Candidate Name	Centre Number	Candidate Number
		2

WJEC CBAC

GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY - BY5

P.M. FRIDAY, 25 June 2010

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**12**	
2	**12**	
3	**14**	
4	**12**	
5	**10**	
6	**10**	
7	**10**	
Total	**80**	

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INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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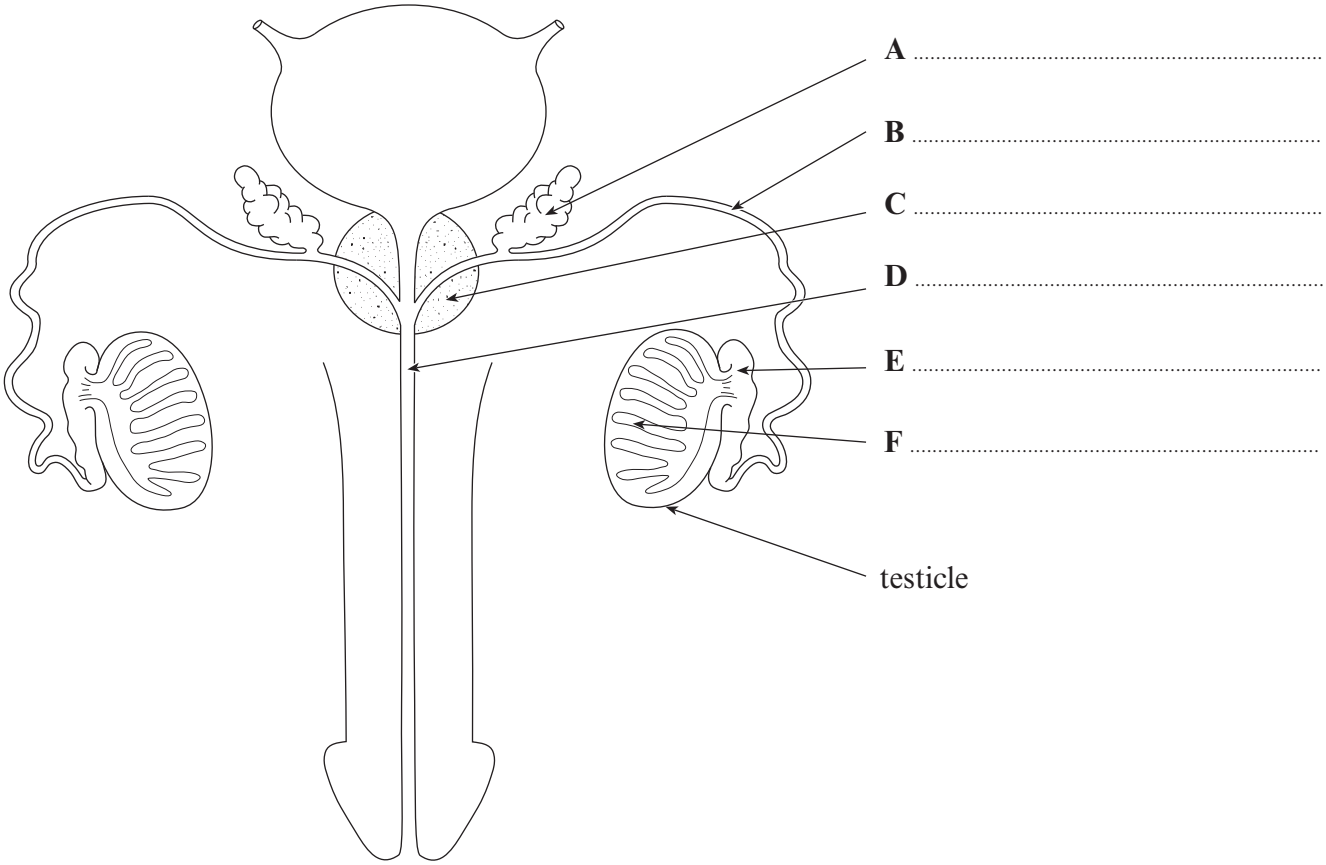
1. The diagram below shows the human male reproductive system.



(a) Label the structures **A – F**. [6]

(b) Complete the following using appropriate biological terms. [6]

Spermatozoa are produced in the ..... of the testes by a process called ..... . Spermatogonia divide many times to produce ..... . These undergo meiosis and the products of the first meiotic division are haploid ..... . These undergo the second half of the meiotic division producing ..... which differentiate and mature into spermatozoa. The spermatozoa are protected and nourished by ..... cells.

