|  |  |
| --- | --- |
| |  | | --- | | *Human Perspectives ATAR Units 1 & 2* | |

Answers

Chapter 14 Technologies are available to assist in reproduction

Questions 14.1

Recall knowledge

**1** Define ‘infertility’.

Answer*:* Infertility is defined as being unable to achieve pregnancy despite frequent unprotected sex over the period of at least a year.

**2** List the reasons that a male may be infertile.

Answer*:* Sperm production (sperm count, sperm morphology, sperm motility).

Semen may flow into the bladder rather than out the urethra.

Male’s immune system may develop antibodies for their own sperm.

Blockages in the male reproductive tract may occur, preventing sperm being expelled.

Hormonal imbalances can affect sex drive and sperm production.

**3** Describe polycystic ovarian syndrome.

Answer*:* PCOS is a hormonal condition where the ovaries fail to produce mature follicles. No eggs are released and therefore cannot be fertilised.

**4** Define ‘endometriosis’ and describe why it affects fertility.

Answer*:* Endometriosis is a condition where cells of the endometrium grow outside the uterus. The resulting scar tissue or distortion of the uterine tubes can affect fertility by blocking the egg’s release or pathway through to the uterus.

**5** Gonorrhoea and chlamydia may both result in scarring of the uterine tubes. How does this affect fertility?

Answer*:* The scarring may prevent the egg moving down the fallopian/uterine tubes. If the egg cannot enter the tubes it cannot be fertilised and move into the uterus for implantation.

**6** Explain how ovulation tracking can increase the chances of conception.

Answer*:* Ovulation tracking involves a series of blood tests tracking the level of luteinising hormone (LH). There is a surge of LH before ovulation, and fertilisation is most likely to be successful if insemination occurs 24 hours before ovulation.

**7** What hormone is used to stimulate the development of follicles in the ovary? Explain how this increases the chances of pregnancy.

Answer*:*  Follicle Stimulating hormone (FSH). If FSH levels are low, then no or few follicles would reach maturity for ovulation. Correcting these levels will produce more follicles to be matured and ovulated.

**8** Describe a situation where it is unlikely that artificial insemination would be successful.

Answer*:* Artificial insemination would be unsuccessful if the woman is not producing mature follicles, or if she has scarring on her uterine tubes that limits the egg and sperms movement. If she has endometriosis, she may not have a suitable endometrium for implantation, or fibroids.

**9** What does ‘GIFT’ stand for?

Answer*:* Gamete intrafallopian transfer

**10** Describe the steps involved in IVF.

Answer:

* Hormonal treatments are given to the female to stimulate multiple follicles in her ovaries, to control ovulation and to prepare the uterine lining.
* When the eggs are mature, they are retrieved from the ovaries.
* The eggs are then mixed with sperm in a suitable environment and temperature (37oC) to encourage fertilisation and development
* Two to six days after collection the embryo/s are inserted into the uterus via a catheter.

**11** List five factors that a person or couple would need to think about when considering using assistedreproductive technologies.

Answer:

* What to do with excess embryos
* Religious beliefs
* Cost for the technologies
* Risk of multiple births
* Ongoing fertility issues

**12** List four possible outcomes for frozen embryos.

Answer:

* The couple can implant another one
* Disposal of the embryos
* Donation to other people or couples
* Donation to research.

Apply knowledge

**13** Explain why a high percentage of sperm with a bent tail reduces the chances of conception.

Answer*:* A bent tail will reduce sperm motility. Instead of being able to swim in a clear forward direction, they are more likely to swim in circles and are therefore unlikely to reach an egg for conception.

**14** Explain why a female is less likely to conceive when she is 40 years old than when she was 25 years old.

Answer*:* The older a female, the number of healthy eggs she has decreases. This is because all her immature oocytes have been with her since birth.

**15** List two similarities and two differences between endometriosis and fibroids.

Answer: Similarities: Both can block the egg’s release or pathway into the uterus. Both affect fertility. Both can distort the uterine tubes.

Differences: Fibroids are benign growths in the muscular part of the uterus; endometriosis is when endometrial tissue grows outside the uterus.

**16** The highest chance of conception occurs when insemination is two to three days prior to ovulation.Use your understanding of human reproduction to explain this observation.

Answer*:* Sperm can survive for up to four days in the female reproductive tract. The egg is only able to be fertilised in the 24 hours following ovulation. Sperm needs to be able to enter the cervix, swim through the uterus and up two-thirds of the uterine tubes. If insemination occurs two to three days before ovulation, there is sufficient time for enough sperm to be present in the uterine tubes for fertilisation to occur.

