



NATIONAL SENIOR CERTIFICATE EXAMINATION  
NOVEMBER 2020

**LIFE SCIENCES: PAPER II**

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<p><b>SOURCE MATERIAL BOOKLET FOR QUESTIONS 1, 2 AND 3</b></p>
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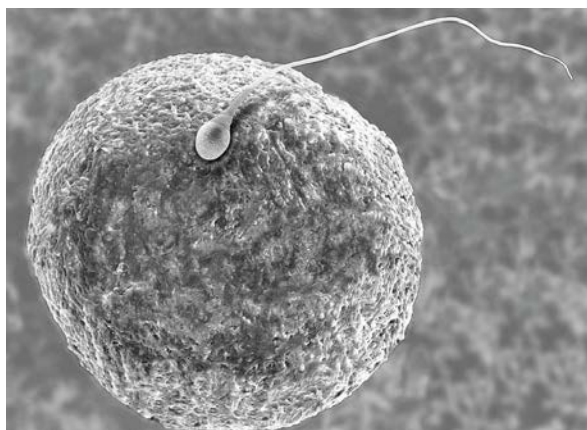
**SECTION A****QUESTION 1**

Read the information below. Use this information, as well as your own knowledge to answer Question 1 in the question paper.

**Past, present, and future of birth control**

When a single sperm penetrates an ovum a zygote is formed. After many divisions of the zygote by mitosis, a small ball of cells is formed. Once implantation of this ball of cells occurs, a pregnancy results. Despite the United Nation's statement that contraception is a basic human right, every year there are more than 200 million unwanted pregnancies worldwide. Human fertility is therefore both a blessing and a curse: for many, it can lead to poverty and suffering, which is why humans have long searched for an effective method of contraception that would enable them to take control of their fertility and decide if, when, and how often they become pregnant.

**Figure 1 – Photo of human ovum with sperm cell placed on it**



Magnification: egg 260X, sperm 760X.

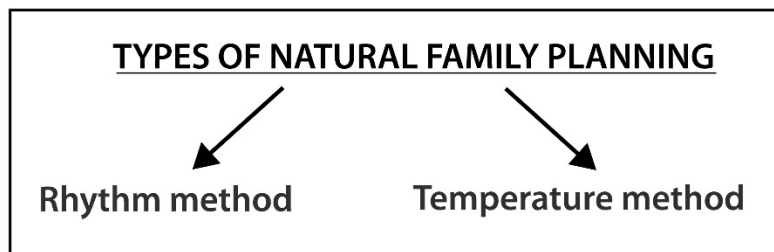
[Adapted: <<https://images.fineartamerica.com>>]

People have tried very hard to understand women's fertility and human reproduction. It's not entirely surprising that only a few worked out exactly what sex had to do with pregnancy – scientists didn't identify sperm until 1678. It took another 100 years to work out the function of sperm. Mammalian ova weren't identified until 1827 by Karl Ernst von Baer. It was another 103 years until Herman Knaus in Austria and Kyusaku Ogino in Japan were able to work out the timing of ovulation in women. Physiologists only demonstrated in the 1970s when, in the menstrual cycle, fertilisation of the ovum was most likely.

[Adapted: <<https://www.mayoclinic.org>>]

## Contraceptive methods – natural family planning methods

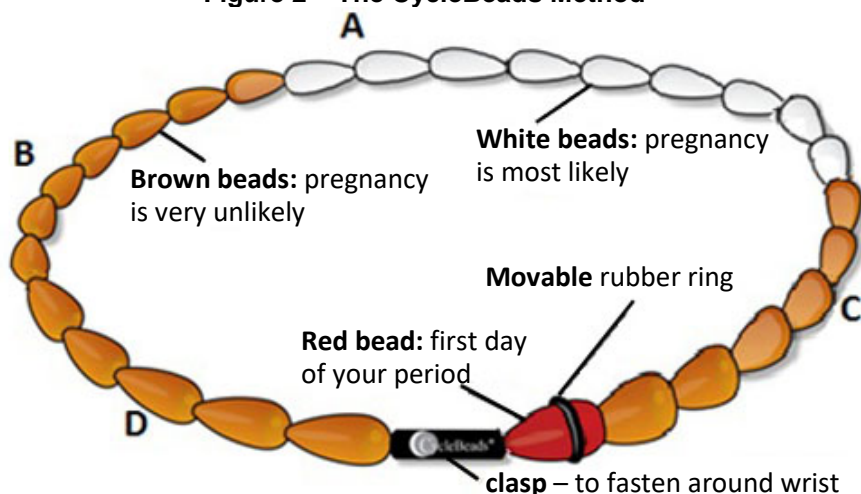
Avoiding intercourse at certain times has been used as a birth control method ever since it was first discovered that sexual intercourse led to pregnancy. (In ancient India it was thought sex must be avoided during menstruation as it was believed that babies were formed when menstrual blood combined with men's semen!)



The **temperature method** of birth control uses the fact that a woman's body temperature changes throughout the menstrual cycle. The process of ovulation takes about 24 hours. Once the ovum is in the Fallopian tubes, it only stays alive for about 24 – 48 hours. After ovulation has occurred, the body temperature rises and stays higher until menstrual bleeding begins. Therefore, by monitoring her body temperature throughout her menstrual cycle, a woman can be relatively certain that she is not fertile if her body temperature has increased and has remained higher for at least two days.

**CycleBeads**, developed by the Institute for Reproductive Health at Georgetown University in the USA, are a colour-coded string of beads (that may be worn as a bracelet) that represent the days of a woman's menstrual cycle. It is used to keep track of her menstrual cycle and assist her in using the rhythm method of contraception. Starting on the first day of her period, a band or rubber ring is put around the red bead. Every day thereafter, the band is moved clockwise to the next bead. The colour of the bead lets her know if she is highly likely to be fertile on that day. With correct use, CycleBeads are 95% effective at preventing pregnancy.

