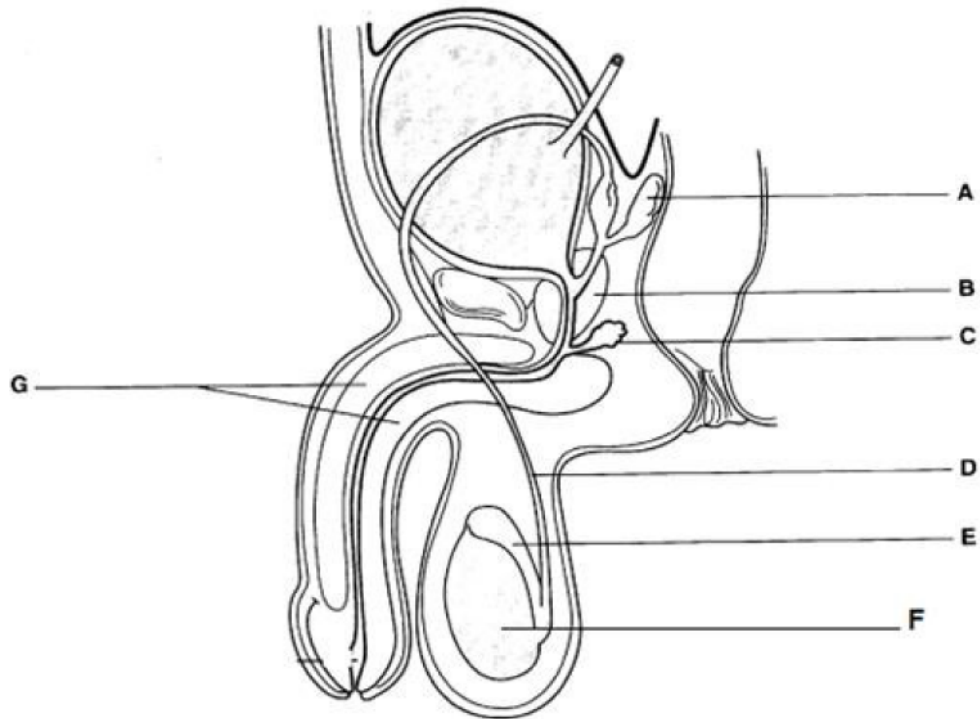


1. Ageing is known to affect the male urinogenital system in a number of ways.

Fig. 35.1 is a diagram of the male urinogenital system.



**Fig. 35.1**

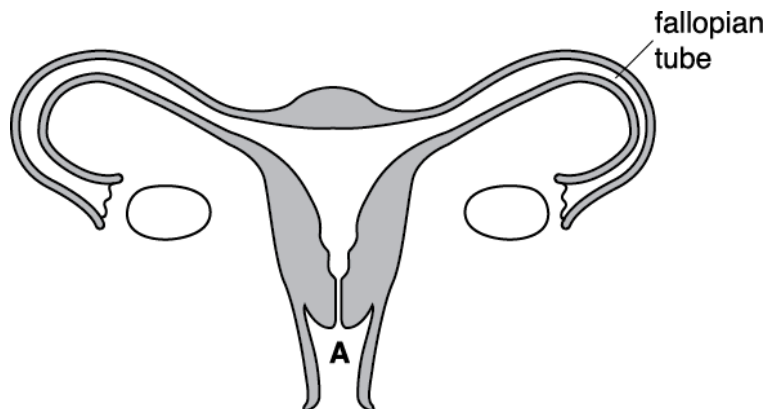
Complete Table 35.1 below so that the correct letter from Fig. 35.1 is against each of the following statements:

Statement	Letter
If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.	
Changes in this structure mean sperm can fail to become motile.	
Changes in this structure can lead to more chromosome abnormalities in sperm.	
Changes in tissues here can lead to erectile dysfunction.	

**Table 35.1**

[4]

2(a). The figure shows a diagram of the female urinogenital system.

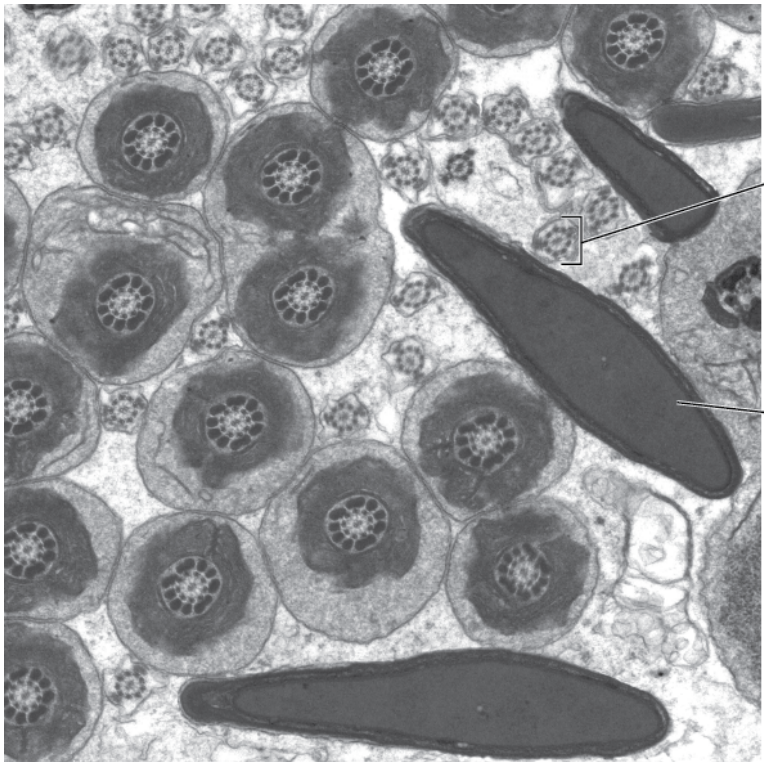


Draw a line the figure, starting at the region labelled A, to indicate the path that sperm travel before meeting a secondary oocyte.

*This question should be answered on the figure.*

[1]

(b). The following figure is a photomicrograph of sperm cells in the testes. Some of the sperm cells are seen in cross-section.



Identify the precise part of the sperm cell labelled A in the photomicrograph.

-----  
----- [2]

(c). Fertilisation is the fusion of a male and female gamete.

Outline how fertilisation increases genetic variation.

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-----  
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-----  
----- [2]

(d). Implantation is the first stage of pregnancy.

(i) Name the stage of embryo development that consists of a few dozen cells, which form approximately five days after fertilisation.

----- [1]

(ii) State the precise location where implantation usually occurs.

-----  
----- [2]

(iii) The implantation of a fertilised egg in the fallopian tube is known as an ectopic pregnancy.