(Total 12 marks)

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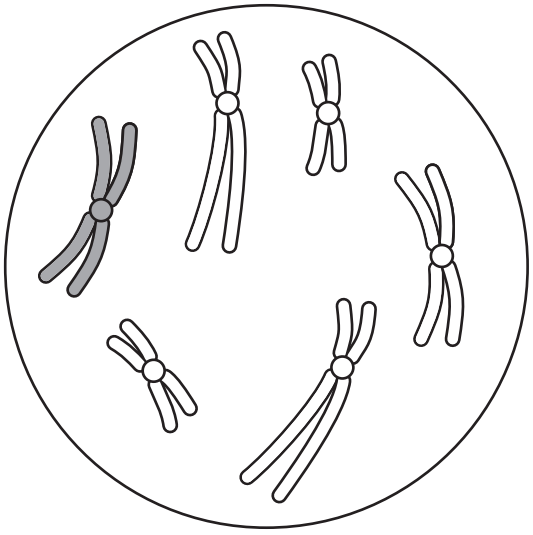
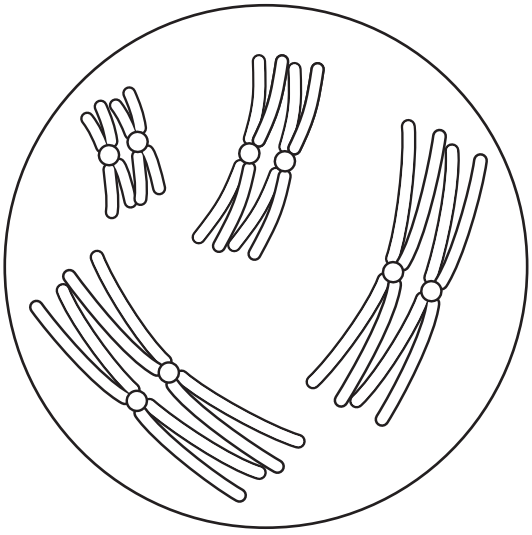
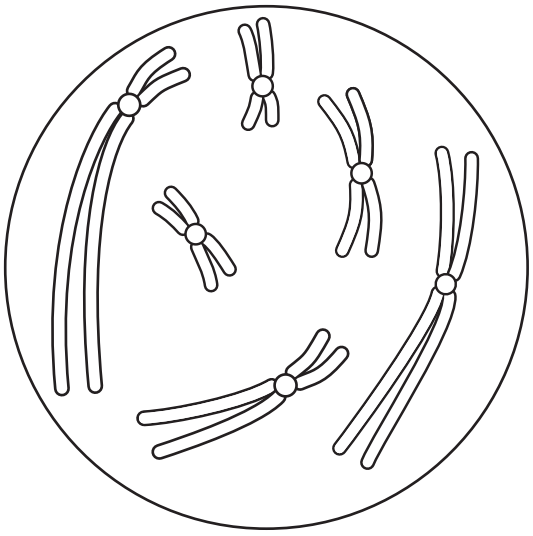
2. The following diagrams, **A** to **D** are of nuclei undergoing mitosis or meiosis.



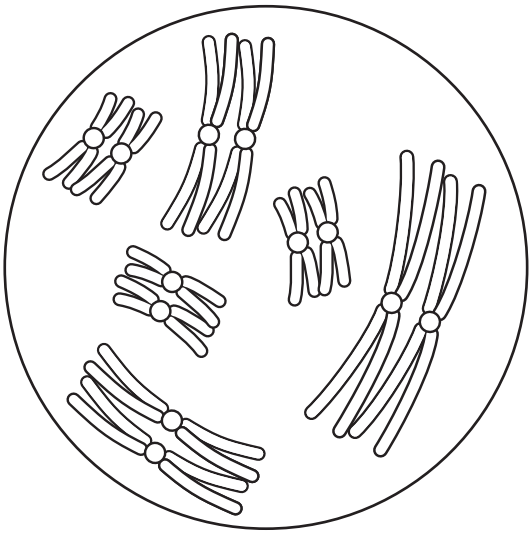
A



B



C



D

(a) On diagram **A** one chromosome has been shaded. Shade the homologous chromosome. [1]

(b) Which of the diagrams **A-D** show cells undergoing prophase 1 of meiosis. [1]

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(c) The diploid number of chromosomes in a mosquito *(Culex sp.)* is 6 (2n 6) and in a kangaroo *(Macropus sp.)*12 (2n 12).
State which of the diagrams, A, B, C or D represents the following: [2]

Haploid cell from a kangaroo .....

Diploid cell from a mosquito .....

(d) (i) A species of ant *(Myrmecia pilosula)* has a diploid number 2. Why is it not possible to have an organism with a diploid number lower than this? [1]

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(ii) In this species of ant the male is haploid, suggest the type of cell division this organism would use to produce sperm cells. [1]

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(e) The following gives the names of some stages of cell division.

