Dalkeith High School

CfE Higher Human Biology

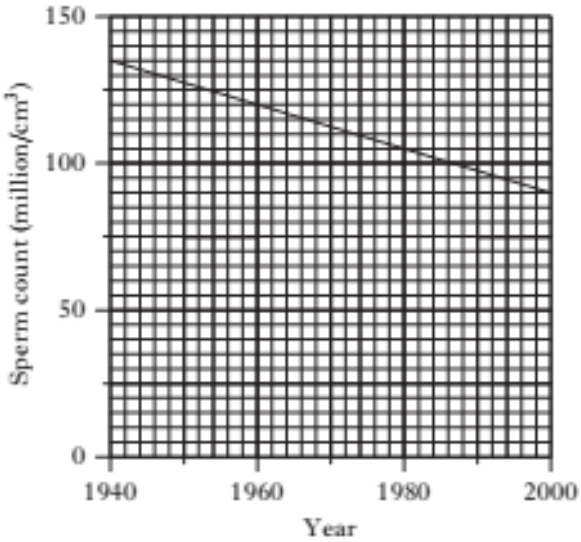
Unit 2

Physiology and Health

Past Paper Questions

Reproductive Organs

1. The sperm counts of a sample of men taken between 1940 and 2000 are shown in the graph below.



What is the average reduction in sperm count per year?

a) 0·67 million/cm3/year
b) 0·75 million/cm3/year
c) 0·92 million/cm3/year
d) 45 million/cm3/year

2. A function of the interstitial cells in the testes is to produce

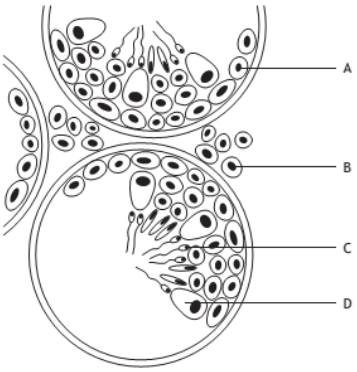
   a. Sperm
   b. Testosterone
   c. Seminal fluid
   d. Follicle stimulating hormone (FSH)

3. Which of the following is **not** a function of the secretions from the prostate gland and seminal vesicles?

   a. They add sperm to semen
   b. They add sugar to semen
   c. They add fluid to semen
   d. They add enzymes to semen

4. One function of the seminal vesicles is to
   a. Produce testosterone
   b. Allow sperm to mature
   c. Store sperm temporarily
   d. Produce nutrients for sperm

5. The diagram below shows a cross-section of part of a testis.



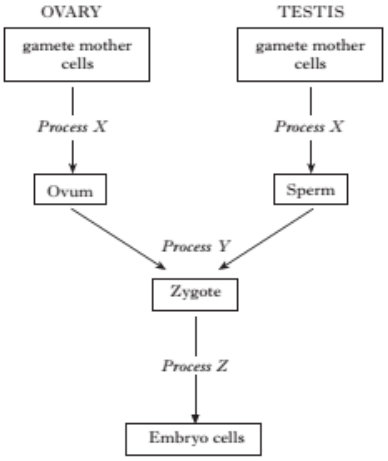
Which cell can produce testosterone?

6. The table below contains information about four semen samples.

	Semen sample			
	A	B	C	D
Number of sperm in sample (millions/cm^3)	40	30	20	60
Active sperm (percent)	50	60	75	40
Abnormal sperm (percent)	30	65	10	70

Which semen sample has the highest number of active sperm per cm^3?

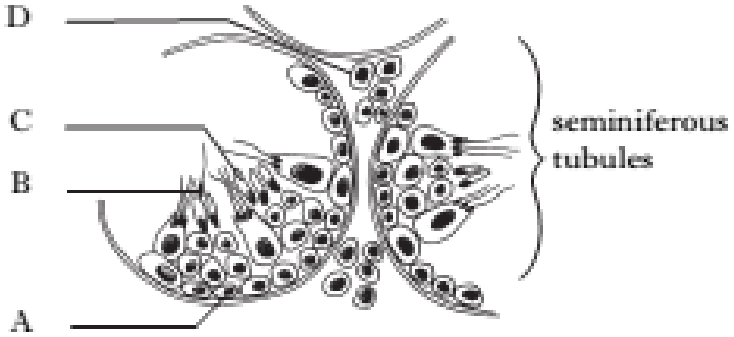
7. The diagram refers to human reproduction.



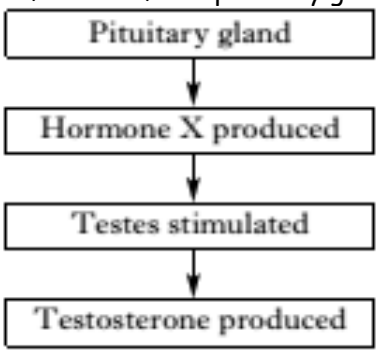
Which of the following correctly identifies processes X. Y and Z?

	X	*Y*	*Z*
A	Mitosis	Meiosis	Fertilisation
B	Meiosis	Fertilisation	Mitosis
C	Meiosis	Mitosis	Fertilisation
D	Mitosis	Fertilisation	Meiosis

8. The diagram below shows a section through seminiferous tubules in a testis.
   Which cell produces testosterone?



9. The diagram below shows the influence of the pituitary gland in testosterone production.



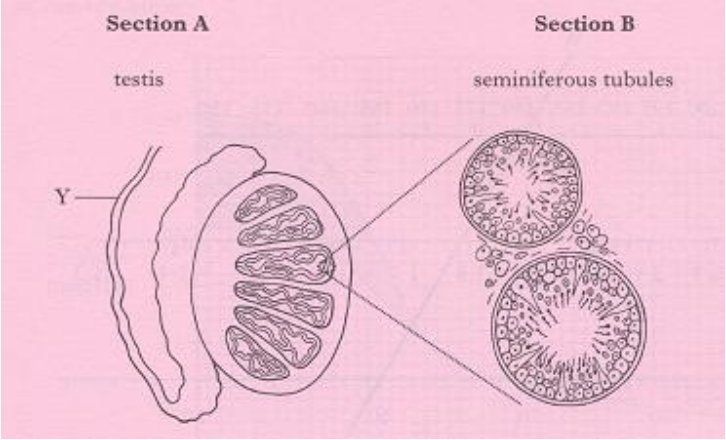
   What is hormone X?

   a. Luteinising hormone
   b. Follicle stimulating hormone
   c. Oestrogen
   d. Progesterone

10. From what structure in the female reproductive system does a corpus luteum develop?

   a. Endometrium
   b. Graafian follicle
   c. Fertilised ovum
   d. Unfertilised ovum

11. The diagram shows sections of a testis and two seminiferous tubules.



a) Name structure Y. (1)

b) Follicle stimulating hormone (FSH) affects the testes. (1)

   i. State where FSH is produced in the body. (1)

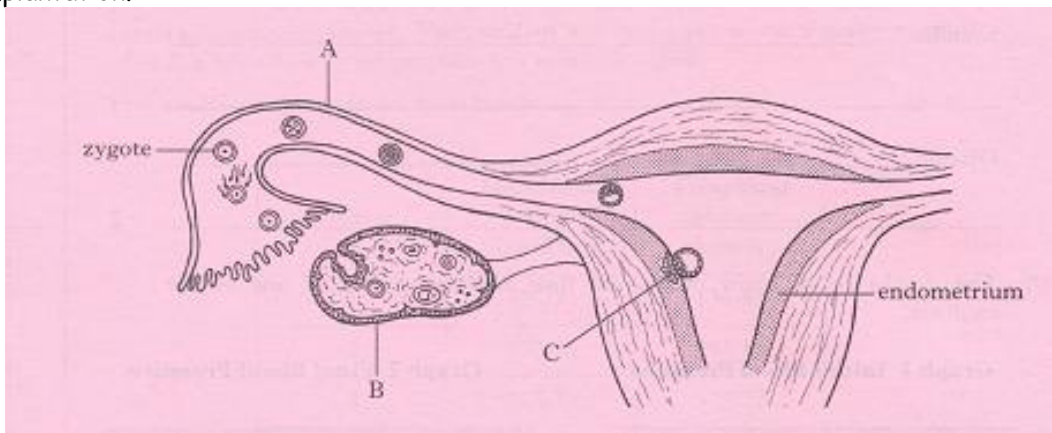
   ii. What effect does FSH have on the testes? (1)

c) i. On Section B use an X to mark the site of testosterone production. (1)

   ii. Describe how the concentration of testosterone in the blood is prevented from becoming too high. (2)

   iii. Suggest why testosterone injections are sometimes used to treat infertility in men. (1)

12. The diagram shows stages in the development of a human embryo from fertilisation to implantation.



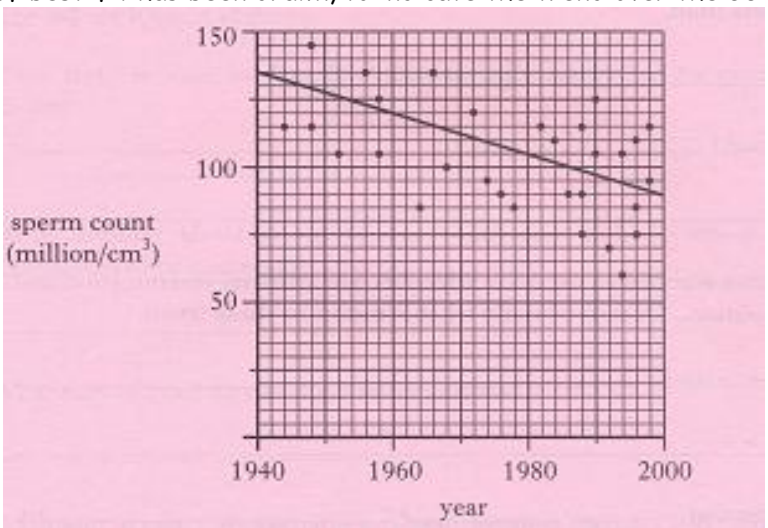
a. Name the parts labelled A and B. (1)

b. What term is used to describe the first few divisions of the zygote? (1)

c. Name a hormone which is involved in preparing the endometrium for implantation and state where it is produced. (1)

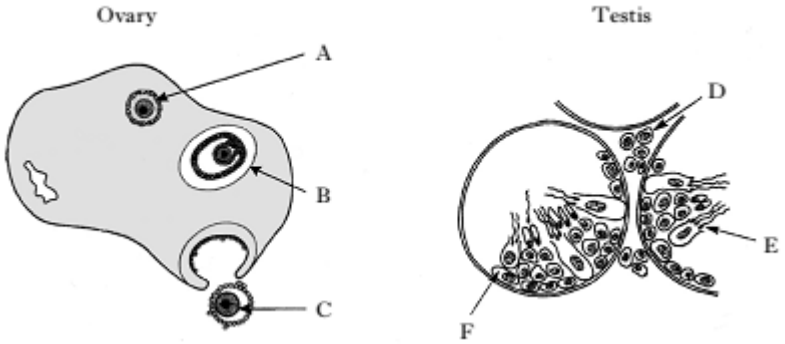
d. What organ will develop from the tissue labelled C? (1)

13. The sperm counts of 30 men taken between 1940 and 2000 are shown in the graph below. A line of best-fit has been drawn, to indicate the trend over the 60-year period.



a. Using the line of best-fit, calculate the percentage decline in sperm count over the 60-year period. (1)
b. From the graph, what is the maximum sperm count for any one individual recorded during this period? (1)
c. Some insecticides are thought to influence sperm production. Explain why animals at the end of food chain are more likely to be affected by insecticides. (1)
d. Name the pituitary hormone which stimulate the production of sperm. (1)
e. Name a gland which adds fluid to sperm during ejaculation and describe one function of this fluid. (2)
f. Two treatments sometimes used for infertility are artificial insemination and in vitro fertilisation. Describe briefly what is meant by these terms. (2)

14. The diagrams represent gamete production in an ovary and part of a testis.



a. i) Which letter represents a mature ovum? (1)
ii) Identify one labelled part of each organ which is affected by FSH. (2)

Letter	Name

iii) Describe the effect of testosterone on the testes of an adult.

