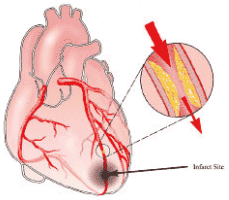
Higher Human

BIOLOGY



UNIT 2- NOTES

Name:

The small print: Key Area 1
Gamete production and fertilisation

(a) Gamete production in the testes.

- Testes produce sperm in the seminiferous tubules and testosterone in the interstitial cells…… ☐
- The prostate gland and the seminal vesicles secrete fluids that maintain the mobility and viability of the sperm.
  …… ☐

(b) Gamete production in the ovaries.

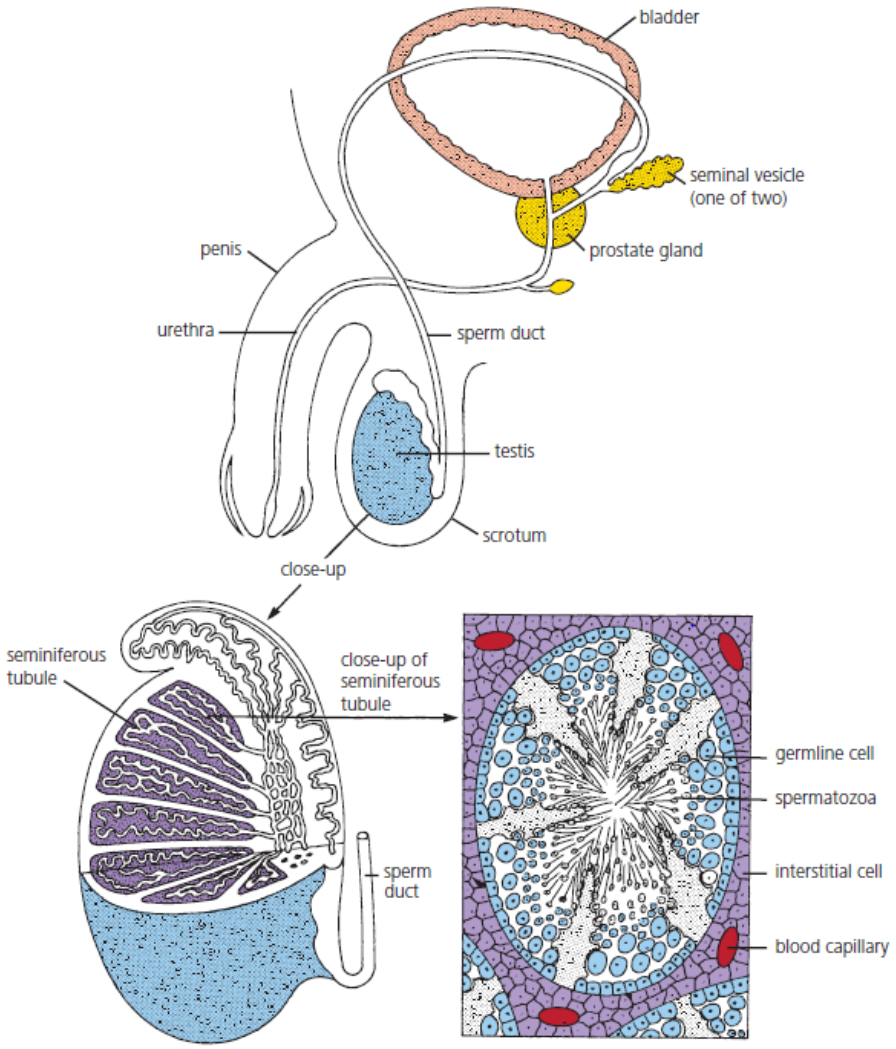
- The ovaries contain immature ova in various stages of development. Each ovum is surrounded by a follicle that protects the developing ovum and secretes hormones.
  …… ☐

(c) Fertilisation.

- Mature ova are released into the oviduct where they may be fertilised by sperm to form a zygote.
  …… ☐

Reproductive Organs and Hormones

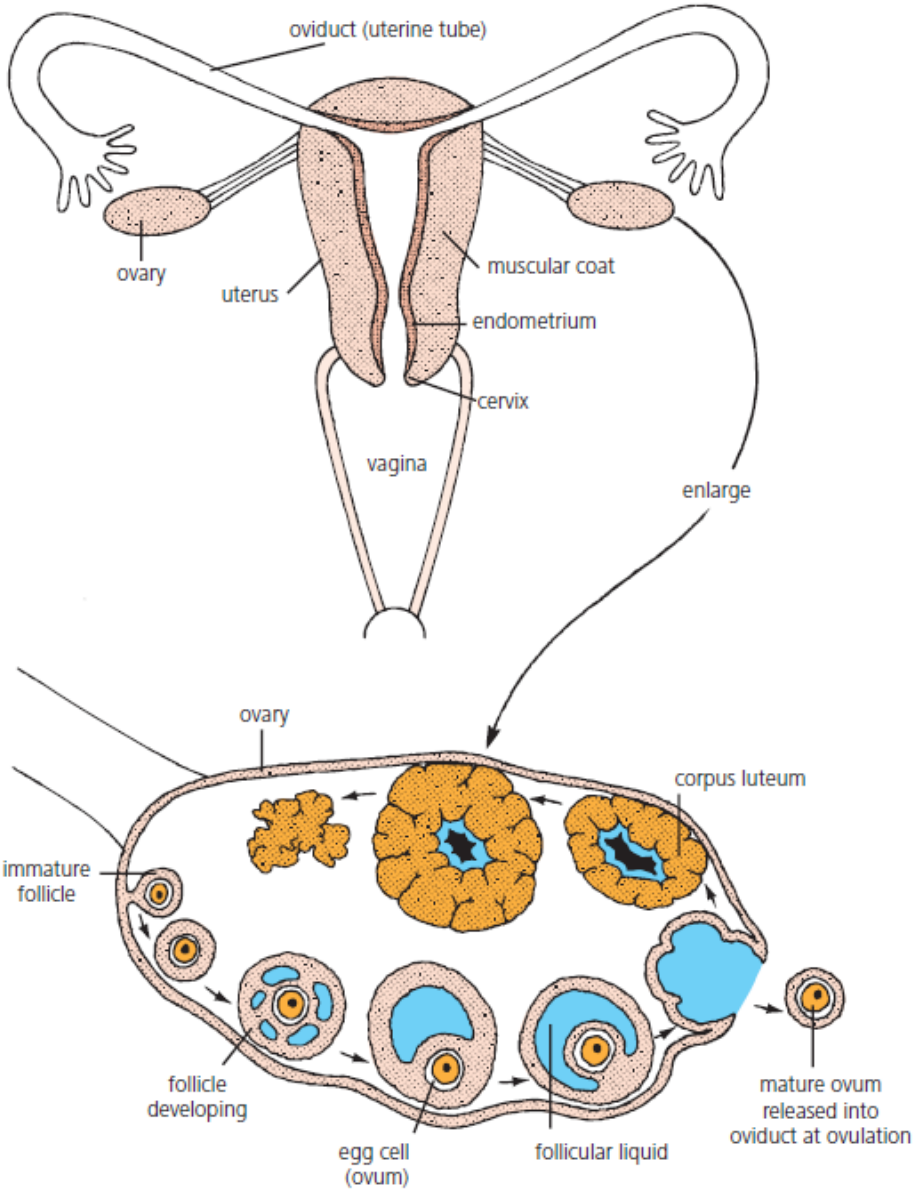
Gamete production in the testes



Gametes (sex cells) are produced from germline cells. In males, sperm are produced in _____ _____ found in the testes. The surrounding _____ cells produce the male hormone _____ which stimulates sperm production.

The _____ gland and _____vesicles secrete fluids that maintain the _____ and _____of the sperm.

Gamete production in the ovaries and fertilisation



The ovaries contain immature _____ in various stages of development. Each ovum is surrounded by a _____ that protects the developing ovum and secretes _____.

Mature ova found inside follicles are released into the _____ where they may be fertilised by sperm to form a _____.

The small print: Key Area 2

Hormonal control of reproduction

(a) Hormonal influence on puberty.

- Pituitary gland stimulated to release FSH and LH or ICSH by releaser hormone produced by hypothalamus. This triggers onset of puberty…… ☐

(b) Hormonal control of sperm production

- FSH promotes sperm production and ICSH stimulates production of testosterone. Testosterone also stimulates sperm production and activates prostate and seminal vesicles. Negative feedback control of testosterone on FSH and ICSH. ……..☐

(c) Hormonal control of menstrual cycle.

- Menstrual cycle takes approx. 28 days, first day of menstruation is day one of cycle. …….. ☐
- FSH stimulates development of follicle and production of oestrogen by follicle in follicular phase. …… ☐
- Oestrogen stimulates proliferation of endometrium, preparing it for implantation, and affects consistency of cervical mucus ,making it more easily penetrated by sperm. ……☐
- Peak levels of oestrogen stimulate a surge of LH. LH surge triggers ovulation.
- Ovulation is release of egg (ovum) from follicle in ovary. ……☐
- In the luteal phase the follicle develops into a corpus luteum which secretes progesterone. …… ☐
- Progesterone promotes further development and vascularisation of endometrium preparing it for implantation of fertilisation occurs. …….☐
- The negative feedback effect of the ovarian hormones on the pituitary gland and the secretion of FSH and LH prevent further follicles from developing. ☐
- Lack of LH leads to degeneration of the corpus luteum with a subsequent drop in progesterone levels which leads to menstruation. …… …☐
- If fertilisation does occur, the corpus luteum does not degenerate and progesterone levels remain high. ……☐

Hormonal Control of reproduction

Hormonal onset of puberty

At puberty, the _____ starts to produce a _____ hormone. This stimulates the_____ gland to start releasing:

Male:
1. _____ (FSH)
2. _____(ICSH)

Female:
1. _____ (FSH)
2. _____(LH)

Hormonal control of sperm production

_____ promotes sperm production.

_____ stimulates the production of testosterone.

Testosterone also stimulates _____ production and activates the _____ gland and seminal vesicles.

Testosterone exhibits _____ _____ control on pituitary gland.

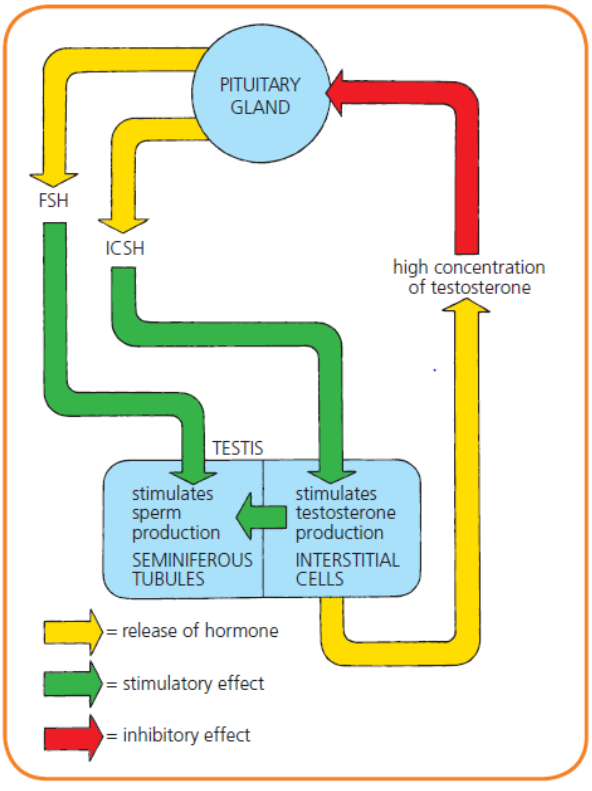


Figure 8.4 Self-regulation of testosterone production

Applying your knowledge question: **'Briefly describe the means by which excessive production of testosterone is prevented.'** (3)

Influence of pituitary hormones on ovaries

FSH stimulates the development of the _____ and the production of _____ by the follicle.

LH triggers _____ and brings about the development of the _____ _____, which in turn secretes progesterone.

