Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1075/01

S16-1075-01

BIOLOGY/HUMAN BIOLOGY – BY5

A.M. THURSDAY, 23 June 2016

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**10**	
3.	**16**	
4.	**21**	
5.	**13**	
6.	**10**	
Total	**80**	

1075 010001

ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
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.

Examiner only

Answer **all** *questions.*

1. *(a)* Bananas are grown on large plantations in tropical regions such as South America, using monoculture production methods.

(i) Define the terms:

I. biodiversity; [1]

.....

.....

II. monoculture. [1]

.....

.....

(ii) Describe and explain the effects of banana production on biodiversity in South America. [2]

.....

.....

(b) Multinational banana companies own plantations, sea transport, ripening facilities and distribution networks in countries where the bananas are consumed. The data below was published by one such company.

	Banana Carbon Footprint (Farm-to-Retail Distribution Centre) /kg	
	USA	Europe
Per box (18kg)	18	24

(i) Define the term *'carbon footprint'*. [1]

.....

.....

(ii) Explain the difference in the values for USA and the values for Europe. [2]

.....

.....

Examiner only

(c) In an attempt to reduce their carbon footprint for their USA operation, the company switched to transporting the bananas part of the way by rail, instead of taking them the whole way by truck.

(i) Explain why this would reduce the carbon footprint. [2]

.....

.....

.....

(ii) How would this change benefit the environment? [1]

.....

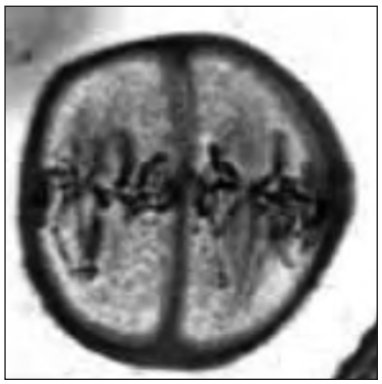
.....

10

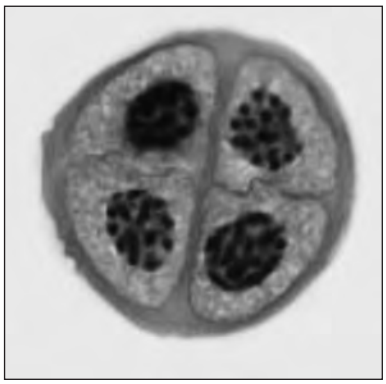
1075 010003

Examiner only

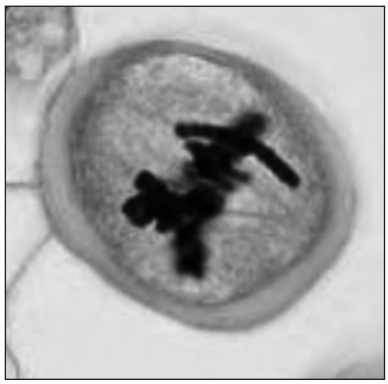
2. The photomicrographs show some stages of cell division in a flower of a lily, *Lilium candidum*.



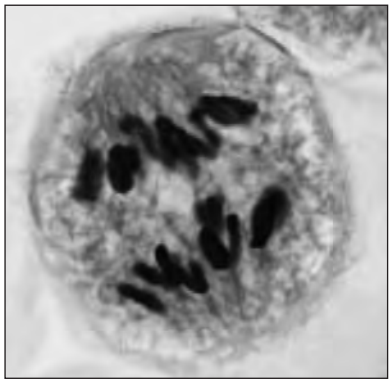
A



B

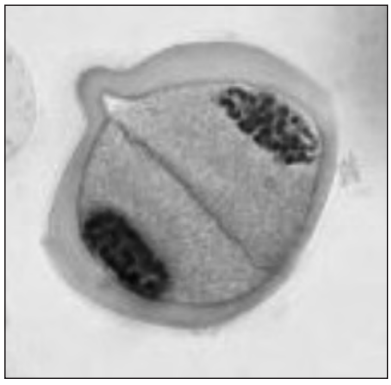


C



D

E



F

(a) (i) Identify the type of cell division shown. [1]

.....

(ii) State a part of the flower that could have been used to produce the photomicrographs. [1]

.....

(iii) Write the letters in the order the stages would occur (the first one has been done for you). [2]

1 **E** 2 ..... 3 ..... 4 ..... 5 ..... 6 .....

(iv) Use photomicrograph **E** to find the haploid number of *Lilium candidum*. [1]

Haploid number .....