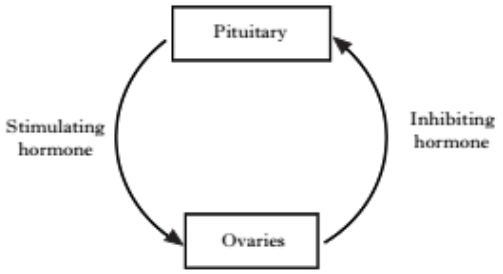
Hormonal Control

15. How many days after ovulation is menstruation most likely to occur?
    a. 5
    b. 10
    c. 15
    d. 20

16. Which of the following change indicate ovulation is likely to have taken place?

	Cervical mucus	*Body temperature*
A	Becomes sticky	Rises
B	Becomes sticky	Falls
C	Becomes watery	Rises
D	Becomes watery	Falls

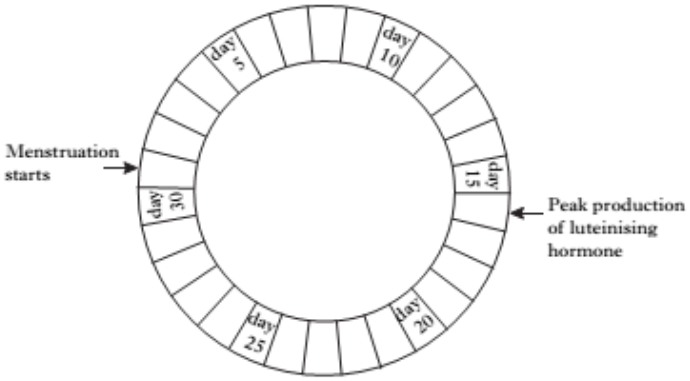
17. The diagram below represents part of the mechanism which controls ovulation.



The hormones indicated above are

	Stimulating hormone	*Inhibiting hormone*
A	FSH	Oestrogen
B	Progesterone	FSH
C	Oestrogen	LH
D	LH	Testosterone

18. On which day in the following menstrual cycle could fertilisation occur?

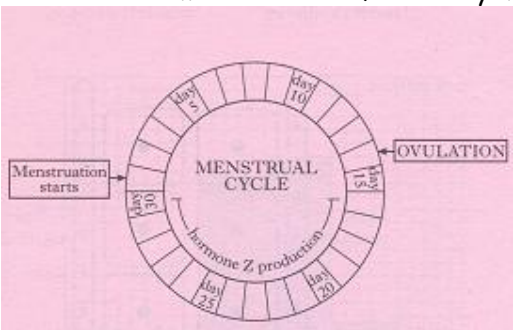


    a. Day 30
    b. Day 17
    c. Day 14
    d. Day 2

19. After ovulation the follicle develops into the
    a. Corpus luteum
    b. Fallopian tube
    c. Endometrium
    d. Zygote

20. As an ovum develops within the ovary, it is surrounded by
    a. A Graafian follicle
    b. Seminal fluid
    c. A corpus luteum
    d. The endometrium

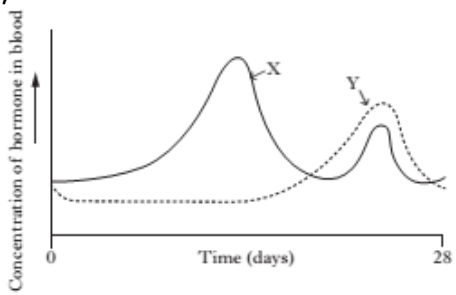
21. The diagram below illustrates the hormonal control of a 30-day menstrual cycle.



Which line of the table identifies correctly hormone Z and the structure which produces this hormone?

	Hormone Z	Produced by
A	LH	Ovary
B	Oestrogen	Corpus luteum
C	Progesterone	Graafian follicle
D	Progesterone	Corpus luteum

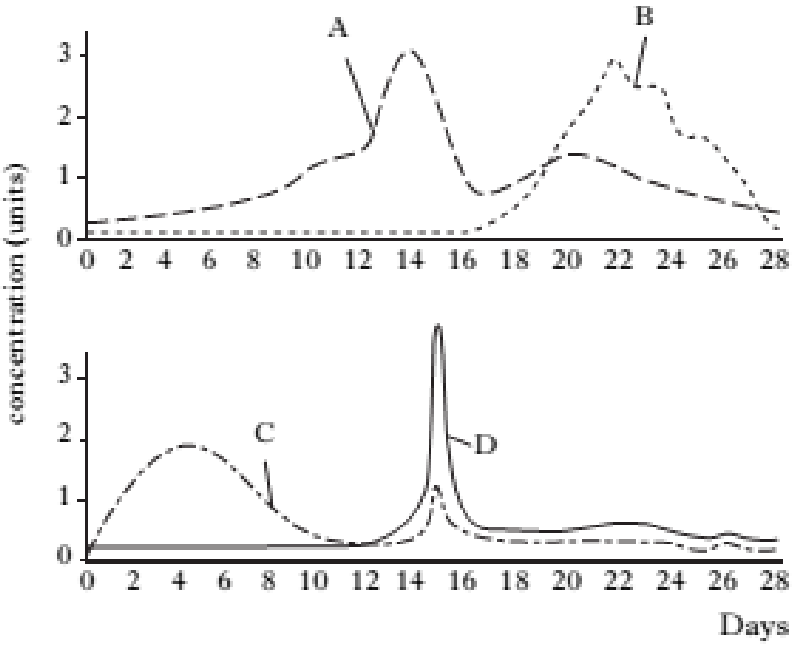
22. The graph below shows changes in the concentration of hormones X and Y in the blood during the menstrual cycle.



Which of the following correctly identifies hormones X and Y?

	Hormone X	*Hormone Y*
A	LH	Oestrogen
B	Oestrogen	FSH
C	Oestrogen	Progesterone
D	Progesterone	Oestrogen

23. The graphs below show the hormones involved in the menstrual cycle.



Which line represents oestrogen?

24. Changes in the ovary during the menstrual cycle are described below.

1 Corpus luteum forms

2 Ovulation occurs

3 Progesterone is produced

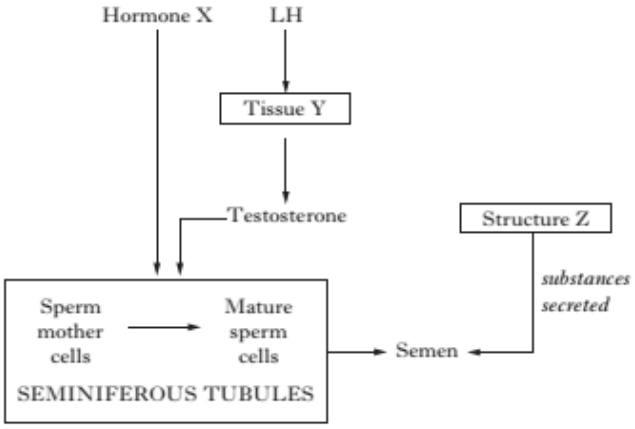
4 Corpus luteum degenerates

5 Follicle develops

The sequence in which these changes occur following menstruation is

a) 2, 3, 1, 5, 4
b) 2, 1, 3, 4, 5
c) 5, 3, 2, 1, 4
d) 5, 2, 1, 3, 4.

25. The flowchart summarises the processes involved in the production of semen.



a) Name hormone X and tissue Y. (2)

b) Semen contains substances secreted by structure Z.

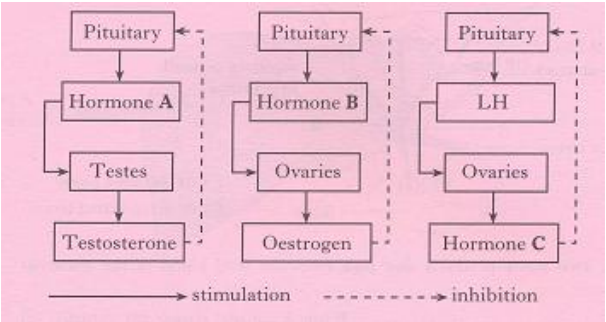
   i. Identify structure Z. (1)

   ii. Describe the role of the secretions from the seminal vesicles and structure Z. (1)

c) Complete the table to show the percentage of each type of cell which would contain a Y chromosome. (1)

Cells	*Percentage of cells containing a Y chromosome*
Sperm mother cells	
Mature sperm cells	

26. The diagrams show the hormonal control of the testes and ovaries by the pituitary gland.



a. i) What name is given to this type of hormonal control? (1)

   ii) Identify hormones A, B and C. (2)

   iii) State an effect of oestrogen on the pituitary gland, other than that shown above. (1)

   iv) Where in the testes is testosterone produced? (1)

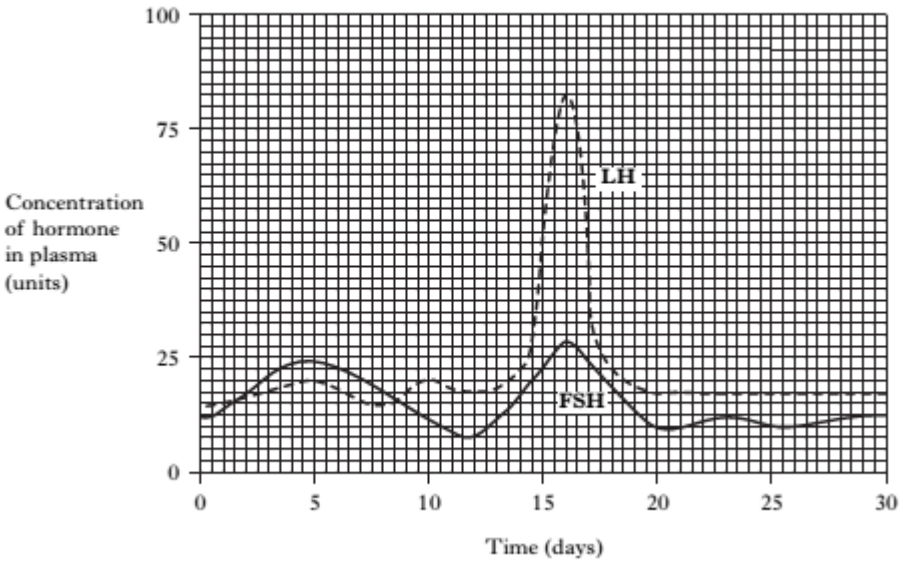
b. The female contraceptive pill rises the levels of ovarian hormones in the blood. Explain why this has a contraceptive effect. (2)

27. The graphs below show the plasma concentration of certain hormones throughout a woman's menstrual cycle.

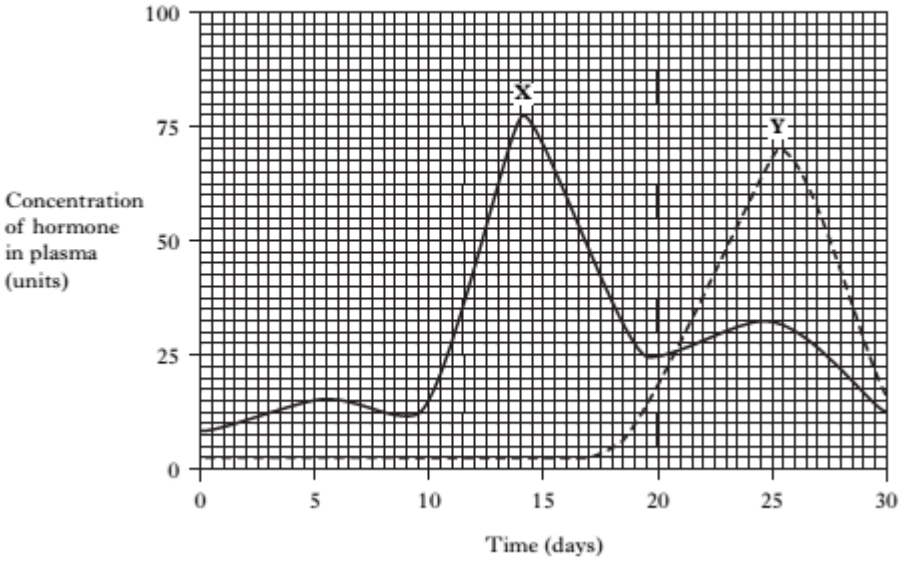
Graph 1 shows the concentration of FSH and LH.

Graph 2 shows the concentration of two other hormones, X and Y.