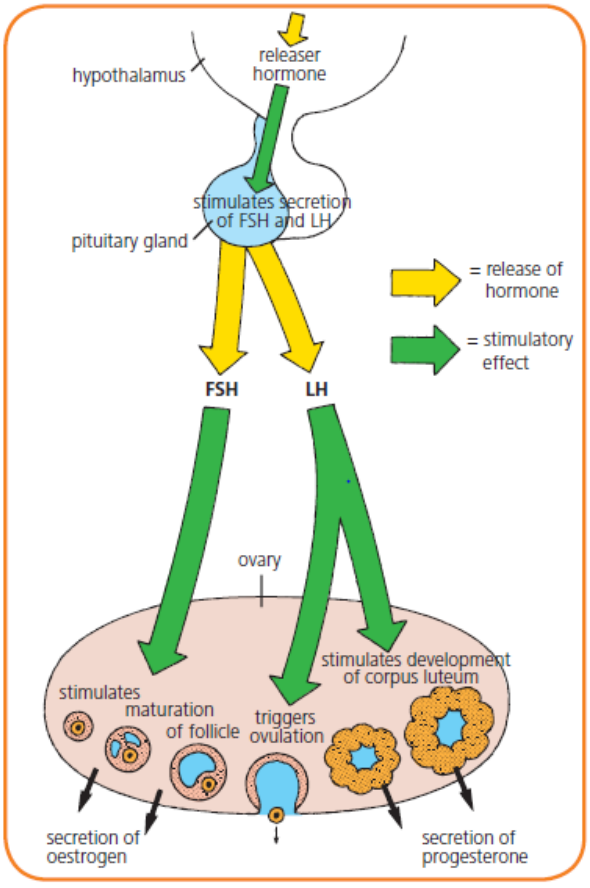


Figure 8.5 Effect of pituitary hormones on ovary

Influence of ovarian hormones (oestrogen and progesterone)

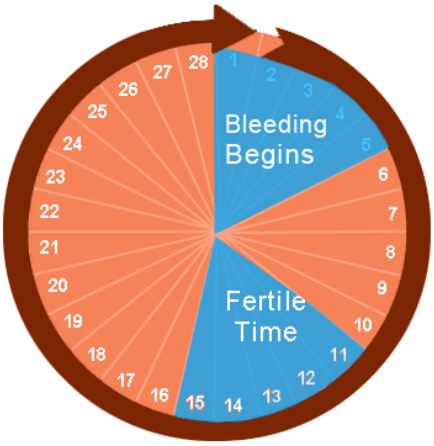
Use the diagrams and information on pg 130 and 131 of higher human text book to note the influences of oestrogen and progesterone on the uterus and pituitary gland.

Hormonal control of the menstrual cycle

The actions described above fit together in a cycle called the menstrual cycle.

The _____ cycle takes approximately 28 days.

The first day of menstruation where the old _____ (uterus lining) is shed (this lasts approximately 5 days) is regarded as day _____ of the cycle.



Follicular phase

The first 14 days are called the _____ _____. FSH stimulates the development of a follicle in the ovary and also stimulates the production of _____ by the follicle. The levels of oestrogen gradually build up. This stimulates _____ of the endometrium, preparing it for _____.

It also makes mucus produced by the cervix much _____, making it easier for sperm to_____.

Peak levels of oestrogen around day _____ stimulate a surge in the secretion of _____ which triggers _____.

Luteal phase

Days 14 – 28 are called the _____ phase. Once the egg has been released, the surrounding follicle develops into a _____ _____ which secretes progesterone. Progesterone promotes further development and _____ (formation of blood vessels) of the endometrium, preparing it for implantation if fertilisation has occurred.

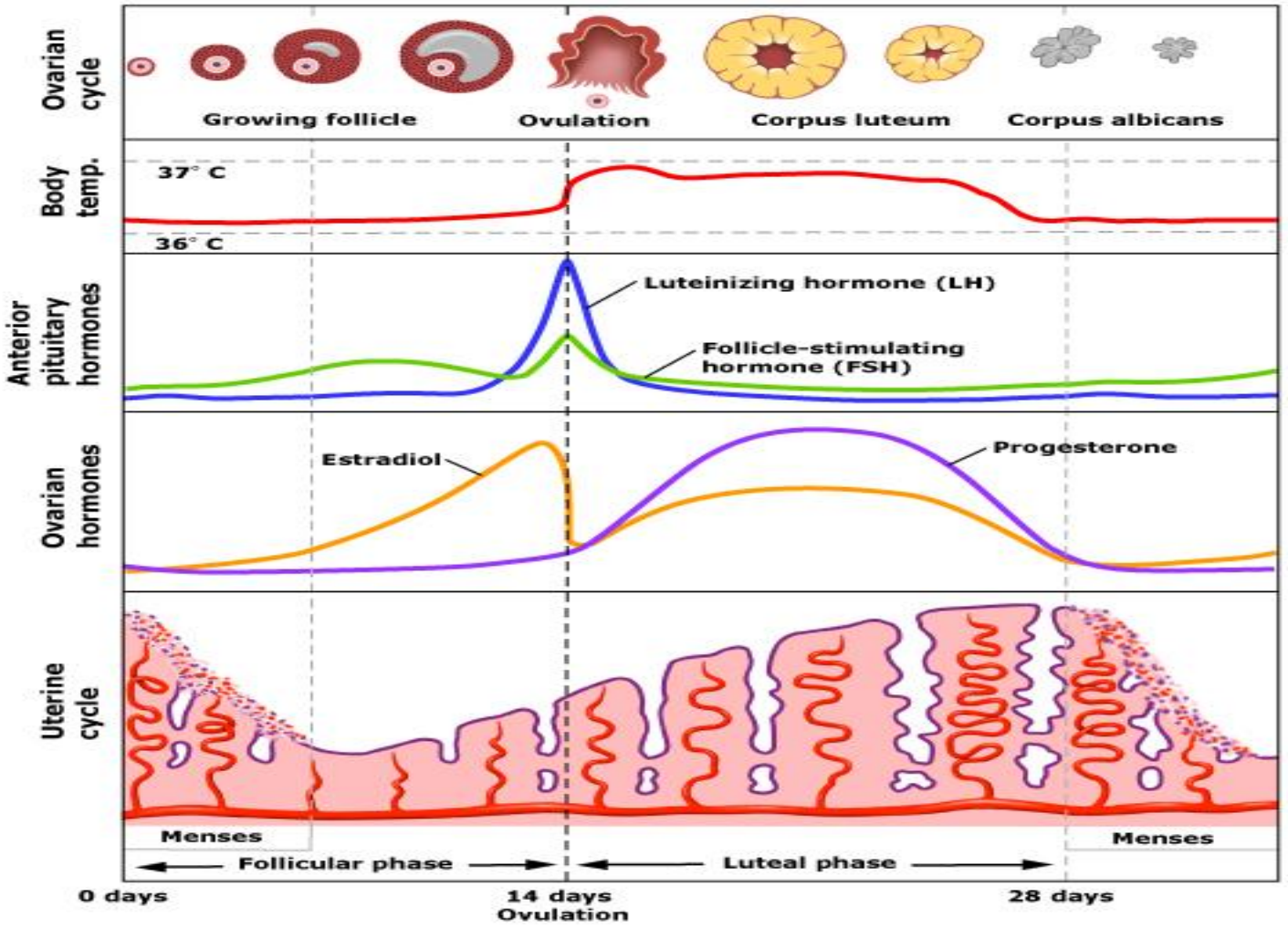
High levels of ovarian hormones (oestrogen and _____, produced by the ovary) exhibit a _____ _____ _____ on the pituitary hormones (FSH and _____) thus reducing their release and preventing further _____ from developing in the ovary and being released.

If there is no pregnancy, the _____ of LH which maintains the corpus luteum leads to degeneration of the corpus luteum. It then stops producing _____ which then leads to the _____ being shed during _____.

If fertilisation **does** occur, the corpus luteum does not degenerate which means _____ levels remain high.

Using the notes above about the menstrual cycle, annotate the graph to describe and explain the effect of each hormone at each stage.

Then try SQA 2015-Q14 A (Essay)/ TYK questions pg 133 of textbook


Ovarian cycle
Growing follicle
Ovulation
Corpus luteum
Corpus albicans
Body temp.
37° C
36° C
Anterior pituitary hormones
Luteinizing hormone (LH)
Follicle-stimulating hormone (FSH)
Ovarian hormones
Estradiol
Progesterone
Uterine cycle
Menses
Menses
Follicular phase
Luteal phase
0 days
14 days
Ovulation
28 days

Unit 2: Key Area 1 and 2: Glossary

Term	Definition
Testes	
Testosterone	
Sperm	
Seminiferous tubules	
Interstitial cells	
Prostate gland	
Seminal vesicles	
Ovaries	
Ova	
Follicle	
Zygote	
Follicle stimulating hormone	
Interstitial cell stimulating hormone	
Luteinising hormone	
Oestrogen	
Progesterone	
Follicular phase	
Luteal phase	
Corpus luteum	
Ovulation	

The small print: Key Area 3

The biology of controlling fertility

- Infertility treatments and contraception are based on the biology of fertility…….. ☐

(a) Women show cyclical fertility leading to a fertile period. Men show continuous fertility.

- Women are only fertile for a few days during each menstrual cycle……☐
- Men continuously produce sperm in their testes so show continuous fertility… ☐
- Identification of the fertile period. A women's body temperature rises around 0.5°C after ovulation and her cervical mucus becomes thin and watery. ……☐

(b) Treatments for infertility

- Stimulating ovulation. Ovulation is stimulated by drugs that prevent the negative feedback effect of oestrogen on FSH. ……☐
- Other ovulatory drugs mimic the action of FSH and LH. These drugs can cause super ovulation that can lead to multiple births or can be collected for IVF……☐
- Artificial insemination. Several samples of semen are collected over a period of time…… ……☐
- Artificial insemination. Is particularly useful where the male has a low sperm count. If a partner is sterile a donor may be used to provide semen.

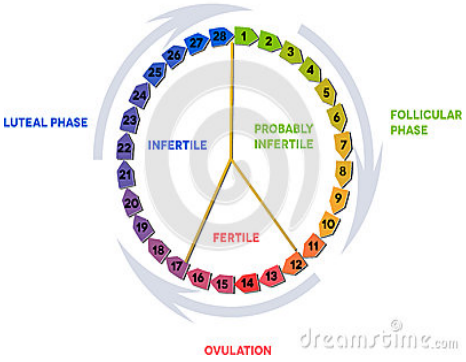
  …… ……☐
- Intracytoplasmic sperm injection (ICSI) can be used if mature sperm are defective or very low in number. The head of the sperm is drawn into a needle and injected directly into egg to achieve fertilisation. ……☐
- In vitro fertilisation (IVF). Surgical removal of eggs from ovaries after hormone stimulation, incubation of zygotes and uterine implantation. ……☐
- The eggs are mixed with sperm in culture dish. Fertilised eggs are incubated until they are at least 8 cells then transferred to uterus for implantation…….. ☐
- The use of IVF with pre-implantation genetic diagnosis to identify single gene disorders and chromosomal abnormalities. ……☐

(c) Physical and chemical methods of contraception.

- Biological basis of physical methods used to prevent pregnancy. ……☐
- Understanding how barriers, intra-uterine devices and steralisation procedures prevent pregnancy. ……☐
- The oral contraceptive pill is a chemical method of contraception that contains synthetic oestrogen and progesterone that mimics negative feedback preventing FSH and LH release from pituitary. ……☐
- The progesterone only (mini) pill causes thickening of the cervical mucus. ……☐
- The morning after pill prevents ovulation or implantation. ……☐

Biology of Fertility Control

Fertility



Females exhibit _____ fertility, with a fertile period for the few days surrounding _____ and then otherwise infertile. At ovulation, body temperature increases by approx _____°C and _____ mucus becomes thin and watery (due to action of oestrogen) so the _____ _____ can be calculated.

Males are _____ fertile – their levels of fertility _____ _____ change. This is due to the negative feedback effects of testosterone maintain a relatively constant level of pituitary hormones _____ and _____. This results in a steady quantity of testosterone being secreted and therefore sperm being produced.

Treatment for infertility

Stimulating ovulation

A women may fail to ovulate because of an underlying factor and in such cases ovulation can be stimulated.

Ovulation is stimulated by _____ that prevent the negative feedback effect of oestrogen on _____.

Other ovulatory drugs can mimic the action of _____ and _____. These drugs can cause super ovulation that can result in _____ births or be used to collect _____for In vitro fertilisation (IVF) programmes.

Artificial insemination

Insemination is the introduction of semen into the female reproductive tract. This usually occurs naturally via sexual intercourse. _____ _____ is insertion of semen by some other means.

Several samples of _____ are collected over a period of time and injected using a _____ into the female.

It is particularly useful where the male has a low sperm _____. If the male is _____ (does not produce any functional sperm), a _____ may be used.