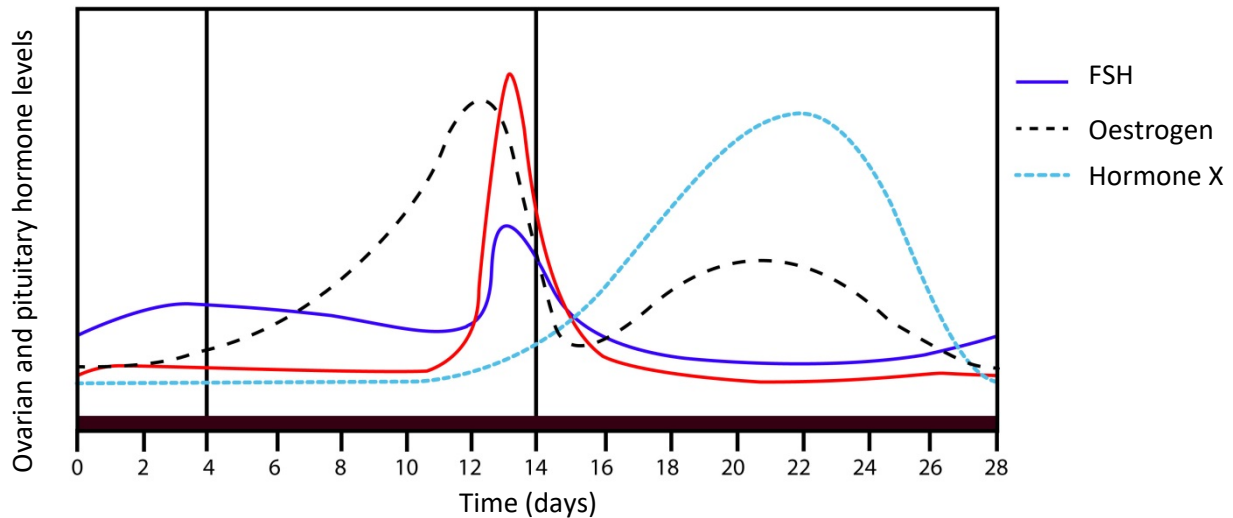
**Figure 2 – The CycleBeads Method**



### INSTRUCTIONS FOR USE:

- On the first day of your period, move the ring to the red bead.
- Mark this date on your calendar.
- Every morning move the ring to the next bead. Always move the ring from the wider to the narrower end of the bead (i.e. clockwise in the diagram.)

[Adapted: Are'valo, M., Jennings, V. & Sinai, I. 2002. Efficacy of a new method of family planning: the StandardDays Method. *Contraception* 65: 333 – 338.] [Adapted: <<https://www.psi.org>>]

**Figure 3 – Menstrual cycle graph showing hormone levels**

[Adapted: &lt;britannica.com&gt;]

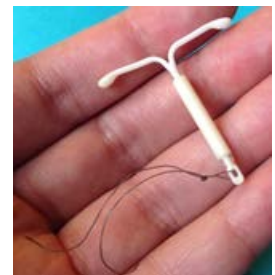
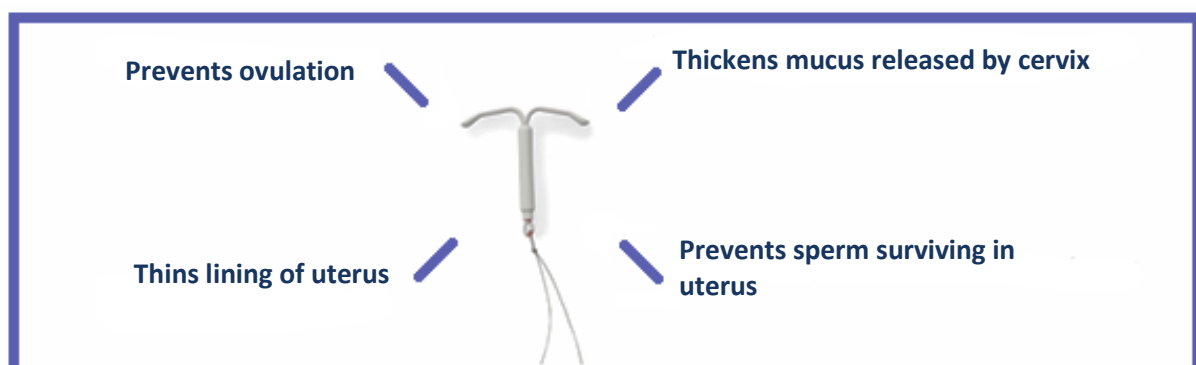
[Adapted: Burroughs, V. L. & Burroughs, B. 1990. *Contraception: A Guide to Birth Control Methods*. Prometheus Books. Buffalo, NY][Adapted: Grimes, D. Gallo, M. Grigoreiva, V. 2005. Fertility-awareness based methods for contraception: Systematic review of randomised controlled trials. *Contraception*. 2005(72):85-90.][Adapted: <<https://www.plannedparenthood.org>>]

## Chemical contraception




### ***Intra Uterine Devices (IUDs)***

The first specifically designed IUD was made in 1909. There are two types of IUDs: a copper IUD, first produced in 1969, that does not release hormones, and a plastic IUD introduced in 1996, that releases controlled doses of hormones.

**Mirena** is a brand-name IUD that releases high levels of an artificial form of the hormone progesterone. The Mirena is used to prevent pregnancy and can be used to reduce the thickness of the endometrium and therefore prevent heavy menstrual bleeding in women. The Mirena contains 52 mg of artificial progesterone and is set to release 0,02 mg of the hormone per day. Mirena is 99% effective in preventing pregnancy.