Graph 1



Graph 2



a. Where in the body are FSH and LH produced? (1)

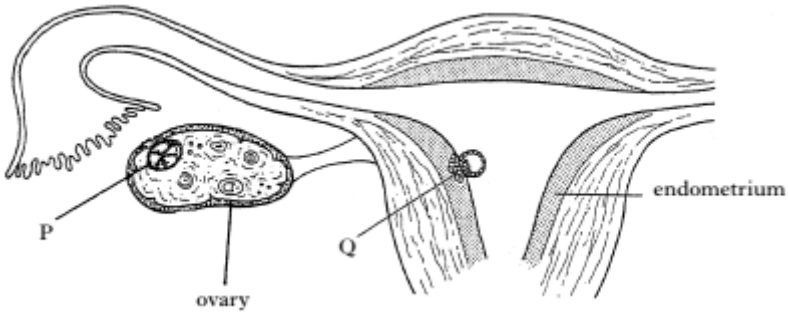
b. Name hormones X and Y. (1)

c. What is the maximum concentration of hormone Y? (1)

d. On which day did ovulation occur? Give a reason for your answer (2)

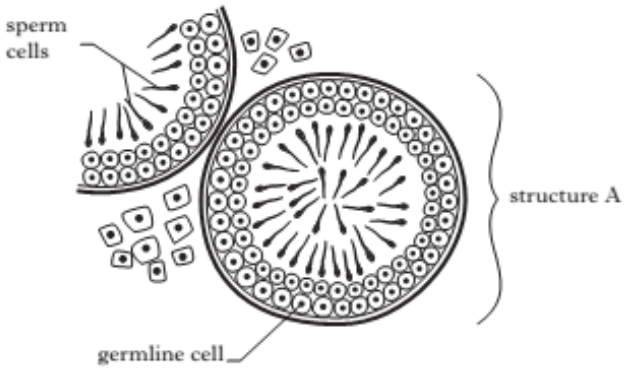
e. During her next cycle, the woman became pregnant.
Describe any differences which would occur in the concentrations of FSH and hormone Y after day 25. (2)

28. The diagram shows part of the reproductive system of a woman in early pregnancy.

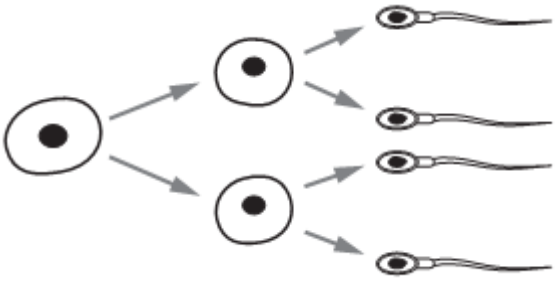


a. Place an X on the diagram to show where fertilisation occurred. (1)
b. Structure P produces progesterone during early pregnancy.
   i) Name structure P. (1)
   ii) State one function of progesterone during early pregnancy. (1)

29. The diagram below represents sperm production in a cross section through part of a testis.



a. i) Name structure A. (1)
   ii) Describe two ways that the pituitary gland stimulates sperm production in structure A. (2)
b. The diagram below shows a germline cell dividing to produce sperm cells.



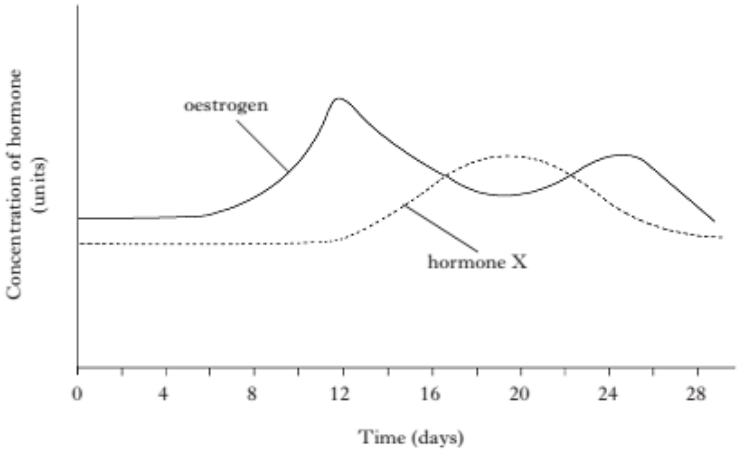
   i. Name this type of cell division. (1)
   ii. State how many of the sperm cells shown in this contain an X chromosome and autosomes? (1)
c. The average sperm count in the developed world has fallen by one third over the last 15 years.
   The present average sperm count is 30 million/cm^3 of semen.
   Calculate the average yearly fall in sperm production over the 15 year period. (1)

d. In fertility clinics, samples of semen are collected to determine if a man is fertile or not.
A man is fertile if his semen contains at least 20 million sperm per cm^3. In addition, 75% of the sperm cells must be active and 30% must be of normal shape.
The table below shows the results of semen analysis from four men.

	Men			
	P	*Q*	*R*	*S*
Number of sperm in sample (millions/cm^3)	25	22	20	23
Percentage of inactive sperm	20	25	15	30
Percentage of misshapen sperm	70	60	65	50

i) State how many of the men are infertile. (1)
ii) Explain how artificial insemination could be used to enable a couple to have a child when the man has a low sperm count. (2)

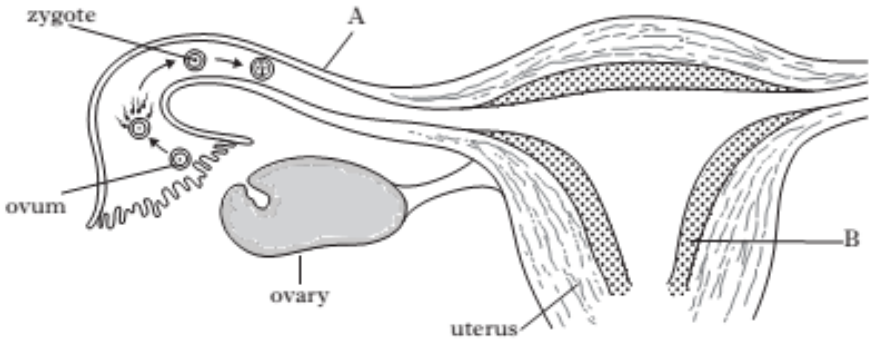
30. The graph below shows the concentration of two ovarian hormones in a woman's blood during her menstrual cycle.



a. Name hormone X. (1)
b. What effect does oestrogen have on the following structures?
i) The uterus between days 4 and 12 in the cycle. (1)
ii) The pituitary gland on day 12 of the cycle. (1)
c. Describe one way in which the graph would be different if the woman became pregnant during this cycle. (1)
d. The diagrams below show sections through two structures found in the ovary at different times in the menstrual cycle.

i) Name the structure P and Q. (1)
ii) What key event in the menstrual cycle occurs before P develops into Q? (1)

31. The diagram below shows the fertilisation of an ovum and its subsequent early development.



a. Name structures A and B. (2)
b. The ovum is released from the Graffian follicle which then becomes the corpus luteum. These structures are affected by pituitary hormones.
Complete the table below to describe the effect of these hormones on the structures. (2)

Structure	*Pituitary hormone*	*Effect on structure*
Graafian follicle	FSH	
Corpus luteum	LH	

c. During its journey down structure A, the zygote undergoes repeated cell divisions.
What name is given to this series of early cell divisions? (1)

32. Describe hormonal control of the menstrual cycle under the following headings;
i) Events leading to ovulation; (6)
ii) Events following ovulation. (4)

Controlling Fertility

33. The following procedures can be used in the treatment of infertility:
1. Artificial insemination
2. Intracytoplasmic sperm injection
3. Pre-implantation genetic screening

Which of these procedures involve in vitro fertilisation (IVF)?

a. 1 and 2
b. 2 and 3
c. 1 and 3
d. 1, 2 and 3

34. Which fertility treatment would be appropriate for a woman with blocked uterine tubes?
    a. Provision of fertility drugs
    b. In vitro fertilisation
    c. Artificial insemination
    d. Calculation of fertile period

35. The morning after pill works by

    a) causing thickening of cervical mucus
    b) preventing release of oestrogen
    c) preventing implantation
    d) Causing menstruation.

36. In fertility clinics, samples of semen are collected for testing.
    The table below shows the analysis of semen samples taken from five men.

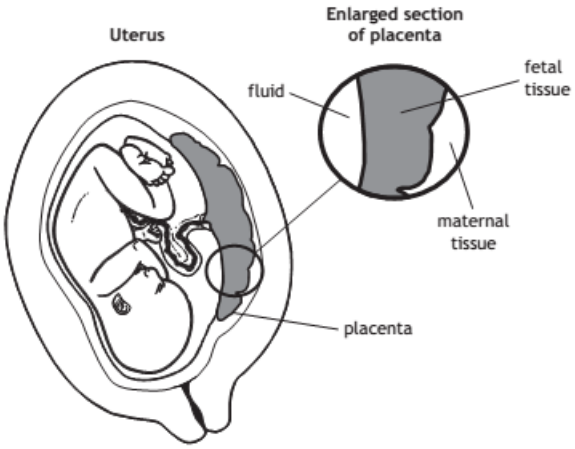
Semen sample	*1*	*2*	*3*	*4*	*5*
Number of sperm in sample (millions/cm^3)	40	19	25	45	90
Active sperm (percent)	65	60	75	10	70
Abnormal sperm (percent)	30	20	90	30	10

    A man is fertile if his semen contains at least 20 million sperm cells/cm^3 and at least 60% of the sperm cells are active and at least 60% of the sperm cells are normal.
    The semen samples that were taken from infertile men are
    a. Samples 3 and 4 only
    b. Samples 2 and 4 only
    c. Samples 2, 3 and 4 only
    d. Samples 1, 2, 4 and 5 only.

37. Which of the following forms of contraception causes thickening of the cervical mucus?

    a) Mini-pill
    b) Barrier methods
    c) Morning-after pill
    d) Intra-uterine device

38. Chorionic villus sampling (CVS) is a technique which can be used during antenatal screening. The cells obtained from CVS are used to prepare a karyotype.
    a. The diagram below shows the uterus of a pregnant woman with a section of the placenta enlarged.



        i) Place a cross (X) on the diagram of the enlarged section of placenta to indicate the area from which cells are removed during CVS. (1)
        ii) Describe the process by which a karyotype is produced from cells removed during CVS. (2)
        iii) Suggest an advantage of using CVS rather than amniocentesis during antenatal screening. (1)
    b. Name the type of antenatal screening tests which are routinely carried out to monitor the concentration of certain substances, such as protein, in a pregnant woman's blood. (1)

39. Discuss the biological basis of contraception. (10)

40. Discuss procedures that can be used to treat infertility. (8)

41. Give an account of the causes and treatment of female infertility. (8)

Ante and Post-natal Screening

42. Phenylketonuria is caused by a single autosomal gene.
    A man and a woman, who are unaffected, have an affected child.
    What is the probability that their next child will be affected?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

43. A 40g serving of breakfast cereal contains 2mg of iron. Only 25% of this iron is absorbed into the bloodstream.
    If a pregnant woman requires a daily uptake of 6mg of iron, how much cereal would she have to eat each day to meet this requirement?
    a. 60g
    b. 120g
    c. 240g
    d. 480g

44. The following are three forms of antenatal screening.
    1. Anomaly scan
    2. Amniocentesis
    3. Chorionic villus sampling

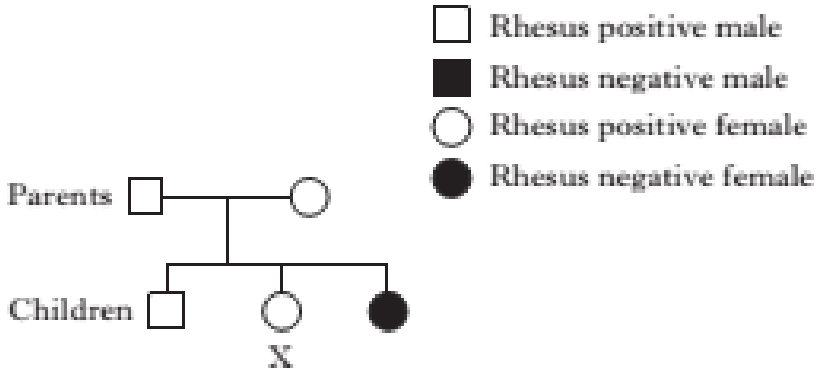
    Which of these involve the production of a karyotype?
    a. 1 only
    b. 2 only
    c. 2 and 3 only
    d. 1,2 and 3

45. The table below shows some genotypes and phenotypes associated with forms of sickly-cell anaemia.

Genotype	*Phenotype*
AA	unaffected
AS	sickle-cell trait
SS	acute sickle-cell anaemia

A woman with sickle-cell trait and an unaffected man have a child together
What are the chances that their child will have acute sickly-cell anaemia?
    a. None
    b. 1 in 1
    c. 1 in 2
    d. 1 in 4

46. The family tree below shows the transmission of the Rhesus D-antigen. The gene for the Rhesus D-antigen is not sex linked.



The parents are expecting a fourth child. What is the chance that this child will be Rhesus negative?