Suggest why the symptoms of an advanced ectopic pregnancy may be low blood pressure and a high pulse rate.

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----- [2]

3. Monitoring the changes in the body brought about by reproductive hormones is an important part of fertility treatment.

Hormones control the production of mucus by cells of the cervix.

- Cervical mucus contains water and glycoproteins known as mucins.
- The mucus changes from a thick, sticky consistency to a thin, watery consistency in response to changing levels of reproductive hormones.

Clomiphene is a fertility drug. It binds to oestrogen receptors in the hypothalamus preventing oestrogen from binding.

Clomiphene stimulates more follicles to mature in the ovaries. This increases the chances of a successful pregnancy.

Suggest how clomiphene increases the chances of a successful pregnancy.

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**[3]**

4(a). The human placenta can be considered unique amongst the many human organs in that, unlike other organs, it is a temporary structure.

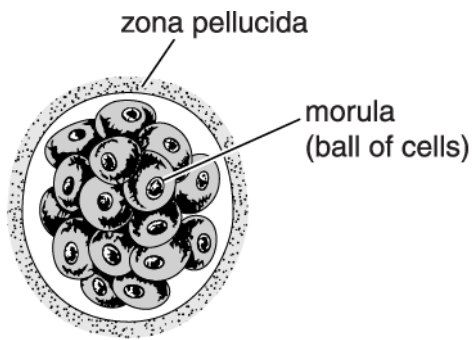
After implantation, it is essential that the placenta develops correctly so that pregnancy is successful.

Using the placenta as an example, explain what you understand by the term *organ*.

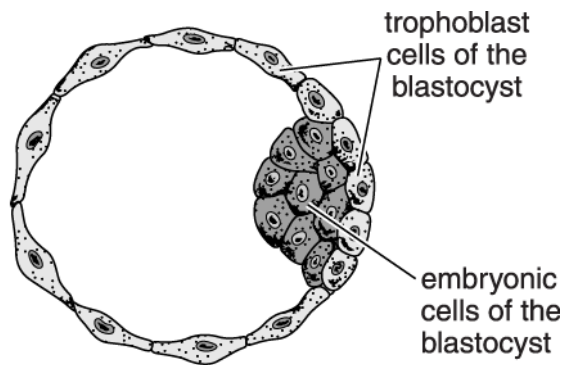
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[2]

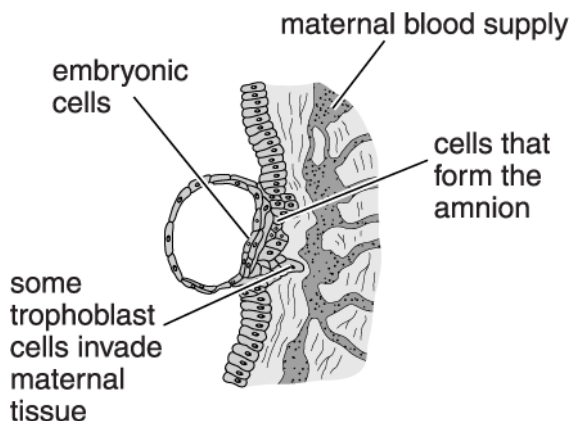
(b).



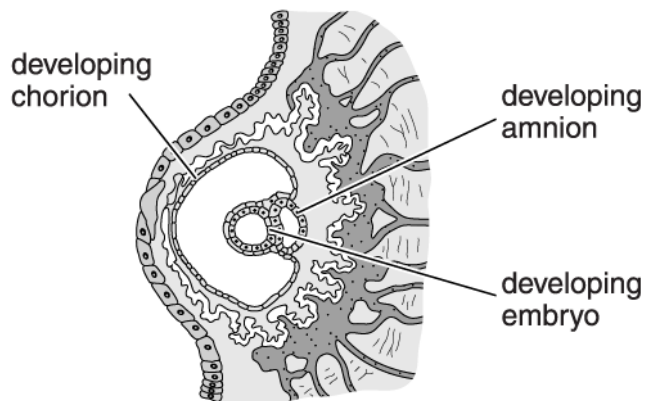
(a) 3–4 days



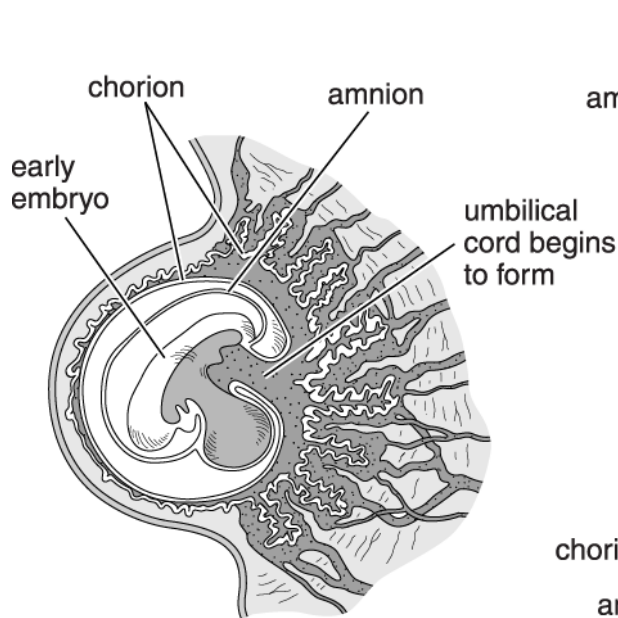
(b) 5–6 days



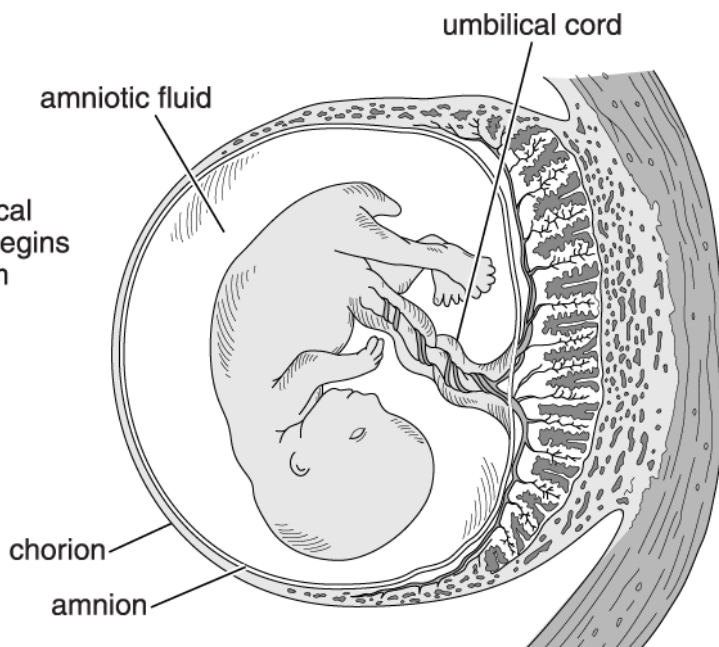
(c) 7–8 days



(d) 3 weeks



(e) 4 weeks



(f) 8 weeks

Fig. 1.1

Fig. 1.1 shows some of the stages that follow fertilisation and the early events in the development of the embryo and the placenta. The diagrams are not drawn to scale.

