

**H1**

ANDERSON JUNIOR COLLEGE  
HIGHER 1  
JC2 MID YEAR COMMON TEST

NAME

PDG





INDEX NUMBER


**BIOLOGY****8875/02**

Paper 2 Core Paper

**18 September 2015****Friday  
2 hours**

Additional Materials: Answer Paper

**READ THESE INSTRUCTIONS FIRST**

Write your name and PD group on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graph or rough working.

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

**Section A**Answer **all** questions.**Section B**Answer **all** questions

All working for numerical answers must be shown.

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

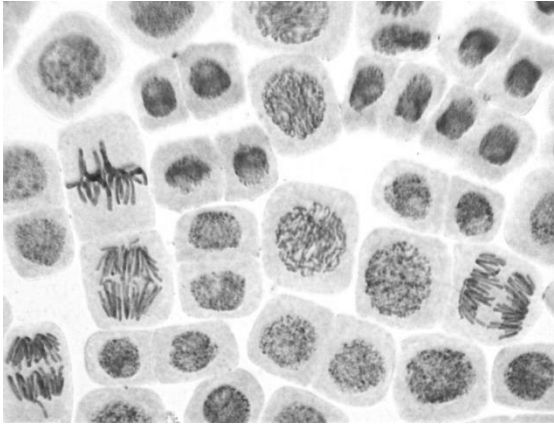
The number of marks is given in brackets [ ] at the end of each question or part question.

Calculators may be used

For Examiner's Use	
<b>PAPER 1</b>	
<b>1-30</b>	
	<b>30 marks</b>
<b>PAPER 2</b>	
<i>Section A</i>	<i>40 marks</i>
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<i>Section B</i>	<i>20 marks</i>
<b>5</b>	
<b>PAPER 2</b>	
	<b>60 marks</b>
<b><u>TOTAL</u></b>	
	<b><u>90 marks</u></b>

**Section A**

Answer **all** the questions in this section.

1	<p>Fig. 1.1 below shows cells of an organism in various stages of mitosis.</p>  <p style="text-align: center;">Fig. 1.1</p>							
(a)	<p>On Fig. 1.1, use labels and label lines to indicate one cell in each of the following stages of mitosis.</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th style="width: 33%;">Prophase</th><th style="width: 33%;">Metaphase</th><th style="width: 33%;">Anaphase</th></tr> </thead> <tbody> <tr> <td style="height: 30px;"></td><td></td><td></td></tr> </tbody> </table>	Prophase	Metaphase	Anaphase				[3]
Prophase	Metaphase	Anaphase						
(b)	<p>Explain how interphase ensures production of genetically identical daughter cells at the end of mitosis.</p>	[2]						
	<p>_____</p> <p>_____</p> <p>_____</p>							

	<b>(c)</b>	Most chemotherapeutic drugs against cancer are inhibitors that interfere with the function of microtubules. However, these drugs do not specifically target cancer cells. They also interfere with the function of normal cells and cause severe side effects.  To overcome this challenge, scientists use microtubule inhibitor drugs that replace a fixed structural element with a flexible hinge that swings open or shut in response to blue light.	
	<b>(i)</b>	Explain how interfering with the function of microtubules help to treat cancer.	[3]
		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	
	<b>(ii)</b>	State one function of microtubule in normal cells.	[1]
		<hr/>	
	<b>(ii)</b>	Suggest how light could cause structural changes in the drug.	[1]
		<hr/> <hr/> <hr/>	
			[Total: 10]

- 2 (a) A molecule of messenger RNA (mRNA) was produced during transcription of a gene.

Part of the template sequence of DNA was ATGC. Fig. 2.1 shows the part of the molecule of messenger RNA corresponding to that sequence of four bases.

