Total for Sections B & C

X009/301

NATIONAL QUALIFICATIONS 2011

WEDNESDAY, 1 JUNE 1.00 PM - 3.30 PM

HUMAN BIOLOGY HIGHER

Fill in these boxes and read what is printed below.	
Full name of centre	Town
Forename(s)	Surname
Date of birth Day Month Year Scottish candidate numb	er Number of seat

SECTION A—Questions 1–30

Instructions for completion of Section A are given on page two. For this section of the examination you must use an HB pencil.

SECTIONS B AND C

- 1 (a) All questions should be attempted.
 - (b) It should be noted that in Section C questions 1 and 2 each contain a choice.
- 2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- 3 Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the Invigilator and should be inserted inside the **front** cover of this book.
- 4 The numbers of questions must be clearly inserted with any answers written in the additional space.
- 5 Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required a supplementary sheet for rough work may be obtained from the Invigilator.
- 6 Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.





Read carefully

- 1 Check that the answer sheet provided is for **Human Biology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil**, and where necessary, an eraser.
- Check that the answer sheet you have been given has your name, date of birth, SCN (Scottish Candidate Number) and Centre Name printed on it.
 Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

The digestive enzyme pepsin is most active in the

- A stomach
- B mouth
- C duodenum
- D pancreas.

The correct answer is **A**—stomach. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



Changing an answer

If you decide to change your answer, carefully erase your first answer and, using your pencil, fill in the answer you want. The answer below has been changed to D.



SECTION A

All questions in this section should be attempted. Answers should be given on the separate answer sheet provided.

1. A DNA molecule consists of 4000 nucleotides of which 20% contain the base adenine.

How many of the nucleotides in this DNA molecule will contain guanine?

- A 800
- B 1000
- C 1200
- D 1600
- 2. The function of tRNA in cell metabolism is to
 - A transport amino acids to be used in synthesis
 - B carry codons to the ribosomes
 - C synthesise proteins
 - D transcribe the DNA code.
- **3.** The Golgi apparatus is involved in the packaging of
 - A ribosomes
 - B monosaccharides
 - C RNA
 - D enzymes.
- 4. Which of the following cells secrete antibodies?
 - A B-lymphocytes
 - B T-lymphocytes
 - C Red blood cells
 - D Macrophages

5. The diagram below summarises different types of immunity.



Which type of immunity would arise from breast feeding?

6. Haemophilia is a sex-linked recessive condition. A woman, who does not have this condition, has a haemophiliac son. The boy's father is also a haemophiliac.

What are the genotypes of the parents?

	Father	Mother
A	$\mathbf{X}^{\mathrm{H}}\mathbf{Y}$	$X^{H}X^{h}$
В	$\mathbf{X}^{\mathrm{h}}\mathbf{Y}$	X^hX^h
С	$\rm X^h Y$	$\mathbf{X}^{\mathrm{H}}\mathbf{X}^{\mathrm{H}}$
D	${\rm X}^{ m h}{\rm Y}$	$X^{H}X^{h}$

[Turn over

7. The table below shows the results of chemical tests on five carbohydrates.

	Chemical test			
Carbohydrate	Iodine solution	Benedict's solution	Barfoed's reagent	Clinistix strip
starch	turns blue-black	stays blue	stays blue	stays pink
sucrose	stays brown	stays blue	stays blue	stays pink
lactose	stays brown	turns orange	stays blue	stays pink
fructose	stays brown	turns orange	turns orange	stays pink
glucose	stays brown	turns orange	turns orange	turns purple

What is the minimum number of tests that would need to be carried out to identify an unknown carbohydrate as lactose?

- A one
- B two
- C three
- D four
- 8. Huntington's Disease is an inherited condition in humans caused by a dominant allele which is not sex-linked.

A woman's father is heterozygous for the condition and her mother is unaffected.

What is the chance of the woman having the condition?

- A 1 in 1
- B 1 in 2
- C 1 in 3
- D 1 in 4

9. The cell shown below is magnified six hundred times. What is the actual size of the cell?



18 mm

- $A = 1080\,\mu m$
- B 108 μm
- C 30 μm
- D 3μm

10. The diagram shows the chromosome complement of cells during the development of abnormal human sperm.



A sperm with chromosome complement 23+X fertilises a normal haploid egg. What is the chromosome number and sex of the resulting zygote?

	Chromosome number	Sex of zygote
А	24	female
В	46	female
С	46	male
D	47	female

11. 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/cm³ 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.
- **12.** The graphs below show the hormones involved in the menstrual cycle.



Which line represents oestrogen?

- **13.** The vein in the umbilical cord carries
 - A oxygenated fetal blood
 - B deoxygenated fetal blood
 - C oxygenated maternal blood
 - D deoxygenated maternal blood.
- **14.** 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.
- **15.** The diagram below shows the blood supply to cells lining an air sac in the lungs.