The following passage describes some of these events.

Complete the passage by inserting the **most appropriate** term.

Immediately following fertilisation, the \_\_\_\_\_ divides rapidly by \_\_\_\_\_.

Within three to four days, a ball of cells known as the morula has been formed. The formation of the morula occurs as it travels down the \_\_\_\_\_.

The morula develops into the blastocyst. The blastocyst implants into the \_\_\_\_\_ of the uterus approximately seven days after fertilisation.

Some of the dividing cells in the blastocyst \_\_\_\_\_ to form structures in the early embryo. Other cells will eventually become part of the structures that protect the developing embryo, such as the amnion and the chorion. These are known as the **extra-embryonic membranes**.

[5]

- (c). One role of the trophoblast cells shown in Fig. 1.1(b) is to secrete the hormone human chorionic gonadotrophin (HCG).

State the role of HCG in pregnancy.

-----  
-----  
----- [1]

- (d). It is important that clinicians identify that a mother is carrying twins.

State the term that is given to the condition where twins are known to be present in the uterus.

----- [1]



- (e). Identical twins may or may not share some of the extra-embryonic membranes that develop in early pregnancy. This depends on the stage at which the embryonic cells split into two separate groups of cells.

The three possible types of identical twin are shown in Table 1.1.

Description	Name of twin type
Each twin has a separate chorion and amnion	Dichorionic-diamniotic or <b>DiDi</b>
Both twins share the same chorion and amnion	Monochorionic-monoamniotic or <b>MoMo</b>
Both twins share the same chorion but each has a separate amnion	Monochorionic-diamniotic or <b>MoDi</b>

Table 1.1

- (i) Using the information in Fig. 1.1 and Table 1.1, suggest which type of identical twin will form if the embryonic cells split between 5 and 6 days after fertilisation.

----- [1]

- (ii) Using the information in Table 1.1, state which of the three types of twins could also be **non-identical twins**.

----- [1]

- (iii) Using the information in Fig. 1.1(f), suggest why **MoMo** twins (both twins sharing the same chorion and amnion) are at a higher risk of experiencing oxygen deprivation in the later stages of pregnancy.

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 -----  
 ----- [1]

- (iv) How does a clinician identify that a mother is carrying twins?

-----  
 ----- [1]

5. Storage of sperm by cryopreservation is not limited to human sperm samples.

The maintenance of the dairy cow population in the United Kingdom also relies on being able to store semen from bulls. These bulls have been bred to father offspring with a high milk yield. Their semen is used to inseminate cows that have also been bred to produce a high milk yield.

Sperm cells may become damaged during cryopreservation or during the thawing process.

Most of the damage that occurs is due to the disruption of the cell surface membranes or intracellular membranes, such as the nuclear envelope.

In addition to the nuclear envelope, identify two further **intracellular** membranes that may be damaged during the cryopreservation or thawing of sperm cells.

1

-----

2

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[2]

6(a). Some couples are unable to conceive naturally. The Human Fertilisation and Embryo Authority (HFEA) regulates the use of fertility treatment and other assisted conception procedures that are carried out in the UK.

- A possible cause of male infertility may be anatomical abnormalities of the male reproductive system.
- One procedure that has been developed in recent years is Surgical Sperm Removal (SSR).
- In this procedure, microsurgery is carried out under local anaesthetic and a fluid containing sperm is collected directly from the epididymis.

(i) Name the structure through which sperm normally leave the epididymis.

----- [1]

(ii) Suggest why the concentration of sperm in the fluid collected from the epididymis will be greater than that in semen.

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----- [2]

(b). Sperm that has been collected using SSR may be used in IVF treatment or in ICSI.

(i) State what the initials IVF and ICSI represent.

IVF -----  
ICSI ----- [1]

(ii) More embryos result from the use of SSR-collected sperm in ICSI than from the use of SSR-collected sperm in IVF treatment.

Suggest why.

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-----  
----- [1]

7(a). In the menstrual cycle, the activity of the reproductive organs is controlled by hormones. Some of these hormones, such as oestrogen, are steroid hormones. Others, such as follicle stimulating hormone (FSH) and luteinising hormone (LH), are glycoproteins.

Oestrogen, FSH and LH molecules carry out their function by binding to receptors.

- Oestrogen receptors are found in the cytoplasm of target cells.
- FSH and LH receptors are found on the cell surface membranes of target cells.

(i) Suggest why receptors for FSH and LH are located on the cell surface membranes but the receptors for oestrogen are located in the cytoplasm.

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-----  
----- [2]

(ii) Name the organ responsible for the secretion of FSH and LH.

----- [1]

(b). Fig. 4.1 shows a simplified diagram of the action of the hormone oestrogen on a target cell.