Anaphase 1	Metaphase 2	Anaphase 2	Prophase 1	Telophase 2	Metaphase 1
M	N	P	Q	R	S

(i) Using only the letters, give the correct sequence of the stages. [1]

.....

(ii) State the **letter** of the stage when each of the following processes occur. [5]

Pairing of chromosomes .....

Centromeres divide .....

Crossing over .....

Bivalents align on equator .....

Nuclear membrane reforms .....

(Total 12 marks)

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3. Snapdragons are a type of garden plant. A pure breeding strain of a white flowering variety was obtained and crossed with a pure breeding red flowered strain. The two strains were crossed producing F_1 plants all with pink flowers. The F_1 plants were then interbred to produce F_2 plants with the following flower colours:

red 62
pink 131
white 67

The following hypothesis was proposed:
Flower colour in snapdragons is controlled by a single gene with two codominant alleles.

(a) Complete the genetic diagram to explain this cross. Use the following symbols to represent the alleles:

R = red flowers
W = white flowers

Parental phenotypes: Red flowers x White flowers

Parental genotypes .... [1]

Gametes .... [1]

F_1 genotypes ..... [1]

F_1 phenotypes ..... [1]

Gametes ..... [1]

F_2 genotypes ..... [1]

F_2 phenotypes ..... [1]

Expected F_2 phenotype ratio ..... [1]

(b) A chi-squared (χ^2) test is carried out on the data to determine whether the hypothesis is supported or rejected.

(i) The χ^2 statistic is calculated in the following way:

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \qquad \sum = \text{sum of}$$

Complete the following table. [2]

F_2 phenotype	Observed numbers [O]	Expected numbers [E]	O-E	$(O-E)^2$
red	62			
pink	131			
white	67			
total	260	260		

(ii) Calculate the χ^2 value for the above data. Show your working. [1]

χ^2 value = ...

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(c) A suitable Null hypothesis would be that there is no significant difference between the observed and expected numbers.
Biologists consider that if the probability is greater than 5% the deviation is statistically non significant.

Degrees of freedom	Probability													
	0·99	0·98	0·95	0·90	0·80	0·70	0·50	0·30	0·20	0·10	0·05	0·02	0·01	0·001
1	0·00016	0·00063	0·0039	0·016	0·064	0·15	0·46	1·07	1·64	2·71	3·84	5·41	6·64	10·83
2	0·02	0·04	0·10	0·21	0·45	0·71	1·39	2·41	3·22	4·60	5·99	7·82	9·21	13·82
3	0·12	0·18	0·35	0·58	1·00	1·42	2·37	3·66	4·64	6·25	7·82	9·84	11·34	16·27
4	0·30	0·43	0·71	1·06	1·65	2·20	3·36	4·88	5·99	7·78	9·49	11·67	13·28	18·46

(i) Using the figures from the χ^2 table for 2 degrees of freedom, explain whether you would accept or reject the Null hypothesis. [2]

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(ii) What does this suggest about the inheritance of flower colour in snapdragons? [1]

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(Total 14 marks)

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4. *(a)* Part of a particular sequence of bases on a DNA molecule is as follows:

T T A T C T T T C G G G A T G

(i) Give the sequence of nitrogenous bases on the mRNA which is obtained by using this DNA molecule as a template. [1]

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mRNA codons	*Amino acid*
AAG	Lysine (lys)
AAU ACA AGA AUA	Asparagine (asn) Threonine (thr) Arginine (arg) Isoleucine (ile)
CAU CGG CGU	Histidine (his) Arginine (arg) Arginine (arg)
CCC CCG	Proline (pro) Proline (pro)
CUU	Leucine (leu)
GAU GAA GAG GCA	Aspartic acid (asp) Glutamic acid (glu) Glutamic acid Alanine (ala)

mRNA codons	*Amino acid*
GGA	Glycine (gly)
UAU	Tyrosine (tyr)
UGC	Cysteine (cys)
UCG	Serine (ser)
UUG	Leucine (leu)
UCU	Serine (ser)
UGG	Tryptophan (trp)
UUA	Leucine (leu)
UAC	Tyrosine (tyr)

(ii) A sequence of nitrogenous bases on another section of mRNA is shown below.