Which line of the table shows correctly the change in concentration of glucose and oxygen as the blood flows from X to Y?

	Glucose	Oxygen
А	increase	increase
В	increase	decrease
С	decrease	increase
D	decrease	decrease

16. The diagram below shows the liver and its associated blood vessels.

The arrows show the direction of blood flow.



Which of the blood vessels are veins?

- A 1 and 2
- B 1 and 3
- C 2 and 3
- D 2 and 4
- **17.** 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
- **18.** Which of the following statements about red blood cells is true?
 - A They are manufactured in the liver.
 - B They have a lifespan of 240 days.
 - $C \quad Vitamin \quad B_{12} \quad is \quad required \quad for \quad their \\ production.$
 - D They are broken down in the kidney.



19. The graph below shows how female bone

density changes with age.

When a female's bone density falls to 60% of its maximum, there is an increased chance of bone breakage.

This occurs at

- A 60 years
- B 64 years
- C 76 years
- D 84 years.
- **20.** Mature red blood cells have no nucleus and no mitochondria.

Which of the following processes can be carried out by a mature red blood cell?

- A Aerobic respiration
- B Protein synthesis
- C Anaerobic respiration
- D Cell division
- **21.** Which of the following blood vessels is likely to contain blood with the lowest concentration of urea?
 - A Hepatic artery
 - B Hepatic vein
 - C Renal artery
 - D Renal vein

22. Which of the following correctly identifies the locations of the centres that monitor blood water concentration and temperature in humans?

	Blood water concentration	Temperature
А	Hypothalamus	Hypothalamus
В	Hypothalamus	Pituitary gland
С	Pituitary gland	Hypothalamus
D	Pituitary gland	Pituitary gland

- **23.** Infants are more likely to suffer from hypothermia because they have
 - A a low surface area to volume ratio
 - B a high surface area to volume ratio
 - C a low metabolic rate
 - D a high metabolic rate.
- 24. When the body temperature becomes too high, which of the following sets of changes can occur in the skin?
 - A Vasoconstriction and contraction of erector muscles
 - B Vasodilation and contraction of erector muscles
 - C Vasoconstriction and relaxation of erector muscles
 - D Vasodilation and relaxation of erector muscles
- **25.** The diagram below shows reactions involved in deamination.



The reactions shown take place in the

- A small intestine
- B kidney
- C gall bladder
- D liver.

- 26. Which of the following statements is correct?
 - A The somatic nervous system controls mainly involuntary actions using sensory nerves.
 - B The somatic nervous system controls mainly voluntary actions using sympathetic nerves.
 - C The autonomic nervous system controls some involuntary actions using parasympathetic nerves.
 - D The autonomic nervous system controls some voluntary actions using motor nerves.
- **27.** A young person does not smoke because she has seen an advertising campaign showing pictures of famous sports stars who do not smoke.

This is an example of a behaviour called

- A identification
- B discrimination
- C generalisation
- D deindividuation.
- **28.** Which of the following best describes shaping behaviour?

The reward of behaviour which

- A improves performance in competitive situations
- B approximates to the desired behaviour
- C results in the learning of motor skills
- D results in deindividuation taking place.

29. The graph below shows the birth rate and death rate of a population.



The year of greatest increase in population was

- A 1920
- B 1940
- C 1960
- D 1980.
- **30.** When fertilisers enter a loch, the population of bacteria often increases dramatically.

Which line in the table below describes correctly the cause of the increase in the bacterial population and the result of the increase in the bacterial population?

	Cause of the increase in population of bacteria	Result of the increase in population of bacteria
А	death of plants	increase in nitrates
В	decrease in oxygen levels	increase in organic matter
С	increase in nitrates	algal blooms
D	increase in organic matter	decrease in oxygen levels

Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of this answer booklet.

[Turn over for Section B on Page ten

					DO N WRITH THI	OT E IN S
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			SECTION B			
			All questions in this section should be attempted.			
		A	All answers must be written clearly and legibly in ink.			
1.	(<i>a</i>)	The DNA	diagram shows part of an mRNA molecule being formed on a strand of A.			
		\times	DNA A C A T G A C A C G A G	×		
		(1)	In which part of the cell is mRNA formed?			
				1		
		(ii)	Complete the mRNA molecule by filling in the correct base sequence on the diagram.	1		
		(iii)	How many amino acids are coded for by this section of mRNA?			
	(b)	Some Recei disea attacl prote	e diseases are caused when cells in the body produce a harmful protein. nt research has led to the development of antisense drugs to treat such ses. These drugs carry a short strand of RNA nucleotides designed to h to a small part of the mRNA molecule that codes for the harmful in.	1		
		(i)	Suggest how these drugs may prevent the production of a harmful protein.			
				1		
		(ii)	Antisense drugs can be used to treat autoimmune diseases. Describe what is meant by an autoimmune disease.	_		
				1		
				I		