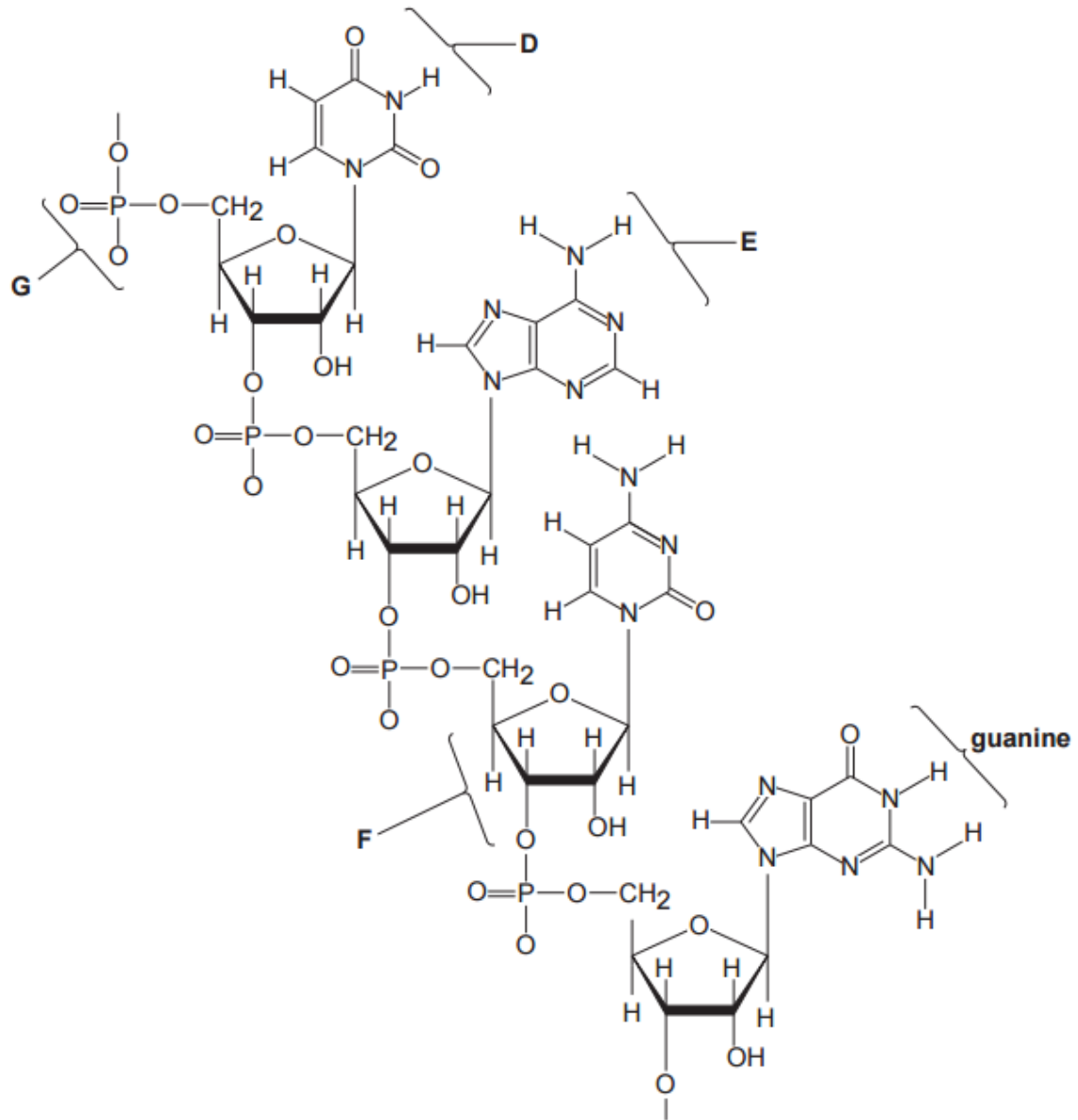


Fig. 2.1

Name the parts of the mRNA molecule shown in Fig. 1.2 labelled D, E, F and G.

D

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E

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F

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G

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(b) The amount of DNA and RNA bases are measured as shown in Fig. 2.2.