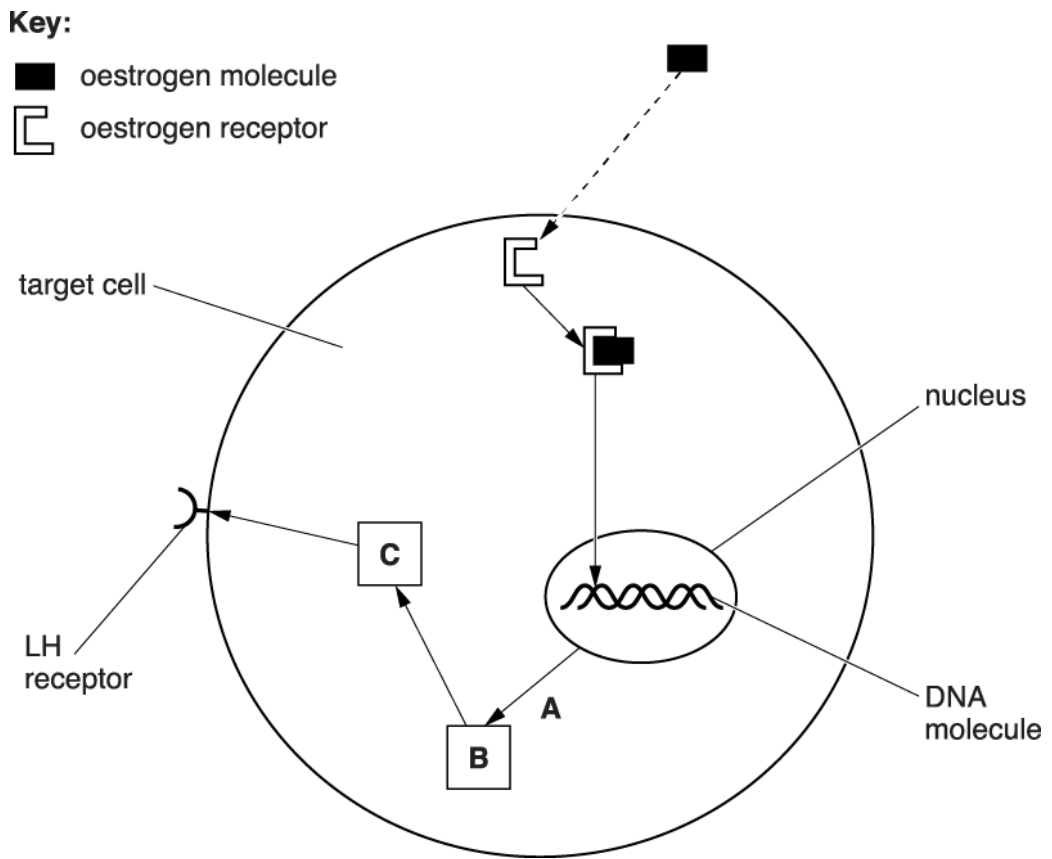


Fig. 4.1

(i) Complete the table below by naming the following molecules and organelles represented in Fig. 4.1.

	Name
Molecule A	
Organelle B	
Organelle C	

[3]

(ii) Suggest the location and the role of the target cell shown in Fig. 4.1.

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-----  
----- [2]

(c). Cells in the endometrium (the lining of the uterus) have receptors for follicle stimulating hormone (FSH).

Suggest what effect FSH has on the DNA in the nuclei of cells in the endometrium during days 5 to 14 of the menstrual cycle.

Give the reason for your suggestion.

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-----  
----- [2]

8. Chemicals in cigarette smoke have been shown to cause damage to cells in ovaries. Damaged cells are no longer able to perform their normal function.

Explain how damage to cells in the ovaries could result in an earlier onset of the menopause.

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-----  
----- [2]

9(a).

Oogenesis occurs in the ovaries of female mammals, resulting in the production of gametes.

- (i) Name the type of nuclear division that results in the production of **secondary** oocytes from **primary** oocytes during oogenesis.

----- [1]

- (ii) Complete the table below to indicate the stage and type of nuclear division in which the events being described occur.

Event	Type of nuclear division	Stage in nuclear division
Chromosomes line up on the equator; there is no association between homologous chromosomes.		
Homologous chromosomes form bivalents.		
Homologous chromosomes separate and are pulled to opposite poles.		
Crossing over occurs.		

[4]

- (b). Fig. 2.1 shows how oestrogen production varies throughout life in human females.

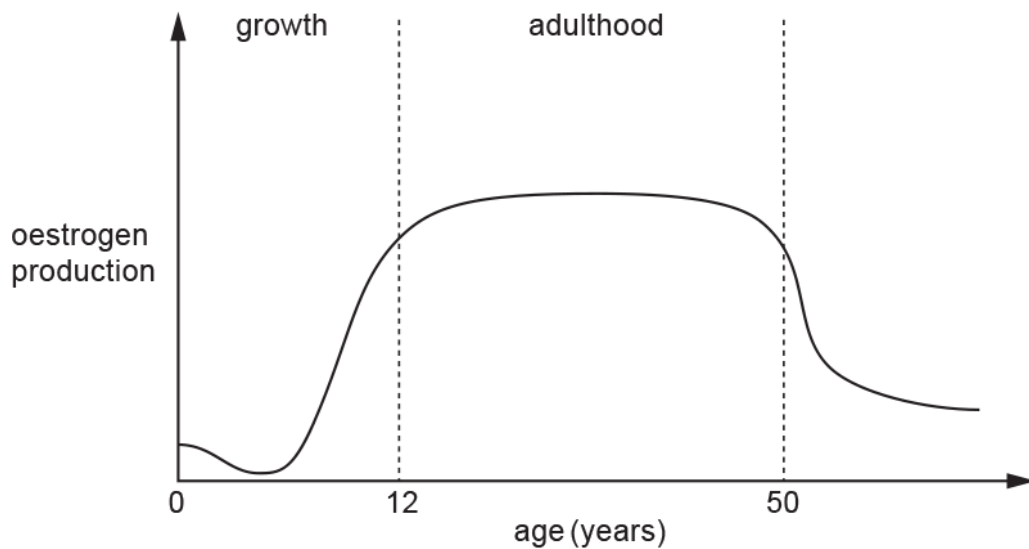


Fig. 2.1

(i) Explain how the rapid increase in oestrogen production towards the end of the growth phase results in the release of secondary oocytes.

-----  
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-----

[2]

(ii) Changes occur to the cells within ovaries over the course of a woman's lifetime.

Use the data in Fig. 2.1 to explain the role of oestrogen production in the changes to ovarian cells that occur during adulthood.

In your answer you should refer to the stages of nuclear division that occur.

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[3]



10. A Robertsonian translocation is a type of chromosomal translocation in which the long arms of two chromosomes fuse together.

Fig. 31.1 shows this event occurring between chromosomes 14 and 21.

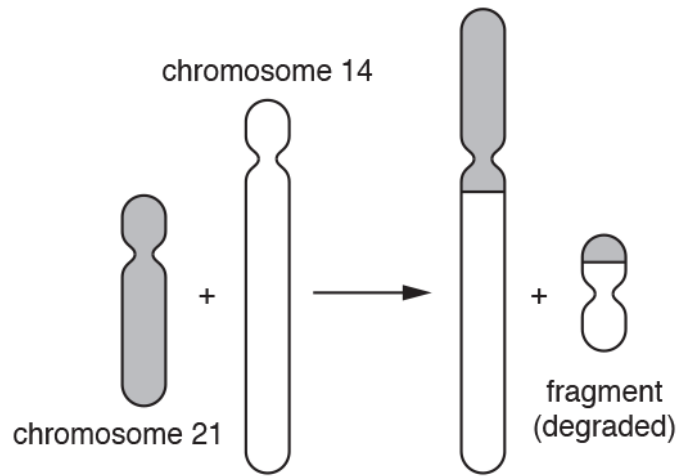


Fig. 31.1

An individual who inherits the translocated chromosome in Fig. 31.1 will either have Down's syndrome or be a carrier of the disorder.

A couple have a child. The mother is a carrier and the father is genetically normal. The genetic material with respect to chromosomes 14 and 21 in the somatic cells of the parents are shown in Fig. 31.2.