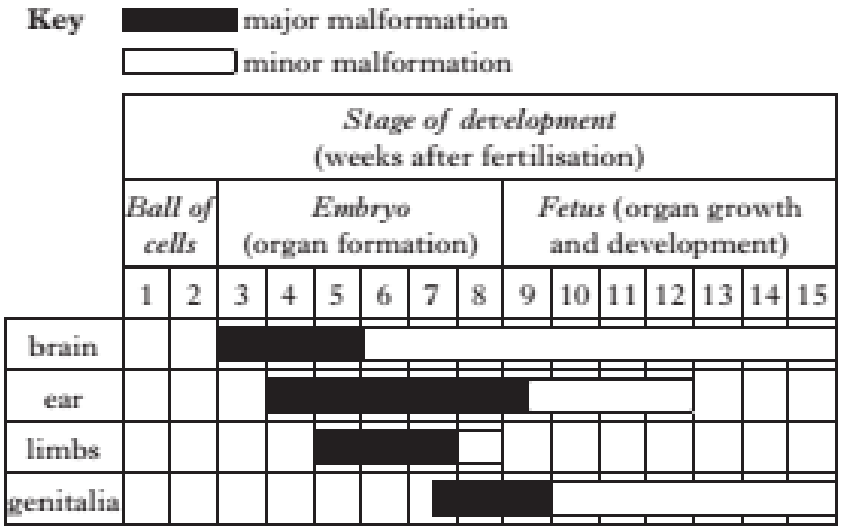
a) 0%
b) 25%
c) 50%
d) 100%

47. Which of the following babies would be most likely to require a blood transfusion immediately after birth?
   a. The first baby of a Rhesus negative mother and Rhesus positive father
   b. The first baby of a Rhesus positive mother and Rhesus negative father
   c. The second baby of a Rhesus negative mother and Rhesus positive father
   d. The second baby of a Rhesus positive mother and Rhesus negative father

48. A child born to parents with different Rhesus factors can be at risk because
   a. Anti-D antibodies from the Rh- mother destroy the baby's red blood cells
   b. Anti-D antibodies from the Rh+ mother destroy the baby's red blood cells
   c. Anti-D antigens from the Rh- mother destroy the baby's red blood cells
   d. Anti-D antigens from the Rh+ mother destroy the baby's red blood cells

49. Nicotine is a chemical which may affect ante-natal development.

The diagram shows the stages of development when major and minor malformations of organs may occur if there is exposure to nicotine.



For how many weeks during pregnancy is there a possibility of major malformations to organs during development?

a) 6
b) 7
c) 9
d) 13

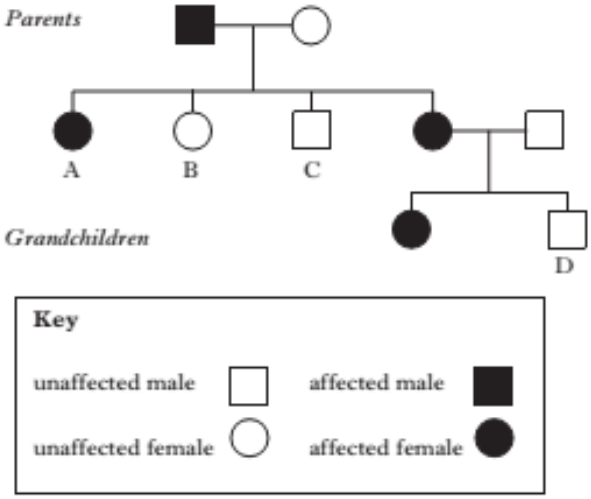
50. Which line in the table below identifies correctly conditions which would increase the risk of the foetus being harmed by the mother's immune system?

	Pregnancy	*Blood type of Mother*	*Blood type of Fetus*
A	First	Rhesus negative	Rhesus positive
B	Second	Rhesus positive	Rhesus negative
C	First	Rhesus positive	Rhesus negative
D	Second	Rhesus negative	Rhesus positive

51. In which of the following situations might a foetus be at risk from Rhesus antibodies produced by the mother?

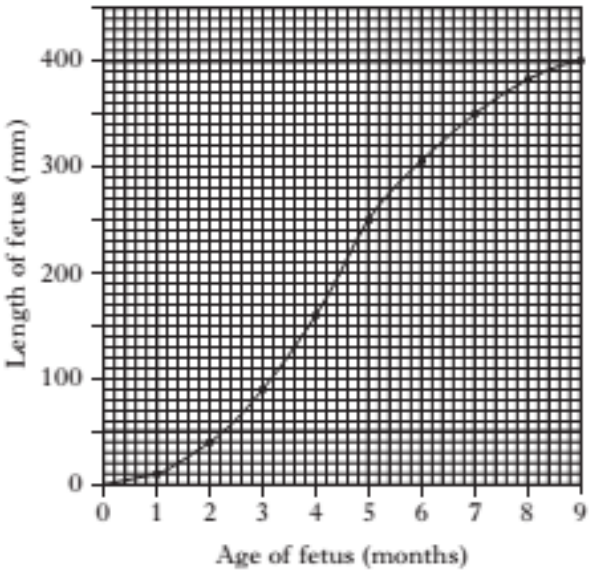
	Father	*Mother*
A	Rhesus positive	Rhesus negative
B	Rhesus positive	Rhesus positive
C	Rhesus negative	Rhesus negative
D	Rhesus negative	Rhesus positive

52. Familial hypercholesterolemia (FH) is caused by an autosomal dominant allele.
The family history below shows the inheritance of FH through three generations.



Which individual confirms that this condition is autosomal? (1)

53. The graph below shows the growth in length of a human foetus before birth.



What is the percentage increase in length of the fetus during the final 4 months of pregnancy? (1)

a) 33·3
b) 60·0
c) 62·5
d) 150·0

54. Cystic fibrosis is a genetic condition caused by an allele which is not sex-linked. A child is born with cystic fibrosis despite neither parent having the condition.

The parents are going to have a second child.

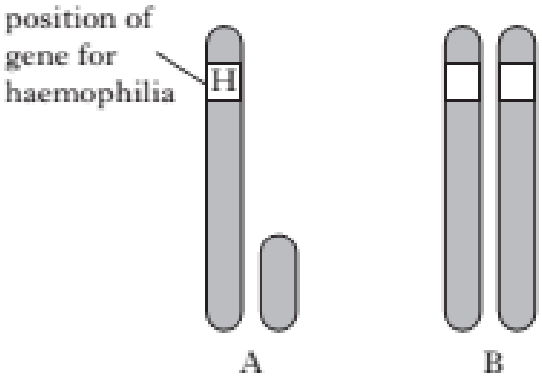
What is the chance this child will have cystic fibrosis?

a) 75%
b) 67%
c) 50%
d) 25%

55. Haemophilia is a sex-linked disorder caused by a recessive allele (h) which results in an individual producing a faulty blood clotting protein.

The diagram below shows the sex chromosomes from two individuals.

a) Individual A is male while individual B is a female carrier of the allele for haemophilia.



i. Complete the diagram by labelling the alleles on the sex chromosomes of individual B. (1)
ii. State the genotypes of individuals A and B. (1)
iii. What is the chance that a daughter produced by this couple will have haemophilia? Explain your answer. (1)

56. Damage to blood vessels sets in motion a series of events which results in the formation of a blood clot. A plasma protein is converted into a meshwork of threads, causing the blood to clot.

Name this plasma protein and describe how it is converted into threads. (2)

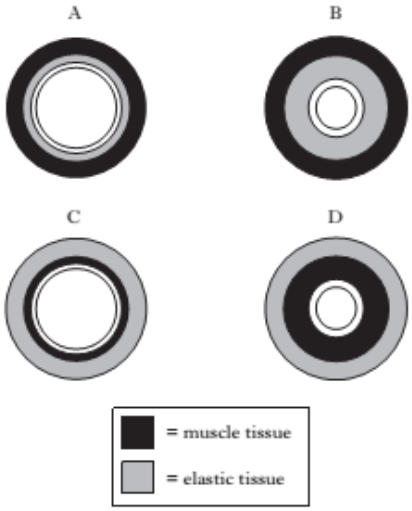
57. Discuss the screening and testing procedures which may be carried out as part of antenatal care. (10)

Arteries, Capillaries and Veins

58. The events leading to formation of a blood clot are listed below.
    1. Clotting factors are released.
    2. An insoluble meshwork forms.
    3. Fibrinogen is converted to fibrin.
    4. Prothrombin is converted to thrombin.

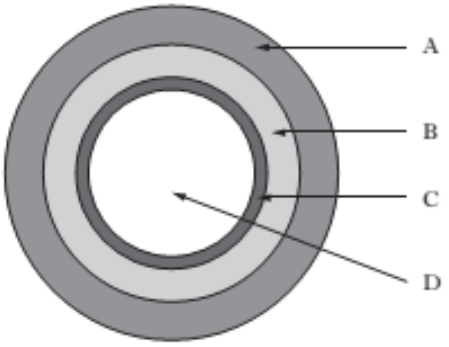
    The correct sequence of these events is
    a. 4, 2, 3, 1
    b. 1, 4, 3, 2
    c. 1, 3, 4, 2
    d. 4, 3, 1, 2

59. Which of these cross sections through a blood vessel represents a vein?



60. Which of the following statements concerning the function of certain blood vessels is correct?
    a. The vena cava carries oxygenated blood from the body to the right atrium.
    b. The pulmonary artery carried deoxygenated blood to the lings from the right ventricle
    c. The pulmonary vein carries oxygenated blood from the lungs to the left ventricle
    d. The aorta carries deoxygenated blood from the body to the left atrium.

61. The diagram below represents a section through an artery.
    Which label correctly identifies a region containing smooth muscle tissue?



62. The diagram below represents part of the plasma membrane of a red blood cell.

The membrane is shown magnified 2 million times.
What is the width of the membrane?
(1 nanometre = 1 x 10^{-6}mm)

a. 0.6 nanometres
b. 6 nanometres
c. 24 nanometres
d. 60 nanometres

63. The diffusion pathway of carbon dioxide within body tissue is

A plasma → tissue fluid → cell cytoplasm

B lymph → tissue fluid → cell cytoplasm

C cell cytoplasm → tissue fluid → plasma

D tissue fluid → lymph → plasma.

64. The table below shows the antigens and antibodies present in the four different blood groups of the ABO system.

Group	Antigen	Antibody
1	B	a
2	None	a and b
3	A and B	None
4	A	b

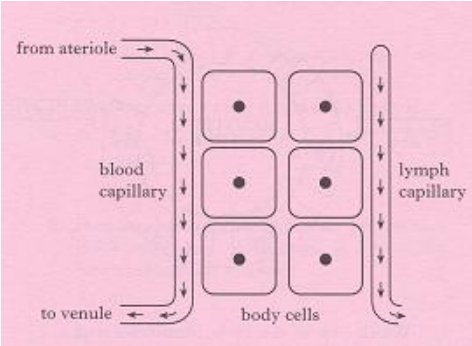
Which of these groups could safely receive a transfusion of blood of group A?

a. 1 and 2
b. 1 and 4
c. 2 and 3
d. 3 and 4

65. A person has blood group AB.
Which entry on the table identifies correctly the antigens and antibodies present?

	Antigens on cells	Antibodies in plasma
A	A and B	Anti-A and anti-B
B	None	Anti-A and anti-B
C	A and B	None
D	none	none

66. The diagram below shows the relationship between blood capillaries, body cells and lymph capillaries.



Which of the following is a correct description of the movement of oxygen to and from the body cells?

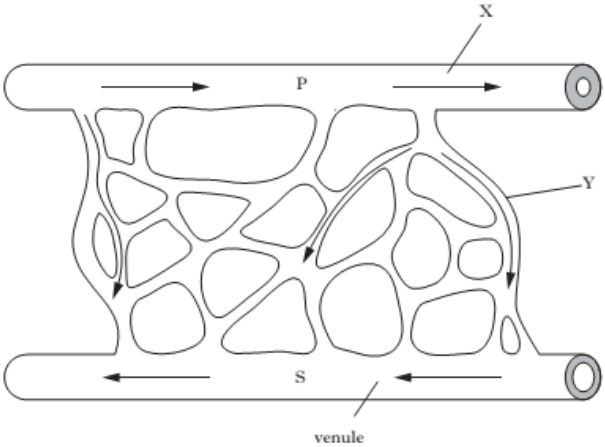
a. From body cells to blood and lymph capillaries
b. From blood capillaries to body cells
c. From lymph capillaries to body cells
d. From blood and lymph capillaries to body cells.

67. Which of the following is not a function of the lymphatic system?
a. It returns excess tissue fluid to the blood.
b. It causes the clotting of blood at wounds.
c. It destroys bacteria.
d. It transports fat from the small intestine.