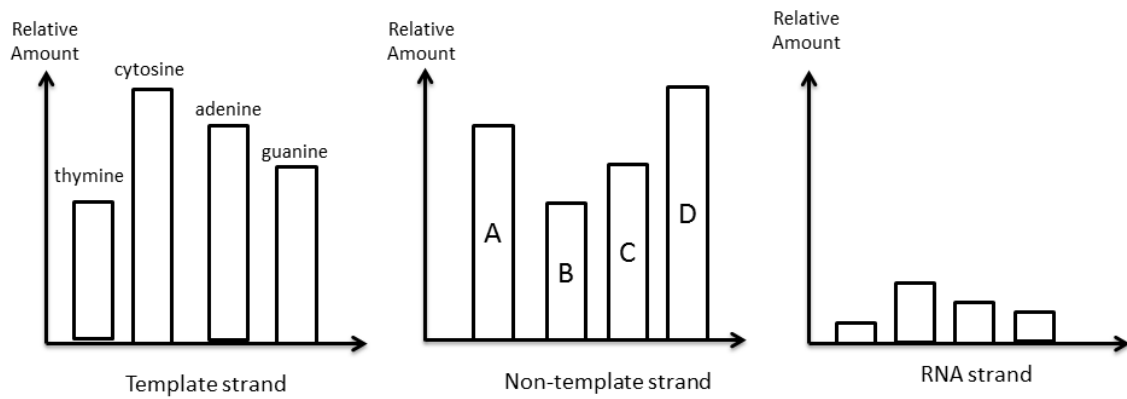


Fig. 2.2

(i) Name the bases A, B, C, and D

**A**

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**B**

.....

**C**

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**D**

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[2]

(ii) Explain why there are fewer bases for RNA strand.

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[2]

(c) Describe 2 features that make DNA a good information storage molecule.

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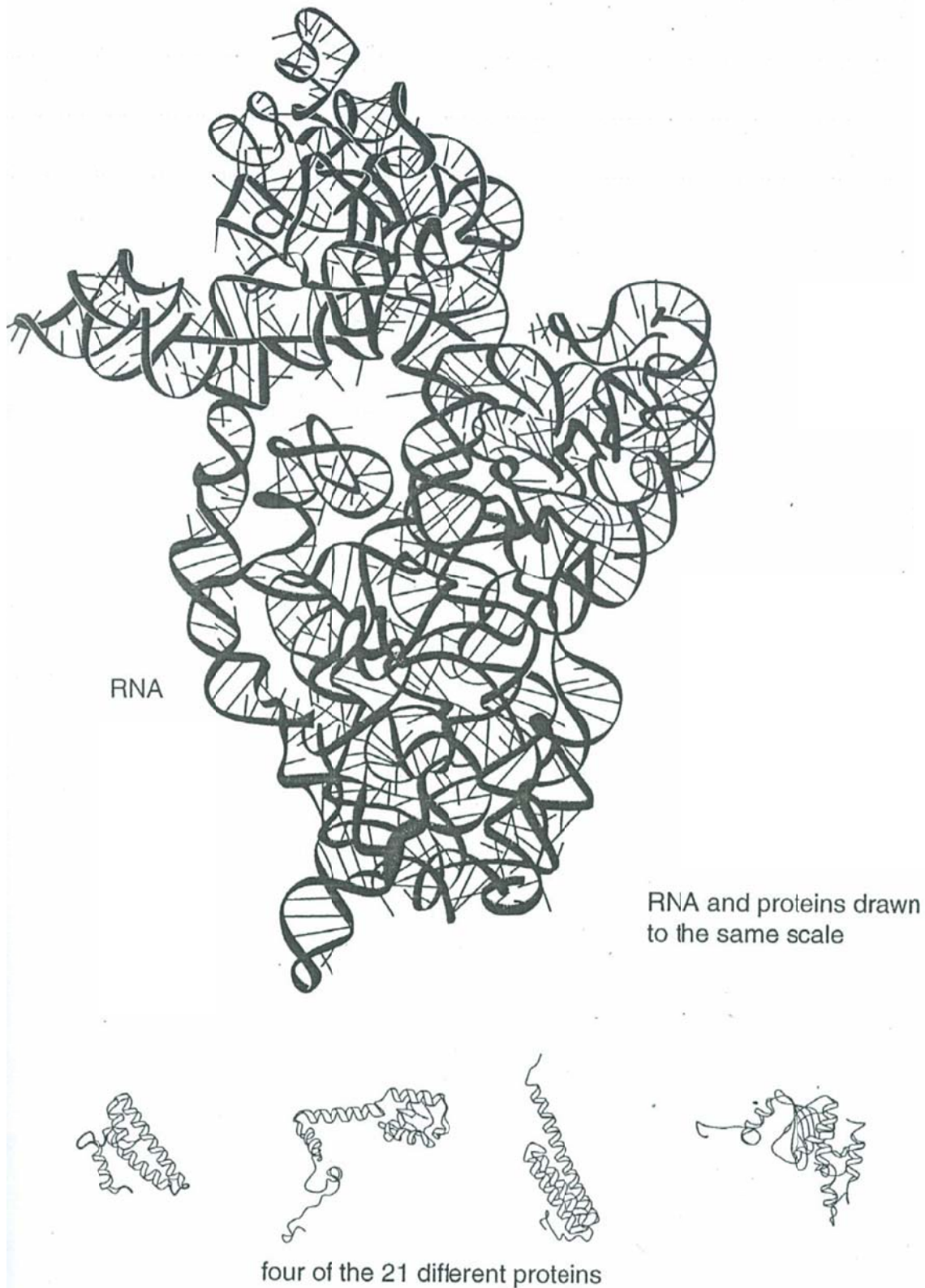
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[2]