**Figure 4 – Mirena IUD**[Adapted: <<https://www.floridainjurylawyer-blog.com>>]Functions of an IUD. [Adapted: <<https://www.bedsider.org>>][Adapted: <<https://www.healthline.com>>], [Adapted: <<https://www.plannedparenthood.org>>]

**Table showing other types of contraception**

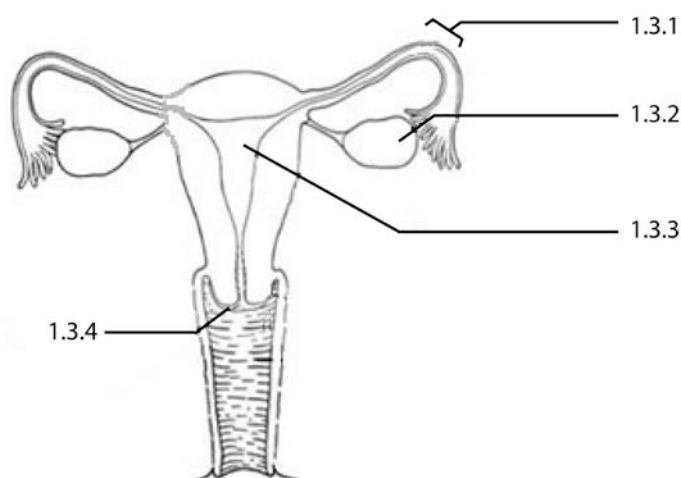
Contraceptive type	Description	
<b>1. Barrier methods</b>		
<b>Female condom</b>	Sheath placed into the vagina that blocks semen entry and prevents pregnancy and STD infection. Easy to use and readily available.	<p><b>Figure 5 – Female Condom</b></p>  <p>[Adapted: &lt;<a href="https://www.menafn.com.com">https://www.menafn.com.com</a>&gt;]</p>
<b>Diaphragm</b>	Rubber cap placed over entrance to cervix to prevent semen entering uterus. Different sizes exist – therefore women must be measured by a doctor for correct size. Can lead to bladder infections. May be uncomfortable to use. Does not protect against STDs.	<p><b>Figure 6 – Different types of diaphragm</b></p>  <p>[Adapted: &lt;<a href="https://encrypted-tbn0.gstatic.com">https://encrypted-tbn0.gstatic.com</a>&gt;]</p>
<b>2. Hormonal method</b>		
<b>Contraceptive pill</b>	Oestrogen and/or progesterone pills – prevent production of ova and therefore ovulation; thickens cervical mucus. Allows complete control of contraception by woman.	<p><b>Figure 7 – Contraceptive pills</b></p>  <p>[Adapted: &lt;<a href="https://wikipedia.com">https://wikipedia.com</a>&gt;]</p>

[Adapted: Grimes, D. A, ed. 1992. Highlights from an International Symposium on IUDs. *The Contraception Report* 3(3): 4.] [Adapted: <<https://www.fpa.org.uk>>]

[Adapted: <<https://www.webmd.com>>]

[Adapted: <<https://www.urologyhealth.org>>]

**Figure 8 – Diagram showing a longitudinal section through the female reproductive system**



[Adapted: <<https://o.quizlet.com>>]

## QUESTION 2

Read the information below. Use this information, as well as your own knowledge to answer Question 2 in the question paper.

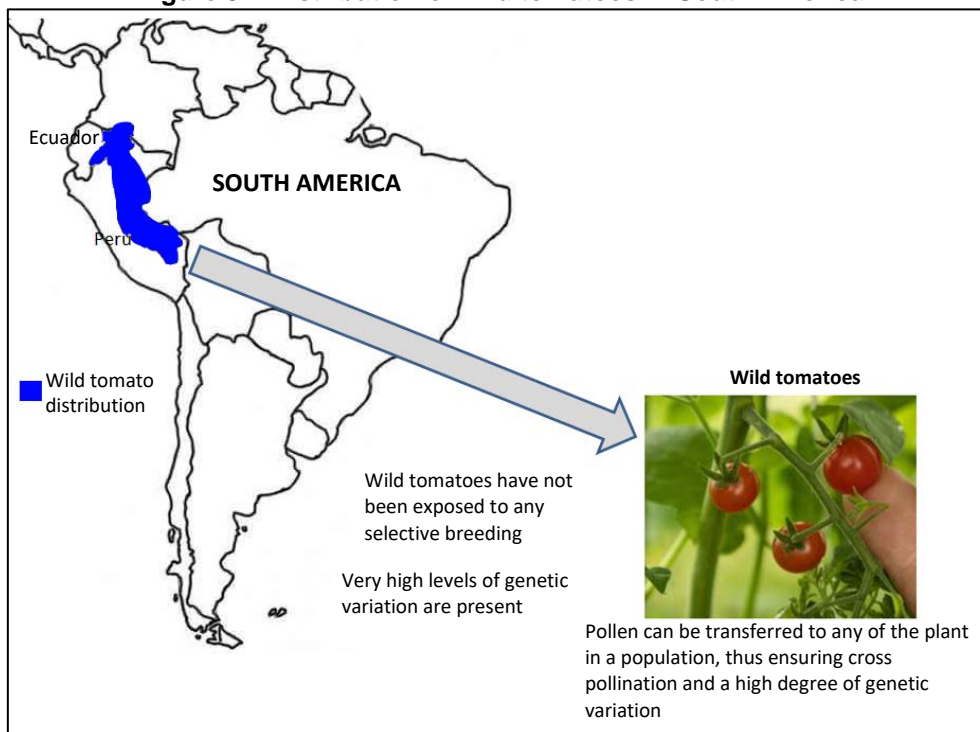
### Growing the best tomatoes

The majority of crops and vegetables that we currently eat were selectively bred from their original wild ancestors within the past 12 000 years. This ultimately led to the accumulation of valuable combinations of alleles. However, unfavourable alleles were also inherited and accumulated through this process, such as those causing susceptibility to certain diseases.

Climate change is accelerating issues regarding food production. One of the consequences of climate change is a shift in the areas where pests and diseases can occur. This means that plants are exposed to new diseases and pests that never previously affected them. Therefore, if farmers keep cultivating the same varieties in the same place, yields can decrease. Plant breeders have realised the problem also exists in other varieties of crop plants, such as tomatoes, that have also been produced in this way. They have tried to re-introduce variation in alleles by crossing the crop species with a wild relative. For example, rice yields in Asia were hit by the "*rice grassy stunt virus*" in the 1970s. Resistant varieties to this virus were then created by crossing modern rice with a wild relative.

Wild tomatoes, which are native to the Andes region in South America, produce pea-sized fruits. The early indigenous peoples such as the Aztecs and Incans started changing the plant characteristics from around AD 700 by selecting mutants with desirable traits, such as larger fruit, for breeding purposes.