**17** Intrauterine insemination can have a higher success rate than natural insemination for some couples. Explain why this happens.

Answer*:* Intrauterine insemination places the sperm directly into the fallopian tubes, negating the need for the sperm to travel through the cervix, uterus and up the uterine tubes. This may be more successful for couples who are experiencing sperm motility or low sperm count issues.

**18** To get pregnant, some couples may consider IVF, but not ICSI. Suggest why they would consider IVF acceptable, but not ICSI.

Answer*:* The key difference between the two is how the sperm fertilise the egg. In IVF the egg and the sperm are left to fertilise themselves; in ICSI a single sperm is directly injected into the egg. The couple may have a religious belief that does not agree with direct fertilisation through the technique of ICSI and may accept that IVF is a more ‘natural’ form of fertilisation.

**19** Gestational surrogacy is more common than traditional surrogacy. Suggest a reason why a:

**a** heterosexual couple might use traditional surrogacy

Answer*:* Traditional surrogacy might be used if the female carries a genetic disease that they do not want passed on to their children. Traditional surrogacy uses the surrogate’s egg and the commissioning father’s sperm.

**b** heterosexual couple might use gestational surrogacy

Answer*:* Gestational surrogacy uses the egg and sperm of the intended parents and the surrogate is the gestational carrier and provides no genetic material. This may be preferred if the couple have a strong desire to have a child that is their own genetic heritage but are unable to naturally conceive or carry a child to full term.

**c** homosexual couple might use traditional surrogacy.

Answer*:* A homosexual couple might choose traditional surrogacy as the surrogate provides her own egg, and only requires the donation of sperm. This can come from the parent (if the couple are male) or can be a donor sperm (if the couple are female).

Questions 14.2

Recall knowledge

**1** Describe how an ultrasound image is produced.

Answer*:* An ultrasound uses high frequency sound waves to produce an image of the foetus. The sound waves are reflected off the foetal tissues to obtain a visual echo of the foetus.

**2** List six reasons why a foetal ultrasound may be performed.

Answer:

* To confirm the pregnancy
* To estimate the stage of the pregnancy
* To determine the number of foetuses
* To identify abnormalities of the cervix or uterus
* To monitor the growth of the foetus
* To determine the gender of the foetus
* To evaluate the anatomy of the foetus
* For genetic screening
* To study the placenta and amniotic fluid
* To identify birth defects
* To determine the position of the foetus.

**3** Describe how an amniocentesis is able to identify chromosomal, genetic or neutral abnormalities.

Answer*:* Amniocentesis uses ultrasound to guide a needle through the abdominal wall into the amniotic cavity. Fluid and living foetal cells are extracted and examined for biochemical defects and chromosomal abnormalities.

**4** What does ‘CVS’ stand for?

Answer*:* Chorionic villus sampling

**5** State the reason for foetal monitoring.

Answer*:* Foetal monitoring is the regular recording of the baby’s heart rate in order to detect indicators of stress during labour and birth. The aim is to identify any risk of injury to the foetus or risk of oxygen deficiency so that appropriate action can be taken.

**6** Describe the use of a fibre-optic scope to study the foetus.

Answer*:* A fibre-optic scope is a small telescope-like instrument, around the size of a hypodermic needle that is introduced into the uterus through the abdominal wall. It is used to view the external appearance of the foetus if a previous ultrasound has indicated the possibility of foetal abnormalities.

**7** List the places where foetal blood is collected from for testing.

Answer*:* The umbilical cord; a foetal blood vessel

**8** Identify the most common use of biochemical analysis for newborn babies in Australia.

Answer*:* The assessment of marker proteins that detect phenylketonuria (PKU) or alpha-fetoprotien (AFP).

Apply knowledge

**9** Use a table to compare and contrast the uses, advantages and disadvantages of the different techniques used to monitor and diagnose foetal health.