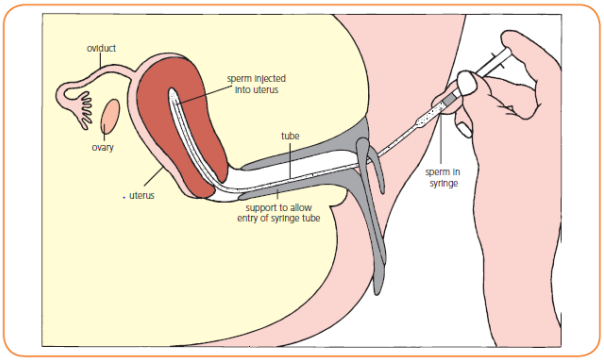


Figure 9.4 Artificial insemination

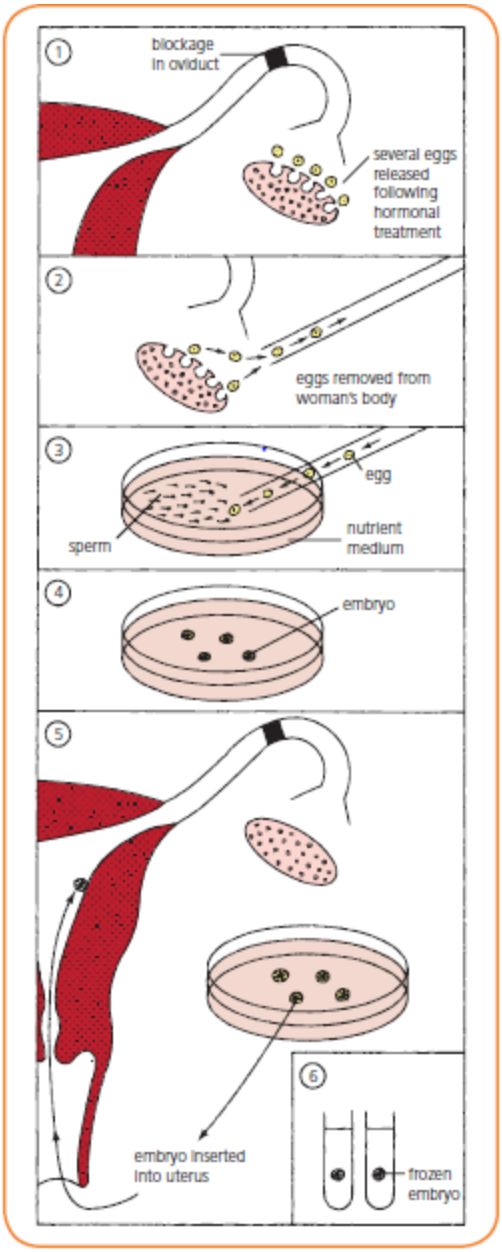


Figure 9.5 *In vitro* fertilisation (IVF)

Intracytoplasmic sperm injection (ICSI)
If mature sperm are _____ or very _____ in number, ICSI can be used. The _____ of the sperm is drawn into a _____ and injected directly into the egg to achieve _____.

In vitro fertilisation (IVF)
After _____ stimulation to allow multiple _____, eggs are surgically removed from the ovaries. Eggs are mixed with _____ in a culture dish. Zygotes are _____ until they have formed at least 8 cells and then transferred to the _____ for _____.

Before the zygotes are transferred to the uterus one or two cells may be removed and tested for _____ _____ _____ or chromosomal abnormalities. _____ _____ (PGD) is a specific approach used to check for *known* chromosomal or gene defects.

Contraception

Contraception is the intentional prevention of conception or pregnancy by natural or artificial means.

Physical forms of contraception:

1. Barrier methods e.g. _____, _____, _____

A barrier methods makes use of a device that physically blocks the ability of the sperm to reach the _____.

2. Intra-uterine devices (IUD).

A T shaped structure that is fitted into the uterus for many months or _____ to prevent _____ of an embryo into the endometrium.

3. _____ procedures.

In men a _____ involves the cutting and tying of the _____ _____, thereby preventing sperm being released during sexual activity. Sperm produced after the sterilisation procedure undergo phagocytosis and are destroyed.

In women _____ _____ involves the cutting and tying of the _____ to prevent egg meeting sperm and reaching the uterus.

Sterilisation is a highly effective method of contraception but it is usually _____.

Chemical forms of contraception:

Chemical contraceptives are based on combinations of _____ (man made) hormones that _____ negative feedback and so prevent the release of _____/_____.

1. The oral contraceptive pill contains synthetic _____ and progesterone that mimics negative feedback action, preventing release of FSH and LH from pituitary gland.

2. Morning-after pills prevents _____ or implantation after unprotected intercourse.
3. '_____- only pill' (mini pill) thickens the cervical mucus, reducing the viability of the sperm and their access to the _____.

Unit 2: Key Area 3 Glossary

Term	Definition
Cyclical fertility	
Stimulating ovulation	
Artificial insemination	
ICSI	
IVF	
Barrier method	
Intra-uterine devices	
Vasectomy	
Tubal ligation	
Oral contraceptive pill	
Morning after pill	
Progesterone only 'mini' pill.	

ESSAY (2014)
Discuss procedures that can be used to treat infertility.

CONSOLIDATION QUESTIONS

- SQA 2017-Section 2 Q4
- SQA REVISED HIGHER 2014-Section 2 Q6
- Testing your knowledge questions-Page 142 of textbook

The small print: Key Area 4
Ante and postnatal screening

- A variety of techniques can be used to monitor the health of the mother, developing fetus and baby…….. ☐

(a) Antenatal screening

- Antenatal screening identifies the risk of a disorder so that further tests and a prenatal diagnosis can be offered……☐
- Ultrasound imaging: Pregnant women are given two ultrasound scans. ……☐
- Dating scans which determine pregnancy stage and due date are used with tests for marker chemicals which vary normally during pregnancy……☐
- Anomaly scans may detect serious physical abnormalities in the fetus ……☐
- Blood and urine tests: Routine blood and urine tests are carried out throughout pregnancy to monitor the concentrations of marker chemicals. ……☐
- Diagnostic testing: Amniocentesis and chorionic villus sampling (CVS) and the advantages and disadvantages of their use. ……☐
- Cells from samples can be cultured to obtain sufficient cells to produce a karyotype to diagnose a range of conditions. ……☐

(b) Analysis of patterns of inheritance in genetic screening and counselling.

- Patterns of inheritance in autosomal recessive, autosomal dominant, incomplete dominance and sex-linked recessive single gene disorders. ……☐

(c) Postnatal screening

- Diagnostic testing for phenylketonuria (PKU)…… ……☐
- In PKU a substitution mutation means that the enzyme which converts phenylalanine to tyrosince is non-functioning. ……☐

Ante and Postnatal Screening

Antenatal screening

The health of a pregnant women and her developing fetus can be monitored using a variety of techniques and tests.

Antenatal screening identifies the _____ of a disorder so that further tests and a pre-natal (before birth) _____ can be offered.

Ultrasound imaging

Pregnant women are given two ultrasound scans. An ultrasound scanner is held against the abdomen and it picks up high frequency sounds that have bounced off the fetus. These sounds are converted to an ultrasound image on the computer screen.

A _____ scan is carried out at around 8-14 weeks pregnant. This is to determine the stage of pregnancy and the _____ _____.This is used in conjunction with tests for marker chemicals which vary normally during pregnancy.

A further scan, an _____ scan is carried out between 18-20 weeks of pregnancy. This may help detect any serious physical _____ in the fetus.

Blood and urine tests

Routine blood and urine tests are carried put throughout pregnancy. These are to monitor the concentrations of _____ chemicals.

Some medical conditions are indicated by the presence of certain marker chemicals in the blood and urine. However these markers may vary throughout pregnancy. Human chorionic gonadotrophin (HCG) for example increases during week 6-10 of pregnancy but decreases to a low level after this in a normal pregnancy (See graph).

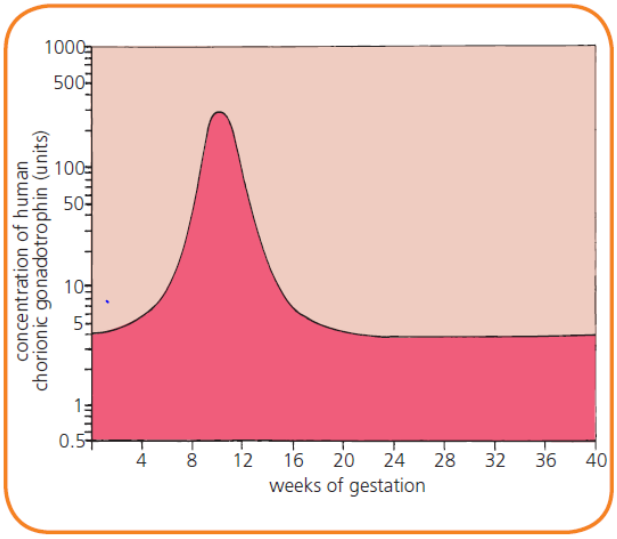


Figure 10.3 HCG levels during normal pregnancy

If the levels remain high and do not decrease this could be an indication the fetus has Down syndrome.

Due to the fact that the levels of different marker chemicals changes throughout pregnancy, the tests for each chemical must be carried out at the appropriate time to prevent a false positive result.

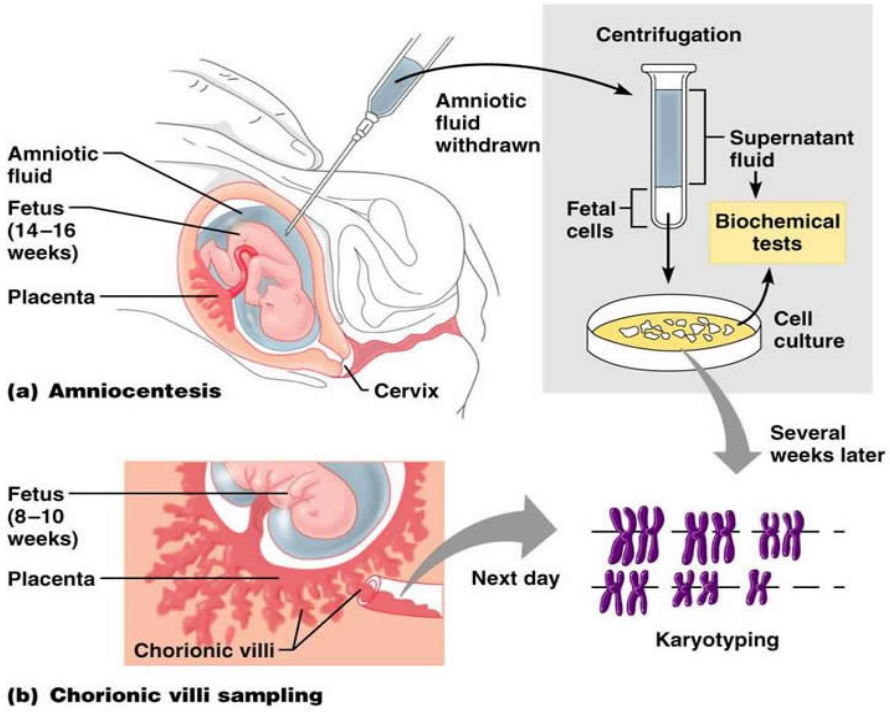
An atypical chemical concentration can lead to **diagnostic testing** to determine if the fetus has a medical condition.

Diagnostic testing

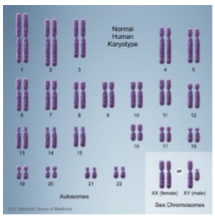
A **screening test** is one used to detect the signs and symptoms of a particular condition and then a degree of risk is provided. A **diagnostic test** however is a definitive test that produces results that can be used to establish whether or not a person is suffering from a specific condition.

_____ takes foetal cells from amniotic fluid and is carried out around 14-16 weeks of pregnancy.

_____ (CVS) take foetal cells from placenta samples.



With both amniocentesis and CVS cells from the samples are cultured to obtain sufficient cells to produce a_____ to diagnose a range of conditions.



A karyotype arranges chromosomes into homologous pairs and is used to observe the number and structure of chromosomes.

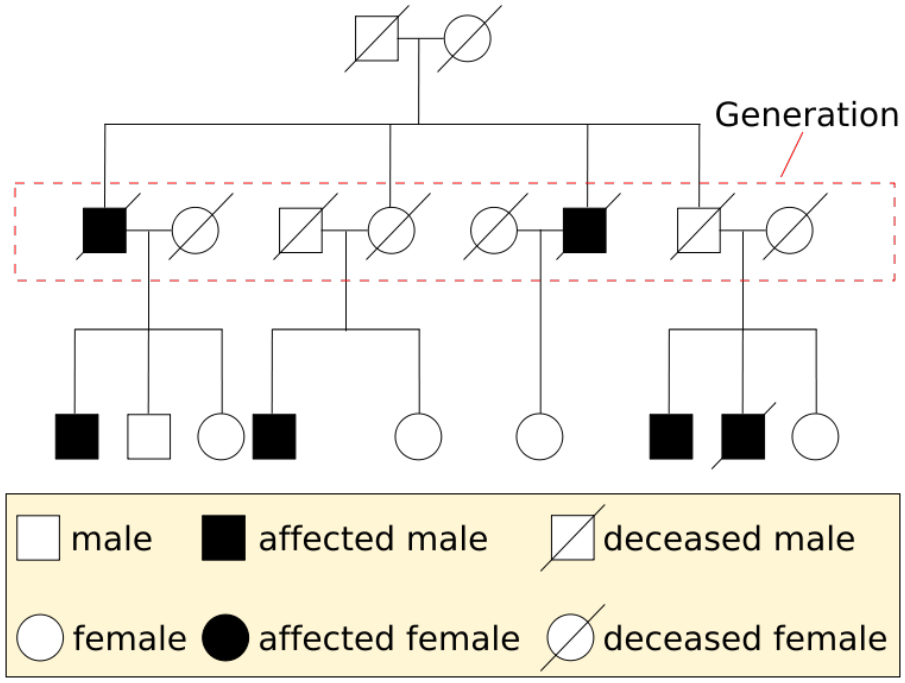
CVS can be carried out _____ in pregnancy but carries a higher risk of _____.

In deciding to proceed with these tests, the element of risk is assessed, as will the decision the individuals are likely to make if a test is positive.