68. Which of the following is not a function of the lymphatic system?
a. Production of tissue fluid
b. Absorption of products from fat digestion
c. Removal of bacteria
d. Production of lymphocytes

69. The main blood vessel supplying the heart muscle itself with oxygenated blood is the
a. Coronary vein
b. Coronary artery
c. Pulmonary artery
d. Pulmonary vein.

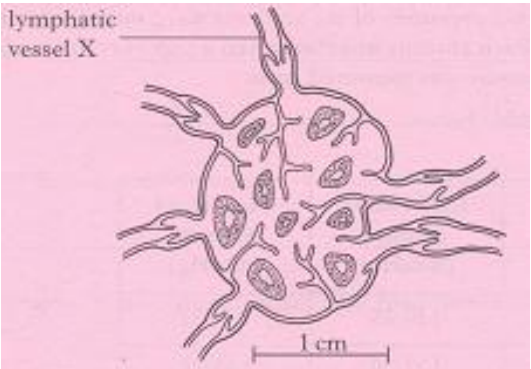
70. The diagram below shows some blood vessels within muscle tissue of an athlete.
The direction of blood flow is indicated by the arrows.



a) Name the type of blood vessels labelled X and Y. (1)
b) Name two substances which are at a higher concentration in the blood at point P than at point S. (1)
c) The athlete ran on a treadmill at high speed for ten minutes.
Explain why the concentration of lactic acid in his blood increased during this time. (1)

d) Tissue fluid surrounds the muscle cells. Some of this fluid is reabsorbed into the bloodstream.
How else is tissue fluid removed from around the muscle cells? (1)

71. The diagram below shows a section through a lymph node.

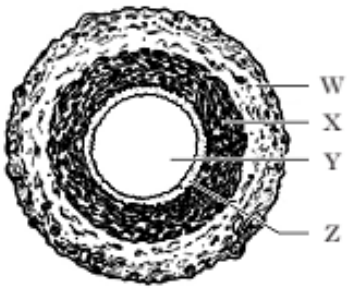


a. Copy and complete the table to name the cells found in the node, and to describe their functions. (3)

Type of cell	Secretion of antibodies (yes/no)	Type of response
B-lymphocytes		
	No	Cell-mediated response
		Non-specific response

b. Copy and add an arrow to the diagram to indicate the direction of flow of lymph in vessel X. Give a reason for your choice. (1)
c. Describe one way in which the composition of lymph differs from plasma. (1)
d. What eventually happens to the lymph after it leaves the gland? (1)
e. Describe one function of the lymphatic system, apart from protecting the body from infection. (1)

72. a) The diagram shows a section through an artery.



i. Name the parts of the artery labelled Y and Z. (1)

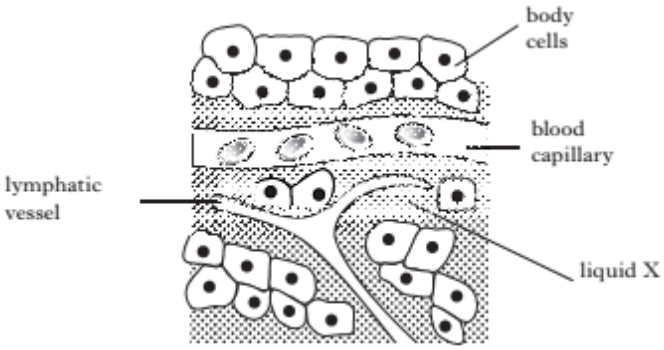
ii. Layer X contains elastic fibres.
Name one other type of tissue found in layer X. (1)

iii. Describe the role of the elastic fibres in the wall of an artery. (1)

b) Veins are another type of blood vessel.
Name a structural feature of a vein and describe its function. (1)

c) Name the two blood vessels which carry blood away from the heart. (1)

73. The diagram below shows the relationship between a blood capillary, body cells and a lymphatic vessel.



a. i) Name liquid X. (1)
ii) State one way in which the composition of this liquid is different from blood plasma. (1)

b. Complete the table below by naming one substance, apart from carbon dioxide and water, which is passed from the cells in each of the following tissues into blood capillaries. (2)

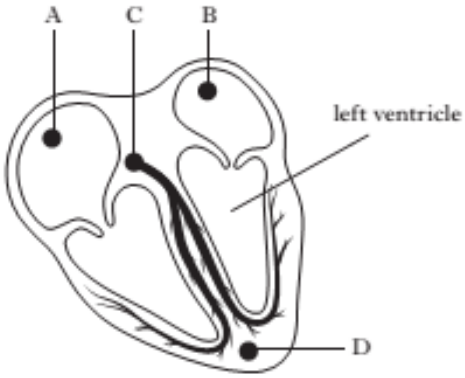
Tissue	*Substance*
Interstitial cells	
Pancreas	
Leg muscle (after a sprint)	

c. Explain how lymph is transported in lymphatic vessels. (2)

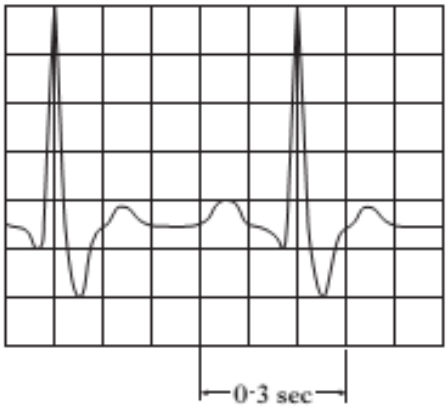
74. Discuss the exchange of substances between plasma and body cells. (10)

Structure and Function of the Heart

75. The diagram below shows a section through the human heart.
    Where us the sinoatrial node (SAN) located?



76. The diagram below shows an ECG trace taken during exercise.

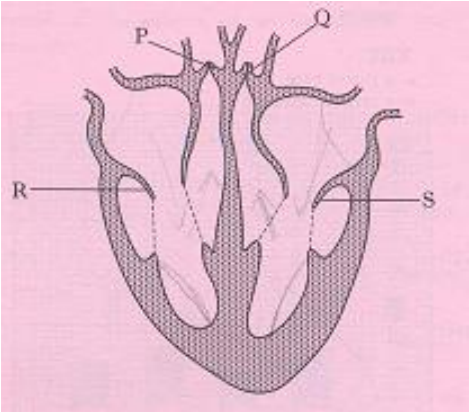


The person's heart rate is

a. 80 bpm
b. 100 bpm
c. 120 bpm
d. 140 bpm

77. The diagram below shows a section through the human heart.
    What is the correct position of the pacemaker?

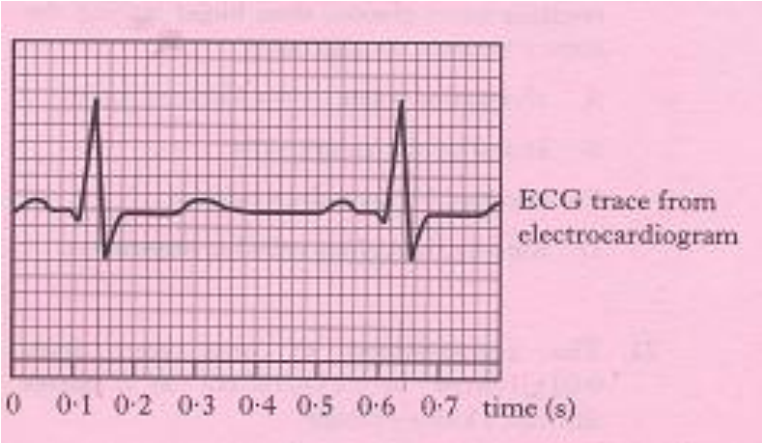
78. The diagram shows a cross section of the heart.



Which of the following describes correctly the movement of the valves during ventricular systole?

a. Valves P and Q open and valves R and S close
b. Valves P and R open and valves Q and S close
c. Valves P and Q close and valves R and S open
d. Valves P and R close and valves Q and S open

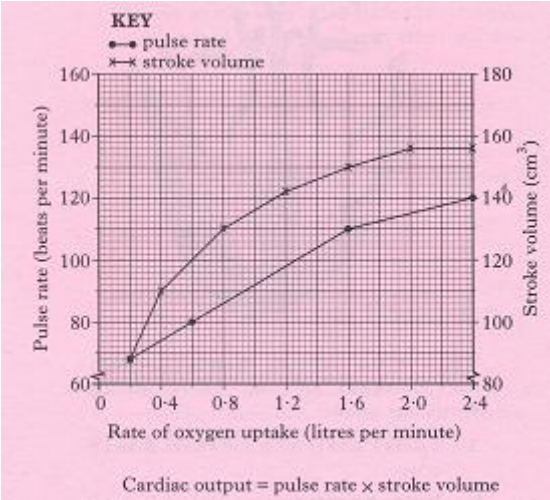
79. The trace below was obtained from a patient who was having the electrical activity of his heart monitored.



What was the heart rate of this patient?

a. 42 beats per minute
b. 72 beats per minute
c. 86 beats per minute
d. 120 beats per minute

80. The graph below shows how pulse rate and stroke volume change with the rate of oxygen uptake.



What is the cardiac output when the oxygen uptake is 1.6 litres per minute?

a. 13.1 litres per minute
b. 14.3 litres per minute
c. 16.5 litres per minute
d. 16.9 litres per minute

81. Which line in the table below describes correctly the state of the heart valves during ventricular systole? (1)

	Atrio-ventricular	Semi-lunar
A	open	open
B	closed	closed
C	open	closed
D	closed	open

82. Cardiac output is calculated using the following formula:

Cardiac output = Heart Rate x Stroke volume

The table below shows the heart rate and cardiac output of four individuals.

Individual	*Heart Rate* (bpm)	*Cardiac Output* (L/min)
A	60	5·8
B	68	6·1
C	72	7·2
D	78	7·6

Which individual has the greatest stroke volume?

83. During a competition, a trained athlete can increase his cardiac output by 7 times.
If an athlete has a resting heart rate of 60 beats/min and a resting stroke volume of 70 cm3/beat, his maximum cardiac output is

a) 8·2 cm3/min
b) 4200 cm3/min
c) 29 400 cm3/min
d) 36 000 cm3/min.

84. Which line in the table below identifies correctly an effect of the autonomic nervous system (ANS) on the sinoatrial node (SAN) in the heart?

	Branch of ANS	*Chemical released*	*Rate of impulse generation by SAN*
A	sympathetic	acetylcholine	increases
B	sympathetic	noradrenaline	decreases
C	parasympathetic	acetylcholine	decreases
D	parasympathetic	noradrenaline	increases

85. Mean arterial pressure (MAP) is a measure of blood pressure in the arteries.
Pulse pressure is the difference between systolic and diastolic blood pressure.

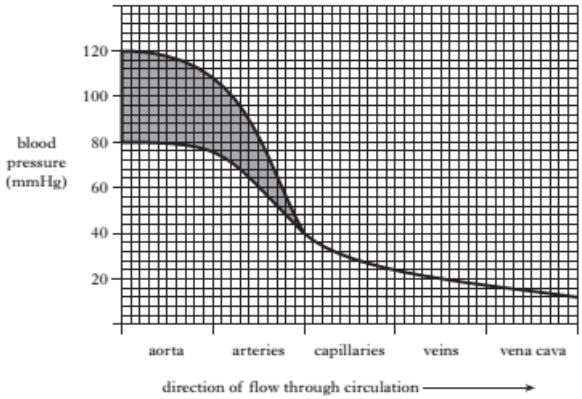
MAP is calculated using the following formula:

MAP = diastolic pressure + (pulse pressure/3)

Using this formula, the MAP of an individual with a blood pressure reading of 122/80 mmHg is

a) 42 mmHg
b) 56 mmHg
c) 94 mmHg
d) 136 mmHg.

86. The difference between systolic and diastolic blood pressure is often referred to as pulse pressure. The graph shows the changes in blood pressure as blood flows through the circulatory system of an individual.