Answer:

|  |  |  |  |
| --- | --- | --- | --- |
| **Technique** | **Use** | **Advantages** | **Disadvantages** |
| Ultrasound | High frequency sound waves to produce an image of the foetus | Provides information about the external appearance of the foetus, rate of growth, placenta. Widely used, a safe technique for the foetus and the mother | Does not diagnose all abnormalities |
| Amniocentesis | A needle is inserted into the uterus to remove living foetal cells from the amniotic fluid  Performed at 16–20 weeks | Used to detect chromosomal abnormalities that an ultrasound cannot diagnose. | Risk of infection, miscarriage or damage to the baby. |
| Chorionic villus sampling (CVS) | Taking a sample of foetal cells from the chorion | Can be done early than amniocentesis (9–19 weeks). Can be tested more quickly, used to detect genetic disorders and biochemical abnormalities (not spina bifida) | Risk of miscarriage after the procedure is 2%. Cannot diagnose spina bifida |

|  |  |  |  |
| --- | --- | --- | --- |
| Blood tests | Blood test of the mother | Available from 10 weeks. Used to identify if there is an increased risk of a disorder | It is a screening test, not a diagnostic test. |
| Foetal monitoring | Regular recording of the baby’s heart rate. Used to indicate stress | No risk to the foetus or mother. Can be used during labour to also monitor mother’s contractions. |  |
| Fetoscopy | An instrument used to gain information about the foetus in the uterus. Can be a stethoscope, or a telescope-like fibre optic scope. | Used to detect abnormalities seen on the outward appearance of the foetus, including cleft lip and palate, missing or malformed ears, or limbs and spinal abnormalities including spina bifida. | A risky and difficult procedure. |
| Foetal blood sampling | Taking foetal blood from the umbilical cord or from a foetal blood vessel via a fetoscope. | Results are obtained quickly, used to diagnose chromosomal abnormalities, foetal oxygenation, foetal anaemia, identify infections or to give medication. | 1–2% risk of miscarriage, risk of infection, blood loss and premature rupture of the amniotic sac. |
| Biochemical analysis | The assessment of marker proteins | Used to detect PKU and alpha-fetoprotein (linked to spina bifida) |  |
| DNA probe | Use of recombinant DNA technology to detect a range of genetic disorders. | Used to detect in the DNA the presence of genes that cause disorders |  |

**10** Explain why an ultrasound is often used during an amniocentesis.

Answer*:* An ultrasound is used to guide the needle through the abdominal wall and into the amniotic sac. This can help prevent accidental injury to the foetus.

**11** An amniocentesis is often performed between 16 and 20 weeks of gestation. Suggest why it is not performed at other times.

Answer*:* Prior to 16 – 20 weeks there is insufficient amniotic fluid available that can be removed. Earlier than 16 weeks has an increased rate of complications.

**12** Explain why chorionic villus sampling may be preferred over amniocentesis, despite the higher risk ofmiscarriage**.**

Answer*:* Chorionic villus sampling is done at 9–19 weeks, much earlier than amniocentesis, which is done at 16–20 weeks. The results from CVS are obtained faster. This is important if the results of CVS indicate termination of the foetus.

**13** A mother’s blood may be tested to screen for some disorders. Justify the importance of this test, anddiscuss its advantage over foetal blood sampling.

Answer: Foetal DNA can be found in the mother’s blood. This is a non-invasive way to screen for abnormal chromosomal number. There is no risk to the foetus, unlike foetal blood sampling, which carries a risk of miscarriage, infection and premature rupture of the amniotic sac. If abnormal chromosome numbers are detected at the screening stage, then further, more invasive and risky tests, can be undertaken.

Chapter 14 activity

Activity 14.1 Should we use assisted reproductive technologies?

Answer*:* Lists that students prepare may contain the following points.

|  |  |
| --- | --- |
| **Arguments for** | **Arguments against** |
| Reproductive technologies allow couples who are unable to have children naturally to do so. | Doctors should not be ‘playing God’. |
| Reproductive technologies may allow children to be produced without hereditary diseases. | Embryos may be destroyed during the application of such procedures – ‘every life is sacred’. |
| People who make use of such technology have a strong desire to have a child and will be good parents. | The cost of these procedures is very high and only the rich benefit; others in need may be overlooked. |
|  | The money used for such technology could be better spent in other areas of health. |
|  | Such technology is driven mainly by profit and not for the benefit of the people being treated. |
|  | There are many children in Australia or other countries who need adoptive or foster parents. It would be better for society if childless couples adopted a child. |

Chapter 14 review questions

Recall

**1** List factors that may lead to infertility.

Answer*:* Factors include sperm production, hormonal imbalance, blockages to the tubes (male and female), reduced rate of ovulation, endometriosis, fibroids.