**Figure 9 – Distribution of wild tomatoes in South America**



[Adapted: <<https://www.worldatlas.com>>; <<https://www.ag.umass.edu>>]

Worldwide tomato production has increased by 300% since 1980 to over 182 million tons per year, worth around R1,32 trillion per year. Global production is expected to continue increasing in the future.

[Adapted: The world's leading producers of tomatoes. *Worldatlas*]

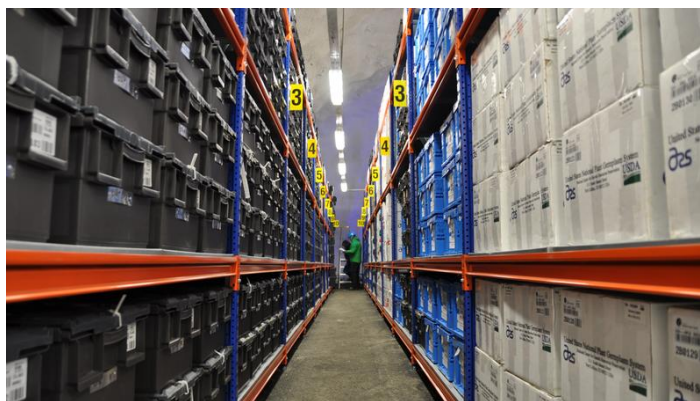
Adapted: Zsögön, A., Čermák, T., Naves, E. 2018. *De novo* domestication of wild tomato using genome editing. *Nat. Biotechnol.* 36, 1211–1216]



In order to preserve the alleles from wild tomatoes, their seeds are being collected from the isolated regions of South America. The seeds are now being sent to breeding organisations around the world. Some are being stored in seed banks such as the C. M. Rick Tomato Genetics Resource Centre at the University of California, Davis. The Centre has seeds from more than 3 800 specimens. This includes both wild tomatoes, as well as seeds from modern tomato varieties.

[Adapted: <<https://www.tgrc.ucdavis.edu>>]

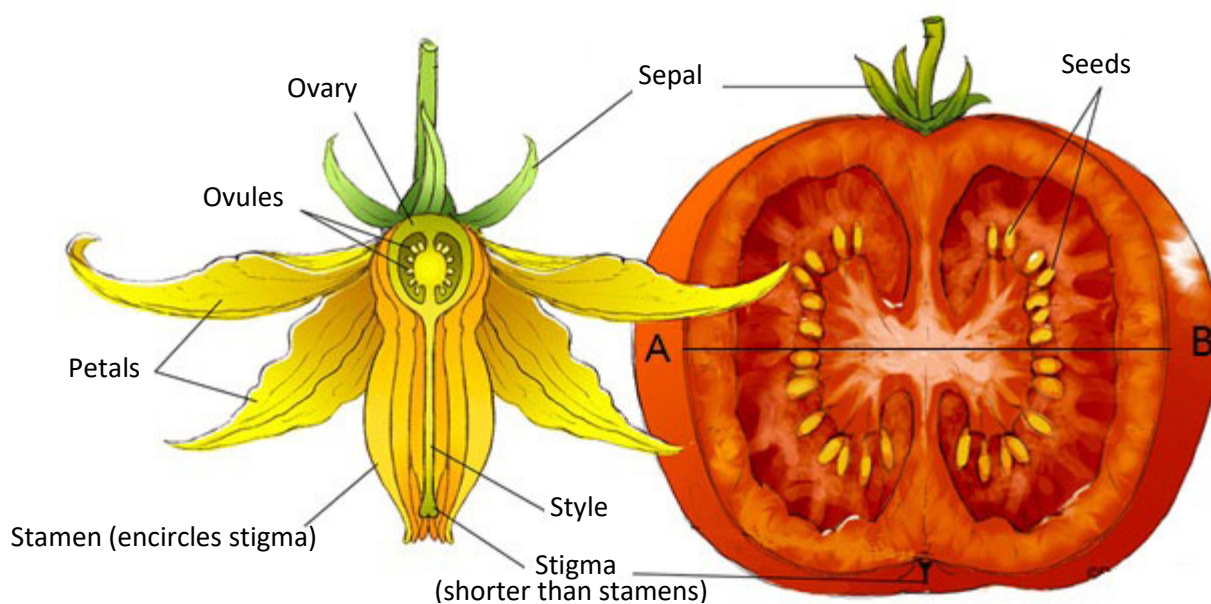
**Figure 10 – Interior of a seed vault (e.g. this one is the Svalbard Global Seed Vault in the Arctic)**



[From: <<https://www.dw8stlw9qt0iz>>]

[Adapted: <<https://www.newscientist.com>>]

**Figure 11 – Flower and fruit of tomato plant**




[Adapted: <<https://www.carlsonstockart.com>>]

## Modern hybrids vs. Heirloom varieties

The varieties of tomato that exist today can be divided into two different types – modern hybrids and heirloom varieties.

These have been developed in different ways as shown in the infographics below:


### A: Heirloom varieties:

<div style="border: 1px solid orange; padding: 2px; display: inline-block;"><b>Heirloom varieties</b></div> (an heirloom is something that is passed down from ancestors)	
1. Before industrialisation of agriculture, farmers grew food on small, often isolated farms	
2. Every year, cross pollination between the same crop plants naturally tended to occur using pollen from nearby plants	
3. Farmers can keep seeds from the best plants for future planting every year	
6. The crop is relatively uniform in appearance and characteristics, but there could be differences in size/quality between them  5. These varieties are obviously well suited to the area where they were bred  4. Therefore each area of farmers tended to produce a variety of plant that was particular to a certain group of farms	

[<<https://www.fleetfarm.com>>]

In order to achieve consistency of fruit, agriculture in the modern world consists of large areas where only a few varieties of each crop are grown, therefore many of these smaller heirloom varieties have died out – leading to a 75% decrease in crop genetic diversity in modern varieties.