ESSAY (2012)
Discuss the screening and testing procedures which may be carried out as part of antenatal care.

Analysis of patterns of inheritance in genetic screening and counselling

Pedigree charts



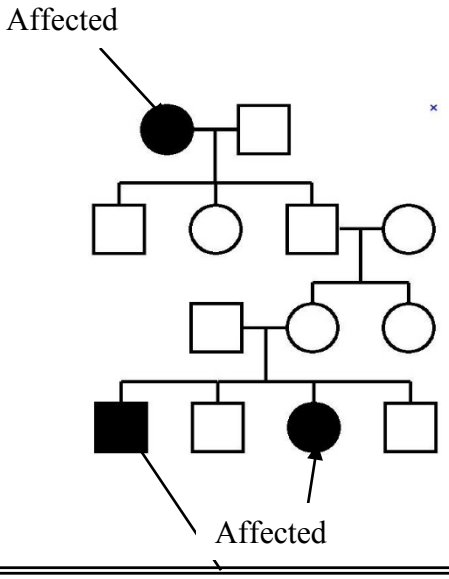
_____ charts are used to analyse patterns of inheritance. Once the phenotype for a characteristic is known and a pedigree chart is constructed, most of the _____ can be determined. This information is used by genetic _____ to advise parents of the possibility and risk of passing on a genetic condition to their _____.

Use this box to mind map the following genetics terms with their definition from N5. **Genotype, phenotype, allele, homozygous, heterozygous, autosomes, sex chromosomes, dominant, recessive**.

Single gene disorders

Autosomal recessive

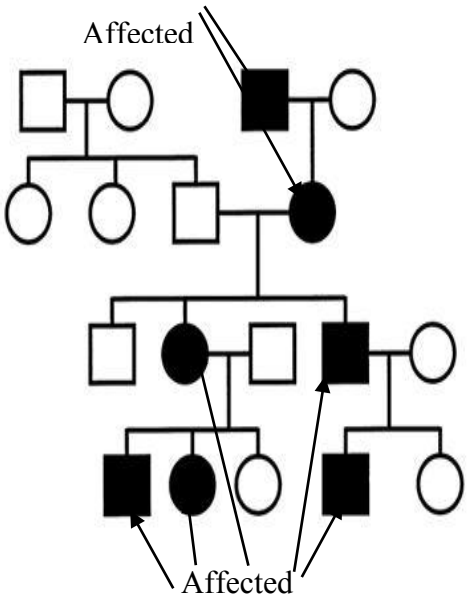
- Affects _____ (not ____ chromosomes)
- Expressed relatively _____
- May _____ generations
- Males and females _____ affected
- **All sufferers homozygous recessive**
- Non-sufferers homozygous dominant or _____
- E.g. Cystic fibrosis



Use this box to note a worked example to answer the question from the PowerPoint.

Autosomal dominant

- Appears in _____ generation
- Each sufferer has an affected parent.
- Males and females affected _____
- **Sufferers homozygous dominant or heterozygous.**
- All non-sufferers homozygous recessive.
- E.g. Huntington's



Use this box to note a worked example to answer the question from the PowerPoint.

Incomplete dominance

One allele of a gene is not completely dominant over the other. There is an in between state in the heterozygote e.g. Sickle cell disease.

____ = normal, _____ = sickle cells

HH alleles = _____

SS alleles = red blood cells are _____ shaped (interferes with the circulation and causes death)

HS alleles = no sickle shaped red blood cells but they are a _____ of the disease.

Use this box to note a worked example to answer the question from the PowerPoint.

Sex linked recessive

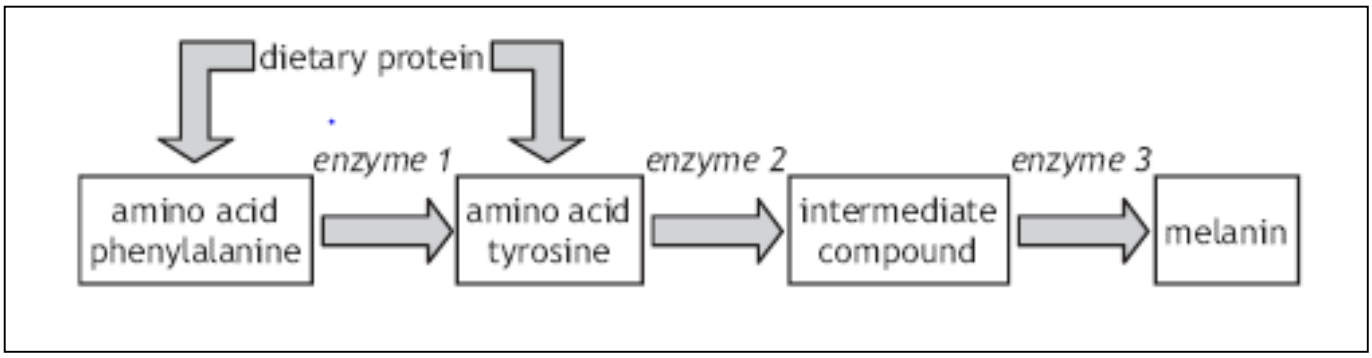
Humans have 22 pairs of _____ and 1 pair of _____ chromosomes. In the females sex chromosomes are _____ and in male they are _____. Sex linked genes are carried on the sex chromosomes (on the X chromosome as the Y chromosome is very small) e.g. haemophilia.

- More males affected than females.
- None of the sons of affected males show the trait.

Use this box to note a worked example to answer the question from the PowerPoint.

Postnatal screening

_____ natal screening occurs days after birth, known as 'heel prick' tests. These can diagnose metabolic diseases such as phenylketonuria (_____), where the baby doesn't produce an _____ to break down the amino acid _____.



This is called an **inborn error of metabolism,** where as a result of a substitution mutation, the body doesn't produce the enzyme necessary to breakdown phenylalanine. If this is not detected soon after birth the baby's mental development is affected.

When tested, those individuals with _____ levels of phenylalanine are placed on a _____ phenylalanine diet.

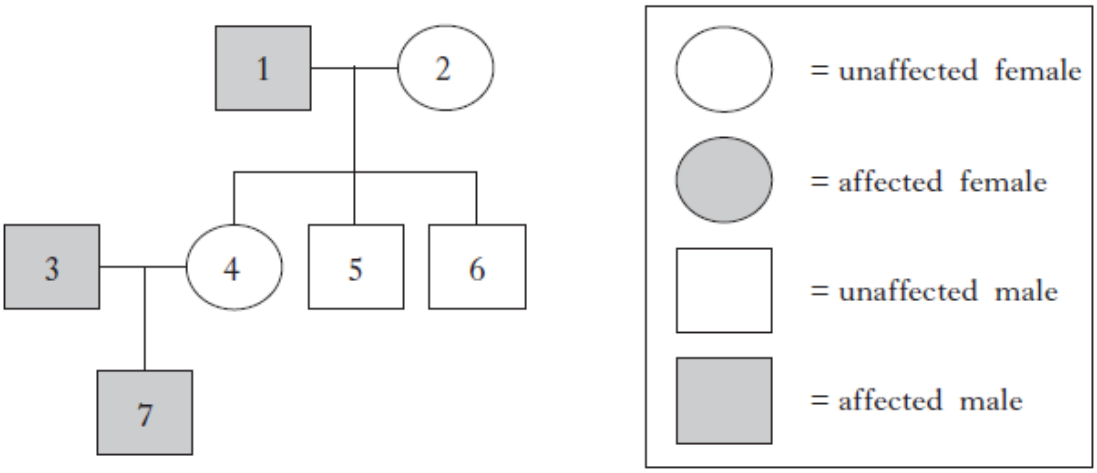
Unit 2: Key Area 4: Glossary

Term	Definition
Antenatal	
Dating scan	
Anomaly scan	
Diagnostic test	
Screening test	
Amniocentesis	
Chorionic villus sampling	
Karyotype	
Alleles	
Dominant	
Recessive	
Homozygous	
Heterozygous	
Carriers	
Genotype	
Phenotype	
Autosomes	
Sex chromosomes	
Pedigree chart	

Consolidation tasks:

- Try the questions below
- Testing your knowledge questions-page 158 of textbook.
- SQA- 2018-MCQ 12,13
- SQA- 2017-MCQ 8,9
- SQA- 2016-MCQ 13,14
- SQA- 2015-MCQ 10 Section 2 Q 6
- SQA-Specimen- MCQ- 6,7,8, Section Q5

5. The diagram below shows the inheritance of a sex-linked condition in a family.



(*a*) The condition is caused by a recessive sex-linked allele represented by the letter **d**.

(i) State the genotypes of individuals 3 and 4.

Individual 3 _____

Individual 4 _____ 1

(ii) Explain why individual 1 could not pass the condition to his sons.

_____ 1

_____

_____

The small print: Key Area 5

The structure and function of arteries, capillaries and veins

(a) Blood circulates from the heart through the arteries to the capillaries then to the veins and back to the heart. There is a decrease in blood pressure as blood moves away from the heart.……☐

(b) The structure and function of the arteries, capillaries and veins: endothelium, central lumen, connective tissue, elastic fibres, smooth muscle and valves.

- Endothelium lining the central lumen of blood vessel is surrounded by layers of tissue. ……☐
- Arteries have an outer layer of connective tissue containing elastic fibres and a middle layer with smooth muscle and more elastic fibres. ……☐
- The elastic walls of the arteries stretch and recoil to accommodate the surge of blood after each contraction of the heart. ……☐
- The role of vasoconstriction and vasodilation in controlling blood flow……☐
- To control blood flow, the smooth muscle surrounding arteries can contract causing vasoconstriction or relax causing vasodilation.……☐
- Capillaries allow exchange of substances with tissues through their thin walls. ……☐
- Veins have an outer layer of connective tissue containing elastic fibres but much thinner muscular walls than arteries. . ……☐
- Veins contains valves to prevent the backflow of blood. . ……☐

(c) The exchange of materials between tissue fluid and cells through pressure filtration and the role of lymphatic vessels. ……☐

- Pressure filtration causes plasma to pass through capillary walls into the tissue fluid surrounding the cells. ……☐
- Tissue fluid supplies cells with glucose, oxygen and other substances.……☐
- Carbon dioxide and other metabolic wastes diffuse out of the cells and into the tissue fluid to be excreted. ……☐
- Much of the tissue fluid returns to the blood ……☐
- Lymphatic vessels absorb excess tissue fluid and return it as lymph to the circulatory system. ……. ……☐
- Tissue fluid and blood plasma are similar in composition, with the exception of plasma proteins, which are too large to be filtered through the capillary walls. ……☐

TASK: Spend time with your table partners to produce a mind map of the things you can remember from N5 about the cardiovascular system. This may include: The heart, blood, blood vessels etc.

The structure and function of arteries, capillaries and veins.

The cardiovascular system

In the human body, substances need to be exchanged continuously. These requirements are met by the _____ system. The cardiovascular system is made up of a fluid connective tissue_____, the heart and blood vessels.

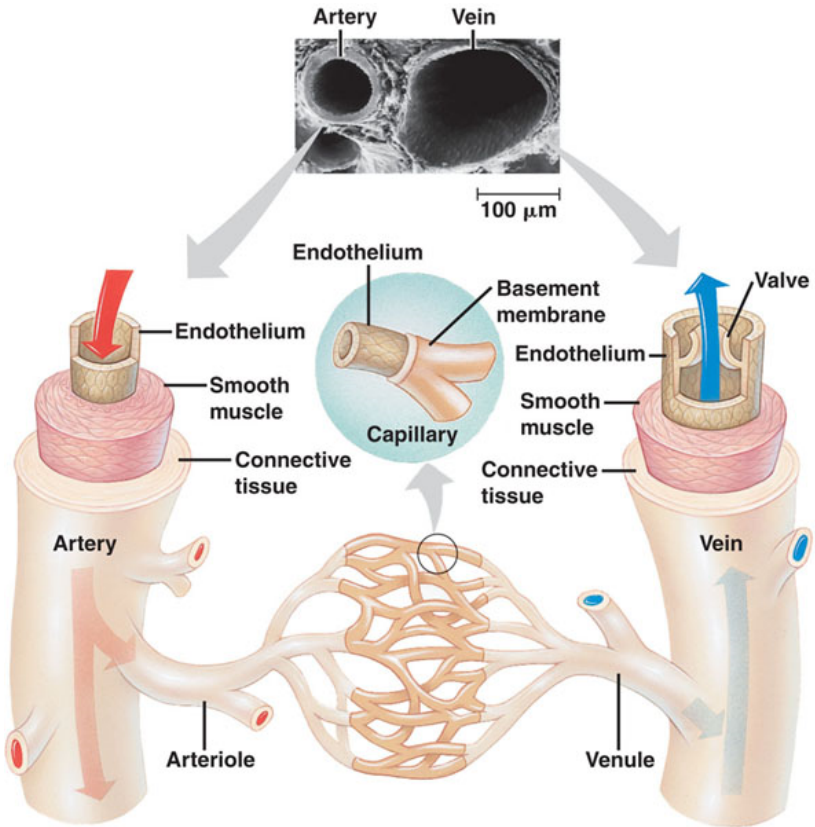
Blood circulates from the heart, through the _____ then to the _____ where the exchange of materials takes place. From there the blood then flows into _____ to be returned to the heart.