The maximum pulse pressure shown in the graph is

a. 40 mmHg
b. 80 mmHg
c. 100 mmHg
d. 120 mmHg

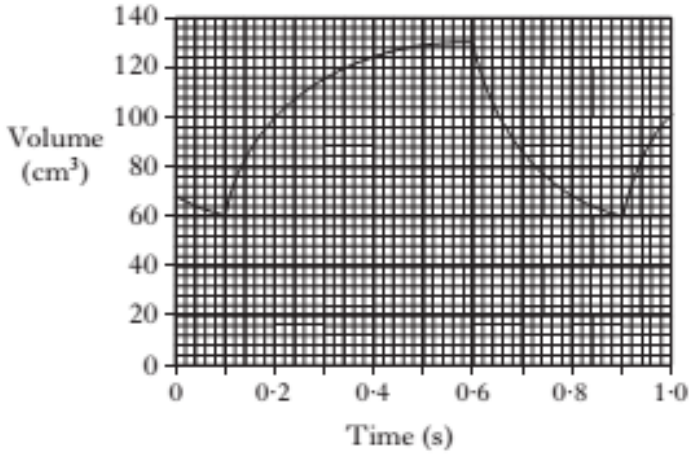
87. The duration of the stages in an individual's cardiac cycle are shown in the table below. (1)

Stage	Duration (s)
Diastole	0.4
Atrial systole	0.1
Ventricular systole	0.3

What is the heart rate of this individual?

a) 48 beats per minute
b) 75 beats per minute
c) 80 beats per minute
d) 150 beats per minute

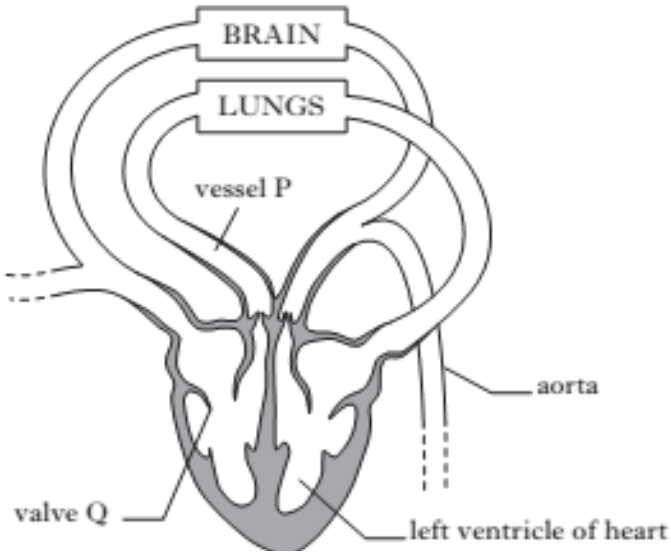
88. The graph below shows changes in the volume of blood in the left ventricle of a man's heart.



a) How long does ventricular systole last? (1)
b) (i) What is the heart rate of this man (in beats per minute)? (1)
(ii) Calculate the volume of blood leaving this man's left ventricle every minute. (1)

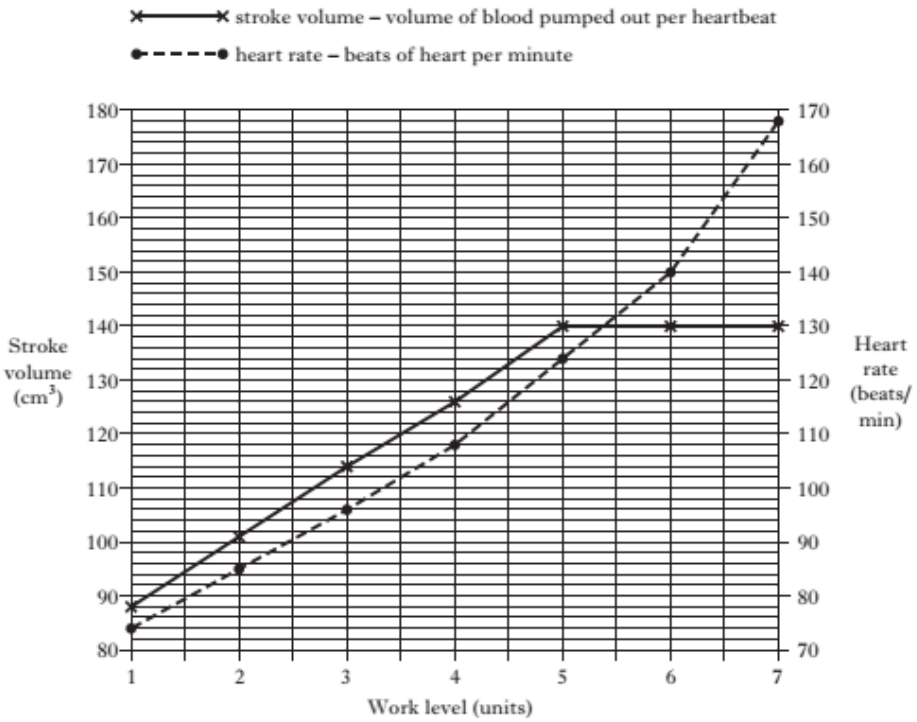
c) When this man exercises, the volume of blood leaving his heart increases significantly. Describe how the nervous system and hormones cause this increase. (3)

89. The diagram below represents part of the human circulatory system.



a. State whether blood vessel P is the pulmonary artery or the pulmonary vein. Give a reason for your answer. (1)
b. Describe one difference in the structure of arteries and veins. (1)
c. Explain why the carbon dioxide concentration of the blood increases as it flows through the brain. (1)
d. Name valve Q and describe its function within the heart. (1)

90. The heart rate and stroke volume of a 40 year old cyclist were monitored as he used an exercise bike.
The cyclist was told to pedal at a constant rate as his work level was gradually raised by increasing the resistance to pedalling.
The graph below shows the changes that occurred in the cyclist's heart rate and stroke volume at seven different work levels.



a. Use data from the graph to describe the changes that occurred in the cyclist's stroke volume when the work level increased from 1 to 7 units. (2)

b. State what the cyclist's heart rate was when his stroke volume was 120cm^3. (1)

c. Cardiac output is the volume of blood leaving the heart in one minute. It is calculated using the formula shown below.

Cardiac output = heart rate x stroke volume

Calculate the cyclist's cardiac output when his work level was 6 units. (1)

d. The table below shows the recommended minimum heart rates that cyclists of different ages should maintain in order to either metabolise fat or improve their fitness.

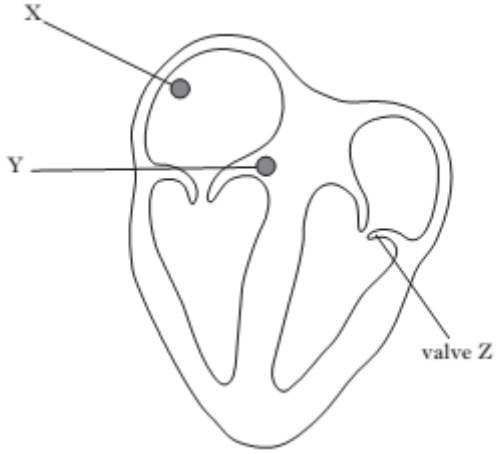
Age	*Minimum heart rate for metabolising fat* (beats/min)	*Minimum heart rate for improving fitness* (beats/min)
10	136	168
20	130	160
30	123	152
40	116	144
50	110	136
60	104	128

i) Use information from the table and the graoh to determine the work level that the cyclist should maintain in order to metabolise fat. (1)

ii) Use information from the table to predict the minimum heart rate for improving the fitness of a 70 year old. (1)

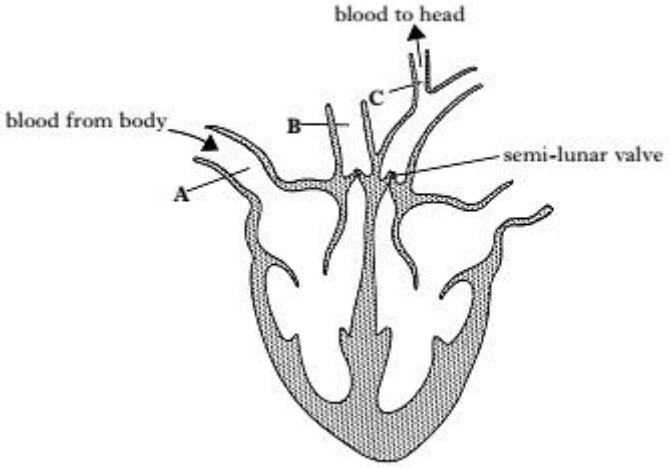
iii) As an individual gets older, their minimum heart rate for improving fitness decreases.
Use the information from the table to calculate the percentage decrease that occurs between the ages of 10 and 60 years. (1)

91. The diagram shows a section through the heart and two areas X and Y, which help to coordinate the heartbeat.



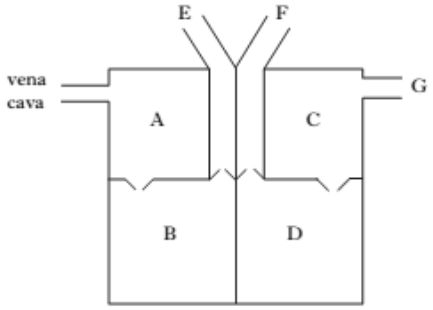
a. i) Name structure X and Y. (1)
   ii) Electrical impulses travel from X to Y.
   What is happening to the heart during this time? (1)
   iii) Draw arrows on the diagram to show the pathway taken by electrical impulses produced by structure Y. (1)
b. i) Name valve Z. (1)
   ii) During which stage of the cardiac cycle is valve Z closed? (1)

92. The diagram below shows the human heart and some associated blood vessels. The arrows on the diagram show the direction of blood flow.



a. Name blood vessels A,B and C. (2)
b. Copy and place arrows on the diagram to show the oath of oxygenated blood as it flows through the heart. (1)
c. Describe the function of the semi-lunar valve labelled on the diagram. (1)
d. During which stage of the cardiac cycle do the semi-lunar valves open? (1)

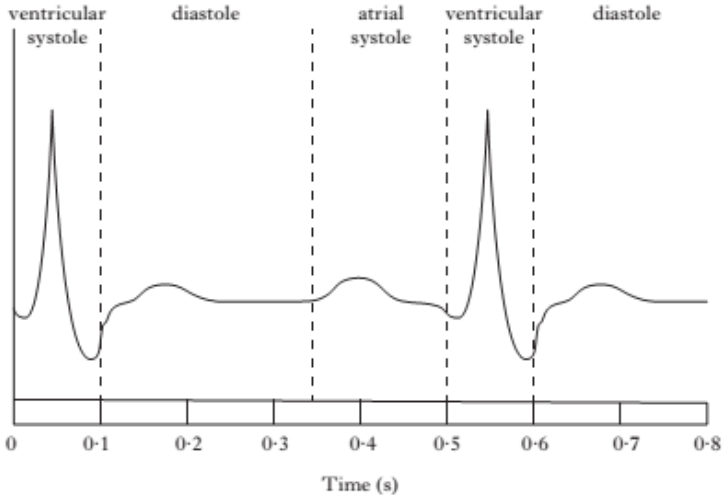
93. The diagram represents a section through the heart.



a. i) Name blood vessels E and F. (1)
ii) State two differences between the composition of the blood in chambers B and D. (1)
iii) Place a cross (X) on the diagram to indicate the position of the sinoatrial nod (SAN). (1)
iv) Describe the effect of the autonomic nervous system in the sinoatrial node (SAN). (2)

b. State the function of the coronary artery. (1)

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



a. Calculate the heart rate of this individual. (1)

b. Complete the following sentence by underlining on option from each pair of options shown in bold.

During the diastole stage of the cardiac cycle, the atrial muscles are **contracted/relaxed** and the ventricular muscles are **contracted/relaxed**. (1)

c. Name the valves which will be open and closed in the left side of the heart during ventricular systole. (1)

d. Predict how this individual's ECG trace would change under the influence of the parasympathetic nervous system. (1)

95. Describe the cardiac cycle under the following headings:

i) Nervous and hormonal control of heart beat (4)

ii) The conducting system of the heart. (6)

CVD

96. The ratio of high-density lipoproteins to low-density lipoproteins in the blood (HDL: LDL) is related to the level of cholesterol in the blood. This in turn can influence the chance of developing atherosclerosis.
Which line in the table below correctly illustrates these relationships?

	HDL:LDL	*Cholesterol level*	*Chance of atherosclerosis*
A	High	Low	Reduced
B	High	High	Increased
C	Low	Low	Increased
D	Low	High	Reduced

97. Statins are drugs which are used to control blood

a) pressure
b) insulin level
c) glucose level
d) cholesterol level.

98. During a competition, a trained athlete can increase his cardiac output by 7 times.
If an athlete has a resting heart rate of 60 beats/min and a resting stroke volume of 70 cm3/beat, his maximum cardiac output is

a) 8·2 cm3/min
b) 4200 cm3/min
c) 29 400 cm3/min
d) 36 000 cm3/min.

99. Which of the following statements about lipoprotein is correct?

a) LDL transports cholesterol from body cells to the heart.
b) LDL transports cholesterol from body cells to the liver.
c) HDL transports cholesterol from body cells to the heart.
d) HDL transports cholesterol from body cells to the liver.