**2** State what ‘GIFT’, ‘ICSI’, ‘IVF’ and ‘IUI’ stand for.

Answer:

GIFT – Gamete intrafallopian transfer

ICSI – Intracytoplasmic sperm injection

IVF – In-vitro fertilisation

IUI – Intrauterine insemination

**3** Describe the steps that occur during an IVF cycle.

Answer:

* Hormonal treatments are given to the female to stimulate multiple follicles in her ovaries, to control ovulation and to prepare the uterine lining.
* When the eggs are mature, they are retrieved from the ovaries.
* The eggs are then mixed with sperm in a suitable environment and temperature (37oC) to encourage fertilisation and development.
* After two to six days, an embryo is inserted into the uterus via a catheter passed through the cervix.

**4** What is foetal monitoring, and why is it used?

Answer*:* Foetal monitoring is the observation and recording of the foetal heartbeat. It is used during labour to check that the baby is receiving the required amount of oxygen. It is also used to check whether the baby is suffering any stress.

**5** What alternatives are there for the unused embryos from IVF?

Answer*:* Unused embryos from IVF can be:

* frozen for later IVF treatments in the event of failure or if the woman wants more children
* thawed and donated to other women
* thawed and destroyed
* thawed and used for scientific research.

**6** In what situations would a doctor advise a female patient to undergo genetic screening or counselling? What testing procedures could the doctor suggest?

Answer*:* Genetic screening or counselling would be advisable if the mother or father has a history of genetic disorders in their family.

Suggested testing procedures may include ultrasound and/or some form of chromosome analysis, such as amniocentesis, chorionic villus sampling, or examining a sample of the mother’s blood for foetal cells that could be tested.

**7** Describe the procedure used for intrauterine insemination.

Answer*:* Sperm is released into the uterus via a catheter that has been inserted through the cervix. Sperm then move naturally through the uterine tubes where they may fertilise an egg. IUI increases the number of sperm that reach the uterine tubes.

Explain

**8** Explain why sperm factors account for approximately 40% of infertility cases.

Answer*:* Sperm are required to be produced in sufficient amounts, move in a forward direction and be able to penetrate the corona radiata and zona pellucida. If sperm count is low, or there are morphology or motility issues then sperm are unable to achieve their role in fertilisation. This accounts for 40% of the total causes behind infertility.

**9** Explain the procedure used in in vitro fertilisation.

Answer:

* The female takes fertility drugs
* The drugs stimulate increased ova (egg) production
* Ova are harvested
* A sperm sample is taken from the male
* Sperm are used to fertilise ova in a glass dish in a laboratory
* One or more embryos are then placed in the female’s uterus.

**10** Explain why ICSI is recommended for couples where poor sperm motility affects the possibility of conception.

Answer*:* ICSI involves injecting a single sperm into an egg, achieving fertilisation. If a couple have issues with sperm motility, ICSI removes the requirement for sperm to swim at all. ICSI may also be used if males are unable to ejaculate.

**11** Explain why surrogacy may be the most suitable option for a person or couple wanting to have a child.

Answer*:* Surrogacy is a suitable option when a female is unable to conceive or carry a baby through pregnancy. Another woman carries the child for the duration of the pregnancy then gives the child to the couple to raise as their own. This can be suitable for homosexual couples who require a donor egg, or donor sperm.

**12** Explain the conditions where donor sperm would be recommended.

Answer*:* Donor sperm would be used in the case of a female same-sex couple who wish to have a child, or a single female who desires to conceive a child on her own. Donor sperm would also be recommended if the male has a genetic disease in his family that he does not want passed on to the offspring, or if the male partner has a very low sperm count.

Apply

13 List the considerations that would be factored into a decision regarding the use of assisted reproductive technologies.

Answer:

* What to do with any excess embryos from IVF cycles
* The cost involved in ART
* Religious beliefs
* Some infertility causes may be genetic, if donor sperm and eggs are not used, the genetic defect may be passed onto the offspring.

**14** Use a table to compare and contrast the methods used for foetal monitoring.

Answer:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Foetal monitoring** | **Fetoscopy** | **Foetal blood sampling** |
| Description | Regular recording of a baby’s heart rate using an electrocardiogram (ECG) to detect indicators of stress or oxygen deficiency | The use of a fetoscope to gain information about the foetus in the uterus. Stethoscope – used to listen to the foetus’ heartbeat.  Fetoscope – a telescope-like fibre optic, inserted via a hypodermic needle into the uterus to observe the foetus within the uterus. | A sample of blood is taken from the umbilical cord or a foetal blood vessel. |

|  |  |  |  |
| --- | --- | --- | --- |
| Advantage | Identifies any risk of injury to the foetus so appropriate action can be taken | Helps detect any eternal physical defects including cleft palate and lip, spina bifida, malformed or missing ears or limbs. | The results from the blood sample are available quickly. |
| Disadvantage (if any) | No risk to foetus or mother. | High risk procedure that is usually only performed by a specialist and if there has been an indication of abnormality in a previous ultrasound. | Risk of miscarriage (1–2%), risk of infection, blood loss and premature rupture of the amniotic sac. |

**15** Explain why amniocentesis is offered to mothers aged 37 or over but is not routinely offered to mothers in their twenties.