IMPORTANT FACT ABOUT BLOOD PRESSURE:

Blood vessels

The hole in the middle of the vessel is called the central _____.
A layer of cells called the _____ lines the central _____ of all blood vessels.

The surrounding layers differ in each type of blood vessel.



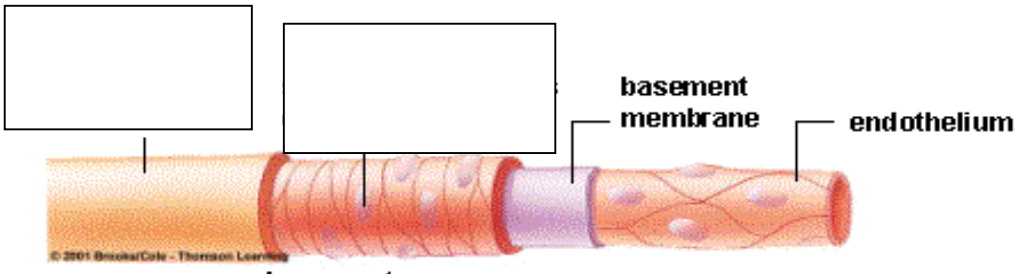
Arteries

Arteries carry blood _____ from the heart.

They have an outer layer of _____ tissue containing elastic fibres and a middle layer containing smooth _____ with more elastic fibres.

The elastic walls of the arteries _____ and recoil to accommodate the surge of blood after each _____ of the heart.

Use the boxes to label the layers of the artery and say what they contain:



To control blood flow the smooth muscle surrounding arteries can contract or become relax depending on the body's requirements. This allows the changing demands of the different tissues to be met. For example, during strenuous exercise, the smooth muscle in arteries leading to working muscles undergo **VASODILATION**, which allows an increase in blood flow. At the same time the smooth muscle in the arteries of the abdominal organs undergo **VASOCONSTRICTION** which reduces blood flow to these parts.

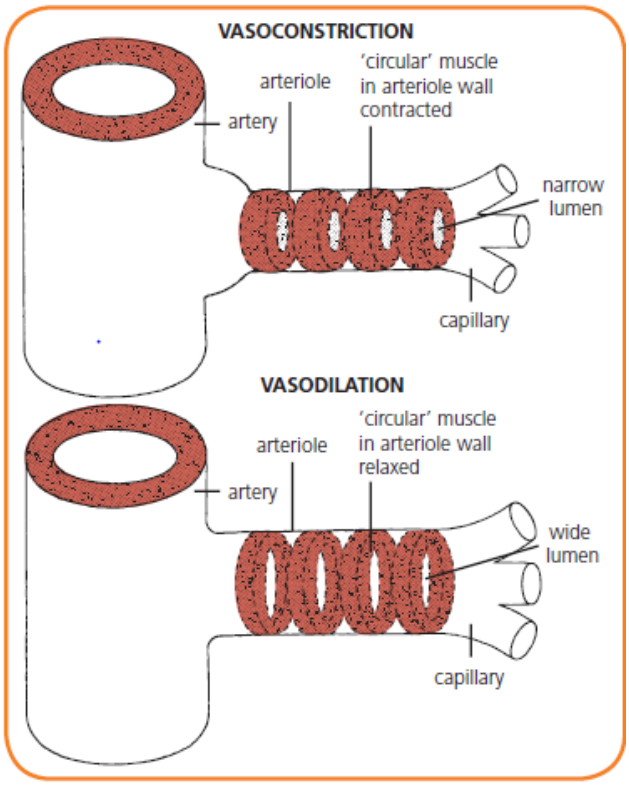


Figure 11.3 Simplified version of vasoconstriction and vasodilation

What is **VASODILATION** of an artery and what effect does it have on blood flow?

_____

_____

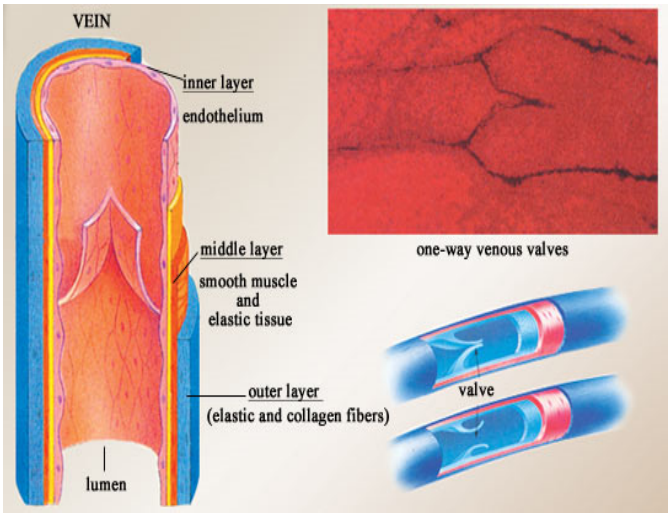
What is **VASOCONSTRICTION** of an artery and what effect does it have on blood flow?

_____

_____

Veins

Veins have an outer layer of _____ tissue containing _____ fibres but a much _____ muscular wall than arteries. They contain _____ to prevent back flow of blood as blood is at a _____ pressure in veins than arteries.



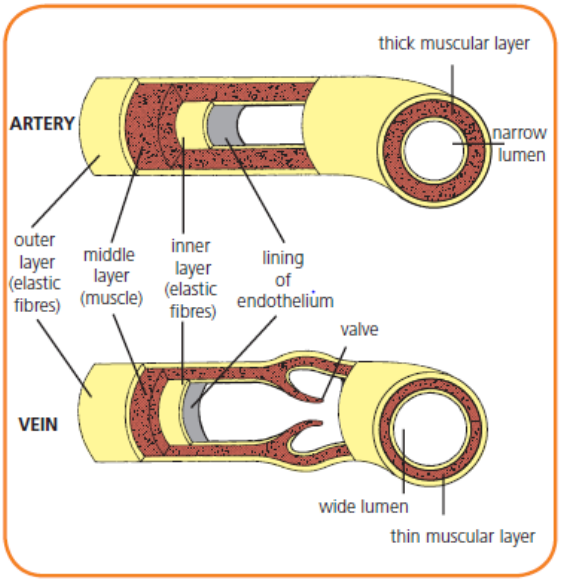
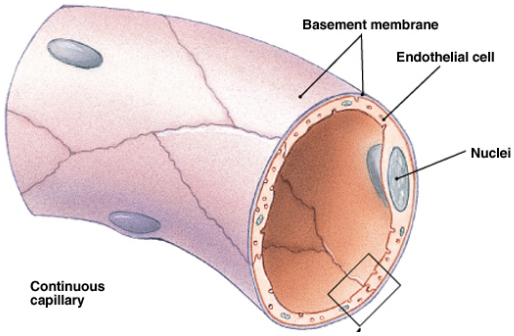
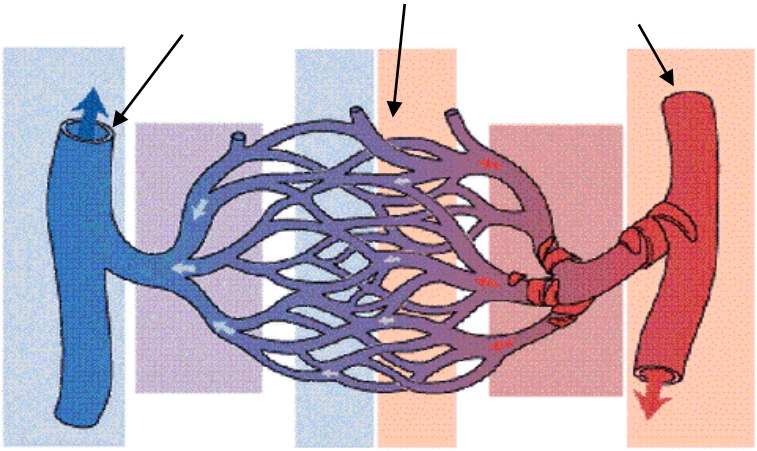


Figure 11.2 Comparison of structure of an artery and a vein

Capillaries



Capillaries are only _____ cell thick to allow exchange of substances with tissues through their thin walls.



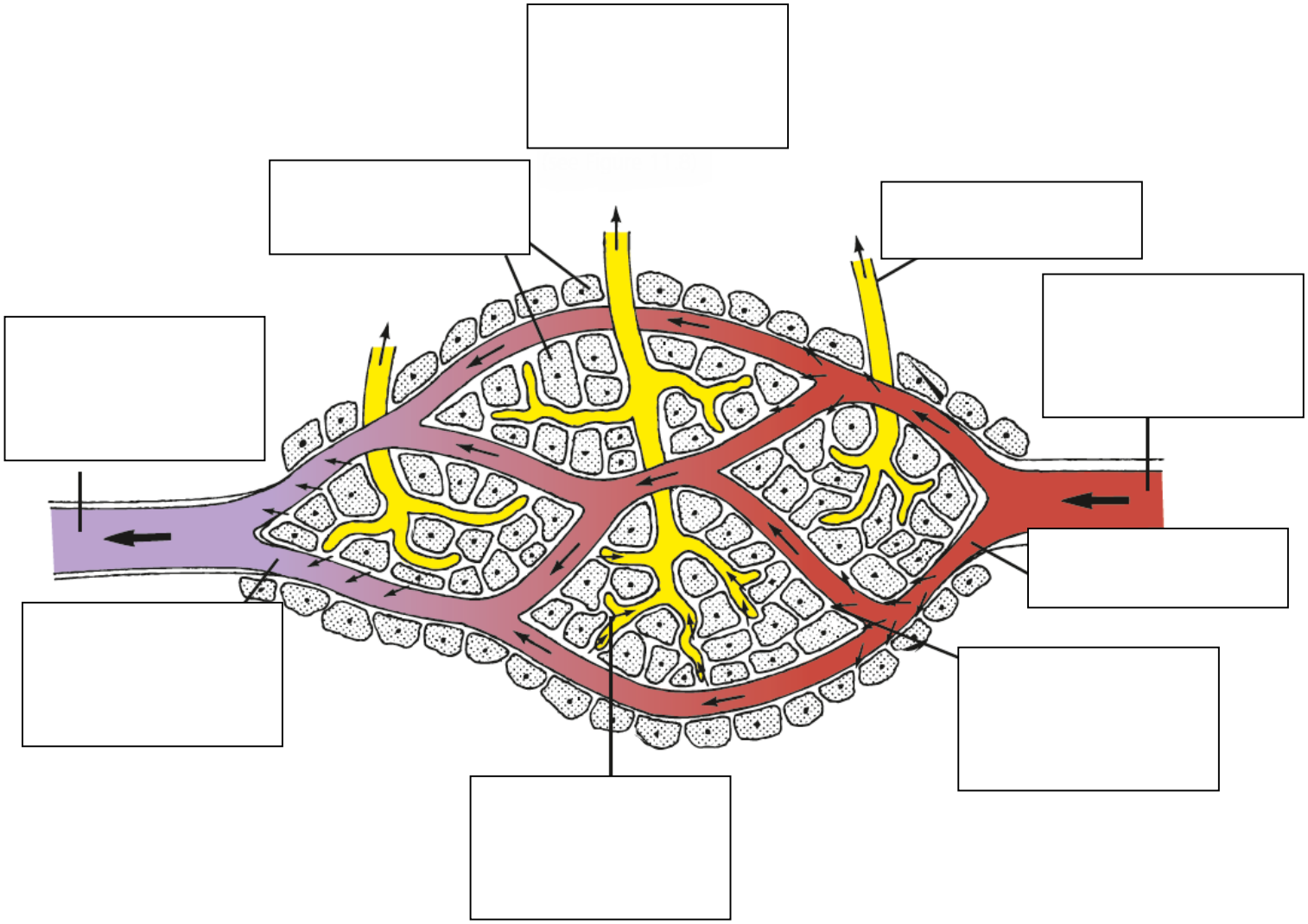
Tissue fluid and the lymphatic system

When blood arrives at a capillary, **pressure filtration** causes **plasma** to pass through capillary walls into the **tissue fluid** surrounding the cells.

The tissue fluid that surrounds cells supplies them with _____ oxygen and other substances. Carbon dioxide and other metabolic wastes diffuse out of cells and into the tissue fluid to be excreted.

Much of the tissue fluid return to the blood. _____ vessels absorb excess tissue fluid and return it as _____ to the circulatory system.

IMPORTANT: Tissue fluid and blood plasma are similar in composition, with the exception of plasma proteins, which are too large to be filtered through the capillary walls.



Consolidation exercises:

ESSAY (2012): Discuss the exchange of substances between plasma and body cells.

TEXTBOOK: Testing your knowledge questions Q2-4 on page 166 of textbook.