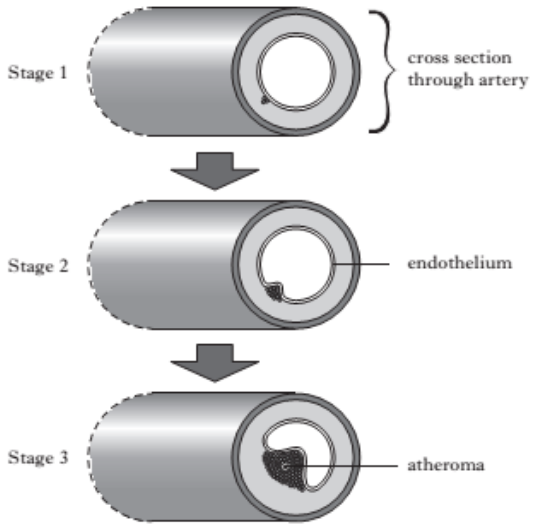
100. Which of the following statements describes correctly the role of lipoprotein in the transport and elimination of excess cholesterol?

a. Low density lipoprotein transport excess cholesterol from the liver to the body cells.
b. Low density lipoproteins transports excess cholesterol from the body cells to the liver.
c. High density lipoprotein transports excess cholesterol from the liver to the body cells.
d. High density lipoprotein transports excess cholesterol from the body cells to the liver.

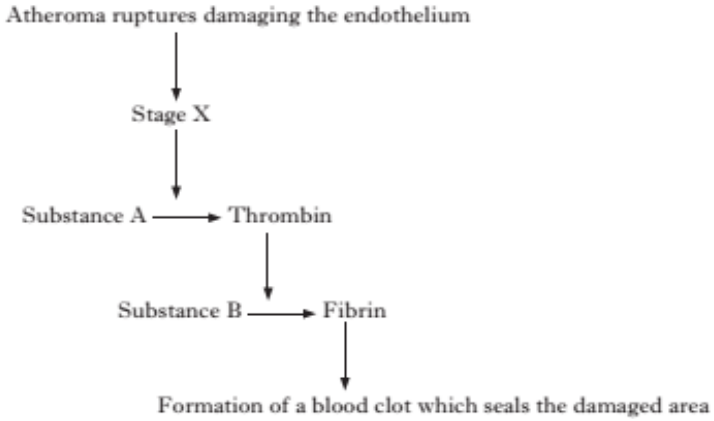
101. Which of the following statements about Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) is correct?

A. LDL deposits cholesterol in the arteries.
B. LDL transports cholesterol to the liver.
C. HDL transports cholesterol to body cells.
D. HDL releases cholesterol in the body cells.

102. The diagram below shows three stages in the formation of an atheroma in an artery.



a. Name one substance which may accumulate in an artery resulting in the formation of an atheroma. (1)
b. Suggest why the blood pressure in an artery at Stage 3 is likely to be raised. (1)
c. If an atheroma ruptures there is a high risk of blood clot formation. The flow diagram below shows the cascade of reactions involved in the formation of a blood clot in an artery.



i) Describe what happens during Stage X. (1)
ii) Name substances A and B. (1)

d. A blood clot can break away from its site of formation and enter the general circulation.
   i) Name this type of blood clot. (1)
   ii) Describe how the movement of a blood clot can lead to a heart attack. (2)

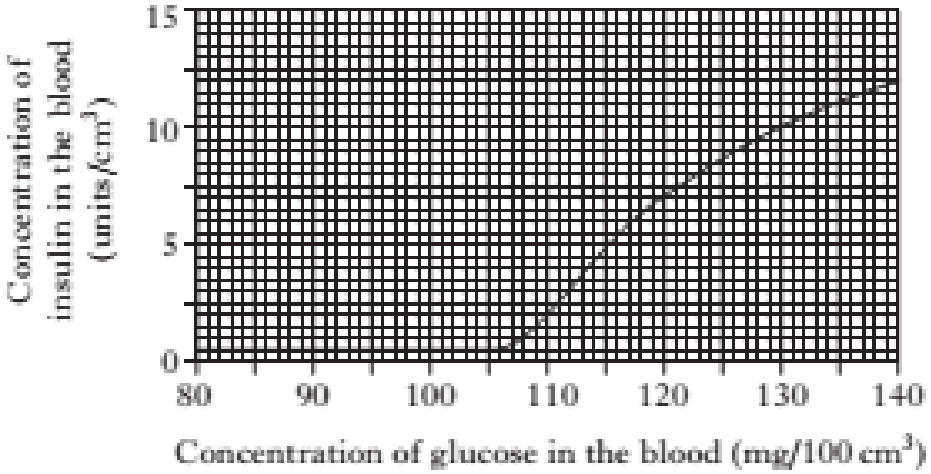
103. Describe the cardiac cycle under the following headings:

iii. The conducting system of the heart; (5)

iv. Nervous control of the cardiac cycle. (5)

Obesity and Glucose Control

104. The graph below shows how the concentration of insulin in the blood is affected by changes in the concentration of glucose in the blood.



What total mass of glucose would be present in an individual with 5 litres of blood and an insulin concentration of 5 units/cm^3?

a. 115mg
b. 575mg
c. 1150mg
d. 5750mg

105. Which of the following statements about diabetes is correct?

a. Type 2 diabetes typically develops in overweight individuals during childhood
b. Type 1 diabetes usually develops in childhood and can be treated by dietary management.
c. Individuals with Type 1 diabetes are unable to produce insulin and have no insulin receptors within their liver.
d. Individuals with Type 2 diabetes are typically overweight and have liver cells which are less sensitive to insulin.

106. The table below contains information about four individuals who lost weight by reducing their daily energy intake through dieting
A reduction in energy intake of 30MJ results in a loss of 1kg.

Individual	*Starting weight* (kg)	*Target weight achieved* (kg)	*Daily energy reduction during diet* (MJ/day)
A	84	78	2
B	90	81	3
C	95	85	4
D	105	90	5

Which individual was first to reach their target weight?

107. By calculating body mass index (BMI), it can be determined whether a person is clinically obese.
The table below contains information about four individuals.

Individual	*Height* (m)	*Mass* (kg)
1	1·60	90
2	2·10	130
3	1·80	100
4	1·30	56

Which of these individuals would be classifies as obese?

a. 2 only
b. 2 and 3
c. 1, 3 and 4
d. All of them

108. Chronic elevation of blood glucose levels is not responsible for which of the following conditions?

a. Renal failure
b. Retinal damage
c. Phenylketonuria
d. Peripheral nerve dysfunction.

109. Which of the following describe correctly typical features of Type 1 diabetes?

	Feature of Type 1 diabetes	
A	occurs in childhood	cells unable to produce insulin
B	develops later in life	cells unable to produce insulin
C	occurs in childhood	cells less sensitive to insulin
D	develops later in life	cells less sensitive to insulin

110. The flow chart below shows how the concentration of glucose in the blood is regulated.

Blood glucose concentration rises → Pancreas secretes less of compound X and more of compound Y → Liver converts glucose to insoluble carbohydrate → Blood glucose concentration falls

Which line identifies correctly the compounds X and Y?

	Compound X	*Compound Y*
A	Glycogen	Insulin
B	Insulin	Glycogen
C	Glucagon	Insulin
D	Insulin	Glucagon

111. Which line of the table identifies correctly the hormones which stimulate the interconversion of glucose to glycogen?

	Glucose to glycogen	Glycogen to glucose
A	Insulin	Glucagon and adrenaline
B	Glucagon and insulin	Adrenaline
C	Adrenaline and glucagon	Insulin
D	Adrenaline	Glucagon and insulin

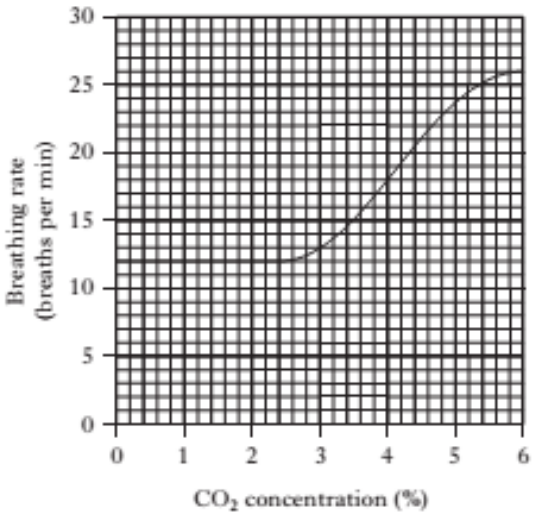
112. Which of the following shows the correct responses to changes in blood sugar concentration?

	Sugar concentration in blood	*Glucagon secretion*	*Insulin secretion*	*Glycogen stored in liver*
A	Increases	Decreases	Increases	Increases
B	Increases	Decreases	Increases	Decreases
C	Decreases	Increases	Decreases	Increases
D	Decreases	Decreases	Increases	Decreases

113. Which line in the table below identifies correctly the effects of Type 1 and Type 2 diabetes?

	Type 1 diabetes	*Type 2 diabetes*
A	develops mainly in children	develops mainly in adults
B	cells become insensitive to insulin	cells remain sensitive to insulin
C	no glucose lost in urine	some glucose lost in urine
D	reduced insulin production	no insulin production

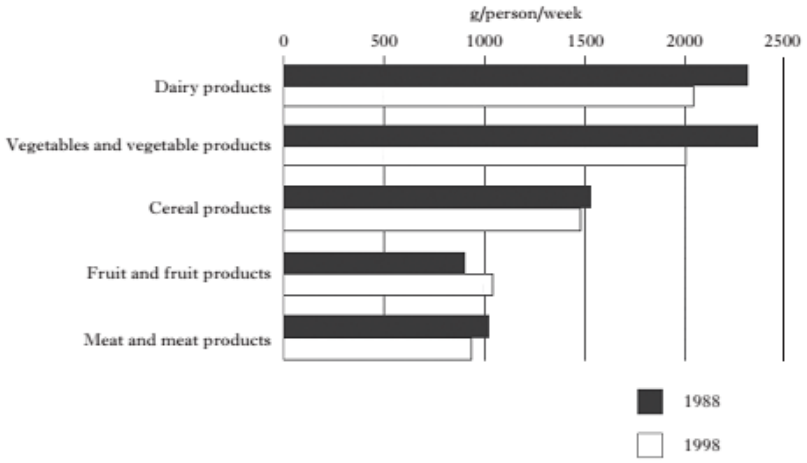
114. The graph below shows the effect of the carbon dioxide concentration of inhaled air on the breathing rate of an individual.



If the volume of one breath is 0·5 litre, what volume of air will be breathed in one minute when the CO2 concentration is 4%?

a) 6 litres
b) 9 litres
c) 18 litres
d) 36 litres

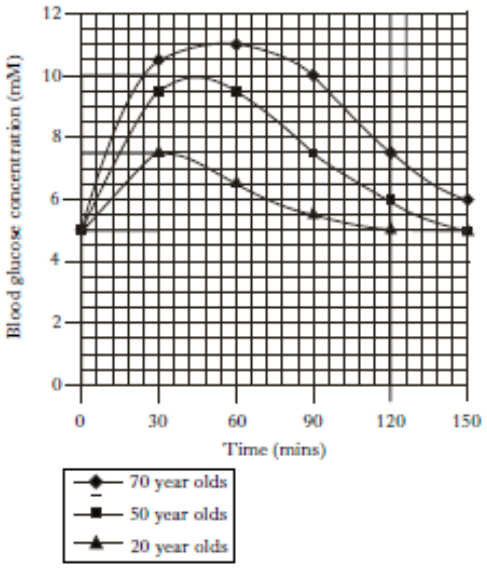
115. The graph below shows how the UK diet changed between 1988 and 1998.



Which of the following conclusions can be drawn from the data?

a) People ate more food in 1998 than in 1988.
b) People ate less food in 1998 than in 1988.
c) People ate a greater variety of food in 1998 than in 1988.
d) People ate a lesser variety of food in 1998 than in 1988.

