

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS General Certificate of Education Advanced Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

830250013

BIOLOGY 9700/43

Paper 4 A2 Structured Questions

October/November 2012

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page. Write in dark blue or black ink.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions.

Section B

Answer **one** question

Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.

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

For Exam	iner's Use
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
Section B	
9 or 10	
Total	

This document consists of 21 printed pages and 3 lined pages.



Answer all the questions.

1 (a) Fig. 1.1 shows a neurone forming three synapses with adjacent neurones.

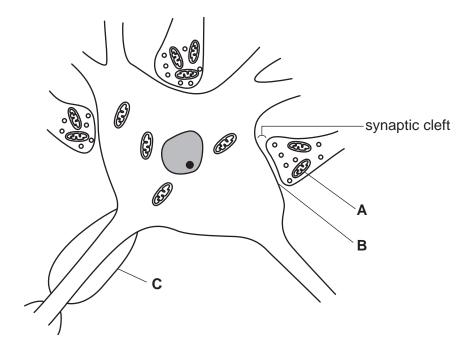


Fig. 1.1

Nar	ne A, B and C.
A	
В	
C	[3]
(b)	Outline the role of structure A in synaptic transmission.
	[3]

;)	The drug nicotine has a similar structure to acetylcholine.	For
	Suggest the effects on brain neurones of inhaling nicotine from a cigarette.	Examiner's Use
	[2]	
	[Total: 8]	

2 The artificial plasmid, pBR322, was constructed to act as a vector. It has often been used to insert human genes, such as the human insulin gene, into the bacterium, *Escherichia coli*.

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The plasmid was constructed to include two genes, each giving resistance to a different antibiotic: an ampicillin resistance gene and a tetracycline resistance gene. The plasmid also has a target site for the restriction enzyme, *BamHI*, in the middle of the tetracycline resistance gene.

A pBR322 plasmid was cut using *BamHI* and the cDNA gene for human insulin inserted into it.

Fig. 2.1 shows pBR322 and the recombinant plasmid.

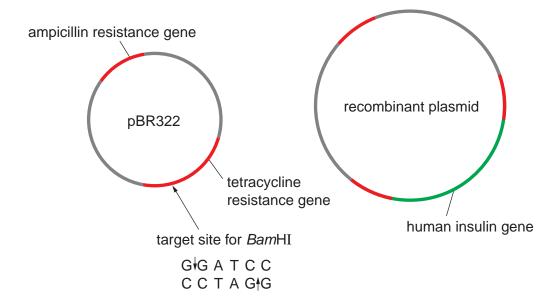


Fig. 2.1

(a)	With reference to Fig. 2.1, describe how a cDNA human insulin gene can be inserted into pBR322 that has been cut by Bam HI.
	[4]

(b) Bacteria were then mixed with the recombinant plasmids. Those bacteria which had successfully taken up recombinant plasmids were identified using the following steps:

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step 1 – the bacteria were spread onto culture plates containing nutrient agar and ampicillin and incubated to allow colonies to form

step 2 – some bacteria from each of the colonies growing on these plates were transferred to plates containing nutrient agar and tetracycline, as shown in Fig. 2.2.

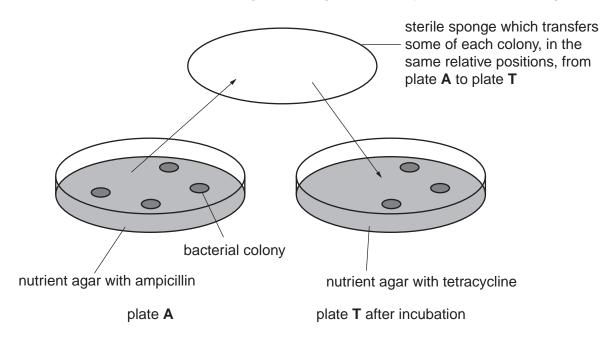


Fig. 2.2

Explain why the bacteria were first spread onto plates containing ampicillin.
[3]