SQA Past papers: SQA2017-Sec 2 Q5
SQA 2018-MCQ Q14
RH 2014-Sec 2 Q9
RH 2013-Sec 2 Q7
RH 2012-Sec 2 Q7

Unit 2: Key Area 5: Glossary

Term	Definition
Arteries	
Veins	
Capillaries	
Valves	
Vasoconstriction	
Vasodilation	
Tissue fluid	
Pressure filtration	
Lymph vessels	
Lymph	

The small print: Key Area 6

The structure and function of the heart

Blood flow through the heart and its associated blood vessels. …….. ☐

(a) Cardiac output and its calculation

- The volume of blood pumped though each ventricle per minute is cardiac output. ……☐
- Cardiac output is determined by heart rate and stroke volume (CO=HR x SV)……☐
- The left and right ventricles pump the same volume of blood through the aorta and the pulmonary artery…… ……..☐

(b) The cardiac cycle……..☐

- Functions of diastole, atrial systole and ventricular systole……..☐
- During diastole, blood returning to the atria flows into the ventricles. ……☐
- Atrial systole transfers the remainder of the blood through the atrio-ventricular (AV) valves to the ventricles. ……..☐
- Ventricular systole closes the AV vales and pumps blood throughout through the semi lunar (SL) valves to the aorta and the pulmonary artery. ……☐
- In diastole, the higher pressure in the arteries closes the SL valves. ……..☐
- Effects of pressure on AV and SL valves. ……☐
- The opening and closing of the AV and SL valves are responsible for the heart sounds heard with a stethoscope. ……..☐

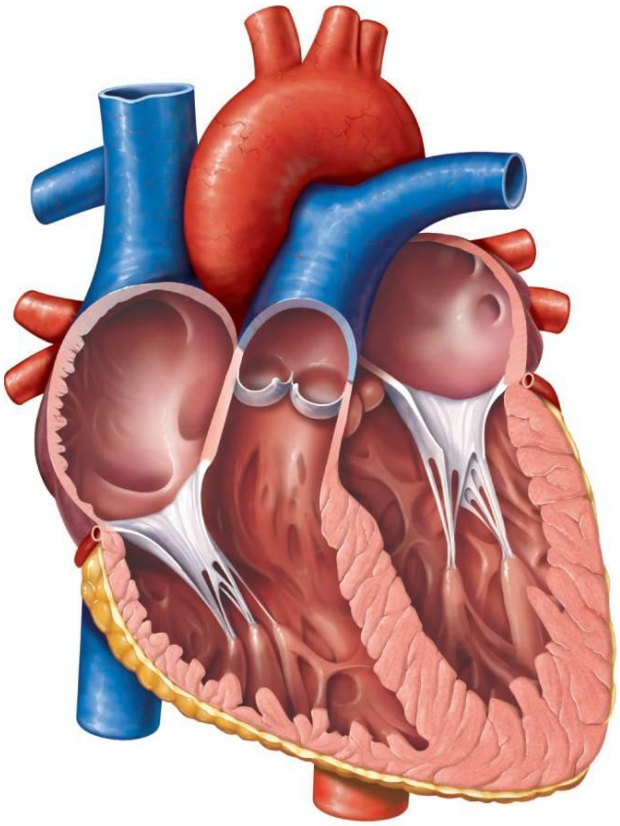
(c) The structure and function of the cardiac conducting system……..☐

- Control of contraction and timing by cells of the sino-atrial node (SAN) and transmission to the atrio-ventricular node (AVN)…… ……..☐
- Impulses in the heart generate currents that can be detected by and ECG……☐
- The medulla regulates the rate of the San through the antagonistic action of the autonomic nervous system ……..☐
- A sympathetic nerve releases noradrenaline which increases the heart rate……☐
- A parasympathetic nerve releases acetylcholine which decreases heart rate……☐

(d) Blood pressure changes in the aorta during the cardiac cycle……..☐

- Measurement of blood pressure using a sphygmomanometer……..☐
- Hypertension is a major factor for many diseases including coronary heart disease. ……☐

The structure and function of the heart



Blood flow through the heart

Cardiac output

At each contraction, the right ventricle pumps the same volume of blood through the pulmonary artery (to the lungs) as the left ventricle pumps through the aorta (to the body).

Heart rate:

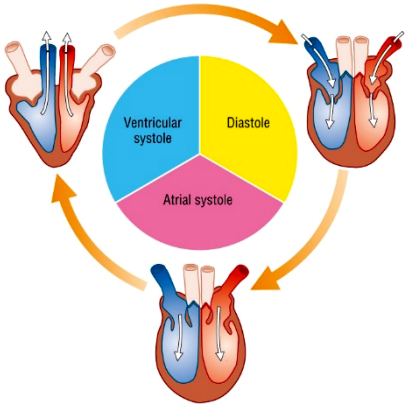
Stroke volume:

Cardiac output:

Use the equation to complete the table below which shows the effects of exercise on cardiac output.

Activity Level	***Heart rate (bpm)***	***Stroke Volume (ml)***	***Cardiac Output (l/min)***
Rest	72	70	
Mild		110	11
Moderate	120		13.4
Heavy (athlete)	200	150	

The Cardiac cycle



The term cardiac cycle refers to the pattern of contraction (systole) and relaxation (diastole) during one complete heartbeat.

The cardiac cycle consists of three stages:

_____

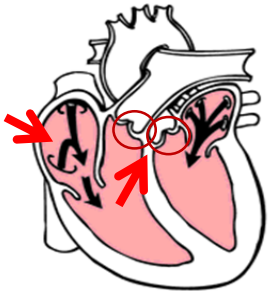
_____

_____

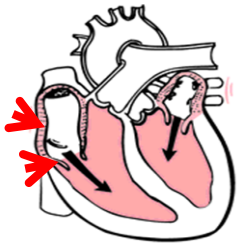
Diastole

During diastole, blood returning to the atria flows into the ventricles via the AV valves. The higher pressure in the arteries closes the SL valves.

During diastole, the AV valves are _____ and the SL valves are _____.



All chambers relaxed



Atria contract

Atrial systole

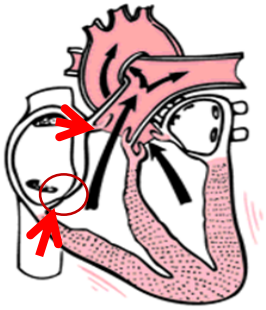
Atrial systole transfers the remainder of the blood through the AV valves and into the ventricles.

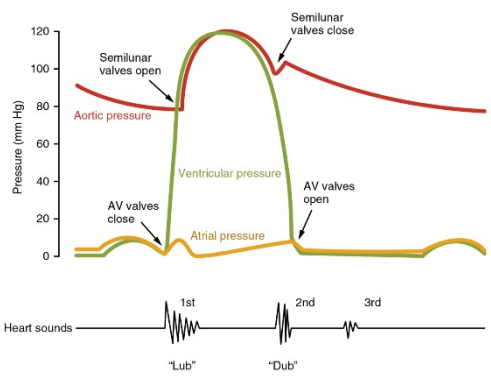
AV valves _____, SL valves _____.

Ventricular systole

Ventricular systole closes the AV valves and pumps blood through the SL valves to the aorta and pulmonary artery.

SL valves _____, AV valves _____.





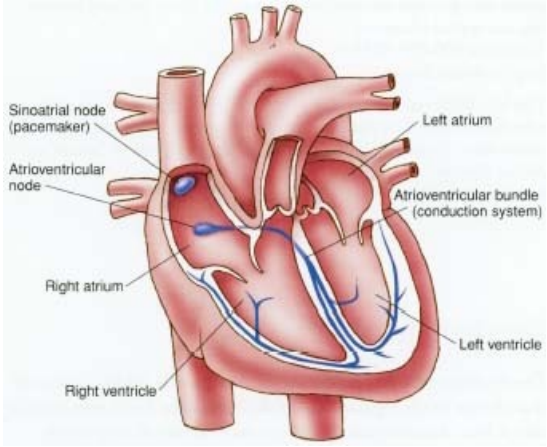
The opening and closing of the AV and SL valves are responsible for the heart sounds heard with a stethoscope.

The structure and function of the cardiac conducting system

The heartbeat originates in the heart itself, it is myogenic. It can however be regulated by nervous and hormonal control.

The auto-rhythmic cells of the Sino-atrial node (SAN) or pacemaker, set the rate at which the heart contracts.

The SAN is located in the wall of the _____ _____.



The SAN generates an _____ impulse that makes cardiac muscle cells contract at a certain rate.

Electrical impulses initiated in the SAN spreads throughout the atria, causing atrial _____. The impulse reaches the Atrio-ventricular node (AVN) which is located in the centre of the heart.

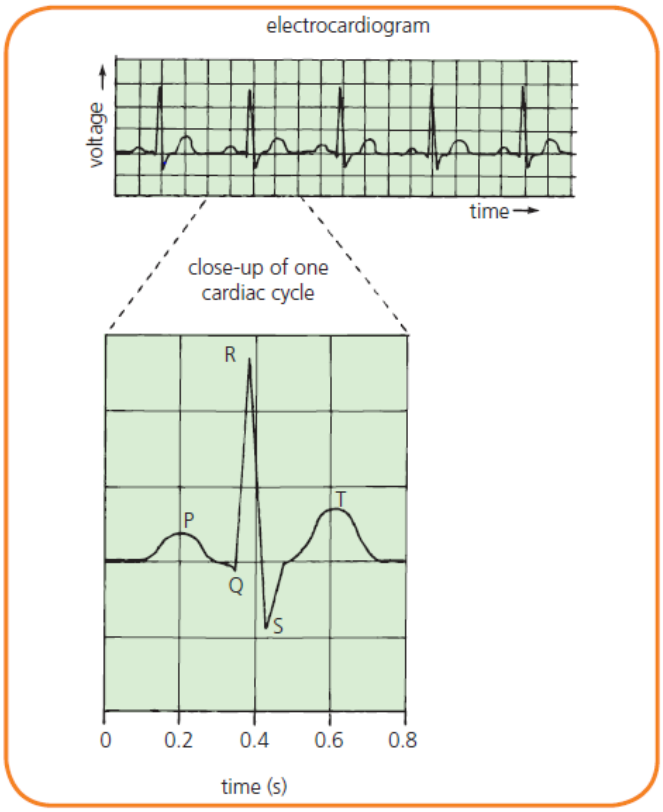
Impulses then travel down fibres in the central walls of the heart and then up through the walls of the ventricles causing ventricular _____.

Summarise the notes above to explain the structure and function of the cardiac conducting system.

Electrocardiograms

Impulses in the heart generate currents that can be detected by an **electrocardiogram (ECG)**.

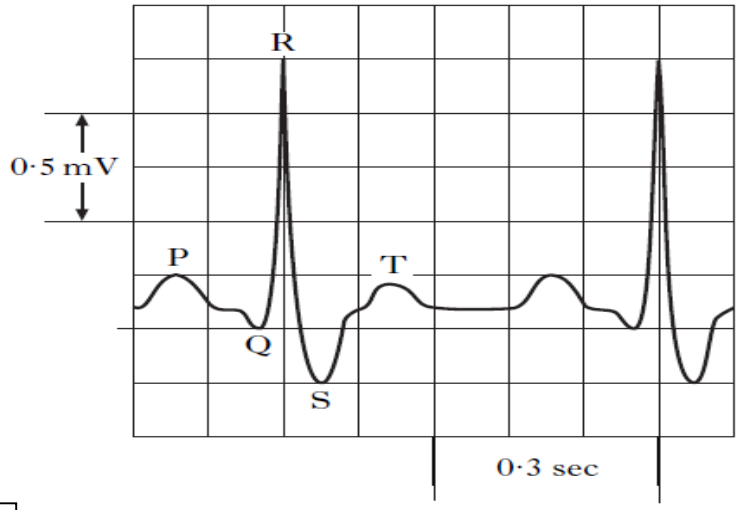
- **P wave** – Wave of electrical activity spreading over atria from SAN. Atrial systole.
- **QRS waves** – Wave of electrical activity passing through ventricles. Ventricular systole.
- **S wave** - Electrical recovery of the ventricles occurring towards the end of ventricular systole.