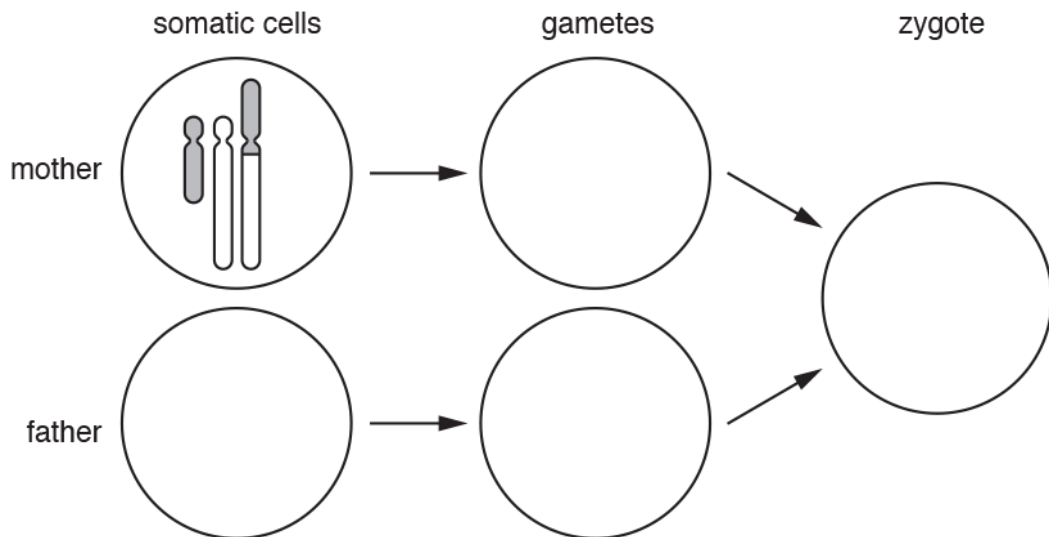


Fig. 31.2

(i) With reference to Fig. 31.2, suggest why the mother does **not** have Down's syndrome.

-----

----- [1]

(ii) The child is born with Down's syndrome.

Complete the diagram in Fig. 31.2 to show the genetic material with respect to chromosomes 14 and 21 in:

- the somatic cell of the father
- the gametes of the mother and father
- the zygote of the child.

[Answer on Fig. 31.2]

[4]

**END OF QUESTION PAPER**

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance										
1		<table border="1" style="width: 100%;"> <tr> <th style="width: 70%;">Statement</th> <th>Letter(s)</th> </tr> <tr> <td><i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i></td> <td>B</td> </tr> <tr> <td><i>Changes in this structure mean sperm can fail to become motile.</i></td> <td>E</td> </tr> <tr> <td><i>Changes in this structure can lead to chromosome abnormalities in sperm.</i></td> <td>F</td> </tr> <tr> <td><i>Changes in tissues here can lead to erectile dysfunction.</i></td> <td>G</td> </tr> </table>	Statement	Letter(s)	<i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i>	B	<i>Changes in this structure mean sperm can fail to become motile.</i>	E	<i>Changes in this structure can lead to chromosome abnormalities in sperm.</i>	F	<i>Changes in tissues here can lead to erectile dysfunction.</i>	G	4	
		Statement	Letter(s)											
		<i>If this is enlarged it can lead to difficulty in starting to urinate or emptying a full bladder.</i>	B											
		<i>Changes in this structure mean sperm can fail to become motile.</i>	E											
		<i>Changes in this structure can lead to chromosome abnormalities in sperm.</i>	F											
<i>Changes in tissues here can lead to erectile dysfunction.</i>	G													
<b>Total</b>		<b>4</b>												
2	a	line drawn from point A to point within (either) fallopian tube;	1	<p><b>CREDIT</b> lines going down both fallopian tubes if arrows are drawn, they must be in the correct direction</p> <p><b>Examiner's Comments</b></p> <p>This required knowledge about the early stages of fertilisation and pregnancy. Initially the path taken by the male gamete in the female urogenital system was required to be drawn on a diagram, followed by the identification of a specific part of a labelled sperm from a micrograph. The role of fertilisation in increasing genetic variation was then looked at, followed by identifying a stage of embryonic development, the location of implantation and explaining the symptoms shown by an advanced ectopic pregnancy. The question tested both AO1 and AO2. The path taken by the sperm was almost universally correct. Marks which were lost were for the path either not reaching the fallopian tube or extending into the ovary.</p>										
	b	<i>idea of end / terminal part of;</i>	2											

### Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
	tail / flagellum;		<p>CREDIT flagella</p> <p><b>Examiner's Comments</b></p> <p>This required knowledge about the early stages of fertilisation and pregnancy. Initially the path taken by the male gamete in the female urogenital system was required to be drawn on a diagram, followed by the identification of a specific part of a labelled sperm from a micrograph. The role of fertilisation in increasing genetic variation was then looked at, followed by identifying a stage of embryonic development, the location of implantation and explaining the symptoms shown by an advanced ectopic pregnancy. The question tested both AO1 and AO2. Candidates found identification of the part labelled A very difficult, the majority incorrectly labelling it in terms of intracellular components such as mitochondria or microfilaments, rather than the tail or flagellum. The end or the terminal part of the tail was rarely identified.</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	<p>gametes are genetically different;</p> <p><i>idea that</i> which gametes fuse is random;</p> <p><i>idea of</i> potentially large number of combinations;</p>	Max 2	<p><b>ALLOW</b> sperm / eggs for 'gametes' throughout</p> <p><b>IGNORE</b> ref. to meiosis (as question is about fertilisation)</p> <p><b>IGNORE</b> random, mating / fertilisation</p> <p>e.g. one egg can be fertilised by any one of a large number of sperm</p> <p><b>Examiner's Comments</b></p> <p>This required knowledge about the early stages of fertilisation and pregnancy. Initially the path taken by the male gamete in the female urogenital system was required to be drawn on a diagram, followed by the identification of a specific part of a labelled sperm from a micrograph. The role of fertilisation in increasing genetic variation was then looked at, followed by identifying a stage of embryonic development, the location of implantation and explaining the symptoms shown by an advanced ectopic pregnancy. The question tested both AO1 and AO2. Candidates either correctly appreciated that gametes were genetically different and that random fusion of gametes took place with only one of many potential sperm effecting fertilisation or incorrectly focused on events which took place in meiosis prior to fertilisation incorrectly linking genetic variation to crossing over and independent assortment or to the combination of different genes provided by each parent on fertilisation.</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	d i	blastocyst;	1	<p><b>CREDIT</b> morula  <b>IGNORE</b> zygote / embryo</p> <p><b>Examiner's Comments</b></p> <p>This required knowledge about the early stages of fertilisation and pregnancy. Initially the path taken by the male gamete in the female urogenital system was required to be drawn on a diagram, followed by the identification of a specific part of a labelled sperm from a micrograph. The role of fertilisation in increasing genetic variation was then looked at, followed by identifying a stage of embryonic development, the location of implantation and explaining the symptoms shown by an advanced ectopic pregnancy. The question tested both AO1 and AO2. Blastocyst was correctly identified in (i) as the stage of embryonic development after approximately five days of fertilisation by most candidates. A few candidates stated zygote or embryo. The endometrium of the uterus was correctly identified</p>
	ii	endometrium;  uterus;	2	<p><b>IGNORE</b> 'lining'</p> <p><b>Examiner's Comments</b></p> <p>Very few candidates correctly linked a fall in blood pressure with blood loss in advanced ectopic pregnancy and that an increase in heart or pulse rate served to maintain blood pressure</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	iii	<p><i>idea that</i> blood loss will lead to a fall in blood pressure (BP);</p> <p><i>idea that</i> heart / pulse, rate rises to maintain blood pressure; AVP;</p>	Max 2	<p>e.g. adrenaline release due to (hypovolemic) shock raises heart / pulse rate</p> <p><b>Examiner's Comments</b></p> <p>The majority of answers described the growth of the blastocyst compressing the blood vessels in the Fallopian tube, causing a restriction of blood flow through and hence the reduced delivery of oxygen and nutrients. Increased heart or pulse rate was required to increase blood flow to supply adequate oxygen and nutrients to the blastocyst. Quite a few candidates also have the misconception that ectopic pregnancy demands more nutrients so there is an increase in blood supply to the Fallopian tube resulting in low blood pressure in the rest of the body. A few candidates even thought that the ectopic pregnancy is not recognised by the body so there is still menstruation and this blood loss causes low blood pressure</p>
		<b>Total</b>	<b>10</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
3		<p>more FSH;</p> <p>(release of FSH) not inhibited by oestrogen;</p> <p>more follicles, ripen / mature;</p> <p>increased, number of (secondary) oocytes released / ovulation;</p> <p><i>idea of</i> more chances of fertilisation;</p>	Max 3	<p>IGNORE ref. to LH throughout</p> <p><b>DO NOT CREDIT</b> (clomiphene) stimulates release of FSH</p> <p><b>CREDIT</b> eggs / ova</p> <p>e.g. more oocytes available to be fertilised</p> <p><b>Examiner's Comments</b></p> <p>This was about the factors needed for successful fertilisation, requiring explanations of factors which facilitated the passage of sperm for fertilisation and of clomiphene in enhancing the chances of a successful pregnancy. This involved an initial consideration of the intracellular modification of proteins to form mucins, followed by the mechanism by which ions moved into the cervical mucus, how this resulted in mucus becoming less viscous and why this allowed sperm to travel more easily for fertilisation. The action of clomiphene on the reproductive hormones oestrogen and FSH was analysed. The question tested both AO1 and AO2. the maturing of more follicles, followed by the release of more secondary oocytes that increased the chances of fertilisation were the three points made by most candidates. Relatively few candidates included the inhibition of FSH release by oestrogen or the fact there were increased levels of FSH. Marks were lost for assuming the binding of clomiphene and blocking of oestrogen stimulated the release of FSH.</p>
		<b>Total</b>	<b>3</b>	



### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
4	a	<p>(organ) is a, collection of / AW, tissues, carrying out / AW, a (specific) function / AW ;</p> <p><i>idea that</i> named tissue(s) allow the placenta to carry out a named function ;</p>	2	<p>Must mention tissue <b>and</b> function <b>DO NOT CREDIT</b> cells instead of tissues</p> <p><b>CREDIT</b> a statement such as 'the placenta contains maternal blood which allows oxygen to be transported to the fetus'</p> <p><b>CREDIT</b> reference to other types of tissue e.g. <i>idea that</i> endocrine tissue of placenta secretes hormones</p> <p><b>ACCEPT</b> ref. to muscle in context of blood vessels</p> <p><b>Examiner's Comments</b></p> <p>Most candidates could explain the meaning of term organ but were unable to give examples of any tissues in the placenta.</p>
	b	<p>zygote;</p> <p>mitosis;</p> <p>fallopian tube / oviduct;</p> <p>endometrium;</p> <p>;</p>	5	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = <b>0 marks</b></p> <p><b>IGNORE</b> fertilised, oocyte / egg</p> <p><b>IGNORE</b> binary fission</p> <p><b>DO NOT CREDIT</b> wall <b>ACCEPT</b> lining</p> <p><b>ACCEPT</b> specialise</p> <p><b>Examiner's Comments</b></p> <p>It was not that uncommon to see endothelium in place of endometrium.</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	maintains / AW, the corpus luteum;	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = 0 marks</p> <p>OR keeps / stimulates, the corpus luteum secreting progesterone.</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates answered this correctly as multiple pregnancy. One candidate suggested expensive as the answer but could not been given a mark.</p>
	d	multiple pregnancy;	1	<b>DO NOT CREDIT</b> if given as part of a list with multiple births
	e	i	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = 0 marks</p> <p><b>ACCEPT</b> correct description</p>
		ii	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = 0 marks</p> <p><b>ACCEPT</b> correct description</p>
		iii	1	<b>ACCEPT</b> only one, exchange system / blood supply

