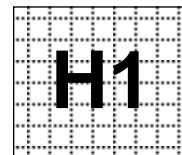


Civics Group	Index Number	Name (use BLOCK LETTERS)
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**ST. ANDREW'S JUNIOR COLLEGE  
2015 Preliminary Examination**

**H1 BIOLOGY**

**8875/2**

**Paper 2: Core**

Wednesday

2 September 2015

2 hours

Additional Materials: Answer Paper  
Cover Sheet for Section B

**READ THESE INSTRUCTIONS FIRST**

Write your name, civics group and index number on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

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

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

**Section A**

Answer **all** the questions.

**Section B**

Compulsory question to be answered on writing paper provided.

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 Examiner's Use	
Section A	
1	/11
2	/10
3	/9
4	/10
<b>Total</b>	<b>/40</b>
5 or 6	/20

This document consists of **9** printed pages.

**[Turn over**

## Section A

Answer **all** questions.

**QUESTION 1**

Amylase is an enzyme that catalyses the break down of starch into maltose. A student investigated the effect of increasing concentration of starch on the activity of amylase. He monitored the time taken for  $2.0 \text{ cm}^3$  of starch solution to be completely hydrolysed for six different concentrations of starch solutions (1.0, 2.0, 3.0, 4.0, 5.0 and  $6.0 \text{ moldm}^{-3}$  respectively). He used his results to calculate the rate of starch digestion and tabulated it in Table 1.1.

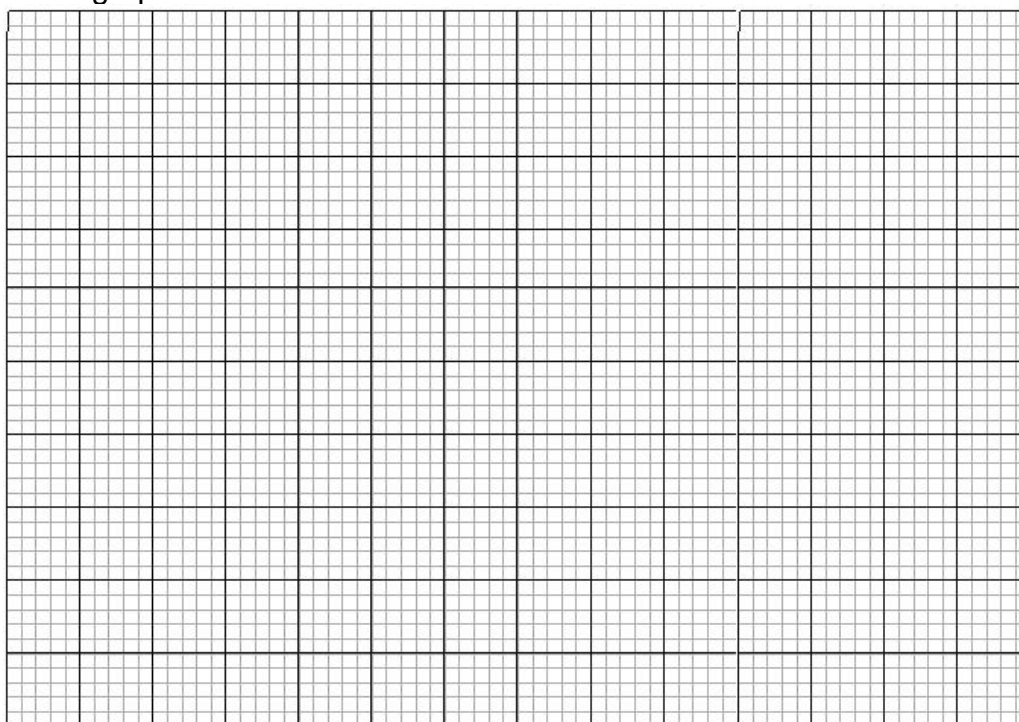
**Table 1.1**

Concentration of starch / $\text{moldm}^{-3}$	Rate of digestion / $\text{s}^{-1}$
0.0	0
1.0	11
2.0	21
3.0	30
4.0	36
5.0	38
6.0	38

- (a) Suggest and explain one way the student could easily monitor the complete hydrolysis of starch in his experiments.

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 .....  
 ..... [2]

- (b) Plot a graph of the data in Table 1.1.



[3]

(c) Account for the shape of the graph drawn in (b).

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..... [4]

(d) Relate one structural feature of starch to its function in plants.

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..... [2]

**[Q1 Total : 11]**

**QUESTION 2**

The shape of domestic pigs' tails is controlled by a single gene with two alleles.

Three possible phenotypes exist: corkscrew (Fig. 2.1), single-loop (Fig. 2.2) and unlooped (Fig. 2.3).