(b) (i) Name the stages shown in the following photomicrographs. [1]

A ..... **C** .....

Examiner only

(ii) Use your knowledge of cell division to describe **two** differences between the arrangement of chromosomes in stages **A** and **C**. [2]

.....

.....

.....

.....

.....

(c) Name **two** processes occurring during this type of cell division which help to ensure genetic variation in the offspring. [2]

.....

.....

10

1075 010005

Examiner only

3. In white clover, *Trifolium repens*, one gene determines the production of a cyanide forming substrate. Allele **A** produces the cyanide forming substrate, whilst allele **a** produces no substrate.

A second gene, located on a different chromosome, determines the production of an enzyme which catalyses the release of cyanide from the substrate. Allele **E** produces the enzyme, whilst allele **e** produces no enzyme.

- Clover that has both **A** and **E** alleles gives off cyanide as soon as its leaves are crushed.
- Clover with **A** but not **E** releases cyanide slowly when its leaves are crushed.
- Clover that does not have **A** cannot release cyanide.

(a) (i) Complete the genetic diagram below to show what proportion of the three types would be produced if clover heterozygous for both genes was self-pollinated. Use the letters for the alleles given above. [3]

Parental genotypes ..... X .....

Gametes ..... X .....

(ii) State the ratio of the offspring which would show: [1]

rapid cyanide release ..... : slow cyanide release ..... : no cyanide release .....

Examiner only

(b) In an experiment where double heterozygotes were self-pollinated the following numbers of offspring were obtained:

rapid cyanide release – 140
slow cyanide release – 49
no cyanide release – 67

(i) Using the ratio from part *(a)*(ii) calculate the **expected** number of each phenotype of the offspring, and enter the values in the table below. [1]

Phenotype	**Observed number (O)**	**Expected number (E)**	**(O – E)**	**$(O - E)^2$**	**$\frac{(O-E)^2}{E}$**
Rapid cyanide release	140				
Slow cyanide release	49				
No cyanide release	67				

(ii) Use the other columns in the table to carry out a Chi square test, testing the Null Hypothesis that *there is no significant difference between the observed and expected results*.

Use the last column in the table and the formula below to calculate χ^2. [1]

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

χ^2 = ...

(iii) Using the 5% probability level and the correct number of degrees of freedom **circle** the critical value of χ^2 **in the table below**. [1]

Degrees of freedom	Probability								
	0.9	0.8	0.7	0.5	0.2	0.1	0.05	0.02	0.01
1	0.016	0.064	0.15	0.46	1.64	2.71	3.84	5.41	6.64
2	0.21	0.45	0.71	1.39	3.22	4.60	5.99	7.82	9.21
3	0.58	1.00	1.42	2.37	4.64	6.25	7.82	9.84	11.34
4	1.06	1.65	2.20	3.36	5.99	7.78	9.49	11.67	13.28

1075 0100007

Examiner only

(iv) State whether you would accept or reject the Null Hypothesis for this cross and explain why. [1]

.....

.....

(c) (i) What is the term for all the alleles in a population? [1]

.....

(ii) Cyanide has a taste which discourages cattle from eating clover leaves. How would the proportion of allele **E** in the population of white clover in a field grazed by cattle compare to the proportion of allele **E** in the population of white clover in a hedgerow inaccessible to cattle? [1]

.....

(iii) Explain how continued grazing would change the frequency of allele **E** in the population. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

Examiner only

(iv) Describe how the cattle grazing might lead to the formation of a new species of clover. [2]

.....

.....

.....

.....

.....

.....

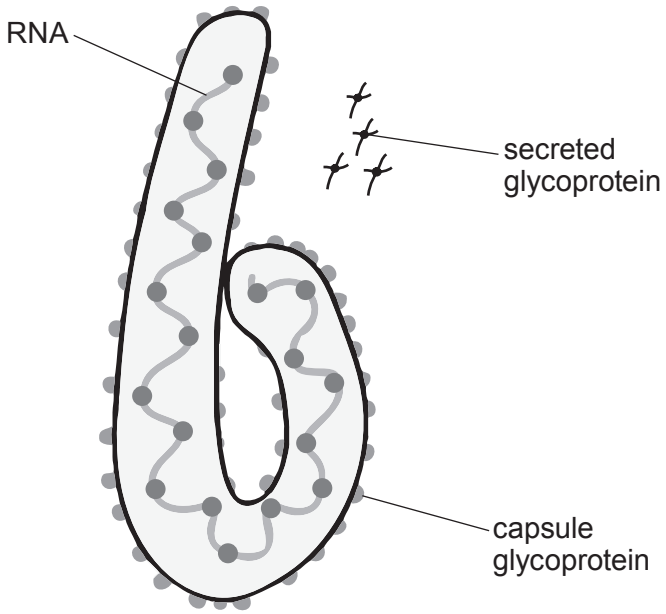
.....