UACAGAGCAUCGUUA

Using the table, determine the order the amino acids would be incorporated into the polypeptide constructed from this mRNA sequence (the abreviations of the amino acids in brackets can be used). You may assume that the sequence is read from the left hand end. [1]

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(iii) Suggest how the cell ensures that the code is read in the correct direction. [1]

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(iv) Proflavin, is a chemical which alters the base sequence of DNA. What is the name given to such a change ? [1]

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(v) If proflavin caused the deletion of the first adenine, (A), in the DNA sequence which codes for the above mRNA, what consequences would this have on the subsequent translation of the sequence? [1]

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(b) Haemoglobin is a protein found in red blood cells.
Haemoglobin is a quaternary protein.
There are three different types of haemoglobin found in adult humans, HbA, HbA_2 and HbF as shown in the table.

Haemoglobin type	*% found in adult*	*Types of polypeptide*
HbA	97	2 alpha chains 2 beta chains
HbA_2	2	2 alpha chains 2 delta chains
HbF	1	2 alpha chains 2 gamma chains

(i) From **this data** suggest how many genes are involved in the production of the haemoglobins found in the adult human. [1]

.....

(ii) Beta thalassaemia is a condition in humans caused by a change in the nucleotide sequence which codes for the primary structure of the beta polypeptide chain. Scientists have now discovered a drug which can switch on the gene for the production of HbF (HbF is the type of haemoglobin found in the fetus). Explain, using your knowledge of protein synthesis, how this drug results in the production of HbF. [4]

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(iii) Give **one** disadvantage in an adult human of not producing beta chains of haemoglobin. [1]

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(iv) Give **one** possible disadvantage if an adult has fetal haemoglobin. [1]

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(Total 12 marks)

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5. Scientists have successfully cloned five puppies from Trackr, a German Shepherd dog who searched for survivors in the rubble of the World Trade Centre after the 9/11 explosions. Trackr died in 2009 but before his death the five puppies shown in the photograph were cloned. The puppies range in age from 2 to 6 months old.

(a) Suggest and describe a method which could have been used to clone these dogs. [4]

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Examiner only

(b) The coat colour in the puppies is not the same. Suggest **two** reasons to explain the difference. [2]

1. .....

2. .....

(c) The phenotype of dogs such as Trackr have been produced by artificial selection. Suggest how natural selection has brought about evolution of coat colour in other species. [4]

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(Total 10 marks)

Examiner only

6. *(a)* State how each of the following are used in the formation of recombinant DNA. [5]

Restriction endonuclease

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DNA ligase

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Reverse transcriptase

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Marker gene

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PCR (polymerase chain reaction)

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(b) (i) What was the aim of the human genome project? [2]

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(ii) Give **two** potential uses of the information gained from it. [2]

1. .....

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2. .....

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(iii) State **one** way in which the information gained from it could be misused. [1]

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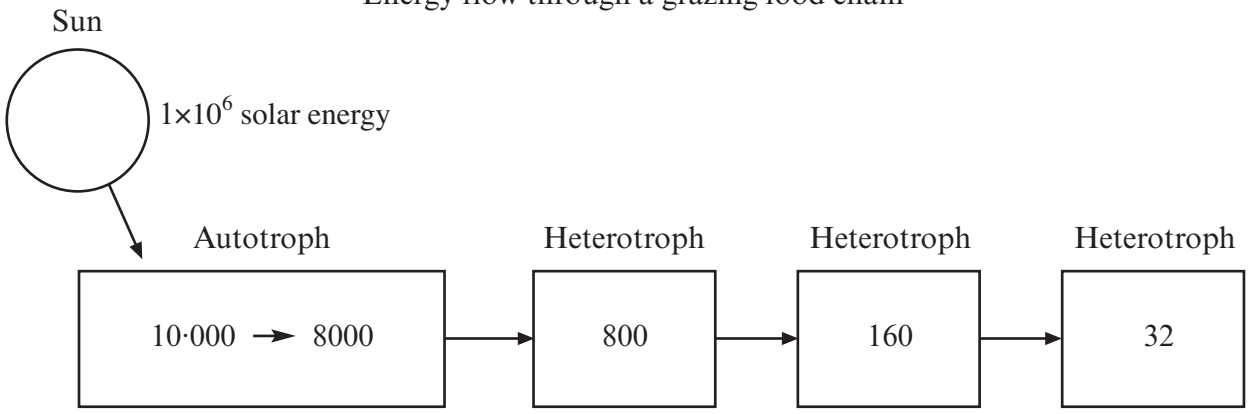
(Total 10 marks)

Examiner only

7. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Using the diagram below explain what is meant by the flow of energy through an ecosystem. Describe how energy is lost at each stage and comment on the efficiency of the transfer. Suggest reasons for any differences in efficiency which you may observe. [10]

Energy flow through a grazing food chain



Figures represent $kJm^{-2}yr^{-1}$

Or, *(b)* Describe the processes of (i) pollination and fertilisation and (ii) the development of the seed and fruit, in plants. [10]

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(Total 10 marks)