Answer*:* The risk of amniocentesis is outweighed by the risk of abnormalities that the baby might have if its mother is over 37. At an older age there is an increased risk of genetic abnormalities. In particular, the incidence of Down syndrome increases dramatically with increasing maternal age.

**16** If a child is born to a surrogate mother, will that child show any resemblance to the surrogate mother? Give reasons for your answer.

Answer*:* If gestational surrogacy is used, no. The appearance will be determined by the DNA inherited via the sperm and the egg. These would not come from the surrogate mother thus the child would not resemble her.

Extend

**17** If it only takes one sperm to fertilise an egg, why is a sperm count of 15 million per millilitre considered a low count?

Answer*:* Sperm mortality is very high and the female reproductive tract is hostile to sperm, with a low pH environment and white blood cells that will attack foreign cells. It also takes thousands of sperm meeting the egg to provide enough enzyme to loosen the cells of the corona radiata. Some sperm may swim up the incorrect uterine tube.

**18** Discuss why it is important that couples who donate embryos are able to stipulate some characteristics of the female getting the embryo. Suggest some characteristics that may be factors.

Answer:

Age of the women – if they are beyond the natural age of menopause (over 51 years of age)

Health – if the recipients health may be compromised by the pregnancy

Previous attempts – the woman must have completed their own treatment and used any of their own embryos that may be in storage.

Social, legal and emotional implications – the woman must undergo counselling to consider the social, legal and emotional implications of being a recipient to a donor embryo.

**19** New ethical and legal issues are arising with the more widespread use of reproductive technologies. In the United States, fertility clinics sell eggs and sperm from donors with specific attributes. They also advertise for donors with particular characteristics, such as being tall, with an athletic build and no major family medical problems. Consider the ethical and legal problems that shopping for gametes might bring. For example, are gametes to be considered like any other commodity? And if a couple have paid for gametes to produce a bright and athletic child, what legal recourse should they have if the child does not meet their expectations? List all the ethical and legal issues you think could arise from the advertising of, or for, gametes. Compare your list with those of other members of your class. You may wish to debate the issues involved.

Answer*:* Answers will vary, but may address some of the following issues.

* Who is the legal parent? Does the biological parent have any rights and/or responsibilities?
* Religious objections
* There may be some social stigma attached to children and their parents when characteristics are specifically selected, versus children whose characteristics occur by chance.
* Economic considerations: shopping for gametes is only available to the wealthy.
* Do the parents have the right to sue the company if the child does not possess the characteristics the parents requested?
* Legal problems surrounding the child’s right to know who their biological parents are and a donor’s right to know the identity of any biological children

**20** Embryos resulting from IVF are tested genetically before they are implanted into the mother’s uterus. An embryo found to have a genetic disorder would probably not be used for implantation. What are some of the moral and ethical issues associated with disposing of unwanted embryos?

Answer*:* Answers will vary but may address some of the following questions.

* When does human life begin?
* Is a human embryo considered to be a person? Does it have the right to live?
* Does an embryo with a genetic disorder have a right to life?
* Is the destruction of a human embryo murder?
* A person with a genetic disorder may be a burden on social resources, including medical resources, government funding, scientific research time and money.
* Some genetic disorders are not serious. At what point does a disorder become serious enough to warrant destruction of the embryo?
* Who makes the decision to destroy the embryo: the biological parent, the woman who was to receive the implanted embryo, the woman and her partner or medical experts?
* What information should be given to the parents/decision-makers before a decision is made to destroy an embryo?

**21** Amniocentesis and chorionic villus sampling are both invasive diagnostic tests that have complications associated with them that may cause harm to the foetus. A cervical-screening-type test is being developed to diagnose genetic abnormalities. Find out the progress being made on developing such a test and how long it is likely to be before it comes into general use. Are other non-invasive techniques being developed?

Answer*:* Individual research so answers will vary, but in September 2009, the University of Queensland, the developers of the test, announced that a commercial company had taken out a licence to use the technology known as Foetal Cell Isolation and Enrichment Technology. As of 2014, the test was still not in general use.