the two sets of gametes as 32 for sperm from the horse and 31 for sperm from the donkey, showing understanding that the chromosome number was halved in each case. A common mistake was to double the number instead. Poorer responses seen were, XX and XY /31 and 32.</p>
	Horse	Donkey								
Sperm cell	32	31								
		<b>Total</b>	<b>2</b>							

Question			Answer/Indicative content	Marks	Guidance
6	a	i	<p>A                      meiosis</p> <p>B                      mitosis</p> <p>C                      mitosis</p>	1	<p><b>all correct responses needed for 1 mark</b></p> <p><b>reject</b> meitosis / miosis</p> <p><b>Examiner's Comments</b></p> <p>Mixed responses were demonstrated for this question. Some candidates obtain the mark but many were challenged by the sequence of cell division. Others referred to fertilisation and other incorrect interpretations of the model. The terms meiosis and mitosis were often spelled incorrectly in answers to this question.</p>
		ii	<p><b>any three from</b></p> <p>zygote contains chromosomes / gene / DNA / alleles from both parents ;</p> <p><b>zygote</b> is split in 2 / undergoes mitosis (to give 2 embryos / piglets) ;</p> <p>piglets have <b>identical / same</b> DNA / genes / alleles / are clones / same genotype ;</p> <p>embryos / piglets have different DNA / genes / chromosomes / alleles from parents</p>	3	<p><b>accept</b> correct references to the letters / stages in the diagram</p> <p><b>accept</b> piglets / embryos come from the same zygote</p> <p><b>ignore</b> similar genes</p> <p>answers with correct descriptions of meiosis / mitosis but without reference to the diagram / scenario = 2 marks</p> <p><b>Examiner's Comments</b></p> <p>It was encouraging to note the good understanding of combined genetic material at the stage of fertilisation, involving gametes from the two parents. Some responses referred to identical features without involving a reference to genetic material (either DNA, chromosomes, genes etc.).</p>

Question			Answer/Indicative content	Marks	Guidance					
	b	i	<table border="1"> <tr><td></td></tr> <tr><td></td></tr> <tr><td>✓</td></tr> <tr><td>✓</td></tr> <tr><td></td></tr> </table>			✓	✓		2	<p><b>accept</b> any clear response eg. crosses (without ticks), shaded boxes</p> <p>three ticks = 1 mark max. four or more ticks = 0 marks</p> <p><b>Examiner's Comments</b></p> <p>Most candidates gave the correct response for this question.</p>
✓										
✓										
		ii	<p><b>any two from</b></p> <p>cells still unspecialised / undifferentiated / stem cells <b>AND</b> can become any type (of cell) ; any gene (at this stage) can be switched on / off ; before 8 cell stage</p>	2	<p><b>ignore</b> 'not fully developed'</p> <p><b>accept</b> genes are activated / inactivated</p> <p><b>Examiner's Comments</b></p> <p>It was unfortunate that, although many realised that the cells were unspecialised, they did not link this to the potential to create any form of cell. A number of responses correctly described the importance of the 8 cell stage but very few candidates incorporated references to genes being switched on/off.</p>					
		iii	<p><b>any one from</b></p> <p>embryo may be destroyed / killed / harmed ; embryo does not have a choice</p>	1	<p><b>accept</b> embryo could have grown to form a baby / person</p> <p><b>ignore</b> playing God / it is immoral / not natural / cause a miscarriage</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates correctly noted that the cell, embryo, potential baby etc. was killed by this procedure.</p>					
			<b>Total</b>	<b>9</b>						