16

1075 010009

Examiner only

4. In 2014, parts of West Africa were hit by an epidemic of Ebola Fever. Most people who caught the disease died. The diagram below shows the virus which causes the disease.



(a) (i) This virus reproduces in the cytoplasm of the host cell. Using information from the diagram, suggest why this virus does not have to enter the nucleus of cells in order to produce proteins. [2]

.....

.....

(ii) Suggest the organelle in the infected cell which would complete the production of glycoprotein. [1]

.....

(iii) Describe the process by which the genetic information of the virus would be translated into amino acid sequences in its proteins. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

Examiner only

(b) When Ebola viruses enter human cells one of their genes controls the production of a glycoprotein that is immediately released.

The gene which codes for this glycoprotein is changed after infecting cells. An extra adenine is inserted at position 1016.

The changed gene then controls the production of the second glycoprotein which forms part of the viral capsule.

Diagrams of the changed and original base sequences for the glycoproteins are shown below.

Changed base sequence

Nucleotide position number	1010		1015		1020		1025	
Changed nucleotide sequence	CUU		GUU		**A**UA	AAA	AAA	AUA	C
Changed amino acid sequence	Leu		Val		.....	.....	.....	.....	

Original base sequence

Nucleotide position number	1010		1015		1020		1025	
Original nucleotide sequence	CUU		GUU		.....	.....	.....	.....	
Original amino acid sequence	Leu		Val		.....	.....	.....	.....	

(i) Use the table below to complete the **changed amino acid sequence in the diagram** above. [1]

First \ Second	**U**	**C**	**A**	**G**	Third
U	Phe	Ser	Tyr	Cys	**U**
	Phe	Ser	Tyr	Cys	**C**
	Leu	Ser	STOP	STOP	**A**
	Leu	Ser	STOP	Trp	**G**
C	Leu	Pro	His	Arg	**U**
	Leu	Pro	His	Arg	**C**
	Leu	Pro	Gln	Arg	**A**
	Leu	Pro	Gln	Arg	**G**
A	Ile	Thr	Asn	Ser	**U**
	Ile	Thr	Asn	Ser	**C**
	Ile	Thr	Lys	Arg	**A**
	Met	Thr	Lys	Arg	**G**
G	Val	Ala	Asp	Gly	**U**
	Val	Ala	Asp	Gly	**C**
	Val	Ala	Glu	Gly	**A**
	Val	Ala	Glu	Gly	**G**

(ii) Complete the **original nucleotide sequence** in the diagram. [1]

(iii) Use the table again to complete the **original amino acid sequence**. [1]

Examiner only

(iv) Explain why the original glycoprotein is smaller than the changed glycoprotein. [2]

.....

.....

.....

.....

(c) On contact with the plasma membrane of human epithelial cells the capsule glycoprotein molecules form transmembrane proteins, which assist the virus in gaining entry to the cells.

Draw a labelled diagram of a typical cell membrane including a transmembrane protein. [2]

Examiner only

(d) The Ebola virus capsule glycoprotein has been purified and injected into mice which then produce antibodies against the protein. The genes for these antibodies have been cut from mouse DNA and inserted into Tobacco Mosaic Virus (TMV) genes. By allowing these viruses to infect tobacco plants, genetically modified tobacco plants can be grown which produce antibodies against Ebola.

(i) Name the enzyme that would be used to cut the antibody producing gene from the mouse DNA. [1]

.....

(ii) Name the vector used to transfer the mouse gene. [1]

.....

(iii) Name the enzyme that would be used to insert the mouse gene into the vector. [1]

.....

(iv) Bacteria could be used instead of tobacco plants to produce the antibodies. What vector would be used in this case? [1]

.....

(v) Give **one** advantage of using bacteria instead of tobacco plants. [1]

.....

(e) The technology described in part *(d)* was used during the Ebola outbreak of 2014 to develop a drug called ZMapp. The drug was only used to treat two Americans who had been working as medics in Africa. Its use was controversial because the drug had not been tested on humans. At the time there were only a few doses of ZMapp available.