				DO NOT WRITE IN THIS MARGIN
The The eithe	diagra numb er side	am below shows a magnified section of the cell membrane of a red blood cell. bers show the relative concentrations of potassium ions that are maintained on of the membrane.	Marks [
red		I cell Plasma 5 units molecule		
<i>(a)</i>	Name	e molecule X.		
(<i>b</i>)	State	one possible function of the protein molecule shown in the diagram.	1	
-			1	
(c)	Expre inside Space	ess, as a simple whole number ratio, the concentration of potassium ions e and outside the cell. e for calculation		
		inside outside	1	
(<i>d</i>)	Use t ions v	the information in the diagram to name the process by which potassium would leave the cell.		
(<i>e</i>)	A san	nple of blood was treated with a chemical that inhibits respiration.	1	
	(i)	Describe how this treatment would change the relative concentrations of potassium ions on each side of the membrane.		
			1	
	(ii)	Explain why the relative concentrations would change.		





			DO N WRIT TH MARG
		Marks	
The diag	gram below shows inheritance of the ABO blood group over three		
cilciatio	is of a family. The fetters represent the blood group of each marvidual.		
	B A Male		
	I 2 Female		
	(A) B		
	, ,		
a) The Allel	ABO blood group system is controlled by three alleles: A , B and O . es A and B are co-dominant and both are completely dominant to allele O .		
(i)	State the genotypes of the following:		
	Individual 1		
	Individual 3	1	
(ii)	What is the blood group of individual 5? Give a reason for your answer.		
	Blood group		
	Reason		
		2	
(iii)	How many of the individuals shown in the family tree have a genotype which is heterozygous?		
		1	
b) D	ng an aparation individual 4 needed a blood transferring		
U) Duri	ng an operation, individuals in the family tree who could safely denote blood to		
ruen	the an the many duals in the family tree who could safely donate blood to		
her.			
her.		1	
her.		1	



				Marks [DO NOT WRITE IN THIS MARGIN
ó.	The c	liagr	am shows a kidney nephron.		
		W	X Collecting duct		
	(<i>a</i>)	(i)	Name structure W.	1	
		(ii)	High blood pressure causes fluid to move from X to W.	1	
		~ /	Name this process and explain what causes the high blood pressure within X.		
			Process	1	
			Explanation		
				1	
	(b)	(i)	Name structure Y.		
				1	
		(ii)	Describe the main process that occurs in structure Y.		
				1	

6. (continued)

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(c) The graph below shows how changes in the concentration of ADH in the blood affect the production rate and solute concentration of urine.



Page seventeen

			DO NOT WRITE IN THIS MARGIN
(a) The d	liggram represents a section through the heart	Marks	
	$\begin{array}{c} E \\ Vena \\ C \\ C \\ B \\ D \\ \end{array} $		
(i)	Name blood vessels E and F.		
	Vessel E		
	Vessel F	1	
(ii)	State two differences between the composition of the blood in chambers B and D.		
	1		
	2	1	
(iii)	Place a cross (\mathbf{X}) on the diagram to indicate the position of the sinoatrial node (SAN).	1	
(iv)	Describe the effect of the autonomic nervous system on the sinoatrial node (SAN).		
		2	
(b) State	the function of the coronary artery.		
		1	

Marks [

8. 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 individuals in the Scottish population who had diabetes in 2008.

Space for calculation

- (b) A student calculated the percentage of the UK population that had been diagnosed with diabetes by averaging the percentage values 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.
- (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 UK government might use this information to plan for the future.

 1

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1

[Turn over

8. (continued)

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

People consulting about diabetes (per 1000 people)



(i) For people aged between 25 and 74 describe one trend shown by the graph which relates to

age _ 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.

Space for calculation

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

Space for calculation

_____ %

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			Marks	MAR	GIN
cont	inu	ed)			
2)	(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			
	(11)				
			. 1		
		[Turn over	r		

8.

		11	THIS
The diag	ram below represents the passage of information through memory.	<i>WIAYRS</i>	
Incomir			
informati	on information		
Z	Short term memory Y Short term memory		
	Displaced information		
(a) (i)	Identify processes X. Y and Z.		
	X		
	Y		
	Z	2	
(ii)	State two forms of information which can enter short term memory.		
	1		
	2	1	
(iii)	Describe how contextual cues help recall from long-term memory.		
		1	
(b) A st She	udent had to learn her SQA candidate number which contained 9 digits was advised to use chunking to help her memorise it.		
Expl	ain why the process of chunking would help her memorise this number.		
		1	

DO NOT

9.	(cor	ntinu	ed)	Marks	DO NOT WRITE IN THIS MARGIN
(c)	(<i>c</i>)	(i)	Patients with Alzheimer's disease find it difficult to form new memories. Which part of the brain is affected by Alzheimer's disease?		
		<<		1	
		(11)	Name the receptor thought to be important in the process of memory storage.		
				1	
			[Turn over		

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10. An investigation was carried out into the effects of organisation on improving the recall of information.