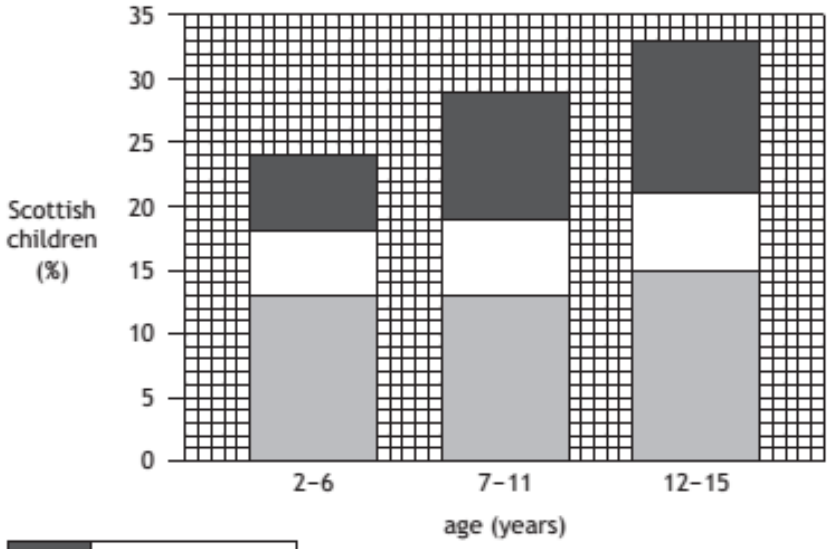
116. High levels of blood glucose can cause clouding of the lens in the human eye. Concentrations above 5·5 mm are believed to put the individual at a high risk of lens damage.
In an investigation, subjects of different ages each drank a glucose solution. The concentration of glucose in their blood was then monitored over a number of hours. The results are shown in the graph below.



For how long during the investigation did 20 year olds remain above the high risk blood glucose concentration?

a) 84 mins
b) 90 mins
c) 120 mins
d) 148 mins

117. The graph below contains information about the body mass index (BMI) of Scottish children in 2009.



	MORBIDLY OBESE BMI above 35
	OBESE BMI 30 to 34·9
	OVERWEIGHT BMI 25 to 29·9

a. State the percentage of children aged 12 to 15 who had a BMI of more than 30 in 2009. (1)

b. Suggest reasons why the percentage of obese children increased between the ages of 2 and 15. (1)

c. Explain how BMI is calculated. (1)

d. Suggest how children could be encouraged to maintain a healthy BMI by use of the following procedures. (2)

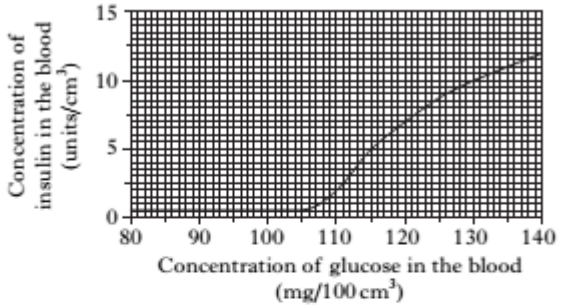
i. Identification

ii. Internalisation

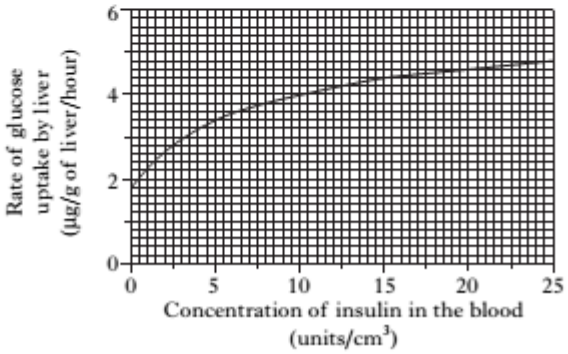
118. The graphs below contain information about the regulation of blood sugar.

Graph 1 shows how the concentration of glucose in the blood affects the concentration of insulin.
Graph 2 shows how the concentration of insulin in the blood affects the rate of glucose uptake by the liver.

Graph 1



Graph 2



a. i) From Graph 1, state the glucose concentration which triggers an increase in insulin production. (1)
   ii) Name the organ which produces insulin. (1)
b. From graph 2, calculate the percentage increase in the rate of glucose uptake by the liver when the concentration of insulin in the blood rises from 10 to 15units/cm^3. (1)
c. From Graphs 1 and 2, state the rate of glucose uptake by the liver when the concentration of glucose in the blood is 130mg/100cm^3. (1)

119. The table below contains information about diagnosed cases of diabetes in the four countries of the UK in 2008.

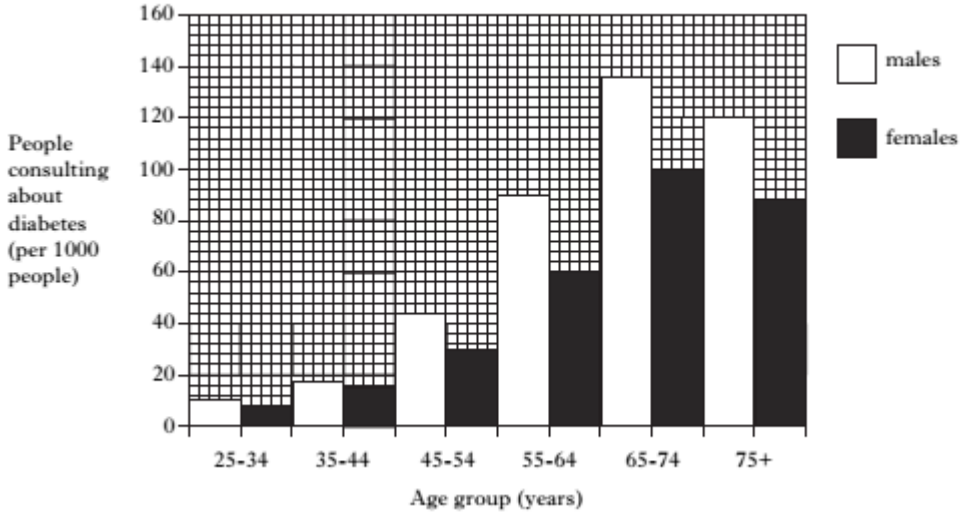
Country	*Population* (million)	*Individuals diagnosed with diabetes* (% of population)
England	51·3	3·9
Scotland	5·4	3·7
Wales	3·2	4·4
Northern Ireland	1·8	3·4
Total	61·7	

a. Use the data in the table to calculate the number of individual in the Scottish population who had diabetes in 2008. (1)

b. A student calculated the percentage of the UK population that had been diagnosed with diabetes by averaging the percentage valves in the table. Suggest why this average is likely to misrepresent the true percentage of people in the UK who have been diagnosed with diabetes. (1)

c. It has been suggested that the number of people in the UK with diabetes will double by the year 2030.
Suggest two different ways in which the current government might use this information tom plan for the future. (1)

d. The graph below contains information about the number of people in Scotland who consulted their doctor about diabetes in 2008.



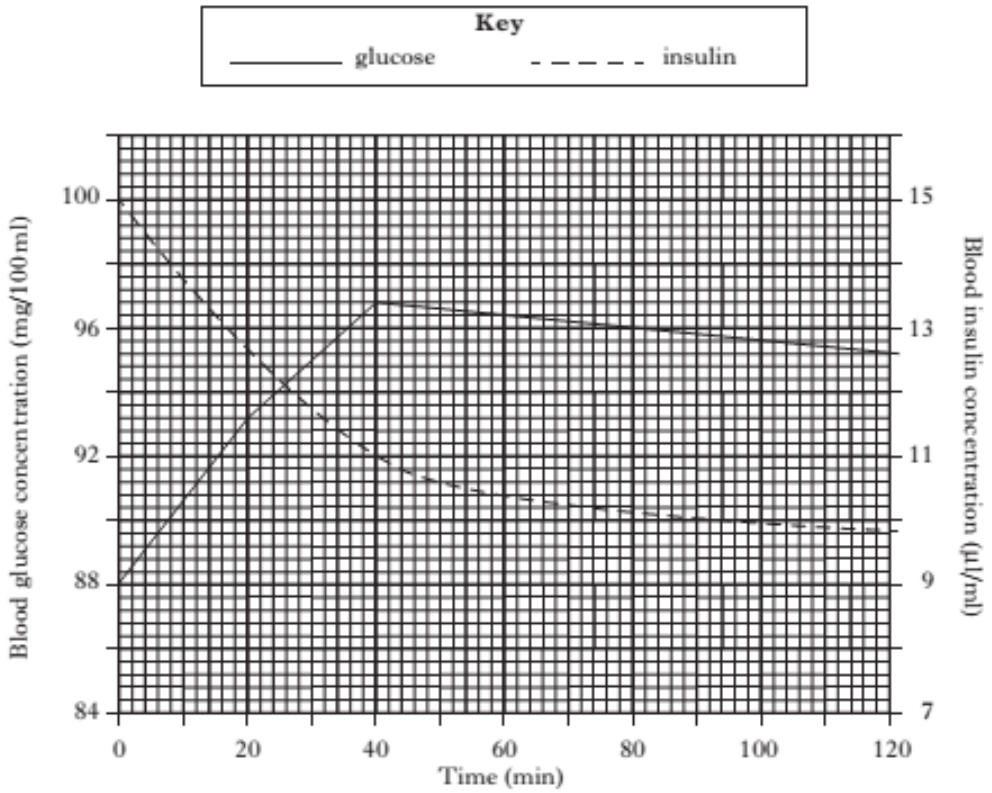
i. For people ages between 25 and 74 describe one trend shown by the graph which related to age and gender. (1)

ii. In a Scottish city 2500 men between 45 and 54 years of age visited their doctor in 2008.
Use the graph to calculate how many of these men would be consulting their doctor about diabetes. (1)

iii. Calculate the percentage decrease in the number of men consulting their doctor between the 65-74 age group and the 75+ age group. (1)

e. i) Type 1 diabetics are unable to produce enough insulin.
Where is insulin produced in the body? (1)
ii) Describe the role of insulin in the liver. (1)

120. The graph below shows the changes in the concentration of glucose and insulin in a cyclist's blood while he cycled at a constant rate for two hours.

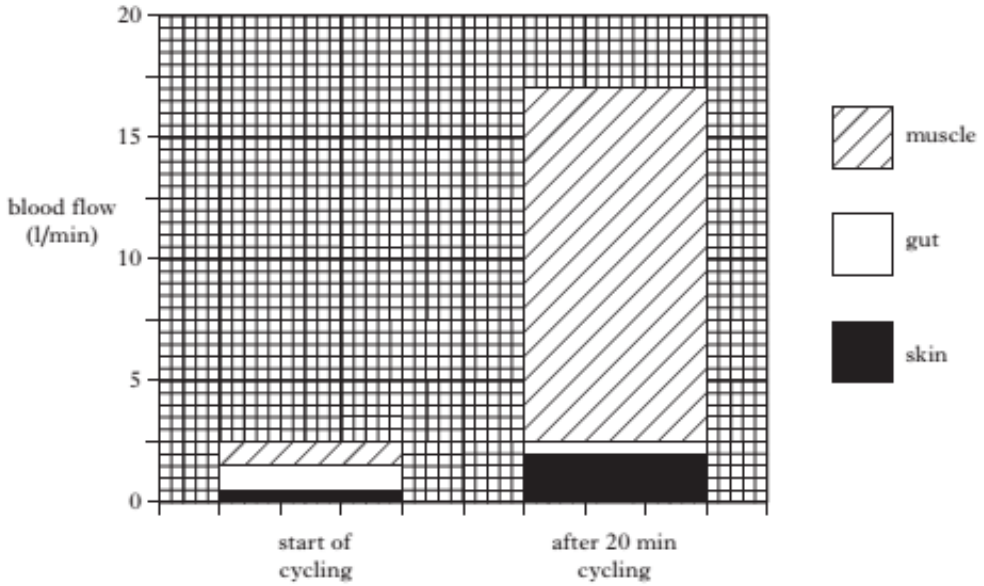


a. i) State the cyclist's blood insulin concentration after he had been cycling for 10 minutes. (1)

ii) State the cyclist's blood glucose concentration when his blood insulin concentration was 11µl/ml. (1)

b. During exercise, adrenaline is released which inhibits the production of insulin. Explain why this is important to the cyclist. (2)

c. The graph below shows the changes that occurred in the distribution of blood to some parts of the cyclist's body after he had been cycling for 20 minutes.



i) Calculate the percentage increase that occurred in blood flow to his skin after he had been cycling for 20 minutes. (1)

ii) Calculate the whole number ratio of muscle to gut blood flow after 20 minutes of cycling. (1)

iii) Describe how changes in the volume and distribution of blood to the muscles occur during cycling. (2)

121. Rising levels of obesity are a major concern in modern Scottish society. Successive governments have tried to promote healthy eating and exercise in an attempt to address this problem.

a. i)One measure of obesity is the body mass index (BMI).
What measurements are taken to calculate BMI? (1)
ii)What is the minimum value of BMI that is generally used to indicate that an individual is obese? (1)

b. Why should the dietary intake of carbohydrate in the form of free sugar be limited? (1)

c. Describe how exercise reduces the risk of an individual becoming obese. (1)

d. State two ways that exercise reduces the risk factors for cardiovascular disease (CVD). (1)