(i) Suggest a reason why the decision to use the drug was taken, even though it had not been tested. [1]

.....

.....

.....

(ii) Apart from the fact that drug had not been fully tested, give **one** reason why using the drug in the way described could be considered unethical. [1]

.....

.....

.....

21

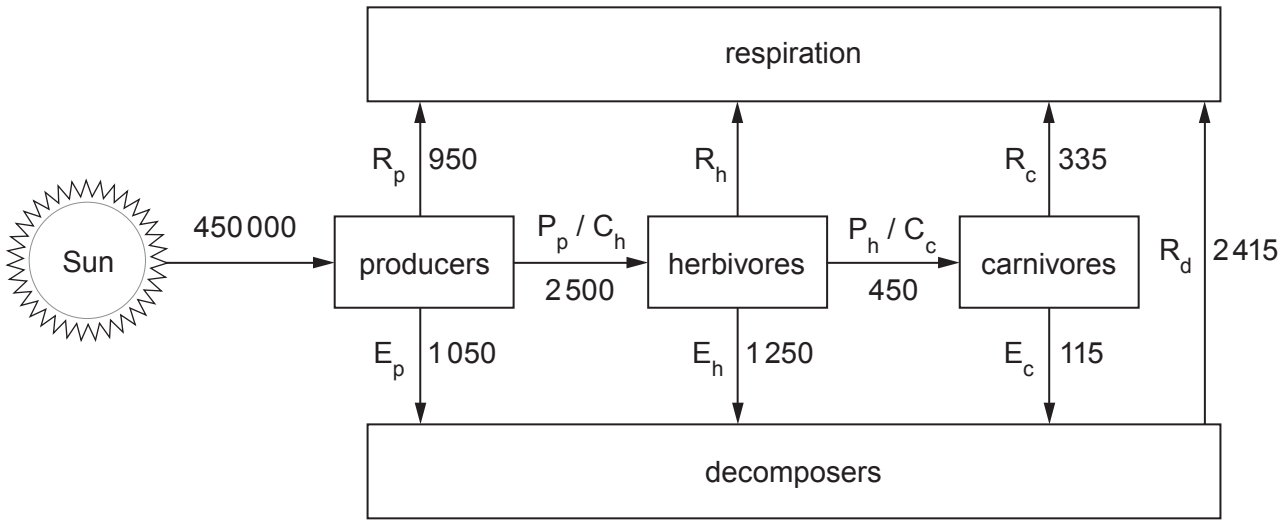
Examiner only

5. The diagram below shows energy transfer through a model ecosystem, where,

C = consumption, P = production, R = respiration, E = death, faeces or urine;

subscripts indicate the feeding group $_p$ = producers, $_h$ = herbivores, $_c$ = carnivores, $_d$ = decomposers,

e.g. C_h = consumption in herbivores.



(a) (i) Define the term *trophic level*. [1]

.....

(ii) Using appropriate letters from the diagram write an equation to represent energy transfer through the herbivores. [1]

(b) The numbers in the diagram represent energy transfer over a given area of ecosystem in a given time.

(i) Suggest suitable units for the values. [1]

.....

Examiner only

(ii) Calculate the following:

I. the photosynthetic efficiency of the producers. [2]

photosynthetic efficiency = ...

II. R_h [2]

R_h = ...

(c) The model assumes that **all** of the biomass produced by one group is transferred to the next group in the food chain. This might not be true in natural ecosystems.

(i) Suggest why this assumption is **not** likely to be true in a woodland ecosystem. [2]

.....

.....

.....

.....

(ii) State the assumption the model makes about the dead organic material that the decomposers receive. [1]

.....

.....

(iii) Conditions in peat bogs are acidic. Describe and explain how this will affect the rate of decomposition. [2]

.....

.....

.....

.....

(iv) Explain whether the assumption the model makes about the dead organic material that the decomposers receive is likely to be true in peat bogs. [1]

.....

.....

.....

Examiner only

6. Answer **one** of the following questions.

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the structure of a broad bean seed, this should include an annotated diagram. Describe how a maize grain differs from a broad bean seed. Name the factors essential for the germination of seeds, giving a reason why each factor is essential. [10]

Or. *(b)* Describe the formation of spermatozoa in mammals. Explain how the process of oogenesis differs. [10]

Examiner only

Examiner only

10

END OF PAPER

BLANK PAGE