Fig. 2.3 shows the molecule of RNA and four of the twenty one protein molecules that make up the small subunit of a ribosome. The individual molecules are shown separated so they can be seen clearly.



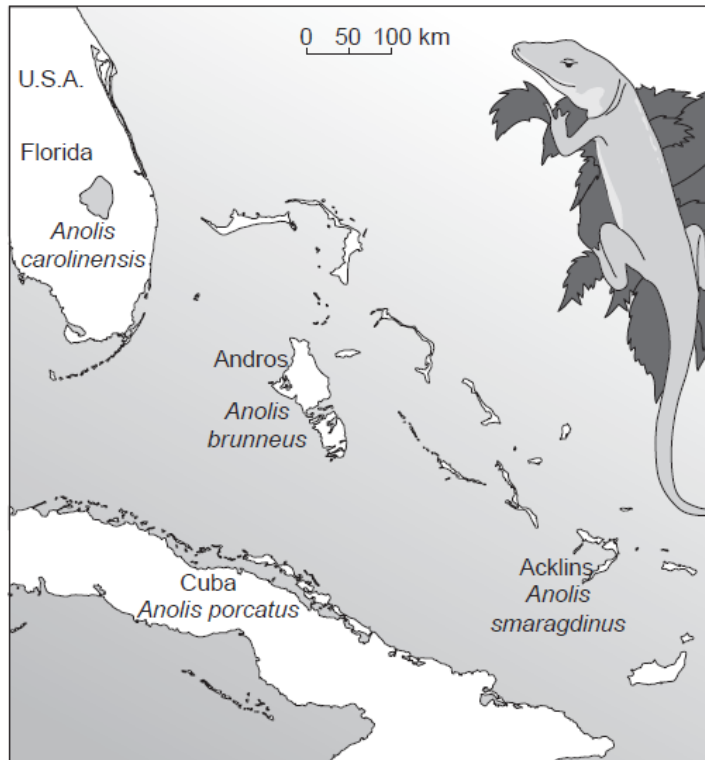
**Fig. 2.3**

- (d) Describe in what ways the helical structures that are shown in Fig. 2.3 in both RNA and protein molecules differ.



- 3 There are many species of the Anole lizards throughout the Caribbean and the surrounding mainland. Each species is found only on one island or a small group of islands, apart from *Anolis carolinensis* which is found in mainland Florida.

Fig. 3.1 shows the distribution of four species of anole lizards.



**Fig. 3.1**

An investigation using DNA analysis was carried out to establish the relationships between the four lizard species, using DNA analysis. The base sequences of a region of mitochondrial DNA from the four species were compared. The percentage differences in base sequences are shown in Table 3.1.

**Table 3.1**

	<i>A. brunneus</i>			
<i>A. brunneus</i>		<i>A. smaragdinus</i>		
<i>A. smaragdinus</i>	12.1		<i>A. carolinensis</i>	
<i>A. carolinensis</i>	16.7	15.0		<i>A. porcatius</i>
<i>A. porcatius</i>	11.3	8.9	13.2	

- (a) The researchers put forth the hypothesis that *A. brunneus*, *A. smaragdinus* and *A. carolinensis* all originated from *A. porcatius* in three separate events.

Explain how the results in Table 3.1 support the hypothesis.