Use the example above to calculate the heart rate of this individual:

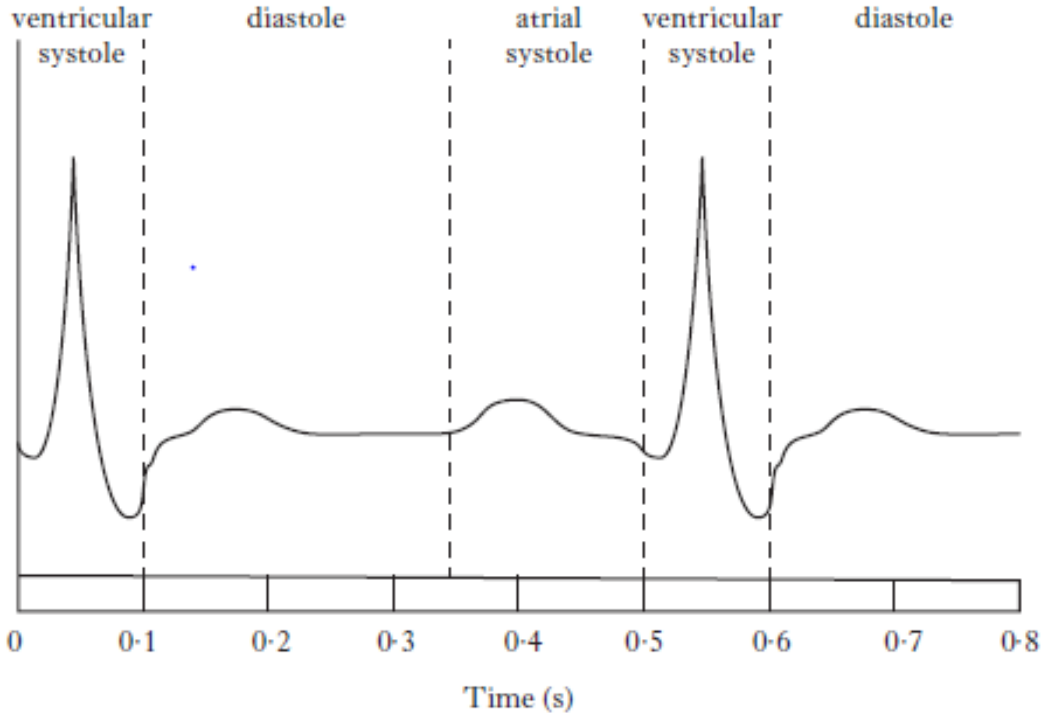
Try the questions below to calculate heart rate from an ECG.

1. An ECG trace is shown below.



What is this person's heart rate?
A 100 beats per minute
B 120 beats per minute
C 150 beats per minute
D 200 beats per minute

2. The diagram below shows an electrocardiogram (ECG) trace of an individual's heartbeat.



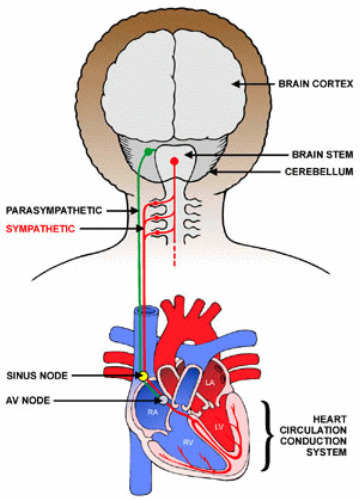
(*a*) Calculate the heart rate of this individual.

Space for calculation

_____ bpm **1**

Regulation of heart rate

The SAN alone initiates each heartbeat. However heart rate is not fixed as it is altered by **nervous** and **hormonal** control.



Nervous control

The _____ region in the brain regulates the rate of the SAN through the _____ _____ _____ (ANS).

It contains two branches which work in _____ (opposing) ways.

A _____ nerve releases _____ which **increases** heart rate.

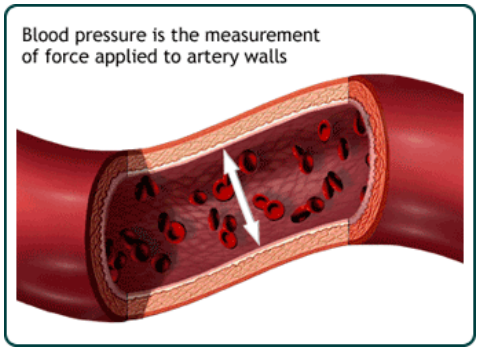
A _____ nerve releases _____ which **decreases** heart rate.

Hormonal control

Under circumstances such as stress and exercise the sympathetic nervous system causes the adrenal glands to produce the hormone _____ which acts on the SAN to increase heart rate.

Blood pressure and changes in the aorta during the cardiac cycle

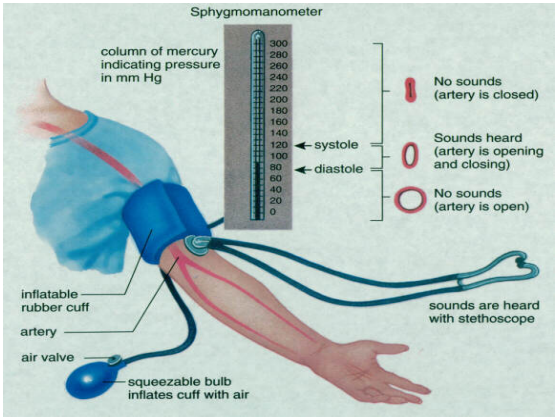
Blood pressure is the force exerted by blood against the walls of the blood vessels. It is generated by the contraction of the ventricles and is therefore highest in the large elastic arteries (Aorta and Pulmonary artery).



Blood pressure changes during the cardiac cycle. It can be measured using a _____.

- A cuff is inflated until the pressure stops blood flow through the arm artery.

- The cuff is allowed to deflate gradually until the pressure of the blood in the artery exceeds that of the cuff. Blood will start to flow through the artery again which will be detected by a pulse, this is the **SYSTOLIC PRESSURE.**
- Blood will begin to flow freely through the artery as the cuff further deflates, and a pulse is not detected. This is the **DIASTOLIC PRESSURE.**



Blood pressure is found to vary considerably from person to person but a typical blood pressure reading for a young adult is 120/80 mmHg.

Using the notes above, explain the difference between systolic and diastolic pressure.

Hypertension (High blood pressure)

Hypertension is the **prolonged elevation** of blood pressure when at rest. It is normally indicated by systolic pressure greater than 140mmHg and a diastolic pressure greater than 90mmHg.

Hypertension is a major risk factor for many diseases including coronary heart disease.

It is commonly found in people who have an unhealthy life style including some of the following:

Unit 2: Key Area 6: Glossary

Term	Definition
Cardiac output	
Heart rate	
Stroke volume	
Diastole	
Systole	
Sino-atrial node	
Atrio-ventricular node	
Electrocardiogram	
Sympathetic nerve	
Parasympathetic nerve	
Hypertension	
Sphygmomanometer	

KA 6 Consolidation questions:

TYK questions-Page 175 of textbook
SQA 2016: Sec 2-Q5
SQA 2015: MCQ-Q10,11
Sec 2-Q6
SQA 2018-Sec2-Q5

The small print: Key Area 7
Pathology of cardiovascular disease (CVD)

(a) process of atherosclerosis, its effect on arteries and blood pressure.

- Atherosclerosis is the accumulation of fatty material (mainly cholesterol, fibrous material and calcium) forming an atheroma or plaque beneath the endothelium……☐
- As the atheroma grows the artery thickens and loses its elasticity……☐
- The diameter of the lumen becomes reduced and blood flow becomes restricted resulting in increased blood pressure……☐
- Atherosclerosis is the root cause of various CVD-angina, heart attack, stroke, peripheral vascular disease……☐

(b) Thrombosis……☐

- Endothelium damage, clotting factors and the role of prothrombin, thrombin, fibrinogen and fibrin……☐
- Thrombus formation and the formation of an embolus……☐
- A thrombosis in a coronary artery may lead to a myocardial infarction (Heart attack)……☐
- A thrombosis in an artery in the brain may lead to a stroke. Cells are deprived of oxygen leading to death of the tissue……☐

(c) Causes and effects of peripheral vascular disorders……☐

- Peripheral vascular disease is narrowing of the arteries due to atherosclerosis of arteries other than to heart or brain. Arteries to legs most commonly affected ……☐
- Pain experienced in legs muscles due to limited supply of oxygen……☐
- A deep vein thrombosis (DVT) -blood clot that forms in a deep vein, most commonly leg ……☐
- This can break off and cause pulmonary embolism in lungs……☐

(d) Control of cholesterol levels in the body……☐

- Cholesterol is a type of lipid found in cell membrane. Used to make sex hormones, testosterone, oestrogen, progesterone……☐
- Cholesterol is synthesised by all cells, but 25% production takes place in liver . ……☐
- A diet high in saturated fats or cholesterol causes an increase in cholesterol levels in the blood . ☐
- Roles of HDL and LDL, LDL receptors, negative feedback control and atheroma formation . ……☐
- Ratios of HDL and LDL in maintaining health …… ……☐
- The benefits of physical activity and a low fat diet…… . ……☐
- Reducing cholesterol through prescribed medication ……☐

Pathology of cardiovascular disease (CVD)

Atherosclerosis

Atherosclerosis is the accumulation of fatty material (consisting mainly of _____, fibrous material and calcium forming an _____, also known as a plaque, beneath the _____.

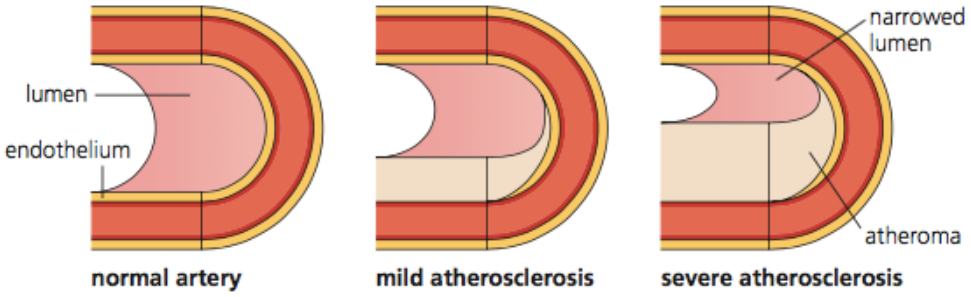


Figure 2.39 Formation of an atheroma in the endothelium of an artery

As the atheroma grows the artery thickens and loses its _____. The diameter of the lumen becomes reduced and blood flow becomes restricted resulting in increased _____ _____.

Atherosclerosis is the root cause of various cardiovascular diseases including _____, heart attack, _____ and _____ vascular disease.

Thrombosis

Atheromas may _____ damaging the endothelium. The damage releases clotting factors that activate the conversion of the enzyme _____ to its active form thrombin. Thrombin then causes molecules of the plasma protein _____ to form threads of fibrin.

The fibrin threads form a meshwork that _____ the blood, seals the wound and provides a _____ for the formation of _____tissue.
The formation of a clot (thrombus) is referred to as _____.

In some cases a thrombus may break loose forming an _____ and travel through the _____ until it blocks a blood vessel.

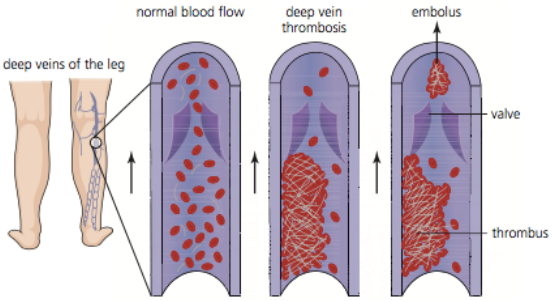
A thrombosis in a _____ artery may lead to a _____ _____ (Heart attack). A thrombosis in an artery in the brain may lead to a _____.

Either way, cells are deprived of _____, leading to death of the _____.

Use the notes on thrombosis above to summarise (a diagram would be useful) what happens after an atheroma ruptures and the resulting effects this can have.

Peripheral vascular disease

Peripheral vascular disease is the narrowing of the arteries due to _____ of arteries other than those of the heart or brain. The arteries to the _____ are most commonly



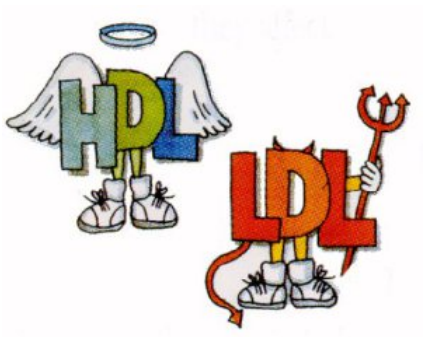
affected. Pain is experienced in the leg muscles due to a limited supply of _____.

A _____ _____ _____ (DVT) is a blood clot (thrombus) that forms in a deep vein most commonly in the leg, and can break off and result in a _____ _____if it travels to a blood vessel supplying the lungs.

ESSAY (2014)
Discuss how cardiovascular disease occurs.

Control of cholesterol levels in the body

Cholesterol is a type of lipid found in the cell membrane. It is also used to make the sex hormones-testosterone, oestrogen and progesterone. Cholesterol is synthesised by all cells but 25% of total production takes place in the _____.
A diet high in saturated fats and cholesterol causes an increase in cholesterol levels in the blood.
There are two types of_____ carrying proteins:



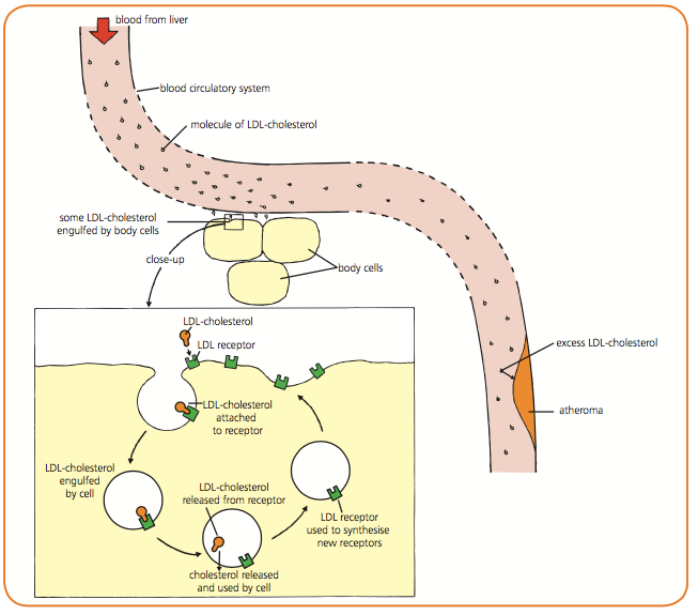
1._____(HDL)
2._____ (LDL)

HDL transports excess _____ **from** the body cells **to** the _____ for elimination. This prevents accumulation of cholesterol in the blood.