	(ii)	Explain why it is important, for identifying bacteria that have successfully taken up the recombinant plasmid, that on pBR322 the target site for <i>Bam</i> HI is in the middle of the tetracycline resistance gene.
		[3]
	(iii)	Use a label line and the letter C to identify, on Fig. 2.2, a colony of bacteria that contain the recombinant plasmid.
		Put your answer onto Fig. 2.2 on page 5. [1]
(c)		smid vectors carrying antibiotic resistance genes are now rarely used in gene inology.
	(i)	Explain why antibiotic resistance genes are now rarely used.
		TO I
		[2]
	(ii)	State one type of gene that has replaced antibiotic resistance genes in plasmid vectors and indicate how its presence can be detected.
		type of gene
		detection
		[2]
		[Total: 15]

3

	icillin-binding proteins (PBPs) are proteins found in the cell surface membranes of teria. PBPs catalyse the final steps in the production of a peptidoglycan cell wall.	For Examiner's Use
(a)	From the information given above, describe the likely molecular structure of a PBP.	
	[2]	
(b)	Penicillin-resistant mutants of the bacterium, <i>Staphylococcus aureus</i> , produce a PBP, PBP2a, that does not bind well with penicillin.	
	Suggest how the presence of PBP2a in the cell surface membrane provides <i>S. aureus</i> with resistance to the effects of penicillin.	
	[0]	
	[3]	
(c)	Explain why penicillin does not affect viruses.	
	[2]	
	[Total: 7]	
	[Total: 7]	

4 (a) Fig. 4.1 shows a light micrograph of a section through a wheat grain.

The structure of a wheat grain is very similar to that of a maize fruit.



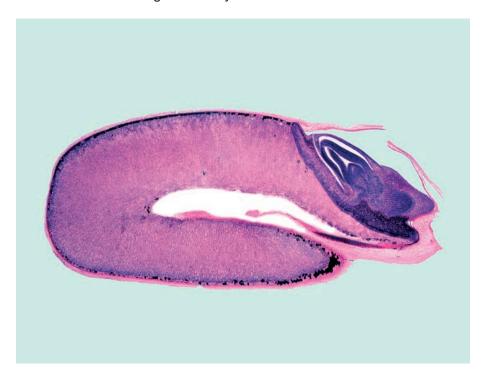


Fig. 4.1

On Fig. 4.1, use label lines and letters to label each of the following parts.

- A endosperm
- **B** fused testa and pericarp (fruit coat)

C embryo [3]

(b) Wheat grains are ground to make flour, which can be used for making bread.

Whole grain flour is made from the complete wheat grain.

Refined (white) flour is produced from wheat grains from which the embryo, aleurone layer and the fused testa and pericarp have been removed.

Table 4.1 shows the carbohydrate, protein and dietary fibre content of bread made from whole grain flour and white flour.

	bread made from whole grain flour	bread made from white flour
protein/g per 100 g	9.4	7.9
dietary fibre/g per 100 g	7.0	2.5
carbohydrate/g per 100 g	42	46

		h reference to the structure of a wheat grain, explain the differences between the apposition of the two types of bread shown in Table 4.1.
		[3]
(c)	of it	e glycaemic index, GI, of a carbohydrate-containing food is a measure of the effect its consumption on blood glucose concentration. If two foods containing the same as of carbohydrate, but different GIs, are consumed, the food with the higher GI will lease blood glucose concentration more rapidly than the food with the lower GI.
	Sug	gest an explanation for each of the following.
	(i)	Foods containing starch have lower GIs than foods containing glucose.
		[1]
	(ii)	Foods containing starch made up mostly of amylose have lower GIs than foods containing starch made up mostly of amylopectin.
		[2]

(d) A diet containing large amounts of foods with a high GI can increase the risk of developing type II diabetes. A study was carried out into the effect of consuming whole cereal grains, refined cereal grains and fruit on the risk of developing type II diabetes.

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- In 1986, questionnaires about diet were completed by 41836 women, all between the ages of 55–69 years old, in Iowa, USA.
- The women were then divided into five groups according to their range of intake of each food type.
- In 1992 the same women were asked whether or not they had developed type II diabetes.
- Their answers were used to calculate the relative risk of developing type II diabetes for each of the five groups.