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iv	ultrasound (scan) / sonogram / listen for 2 heartbeats;	1	<p><b>Examiner's Comments</b></p> <p>The information needed to answer parts (i) and (ii) was present within the stem of the question but many candidates failed to analyse the question correctly and draw this information out. Part (iii) was meant to be a stretch and challenge question. Many candidates appreciated there was only one placenta, few managed to link this fact to a higher oxygen demand with increasing growth or development of the embryos. Candidates who gained this marking point gained it largely on the basis of the umbilical cord being tangled.</p>
			<b>Total</b>	<b>13</b>	
5			<p>mitochondrial, (membrane / envelope);</p> <p>acrosome (membrane);</p>	2	<p><b>DO NOT CREDIT</b> endoplasmic reticulum / Golgi apparatus (as these are not present in spermatozoa)</p> <p><b>CREDIT lysosome only if candidate indicates that the acrosome is a modified lysosome</b></p> <p><b>Examiner's Comments</b></p> <p>This was about the effects of cryopreservation and subsequent thawing on the viability of sperm samples obtained from the semen of bulls. This was a data question and data was provided for candidates to assess both the effects of cryopreservation on viability and if there was a significant difference between samples.</p> <p>Most candidates were aware of mitochondrial membranes being damaged with the more able ones also being aware of the acrosome membrane.</p>
			<b>Total</b>	<b>2</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a	i	vas deferens;	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = 0 marks</p> <p><b>ACCEPT</b> phonetic spelling <b>IGNORE</b> sperm duct</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates stated vas deferens in part (i).</p>
		ii	<p><i>idea of</i> more fluid in semen / less fluid in epididymis;</p> <p>from (secretions of), seminal vesicles / prostate (gland);</p>	2	<p><b>IGNORE</b> references to 'dilution' <b>ACCEPT</b> alternative terms for fluid e.g. liquid</p> <p><b>Examiner's Comments</b></p> <p>In part (ii) most candidates appreciated that fluid had been added to the sperm in the semen resulting in a decrease in concentration and many knew that the origin of the fluid was the seminal vesicles or prostate gland. Candidates that did not score well usually made references to fructose and other substances being added to the sperm. They often gained the second mark point for stating the correct origin. A few candidates incorrectly stated that the concentration of sperm in the epididymis is greater because that is where sperm is made and stored.</p>
	b	i	<p><i>IVF</i> in vitro fertilisation <b>AND</b> <i>ICSI</i> intracytoplasmic sperm injection;</p>	1	<p><b>BOTH</b> responses required for one mark <b>ACCEPT</b> phonetic spelling</p> <p><b>DO NOT CREDIT</b> 'intercytoplasmic sperm injection'</p> <p><b>Examiner's Comment</b></p> <p>Part (i) required an exact knowledge of both terms and many candidates did not know what the initials ICSI represented, giving a variety of incorrect possibilities.</p>

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	<p>(For all types of sperm) sperm directly injected into, (secondary) oocyte, in ICSI;</p> <p><i>idea that</i> (for SSR sperm) sperm have not fully matured / AW;</p>	1	<p><b>ACCEPT</b> a description e.g. sperm may not be fully motile acrosome may not be fully functional</p> <p><b>Examiner's Comment</b></p> <p>Many candidates thought that the C stood for cervical, which could be linked to errors in part (ii). Most candidates stated that sperm are directly injected into the oocyte in ICSI in (ii). Few candidates made reference to the lack of maturity of the sperm. Some candidates wrote about implantation of the sperm in the fallopian tubes in ICSI and fertilisation occurring naturally in IVF.</p>
			<b>Total</b>	<b>5</b>	

**Mark Scheme**

Question			Answer/Indicative content	Marks	Guidance
7	a	i	<p>1 FSH and / or LH cannot, cross / AW, membrane OR oestrogen can cross the, membrane / phospholipid bilayer; 2 (because) oestrogen is lipid soluble OR FSH and / or LH are not lipid soluble;</p> <p>3 membrane / bilayer, is hydrophobic;</p>	2	<p><b>CREDIT</b> 'glycoproteins' for FSH and LH and 'steroids' for oestrogen throughout</p> <p>1.<b>DO NOT CREDIT</b> reference to molecular size</p> <p>2. <b>CREDIT</b> idea that molecule is lipid - like or hydrophobic <b>ACCEPT</b> non-polar / hydrophobic (for lipid soluble) and polar / hydrophilic (for not lipid soluble)</p> <p>3. <b>ACCEPT</b> reference to hydrophobic core (of membrane)</p> <p><b>Examiner's Comments</b></p> <p>Part (i) called for a straightforward link between ability to cross the cell membrane and lipid solubility and most candidates seemed aware of this link. Marks were quite often lost for incorrectly relating the ability to cross the membrane to molecular size, or considering FSH and LH in terms of binding to a receptor on the cell surface membrane, hence repeating the stem of the question.</p>
		ii	(anterior) pituitary gland;	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = <b>0 marks</b></p> <p><b>Examiner's Comments</b></p> <p>Most candidates were aware that the organ was the anterior pituitary gland in (ii) ,the main source of error being the brain.</p>

### Mark Scheme

Question	Answer/Indicative content	Marks	Guidance								
b i	<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 20%;">Letter</th> <th style="width: 80%;">Name</th> </tr> </thead> <tbody> <tr> <td>Molecule A</td> <td>messenger RNA /mRNA ;</td> </tr> <tr> <td>Organelle B</td> <td>ribosome / rough ER / rough endoplasmic reticulum / RER ;</td> </tr> <tr> <td>Organelle C</td> <td>Golgi (apparatus / body) vesicle ;</td> </tr> </tbody> </table>	Letter	Name	Molecule A	messenger RNA /mRNA ;	Organelle B	ribosome / rough ER / rough endoplasmic reticulum / RER ;	Organelle C	Golgi (apparatus / body) vesicle ;	3	<p><b>Mark the first answer in each box.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer = <b>0 marks</b></p> <p><b>IGNORE 'RNA' alone</b>  <input type="checkbox"/></p> <p><b>Examiner's Comments</b></p> <p>Many candidates scored all three points in (i) showing a good knowledge of the roles of the molecules and organelles. Marks were most commonly lost for not identifying RNA as mRNA and for giving vesicle instead of Golgi vesicle.</p>
Letter	Name										
Molecule A	messenger RNA /mRNA ;										
Organelle B	ribosome / rough ER / rough endoplasmic reticulum / RER ;										
Organelle C	Golgi (apparatus / body) vesicle ;										

**Mark Scheme**

Question	Answer/Indicative content	Marks	Guidance
	<p>ii</p> <p>(cell in) primary / Graafian, follicle  <b>OR</b>  (in) ovary;</p> <p><i>because</i>  (these cells) detect a, rise / surge in, LH concentrations  <b>OR</b>  (follicle) responds to (increased) LH by releasing (secondary) oocyte;</p>	<p align="center">2</p>	<p><b>DO NOT CREDIT</b> follicle unqualified</p> <p><b>CREDIT</b> ovarian follicle</p> <p>Needs to include idea of <i>increased</i> LH</p> <p><b>ACCEPT</b> answers which refers to male tissues  e.g.  Leydig cells / interstitial cells / testis / testes for mp 1  <b>AND</b>  (testes) respond to (increased) LH by releasing testosterone for mp 2</p> <p><b>Examiner's Comments</b></p> <p>The Graafian follicle or ovary were correctly identified in (ii) as the target cell in many cases, but the role of LH was less clear. Ovulation appeared in some answers, but it was often not linked to a surge in LH. Noticeably, breast tissue was incorrectly given as an organ with the associated role of lactation.</p>



### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	<p>(stimulates / causes DNA) replication / AW  <b>OR</b>  <i>idea of switching on genes;</i></p> <p><i>idea that so, mitosis / cell division / AW can occur;</i></p>	2	<p><b>CREDIT</b> a description</p> <p><b>ACCEPT</b> cell numbers increase  <b>IGNORE</b> references to thickening of endometrium</p> <p><b>Examiner's Comments</b></p> <p>In this part, which was a stretch and challenge mark, a lot of candidates associated FSH with the thickening of the endometrial lining and many gained one mark for linking the role of FSH in stimulating cell division. Fewer linked FSH to stimulating DNA replication, necessary for mitosis to occur. Candidates that did not score well usually gave vague explanations about the need for the thickening of the endometrium in preparation for the implantation of the zygote. Another common mistake was stating that DNA replicates by mitosis.</p>
		<b>Total</b>	<b>10</b>	
8		<p>no / less, oestrogen / progesterone secreted;</p> <p>(due to damage to) follicular cells;</p> <p>no / less development of, endometrium / uterine lining  <b>OR</b>                      FSH stays high;</p> <p><i>idea of damaged oocytes destroyed;</i></p>	2	<p><b>Examiner's Comments</b></p> <p>This was synoptic with Unit 4 and the question was most commonly answered in terms of cigarettes causing a drop in oestrogen production but no further detail was given in terms of the cells producing the oestrogen or the knock on effect of low oestrogen in terms of the menopause.</p>
		<b>Total</b>	<b>2</b>	

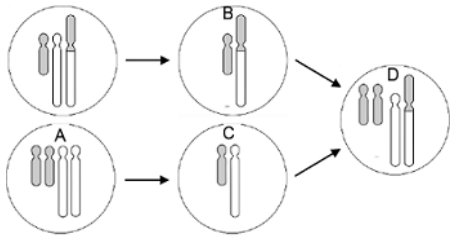
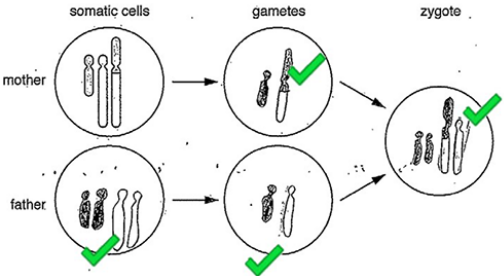
### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																				
9	a	i	<u>Meiosis</u> ✓	1	IGNORE ref to I or II.  <b>Examiner's Comments</b> The vast majority of candidates achieved the mark for (a)(i).																				
		ii	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Event</th> <th style="width: 20%;">Type of nuclear division</th> <th style="width: 20%;">Stage in nuclear division</th> <th style="width: 20%;"></th> </tr> </thead> <tbody> <tr> <td>Chromosomes line up on the equator; there is no association between homologous chromosomes.</td> <td>mitosis</td> <td>(early / late) metaphase</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Homologous chromosomes form bivalents.</td> <td>meiosis</td> <td>prophase I</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Homologous chromosomes separate and are pulled to opposite poles.</td> <td>meiosis</td> <td>anaphase I</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Crossing over occurs.</td> <td>meiosis</td> <td>prophase I</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>	Event	Type of nuclear division	Stage in nuclear division		Chromosomes line up on the equator; there is no association between homologous chromosomes.	mitosis	(early / late) metaphase	✓	Homologous chromosomes form bivalents.	meiosis	prophase I	✓	Homologous chromosomes separate and are pulled to opposite poles.	meiosis	anaphase I	✓	Crossing over occurs.	meiosis	prophase I	✓	4	1 mark per row – needs correct type and stage  <b>Examiner's Comments</b> In (a)(ii) although most candidates scored, many failed to state the correct stage of nuclear division for meiosis by omitting I or II.
Event	Type of nuclear division	Stage in nuclear division																							
Chromosomes line up on the equator; there is no association between homologous chromosomes.	mitosis	(early / late) metaphase	✓																						
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Homologous chromosomes separate and are pulled to opposite poles.	meiosis	anaphase I	✓																						
Crossing over occurs.	meiosis	prophase I	✓																						
	b	i	(rising level of oestrogen) inhibits FSH / causes secretion of LH ✓  LH causes, maturation of follicles / release of secondary oocyte / ovulation ✓  (LH causes) development of corpus luteum (after secondary oocyte release) ✓	2 max	<b>Examiner's Comments</b> Candidates who correctly recognised oestrogen stimulating LH release achieved full marks for (b)(i). Some candidates discussed oestrogen directly causing ovulation and a few felt that both LH and FSH stimulated ovulation. It would be beneficial if these 3 hormones were discussed in terms of their feedback effects on each other and the subsequent changes that occur.																				
		ii	oestrogen production remains high (for most of adulthood) ✓  (primary) oocytes are paused in prophase I (of meiosis) ✓  <i>idea that</i> (high) oestrogen cause, completion / continuation, of meiosis I ✓  (so) forms secondary oocyte ✓  (secondary oocyte) is paused in (metaphase of ) meiosis II ✓	3 max	ALLOW suitable age range (e.g. from 12 to 50)  <b>Examiner's Comments</b> Generally candidates struggled with (b)(ii) and found it difficult to incorporate meiotic stages into their answer, concentrating on mitotic division of cells and the release of a secondary oocyte. However, more able candidates understood the pauses in meiosis and often continued to discuss the completion of meiosis II upon fertilisation. A few candidates wrote about eggs: all candidates should discuss the menstrual cycle and oogenesis in terms of oocytes.																				
<b>Total</b>				10																					

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10		i	does not have trisomy 21 ✓	1	<p>AW e.g. 'no excess of chromosome 21'  <b>ALLOW</b> <u>only</u> has two of chromosome 21</p> <p><b><u>Examiner's Comments</u></b></p> <p>This question required candidates to know that Down's syndrome is a disorder caused by extra genetic material relating to chromosome 21. This can be when there are three distinct copies of chromosome 21(trisomy 21) or some extra material relating to chromosome 21. In this case the mother does not have any extra genetic material and therefore does not have Down's syndrome.</p>

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
ii	 <p>A ✓ B ✓ C ✓ D ✓</p>	4	<p>ALLOW incorrect proportions of translocated chromosome</p> <p>ALLOW diagrams that do not show centromeric regions</p> <p>DO NOT ALLOW drawings without shading</p> <p>ECF (from A) ECF (from B and C)</p> <p><u>Examiner's Comments</u></p> <p>Very few candidates were able to complete all four of the diagrams correctly. Many candidates were not able to identify which chromosomes would be present in the gamete of the mother but were credited with subsequent marks if they understood that the zygote would result from a combination of the two gametes. Candidates need to be careful when completing diagrams such as these to make sure that they include the relevant shading or annotation to distinguish the relevant chromosomes.</p> <p><b>Exemplar 1</b></p>  <p>In this response the candidate completed the diagrams correctly. The shape and shading of the chromosomes was clear and unambiguous.</p>
Total		5	