### B: Modern hybrid varieties:

<div style="border: 1px solid orange; padding: 2px; display: inline-block;"><b>Modern hybrid varieties</b></div>		
1. Breeders self-pollinate plants containing a set of favourable characteristics, collect seeds, plant them and repeat the process over many generations to produce a pure-bred plant. This is referred to as 'parent 1'. This process is repeated with plants containing another set of different favourable characteristics to produce 'parent 2'.		4. New plants are called F1 hybrids. They contain favourable characteristics from each parent (e.g. insect resistance) and are identical to one another. Farmers cannot keep seeds from the plants as there is no guarantee that they will contain the favourable characteristics. They have to buy new seeds each season.
2. Pollen is taken from parent 1 and placed onto the stigma of parent 2. (Self pollination, as well as cross pollination from unwanted plants must be avoided in the process.)		3. Seeds are collected and planted.

[<<https://www.dayliliesinaustralia.com>>]

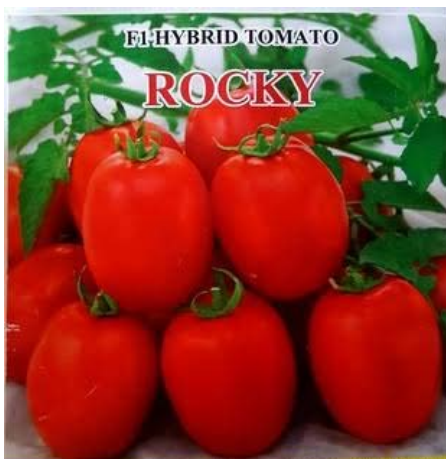
**Figure 12 – A blossom bag used in the cultivation of hybrid tomatoes**



Bag covers flowers after pollination has been performed in step 2 between Parent 1 and Parent 2.

[<<https://www.livingseeds.co.za>>]



**Figure 13 – 'Rocky'\* F1 hybrid tomato seed pack**

[<https://www.aliababa.com>]

**Figure 14 – Three types of heirloom tomato****Costaluto Genovese\*****Big Rainbow\*****Brandywine\***

[<https://qohshorticulture.weebly.com>; <https://www.livingseeds.co.za>]

(\* these are the names of different tomato varieties)

In the future, tomato production will involve attempting to propagate plants **asexually** using techniques such as tissue culture, as well as genetic manipulation, to improve characteristics such as flavour, colour, and nutrient content.

[Adapted: <https://stanfordmag.org>]

[Opeña, R. T., Chen, J. T., Kalb, T & Hanson, P. 2010. Hybrid seed production in tomato]

[Adapted: <International Cooperator's AVDRC Guide. Suggested cultural practices for tomato. 2001>]

[Adapted: What are F1 plants and seeds: How and why of F1 hybrids. <https://www.allotment-garden.org>]

[Adapted: Bai, Y. & Lindhout, P. 2007. Domestication and breeding of tomatoes: What have we gained and what can we gain in the future? *Annals of Botany* 100(5): 1085 – 1094]

## **Polyploidy and tomato hormones**

Israeli scientists have identified a polyploid tomato amongst a crop of natural diploid individuals. The fruits were found to be 50% larger than in the diploid plants. They also contained more juice and were seedless. The lack of seeds is unfortunate for plant growers, as it would be an advantage for farmers to be able to grow these plants commercially.

**Auxins** are a class of natural plant hormones that occur in shoot and root tips where they promote mitosis and therefore stem and root growth. Auxins can be utilised by plant growers as they cause cell differentiation (specialisation) when applied to undifferentiated stem cells of plants.

[Adapted: Kagan-Zur, V., Yaron-Miron, D. & Y. Mizrahi. 2011. A study of triploid tomato fruit attributes. *Journal of the American Society of Horticultural Science*. 116(2):228–231.]

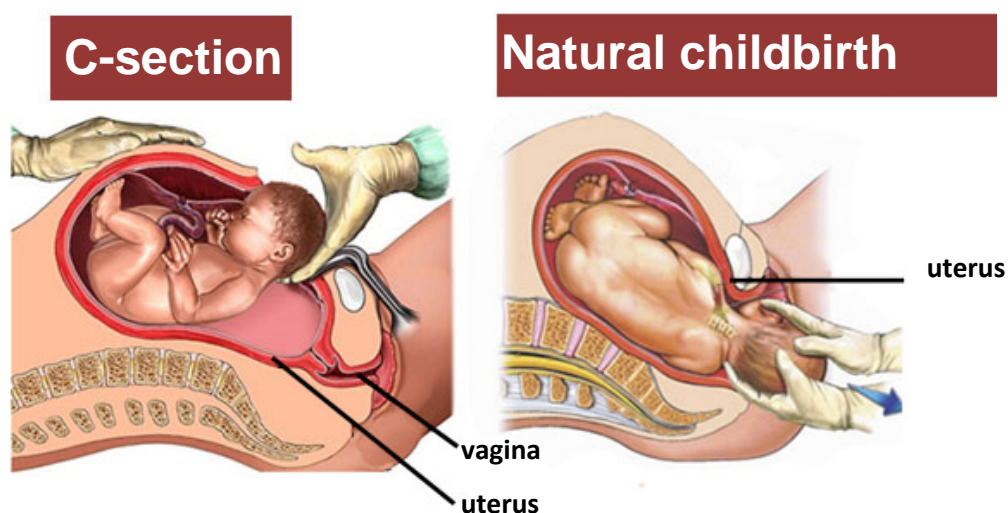
[Adapted: The Institute for Agriculture and Applied Biology, Ben-Gurion University of the Negev.]

**SECTION B****QUESTION 3**

Read the information below. Use this information, as well as your own knowledge, to answer Question 3 in the question paper.

**SOURCE A      What is a Caesarean section?**

A Caesarean section (C-section) is the surgical delivery of a baby by an incision through the mother's abdomen and uterus. The opening is made just wide enough for the baby to fit through. One doctor will use a hand to support the baby while another doctor pushes the uterus to help push the baby out.