Fig. 2.1



Fig. 2.2



Fig. 2.3

When a sow with single-loop tail is mated with the same male with unlooped tail for multiple breeding seasons, they produced the following offspring:

25 single-loop tail

27 unlooped tail

(a) Using the letters **T** and **t**, draw a genetic diagram to show the results of the cross.

..... [5]

- (b) Warthogs also have tails that exhibit the cockscrew, single-loop and unlooped phenotypes. Unlike the cross in (a), however, when a female warthog with single-loop tail is mated with a male warthog with unlooped tail, they produced offspring in the ratio of 1 cockscrew tail : 1 single-loop tail : 2 unlooped tail. Suggest and explain a reason for this difference between the inheritance of 'tail curliness' in pigs and warthogs.

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.....[2]

- (c) Identical twins develop from two genetically identical zygotic stem cells. With reference to a named environmental factor, describe how each twin could have a different phenotype.

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.....[3]

**[Q2 Total : 10]**

**QUESTION 3**

*Astyanax mexicanus* is a single species of tetra fish consisting of a sighted surface-dwelling form (surfacefish) and many blind cave-dwelling forms (cavefish) from different caves. The cavefish have small eyes that do not work, but are able to navigate in the complete darkness of the caves by emitting pressure waves with their mouths. It was found that the surfacefish were more heavily parasitized by a bacteria which infected the eyes as they do not have a thick layer of scale-like tissue covering their eyes, which is present in the cavefish.

It was thought that the ancestral morph of *Astyanax mexicanus*, which lived some 1.2 million years ago, had functional eyes. They were slowly displaced from their river habitats by large predatory fish into smaller streams that flowed through caves.

- (a) Explain how natural selection could have resulted in the evolutionary change demonstrated here.

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- (b) The evolution of the *Astyanax mexicanus* was demonstrated by anatomical homology. Using a named example, discuss another type of homology evidence supporting natural selection.

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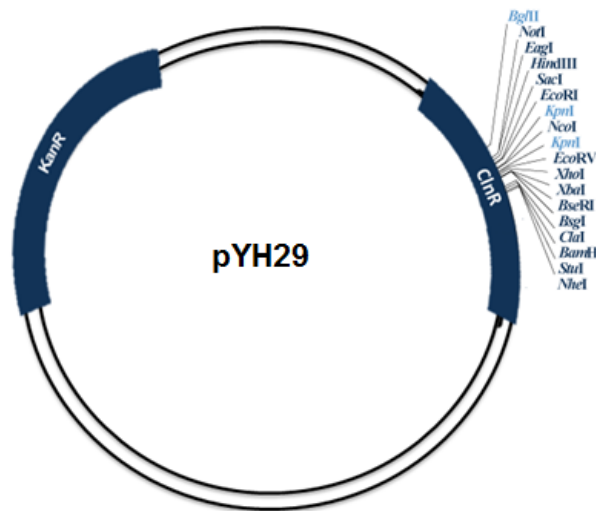
.....[4]

**[Q3 Total : 9]**

### QUESTION 4

Patients suffering from Life-threatening Multiple Thrombosis (LMT) are unable to synthesise sufficient amounts of platelet factor IV (PF4), which are released by activated platelets at sites of injury to promote blood coagulation. Recent advances in genetic engineering has seen preliminary success in cloning human PF4 gene into bacteria for the mass production of PF4 to be used in clinical treatments of LMT.

Fig. 4.1 shows the simplified map of the plasmid, pYH29, used in the cloning of PF4 gene. The selectable markers used are genes that confer resistance to two antibiotics: Kanamycin (KanR) and Clindamycin (ClnR).



**Fig. 4.1**

- (a) The amount of PF4 gene inserts obtained from reverse transcription of extracted mRNA is normally too little for successful cloning. Suggest one way to increase the amount of the PF4 gene inserts.

..... [1]

- (b) The PF4 gene insert was obtained from reverse transcribing extracted mRNA and cut it with *Hind*III (restriction enzyme). Describe and explain the subsequent procedures for cloning the PF4 gene into *E. coli* cells.

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- (c) Using both antibiotics, explain how the researchers ensure that only colonies which contain the PF4 gene insert are cultured in large quantities.

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**[Q4 Total : 10]**



## Section B

Answer **one** question.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections (a), (b) etc., as indicated in the question.

- 5 (a) Discuss the role of proteins in eukaryotic transcription. [6]  
(b) Describe the process of translation. [8]  
(c) Discuss the roles of mRNA, tRNA and rRNA in protein synthesis. [6]

**[Q5 Total: 20]**

**OR**

- 6 (a) Compare substrate level phosphorylation and oxidative phosphorylation. [6]  
(b) Explain the small yield of ATP under anaerobic conditions in both yeast and mammals. [8]  
(c) State the similarities between ATP production in mitochondria and chloroplasts and suggest why these similarities exist. [6]

**[Q6 Total: 20]**