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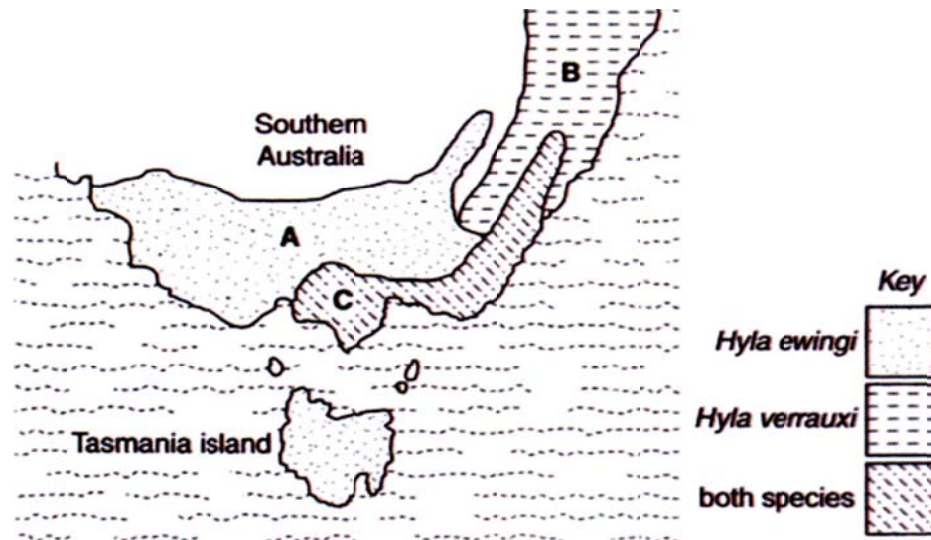
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Besides lizards, frog species are also frequently studied. **Fig. 3.2** shows the distribution of the tree frogs in Southern Australia.

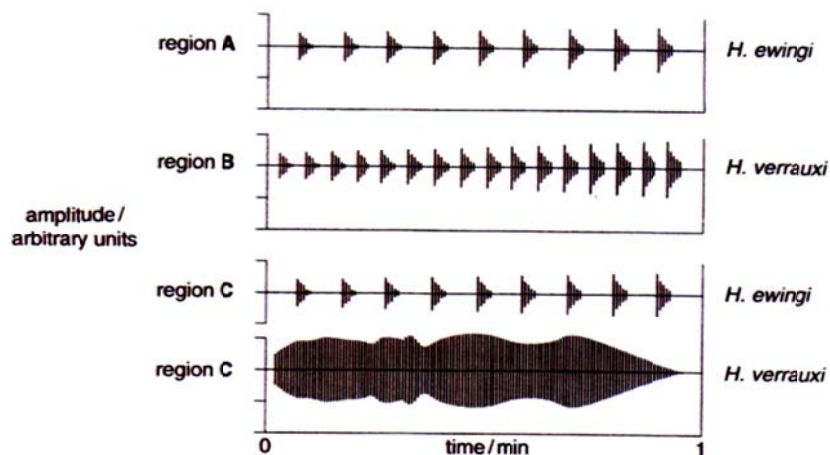


**Fig. 3.2**

*Hyla ewingi* and *Hyla verreauxi* are two closely related species of tree frogs from southern Australia. Research from breeding studies and DNA sequence data has shown that they have weak genetic incompatibility.

Male frogs attract females of the same species for mating by their pulsing call. The pulse rate of the male calls of the two species is almost identical. However, when both species coexist within the same region, the calls of *H. ewingi* are quite different than those of *H. verreauxi*.

**Fig. 3.3** shows the calls of *H. ewingi* and *H. verreauxi* from three regions, **A**, **B** and **C**. The male advertisement calls were recorded and played back electronically to produce the pattern shown.



**Fig. 3.3**

Some female frogs of the species *H. verreauxi* were transferred from region **B** to region **C**. Observations showed that they were not attracted by the calls of the males in region **C**.

(b)	Suggest why this is so.	
	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	[2]
(c)	Explain how the process of natural selection could have led to the different male advertisement call in <i>H. verreauxi</i> in region C.	
	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	[3]
(d)	It was suspected that <i>H. ewingi</i> and <i>H. verreauxi</i> have evolved from a common ancestor. Explain how this phenomenon could have arisen.	
	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	[2]
		[Total: 10]

- 4 Golden Rice™ is a genetically modified form of rice that produces relatively large amounts of  $\beta$  carotene in the endosperm.  $\beta$  carotene is metabolised in the human body to produce Vitamin A.