For each food type, the group with the lowest intake of that food type was allocated a risk of 1.00.

Table 4.2 shows the results of this study.

Table 4.2

food type	range of intake/ servings per week	relative risk of developing type II diabetes
	< 13.0	1.00
	13.0 – 18.5	0.89
whole cereal grains	19.0 – 24.5	0.94
	25.0 – 33.0	0.81
	> 33.0	0.68
	< 6.0	1.00
	6.0 - 9.5	0.96
refined cereal grains	10.0 – 13.5	1.00
	14.0 – 22.0	0.98
	> 22.0	0.87
	< 6.25	1.00
	6.5 – 10.0	1.05
fruit	10.1– 13.5	1.00
	13.6 – 19.0	1.08
	> 19.0	1.14

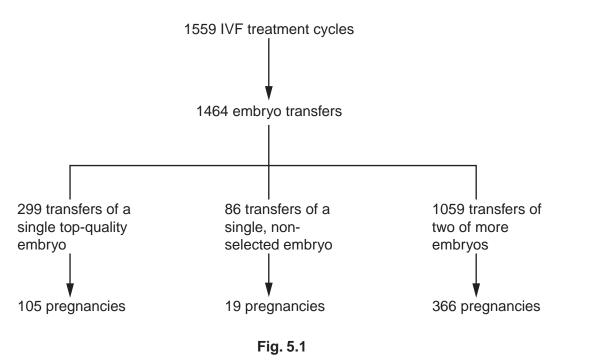
	Describe the effect of increased intake of whole cereal grains on the risk of developing type II diabetes.
	[3]
tł	Explain why the results in Table 4.2 cannot be used to make a direct comparison of the effects of consuming whole cereal grains and refined cereal grains on the risk of developing type II diabetes.
	[2]
	The results in Table 4.2 suggest that eating large quantities of fruit may slightly ncrease the risk of developing type II diabetes.
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	ny couples who are not able to have children naturally are treated using in-vitro ilisation (IVF).
(a)	Describe how and where fertilisation occurs during IVF.
	[2]
(b)	The embryos resulting from IVF are transferred into the mother's uterus. This is sometimes done after 3 days, and sometimes after 5 days.
	Suggest one advantage and one disadvantage of transferring the embryos after 5 days rather than 3 days.
	advantage
	disadvantage
	[2]
(c)	Many IVF clinics usually transfer two or more embryos to the mother's uterus, to increase the chances of a successful pregnancy occurring. However, this increases the risk of more than one embryo developing in the uterus, which in turn increases the risk of problems with the pregnancy or birth.
	A study was carried out to compare the success rates of transferring:
	 a single embryo that had been carefully chosen as being of 'top quality' a non-selected single embryo two or more embryos.

Fig. 5.1 shows the results of this study.

5

[Total: 8]



(i) With reference to Fig. 5.1, explain why transferring a single top-quality embryo is now considered to be the best method to maximise the chance of a successful pregnancy.

[3]

(ii) State one ethical implication of transferring single top-quality embryos in IVF.

						17			
6			fur colour is co ticular order.	ontrolled by a	a gene with	multiple allel	es. These	alleles are lis	sted below
				black and ta agouti = C ^a	an = C ^{bt}		yellow = C black = C ^b	Ç.y O	
	(a)	Sug	gest explanat	ions for the r	esults of th	e following cro	osses betw	een mice.	
		(i)				mice with bloolack offspring		ay produce	all agouti
		(ii)	Crosses between ratio of two years	veen heteroz ellow mice to	ygous pare one black	ents with the g mouse.	jenotype C	^y C ^b always	produce a

	(iii)	Mice with yellow fur crossed with mice with black fur will produce one of the following outcomes:
		 some yellow offspring and some agouti offspring some yellow offspring and some black and tan offspring some yellow offspring and some black offspring.
		[2]
(b)	A te	st cross is used to determine the genotype of an organism.
		cribe how you would carry out a test cross to determine the genotype of a black and mouse.
		[2]
		[Total: 8]

7	(a)	Explain the advantages to a plant species of cross-pollination compared to self-pollination.
		[3]

(b) Some of the most important food plants for humans depend on insect pollinators, such as the honeybee, *Apis mellifera*.