Four students were each asked to look at a card containing 25 words organised into a branching diagram. The card is shown below.



The card was removed after three minutes and each student had to write down as many words as he or she could recall. A score out of 25 was recorded for each student and these were added together to give a total score out of 100 for the group. The procedure was repeated twice. Each time the students were given cards containing 25 different words also organised into branching diagrams. Another group of four students took part in the control for this investigation. The words on their cards were not organised.

The results are shown in the table below.

	Total number of words recalled (out of 100)						
Student Group	1 st card	2 nd card	3 rd card	average			
Experimental	75	78	72				
Control	53	57	55				

(a) Complete the table by calculating the average number of words recalled by each student group.

 $Space \ for \ calculation$

			DO N WRITH THI MARC
(co	ntinued)	Marks	
(<i>b</i>)	In what way would the content of the control cards be		
	similar to the experimental cards?		
	different from the experimental cards?		
		1	
(c)	Suggest two variables, not already mentioned in the description of this investigation, which would have to be kept constant to ensure that a valid comparison could be made between the two groups.		
	1		
	2	2	
(<i>d</i>)	State a conclusion that can be drawn from the results.		
		1	
(<i>e</i>)	How could the reliability of the results of this investigation be improved?		
		1	
(<i>f</i>)	At the start of the investigation the students were told that the person in each group who recalled most words would be given a prize.		
	Why did the design of this investigation include a prize?		
		1	
(g)	In a further investigation into recall, students were given the same card to memorise on three successive occasions.		
	Predict what would happen to the number of words recalled on each successive attempt. Explain your prediction.		
	Prediction		



11. (continued)

- (c) (i) State the importance of the myelin sheath in the transmission of impulses.
 - (ii) Post-natal myelination is necessary for a child to go through the sequence of developmental stages leading to walking.

What term describes this sequence of developmental stages?

[Turn over

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12. The table below shows the biomass of cod and herring stocks in the North Sea between 1967 and 2004.

The biomass figures are estimates of the total mass of each species present in the North Sea during that year. The critical biomass indicates the mass of each species that must be maintained to prevent it becoming endangered.

Fish	Estimat	ed Biomas	Critical biomass			
species	1967	1980	1990	2000	2004	(thousand tonnes)
Cod	235	170	75	50	45	150
Herring	920	130	1170	825	1890	1300

(a) (i) Construct a line graph to illustrate the data for cod.

(Additional graph paper, if required, can be found on *Page thirty-four*)



(ii) For how many years between 1967 and 2004 was the cod endangered?
 Space for calculation

years

2

1

Page twenty-eight

12.	(co	ntinu	ed)	Marks	DO NO WRITE THIS MARGI	T IN IN
	(<i>b</i>)	(i)	Calculate the percentage increase in the estimated biomass of herring between 1980 and 1990.			
			Space for calculation			
				1		
		(ii)	Suggest a reason for the increase in herring biomass between 1980 and 1990.			
				1		
	(<i>c</i>)	Wha by a	t term describes the maximum size of a population which can be sustained particular environment?			
				1		
			[Turn over for Section C on Page thirty			

			DO NOT WRITE IN THIS
		Marks	MARGIN
	SECTION C		
	Both questions in this section should be attempted.		
	Note that each question contains a choice.		
	Questions 1 and 2 should be attempted on the blank pages which follow.		
	Supplementary sheets, if required, may be obtained from the invigilator.		
	Labelled diagrams may be used where appropriate.		
1.	Answer either A or B.		
	A. Give an account of communication under the following headings:		
	(i) the use of language;	4	
	(ii) non-verbal communication.	6	
	OR	(10)	
	B. Give an account of the environmental effects of an increasing huppopulation under the following headings:	ıman	
	(i) deforestation;	6	
	(ii) increasing atmospheric methane levels.	4	
		(10)	
In q for r	uestion 2, ONE mark is available for coherence and ONE mark is avail relevance.	able	
2.	Answer either A or B.		
	A. Discuss factors that affect enzyme activity.	(10)	
	OR		
	B. Discuss the production and use of ATP in the body.	(10)	
	[END OF QUESTION PAPER]		

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ADDITIONAL GRAPH FOR QUESTION 12(*a*)(i)



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