[Adapted: <<https://www.mombasic.com>>]

**WHAT ARE C-SECTIONS FOR?****Medical reasons****Doctor-advised C-sections**

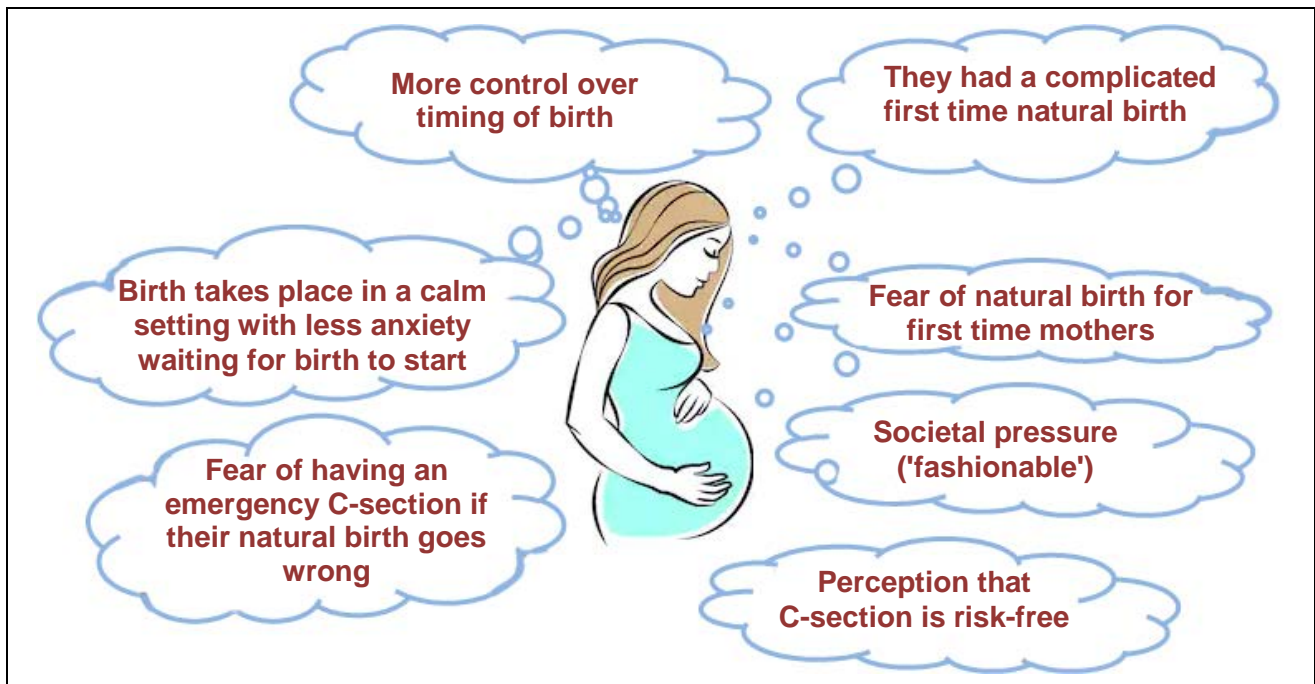
- To enable women with very narrow pelvises to have a baby.
- To enable delivery during a difficult birth where mother and baby experience life-threatening complications.

**Elective****Chosen by patient**

- A C-section performed at the mother's request in order to avoid a vaginal birth, *without any medical reason*.

[Adapted: Paterson-Brown, S. 1998. Should doctors perform an elective caesarean section on request? Yes, as long as the woman is fully informed. *British Medical Journal* 317(7156): 462 – 465.]

[Adapted: Romanis, E. C. 2019. Why the elective caesarean lottery is ethically impermissible. *Health Care Analysis* 27(4): 249 – 268]

**SOURCE B****Why would women choose a Caesarean section?**

[Adapted: Al-Mufti, R. et al. 1997. Survey of obstetricians' personal preference and discretionary practice. *Eur. Journal Obstet. Gynaecol. Repro. Biol.* 73:1–4]

[Adapted: Duperron, L. 2011. Should patients be entitled to caesarean section on demand? *Canadian Family Physician.* 57(11); 1246–1248]


[Adapted: Hannah, M. E. et al. 2000. Planned caesarean section versus planned vaginal birth for breech presentation at term; a randomised multicentre trial. *Lancet* 356(9239): 1375–83]

[Adapted: McMahon, M. J. et al. 1996. Comparison of a trial of labour with an elective second caesarean section. *New England Journal of Medicine* 335:689–695]

[Adapted: National Institute for Health and Clinical Excellence. RCOG Press. 2nd edition 2011. 132.]

[Adapted: Nygaard, I., & Cruikshank, D. P. 2003. Should all women be offered elective caesarean delivery? *Obstetrics & Gynaecology* 102(2): 217–219]

**SOURCE C Problems with Caesarean sections**

<p><b>Health problems for mother</b></p> <ul style="list-style-type: none"> <li>• Post-operative pain and discomfort</li> <li>• Possible bowel and bladder injury</li> <li>• Blood clots</li> <li>• Repeat C-section can result in serious placental and uterine problems and ectopic pregnancies in future pregnancies</li> <li>• Chance of death</li> </ul> 	<p><b>Other issues with C-sections:</b></p> <p>Hospital stay longer than in vaginal birth</p> <p>Small risk of cutting baby during delivery</p> <p>C-sections in first time births often lead to repeat C-sections – due to possibility of rupture along scar-line of previous C-sections</p> <p>Potentially less bonding between mother and infant due to less oxytocin released</p> <p>Scarring</p> <p>Feelings of guilt and failure for not having natural birth</p> <p>Some medical aids do not cover elective C-sections</p>	<p><b>Health problems in children born via C-sections:</b></p> <ul style="list-style-type: none"> <li>• Evidence of higher possibility of obesity in adulthood</li> <li>• Breathing problems (e.g. asthma) at birth and in adulthood</li> <li>• Hormonal problems</li> <li>• Immune problems</li> <li>• Great risk of stillbirths</li> </ul>
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[Adapted: Amu, O. et al 1998. Maternal choice alone should not determine method of delivery. *British Medical Journal* 317(7156): 462 – 465]

[Adapted: Hannah, M. E. 2004. Planned elective caesarean section: A reasonable choice for some women? *Can Med. Assoc. Journal* 170 (5) 813-814]

[Adapted: Hemminki, E., Merilainen, J. 1996. Long-term effects of caesarean sections: ectopic pregnancies and placental problems. *Am. J. Obstet Gynaecol.* 174:1569–1574]