Fig 4.1 shows the metabolic pathway by which  $\beta$  carotene is synthesised in plants, and the enzymes that catalyse each step of the pathway.

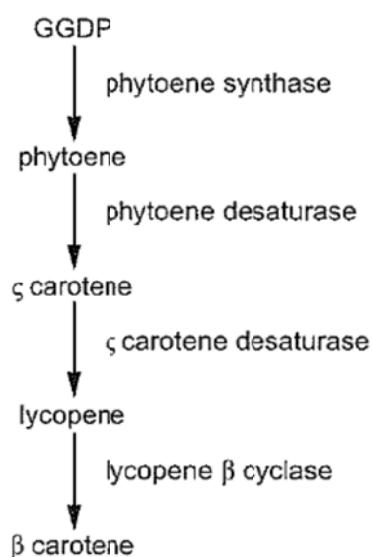


Fig. 4.1

The first types of Golden Rice™ contained a phytoene synthase gene, *psy*, from daffodils and a gene *crtl*, which produced the two desaturase enzymes, from the bacterium *Erwinia uredovora*.

It was found that the first types of Golden Rice™ produced only a very low mass of  $\beta$  carotene per gram of rice. Research continued to try to increase this.

Measurements of the quantities of intermediates in this metabolic pathway in rice endosperm showed that there was always a large amount of GGDP present, and that no phytoene accumulated in the tissues.

- (a) Explain how this suggests it was **not** enzymes produced by the *crtl* gene that were limiting the production of  $\beta$  carotene.

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- (b) Investigations were carried out to see if *psy* genes taken from species other than daffodils would enable rice endosperm to produce greater quantities of  $\beta$  carotene than the first types of Golden Rice<sup>TM</sup>.

- *Psy* genes were isolated from the DNA of maize, tomatoes, peppers and daffodils. The genes were inserted into different plasmids.
- The promoter *Ubi1*, and *crtI* genes from *E. uredovora*, were also inserted into all of the plasmids.
- The four types of genetically modified plasmids were then inserted into different cultures of rice cells.
- The quantity of  $\beta$  carotene produced by these rice cells was measured.

The results are shown in Table 4.1.

**Table 4.1**

Source of <i>psy</i> gene	Total $\beta$ carotene content of rice cells/ arbitrary units
Maize	14
Pepper	4
Tomato	6
daffodil	1

- (i) Explain why a promoter was inserted into the plasmids.

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[2]

- (ii) With reference to Table 4.1, evaluate the effectiveness of the various *psy* genes in increasing the carotenoid content of the maize calluses.

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[2]

- (iii) Explain whether or not these results support the hypothesis that the *psy* gene, not the *crtI* gene, was limiting the production of  $\beta$  carotene in genetically modified rice.

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[2]

	(c)	The original choice of a <i>psy</i> gene from daffodils was made because daffodils produce large amounts of $\beta$ carotene in their yellow petals, and because they are monocotyledonous plants, like rice.  Suggest explanations for the much lower production of $\beta$ carotene in rice containing the <i>psy</i> gene from daffodils than in rice containing the <i>psy</i> gene from maize.	
		..... ..... ..... ..... ..... .....	[2]
			[Total: 10]

**Section B**  
Answer **all** questions.

Write your answers on the separate answer paper provided.  
Your answer should be illustrated by large, clearly labeled diagrams, where appropriate.  
Your answers must be in continuous prose, where appropriate.  
Your answers must be set out in section (a), (b) etc., as indicated in the question.

5	(a)	Compare triglyceride and starch as a storage molecule.	[8]
	(b)	Describe the role of NAD in aerobic respiration.	[6]
	(c)	Explain what is meant by chromosome aberration.	[6]
			[Total: 20]
		<b>OR</b>	
6	(a)	Explain how fluidity of biological membranes can be maintained.	[8]
	(b)	Compare between the movement of insulin and glucose across the cell surface membrane. Explain the differences in their movement.	[6]
	(c)	State the similarities between ATP production in mitochondria and chloroplasts and suggest why these similarities exist.	[6]
			[Total: 20]