Fig. 7.1 shows a honeybee.

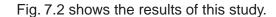


Fig. 7.1

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For Examiner's Use A study was carried out in 2006 to show how four food crops are pollinated.

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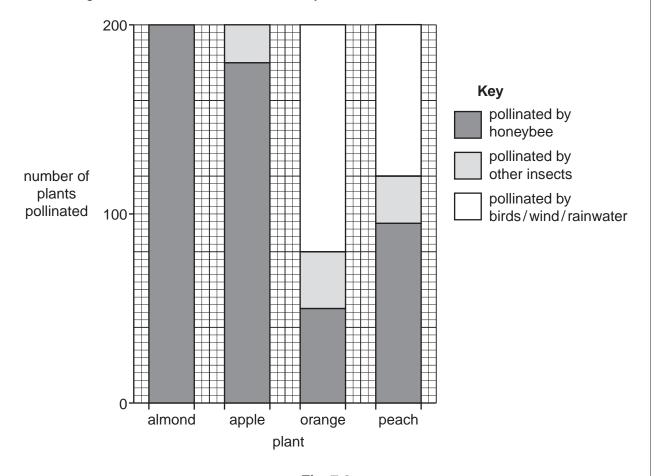


Fig. 7.2

The populations of honeybees in some parts of the world have declined in recent years.

(i)	With reference to Fig. 7.2, explain which crop will be most affected and which crop will be least affected by the decline in honeybees.	ρ
	most affected	
	land offerted	
	least affected	21

(ii)	Suggest reasons why honeybee populations have declined.	For Examiner's
		Use
	[3]	
	[Total: 8]	

8 (a) Fig. 8.1 outlines some steps in glucose metabolism in mammalian cells.

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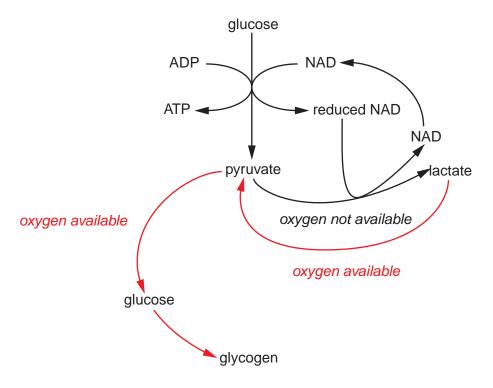


Fig. 8.1

With reference to Fig. 8.1:

(i)	name the part of the cell where glucose is converted to pyruvate
	[1]
(ii)	explain why, in the absence of oxygen, pyruvate needs to be converted to lactate
	[2]
(iii)	name the enzyme responsible for the conversion of pyruvate to lactate
	[1]
(iv)	name the type of reaction and the type of bonds formed when glucose molecules are used to make glycogen.
	reaction
	hands [2]

(b)		scribe how anaerobic respiration in yeast cells differs from anaerobic respiration in mmalian cells.	For Examiner's Use
		[4]	
(c)		respiratory quotient (RQ) is used to determine the type of respiratory substrate, h as carbohydrate or lipid, which an organism uses at any one time.	
	(i)	State how the RQ is calculated.	
		[2]	
	(ii)	State the typical RQ values obtained from the respiration of carbohydrates and lipids.	
		carbohydrate	
		lipid[2]	
	(iii)	Suggest what would happen to the RQ value when respiration becomes anaerobic.	
		[1]	
		[Total: 15]	

Section B

Answer **one** question.

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9	(a)	Describe how crossing over and independent assortment can lead to genetic variation. [9]
	(b)	Outline how artificial selection differs from natural selection. [6]
		[Total: 15]
10	(a)	Outline the process of the photolysis of water and describe what happens to the products of photolysis. [10]
	(b)	Describe the roles of gibberellins in stem elongation. [5]
		[Total: 15]

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