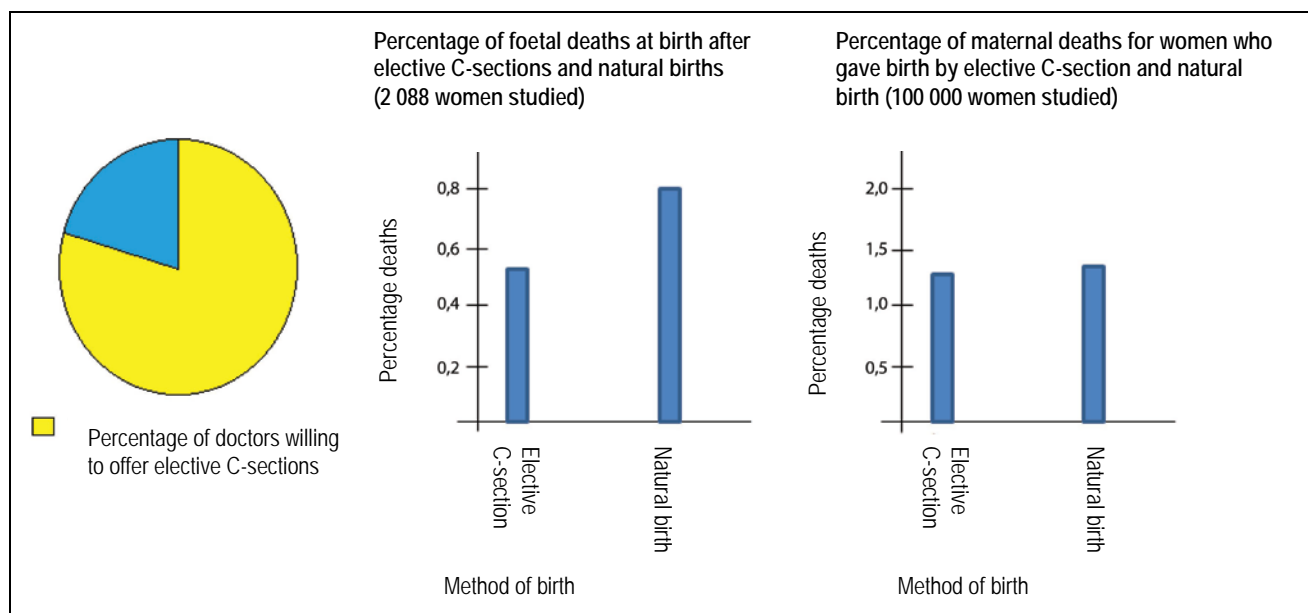
[Adapted: Plante, L. A. 2006. Public health implications of caesarean on demand. *Obstetrical & Gynaecological Survey*, 61(12), 807–815]

[Adapted: Smith, G.C. et al. 2003. Caesarean section and risk of unexplained stillbirth in subsequent pregnancy. *Lancet* 362(9398):1179-84]

[Adapted: Weiner, D. C. P. 1998. The argument against C-section on demand. *New Engl. Journal of Med.* 317(7156): 462–465]

Much of the available information regarding problems relating to C-sections come from studies of emergency C-sections and do not take elective C-sections into account.

[Adapted: Hannah, M. E. 2004. Planned elective caesarean section: A reasonable choice for some women? *Can. Med. Assoc. Journal* 170(5): 813 – 814]

**SOURCE D****Data comparisons between elective C-sections and natural childbirth**

[Adapted: Cotzias et al. 2001. Obstetricians say yes to maternal request for elective caesarean section: a survey of current opinion. *Euro. Journal Obs. Gynaecol. Repro. Biol.* 97(1): 15–16]

[Adapted: Hall, M. H. & Bewley, S. 1999. Maternal mortality and mode of delivery. *Lancet* 354 (9180):776]

[Adapted: Hofmeyr, J. & Hannah, M. E. 2003. Planned caesarean section for breech delivery [Cochrane review]. In: The Cochrane Library, Issue 3. Oxford: Update Software]

**SOURCE E****Advantages of vaginal birth**

**Natural experience** – evolution has resulted in well-adapted structures (uterus muscles and vagina) for natural birth

Triggers release of a protein (UCP2) in a newborn's brain that improves brain development, memory, learning and spatial awareness

**Bacteria** from vagina can boost baby's immune system

As there is **no surgery**, the mother can hold her baby and breastfeed sooner

[Adapted: Bewley, S., & Cockburn, J. 2002. The unfacts of 'request' caesarean section. *Int. Journal Obstet. & Gynaecol.* 109(1): 597–605]

[Adapted: Hannah, M. E. 2004. Planned elective caesarean section: A reasonable choice for some women? *Can. Med. Assoc. Journal* 170(5): 813–814]

[Adapted: Plante, L. A. 2006. Public health implications of caesarean on demand. *Obstetrical & Gynaecological Survey* 61(12): 807–815]

[Adapted: <<https://i.pinimg.com>>]

[Adapted: <<https://www.livescience.com>>]

[Adapted: <<https://www.healthline.com>>]



## SOURCE F                      Law and ethics – Female Reproductive Rights

Medical guidelines state that elective C-sections should not be *routinely* offered. However, doctors should perform them when they are confident a woman is making an informed decision about the risks involved.

Doctors have the obligation to first do no harm to their patients. However, a patient has the right to decide on their choice of medical treatments. This includes the choice between an elective C-section and natural birth. Doctors allow a patient to make decisions about cosmetic surgery (e.g. facelifts and breast implants).

Fear of childbirth is rational – childbirth is always risky and painful. When someone is scared of having any medical procedure, we understand and sympathise with them. So why do we treat fear of childbirth differently? Ignoring this fear and disallowing an elective C-section can cause significant harm psychologically.

When looking at reasons for elective C-sections, we treat women differently just because they are pregnant. Denying women choice, forces one form of childbirth rather than another, and treats women as a mere means to "deliver a new human being", rather than an individual.

[Adapted: American College of Obstetricians and Gynaecologists 2007. ACOG Committee Opinion.]