LDL transports cholesterol **to** body cells. Most cells have LDL receptors that take LDL into the cell where it releases cholesterol.

Once a cell has sufficient cholesterol a _____ _____ system inhibits the synthesis of new LDL _____which means that excess LDL circulates in the _____where it may deposit cholesterol in the _____ forming atheroma's.

A higher ratio of HDL to LDL will result in _____ blood cholesterol and a reduced chance of _____.



<u>Reducing cholesterol levels</u>

1. Regular _____ tends to raise HDL levels, removing more cholesterol from the _____, lowering cholesterol levels.

2. Dietary changes aim to reduce the levels of total fats in the diet and replacing saturated with _____fats contributes to lower cholesterol levels.

3.Prescribed medications such as _____ reduce blood cholesterol by _____ the synthesis of cholesterol by _____ cells.

<u>KA 6 Consolidation tasks:</u>
TYK questions-Page 189 of textbook.

Essay (2016): Discuss the causes, development and associated health problems of atherosclerosis.

SQA 2018-Sec 2-Q6
SQA 2017-MCQ-Q12
SQA 2016-Sec 2-Q6

Unit 2: Key Area 7: Glossary

Term	Definition
Atherosclerosis	
Atheroma	
Angina	
Cardiovascular diseases	
Thrombosis	
Thrombin	
Prothrombin	
Fibrin	
Fibrinogen	
Embolus	
Myocardial infarction	
Stroke	
Peripheral vascular disease	
Deep vein thrombosis	
Cholesterol	
High Density Lipoprotein	

Low Density Lipoprotein	
LDL receptor	
Statins	

The small print: Key Area 8
Blood glucose levels and obesity

(a) Chronic elevated blood glucose levels lead to atherosclerosis and blood vessel damage.

- Leads to epithelial cells taking up more glucose than normal and damaging vessels.....☐
- Atherosclerosis may develop leading to CVD, stroke, peripheral vascular disease.....☐
- Small blood vessels damaged may result in haemorrhage in retina, renal failure and peripheral nerve dysfunction.....☐

(b)Pancreatic receptors and the role of hormones in negative feedback control of blood glucose through insulin, glucagon and adrenaline.....☐

- Pancreatic receptor respond to raised blood glucose levels by secreting more insulin from pancreas.....☐
- Insulin activates conversion of glucose to glycogen in liver so blood glucose levels decrease.....☐
- Pancreatic receptors respond to lowered blood glucose by secreting more glucagon from pancreas☐
- Glucagon activates conversion of glycogen to glucose in liver, increasing blood glucose.....☐
- During exercise/fight or flight responses, blood glucose levels are raised by adrenaline from adrenal glands, stimulating glucagon secretion and inhibiting insulin secretion.....☐

(c) Type 1 and type 2 diabetes.....☐

- Type 1 usually occurs in childhood, unable to produce insulin and can be treated with regular doses of insulin.....☐
- Type 2 typically develops later in life, with likelihood increased with being overweight.....☐
- Type 2's produce insulin but cells are less sensitive to it. Resistance linked to decrease in insulin receptors in the liver, leading to a failure to convert glucose to glycogen.....☐
- In both types, blood glucose rises rapidly after a meal, kidneys remove some of the glucose so it appears in urine.....☐
- Glucose tolerance test used to diagnose diabetes. .....☐

(d) Obesity.....☐

- Obesity is a major risk factor for CVD and type 2 diabetes.....☐
- Characterised by excess body fat in relation to lean body tissue e.g. muscle.....☐
- Obesity may impair health .....☐
- Body mass index (BMI) is used to measure obesity but can wrongly classify muscular individuals as obese. BMI= body mass/ (height squared). BMI > 30 indicates obesity..... .....☐
- Obesity linked to high fat diets and decrease in physical activity. Diet should limit fats and free sugars. Fats=high calorie per g and free sugars require no metabolic energy to digest. ....☐
- Exercise increases energy expenditure and preserves lean tissue. Can help to reduce risk factors for CVD by keeping weight under control, minimising stress, reducing hypertension and improving blood lipid profiles..... . .....☐

Blood glucose levels and obesity

Blood Glucose levels, Atherosclerosis and Blood Vessel Damage

Blood glucose levels

Chronic _____ of blood glucose levels leads to the _____ cells taking in more glucose than normal which damages the _____ _____.
Atherosclerosis may develop leading to _____ disease (CVD), stroke or _____ vascular disease.

Small blood vessels damaged by elevated glucose levels may result in _____ of blood vessels in the _____, renal failure or peripheral _____ dysfunction.

Normal

Haemorrhaged due to elevated sugar levels

Blood glucose regulation

All living cells need a **continuous supply of energy** released from breakdown of glucose during respiration. As the body only obtains supplies of glucose after food is eaten it has a **negative feedback system** to ensure there is a regular supply of glucose present in the blood stream.

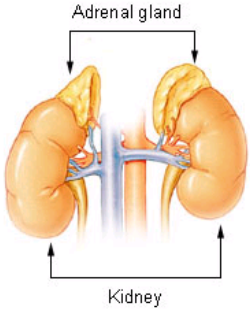
Receptors in the _____ respond to **high blood glucose** levels by increasing secretion of _____ which activates the conversion of glucose to _____ in the liver and so _____blood glucose concentration.

Receptors in the pancreas also respond to **low blood glucose** levels by increasing secretion of _____ which activates the conversion of glycogen to _____ in the liver and so _____ blood glucose level.

Use page 192 in Torrance or 114 in How to pass to draw a diagram to explain how blood glucose is regulated by pancreatic receptors, hormones and negative feedback.

Important: Action of insulin and glucagon

During _____and 'fight or flight' responses, glucose levels are raised by _____ released from the adrenal glands which stimulate glucagon secretion and _____ insulin secretion.



Type 1 and type 2 diabetes

People who have diabetes are **unable to control their blood glucose levels**. If untreated, they can rise to 10-30mmol/l compared with normal levels of around 5mmol/l.

Type ____ diabetes usually occurs in _____. Type 1 diabetics are unable to produce the hormone _____ and can be treated with **regular doses of insulin**.

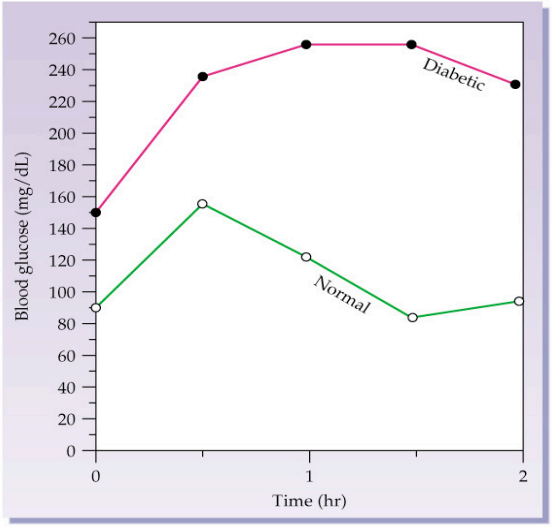
Type ____ diabetes typically develops later in life with the likelihood increasing in _____ individuals.

Type 2 diabetics produce insulin but their cells are less _____ to it. This insulin _____ is linked to a decrease in the number of insulin _____ in the _____ leading to a failure to convert glucose to _____.

In both types of diabetes, individuals **blood glucose concentrations will rise rapidly after a meal**. The kidneys will remove some of this glucose, resulting in glucose appearing in the _____.

Testing urine for glucose is often an indicator of diabetes.

The _____ _____ test is used to diagnose diabetes.



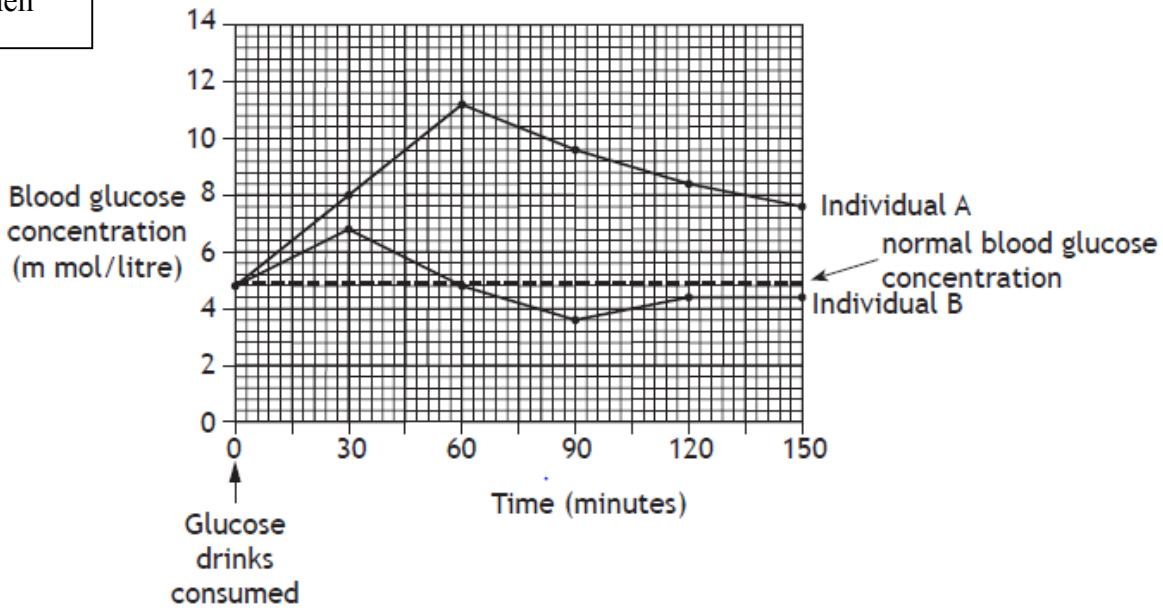
Blood glucose levels are initially measured after fasting. The individual then drinks a glucose solution and changes in their blood glucose concentration are measured for at least the next two hours.

See image- The blood glucose concentration of a diabetic usually starts at a higher level than that of a non-diabetic. During the test a diabetic's blood glucose concentration increases to a higher level than that of a non-diabetic and takes much longer to return to its starting concentration.

Use this information above to help you answer the past paper question over the page.

Q8-
Old
specimen

The graph below shows changes in blood glucose concentration in a diabetic and a non-diabetic individual after each had consumed a glucose drink.



(a) (i) Choose **one** individual, A or B and indicate whether the individual is diabetic or non-diabetic.

Using evidence from the graph, justify your choice.

(ii) Using data from the graph, describe the changes that occurred in the blood glucose concentration of individual A after consuming the glucose drink.

Obesity

Obesity is characterised by **excess body fat in relation to lean body tissue such as muscle.** It is a major risk factor for _____ disease and type _____ diabetes.

_____ _____ _____ (BMI) is commonly used to measure obesity. However caution must be taken as it can wrongly classify muscular individuals as obese.

BMI=

A person is 170 cm tall and weighs 70 kg. They have a body mass index (BMI) of

A 2·4
B 24·2
C 28·8
D 41·2.

A BMI over _____ is used to indicate obesity.

Obesity is linked to high _____ diets and a decrease in _____ activity. The energy intake in the diet should limit _____ as they have a high number of_____ per gram.
Energy intake should also limit _____ _____ as they require no metabolic _____ to be expended in their digestion.

_____ increases energy expenditure and preserves lean tissue.
It can help to reduce risk factors for CVD by keeping _____ under control, minimising _____, reducing _____ (high blood pressure) and improving blood lipid profiles.

Consolidation Questions:
TYK questions: page 198 of textbook.
Extended response question: 'Give an account of the principle of negative feedback with reference to the maintenance of blood sugar levels (9)-How to pass.
'Discuss the diagnosis, treatment and role of insulin in Type 1 and Type 2 diabetes.' (8)-SQA 2016
Past paper questions:
SQA 2018-Sec2-Q7
SQA 2017-MCQ-Q13,14
Sec2-Q7
SQA 2015-Sec2-Q7a-c
SQA Specimen-Sec2-Q8,9
RH 2014-Sec2-Q8
SQA 2016-Sec2-Q7,8,13b

Unit 2: Key Area 8: Glossary

Term	Definition
Pancreatic receptors	
Insulin	
Glycogen	
Glucagon	
Adrenaline	
Type 1 diabetes	
Type 2 diabetes	
Insulin resistance	
Glucose tolerance test	
Obesity	
Body mass index (BMI)	