[Adapted: Brione, R. 2015. To what extent does or should a woman's autonomy overrule the interests of her baby? *New Bioethics*, 21(2): 71–86]

[Adapted: National Institute for Health and Care Excellence 2011. Caesarean Section: Clinical Guideline]

[Adapted: Romanis, E. C. 2019. Why the elective caesarean lottery is ethically impermissible. *Health Care Analysis* 27(4): 249 – 268]

[Adapted: Schiller, R. 2018. Instead of judging women who want C-sections, why not listen? *The Guardian*]

[Adapted: Simpson, K. R et al. 2005. Obstetric "conveniences": Elective induction of labour, caesarean birth on demand, and other potentially unnecessary interventions. *J. Perinat. Neonatal Nurs.* 19: 134–44]

[Adapted: Weiner, M. D. 1998. The argument against C-section on demand. *New Engl. Journal of Med.* 317(7156): 462–465]

[Adapted: <<https://www.nice.ork.uk>>]

## SOURCE G Problems with vaginal births

The traditional view is that C-sections are to be conducted in situations where the lives of women, unborn babies, or both are in danger.

[Adapted: <<https://www.livescience.com>>]

[Adapted: Hall, M. 1987. When a woman asks for a caesarean section. *Brit. Med. Journal* 294: 201–202]

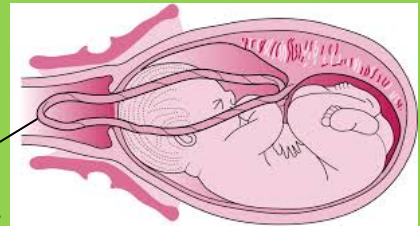
Sphincter (the muscle which keeps anus and urethra closed) defects can occur. This results in leakage of urine / faeces.

[Adapted: Sultan A.H. et al. 1993. Sphincter disruption during natural deliveries. *New England Journal of Medicine* 329: 1905]

Risk of unexplained / unexpected stillbirth  
Complications such as chorion infection, foetal heart abnormalities, umbilical cord prolapse (umbilical cord dropping through vagina ahead of baby)

**umbilical cord prolapse**

[<<https://www.practisingmidwife.co.uk>>]



Risk of haemorrhage (bleeding)

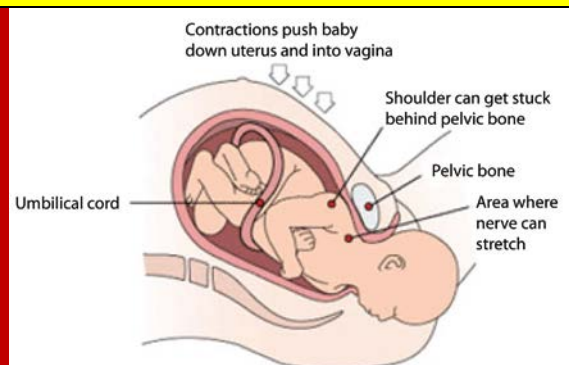
Risk of foetal death increases the longer the foetus is left in the uterus

Stress during birth can cause foetus to gulp in amniotic fluid containing foetal faeces called meconium, clogging the lungs

Damage to the baby during birth can result in:

- brain bleeding
- dislocation of shoulders
- arm fractures
- suffocation

[Adapted: <<https://www.amp.businessinsider.com>>]



[Adapted: Louise D. MD. 2011. Should patients be entitled to caesarean section on demand? YES. *Canadian Family Physician* 57(11): 1246–1248]

[Adapted: Sultan, A. H. & Stanton, S.L. 1996. Preserving the pelvic floor and perineum during childbirth — elective caesarean section? *Br. Journal Obstet. Gynaecol.* 103:731–734]

[Adapted: <<https://www.livescience.com>>]

## SOURCE H Baby's gut bacteria

The gut bacterial community is a complex ecosystem of millions of microbes. It is thought to be important for immune system development. Lack of exposure to the right bacteria in early childhood has been implicated in autoimmune diseases such as asthma, allergies and diabetes.

Babies born via natural childbirth have different gut bacteria than those delivered by C-sections. Scientists discovered that whereas vaginally born babies got most of their gut bacteria from their mother, C-section babies had more bacteria associated with hospital environments in their guts. It is unknown if these differences at birth have any effect on later health. However, differences in gut bacteria between vaginally born and caesarean delivered babies largely disappear by the time the babies are between 6 and 9 months old, but follow-up studies are needed to determine if the early differences influence health outcomes.

Dr Alison Wright, Consultant Obstetrician and Vice President of The Royal College of Obstetricians and Gynaecologists said: "The exact role of the bacterial community in the newborn is still uncertain – we don't think this should deter women from having a caesarean."

[Adapted: Shao, Y. et al. 2019. Stunted gut microbiota and increased pathogen colonisation associated with caesarean birth. *Nature* 574: 117 – 121]

## SOURCE I Comments from women

### Women who had natural childbirth

"Her birth was emotional and extremely peaceful; it was the best experience of both of our lives. Pain is not pretty, but I wasn't able to hold my daughter in my arms until I experienced the pain of childbirth!"

[Adapted: <<https://www.kidspot.com>>]



Beyoncé



Alicia Keys

"I mean it was painful, hell yeah. You have to scream, unless you're totally drugged. But I followed this particular technique which banishes negative thoughts. So it hurt, but I can say I really enjoyed it."

[Adapted: <<https://www.huffpost.com>>]

"It was totally harder. Why nobody tells you about those things? Nobody told me they was gonna stitch my vagina"

[Adapted: <<https://www.huffpost.com>>]

"You came out with your eyes open. Arms up in the air. Screaming. I will never forget it!"

[Adapted: <<https://www.huffpost.com>>]



Cardi B



Keira Knightley

### Women who gave birth via an elective C-section

"I wanted a C-section. I didn't want to go through the pain of natural childbirth. My mom told me the pain was "the most excruciating thing she's ever gone through in her life".

[Adapted: <<https://www.today.com>>]



Britney Spears



Jennifer Lopez

"When I saw my sister pushing that baby out, I was like, Maybe my decision was right. Maybe this was a better out".

[Adapted: <<https://www.huffpost.com>>]

Opted for a C-section because she regarded her hips as too narrow.

[Adapted: <<https://www.mabelandmoxie.com>>]



Victoria Beckham



Christina Aguilera

"I didn't want any surprises."

[Adapted: <<https://www.dailymercury.com>>]

[Adapted: <<https://www.romper.com>>, <<https://www.huffpost.com>>]