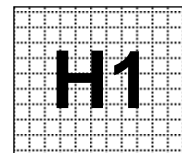


Civics Group	Index Number	Name (use BLOCK LETTERS)
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**ST. ANDREW'S JUNIOR COLLEGE**  
**2017 Preliminary Examination**

**H1 BIOLOGY**

**8875/2**

**Paper 2: Core**

Tuesday

12 September 2017

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	/16
2	/12
3	/12
Sub-total	/40
Section B	
4 or 5	/20
Total	/60

This document consists of **11** printed pages.

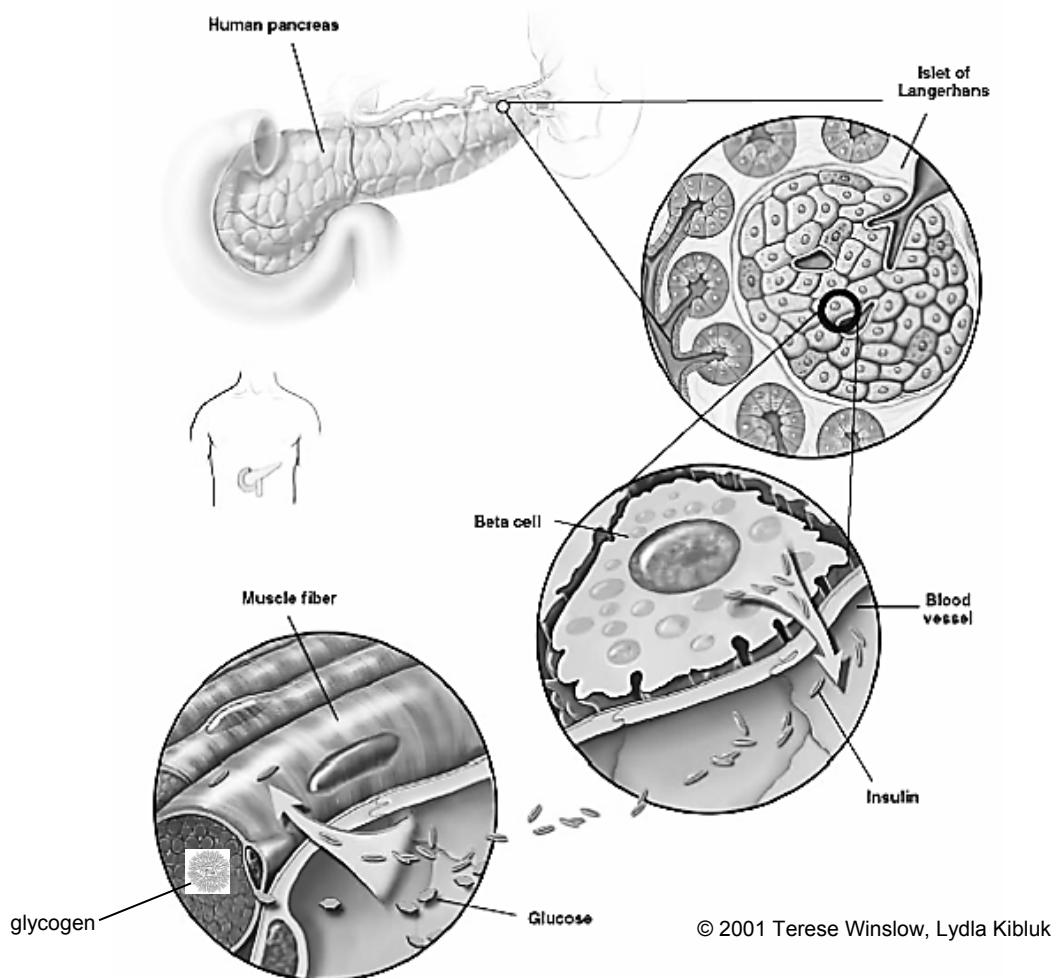
**[Turn over**

## Section A

Answer **all** questions.

### QUESTION 1

Hormones, insulin and glucagon, are proteins that regulate the concentration of blood glucose level. Type 2 diabetes is characterized both by insulin resistance, a condition in which various tissues in the body no longer respond properly to insulin action, and by subsequent progressive decline in beta ( $\beta$ )-cell function to the point that the cells can no longer produce enough additional insulin to overcome the insulin resistance. Researchers are actively exploring use of stem cells as a potential source of deriving new  $\beta$ -cells to treat type 2 diabetes.



**Fig. 1**

The pancreas is located in the abdomen, adjacent to the duodenum (the first portion of the small intestine). A cross section of the pancreas shows the islet of Langerhans which is the functional unit of the endocrine pancreas. Encircled is the beta cell that synthesizes and secretes insulin. Beta cells are located adjacent to blood vessels and can easily respond to changes in blood glucose concentration by adjusting insulin production.

- (a)** Cells that secrete proteins contain a lot of rough endoplasmic reticulum (rER) and a large Golgi body.

**(i)** Describe how the rER is involved in the production of insulin.

.....  
.....[1]

**(ii)** Describe how the Golgi body is involved in the secretion of insulin.

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

- (b)** Using type II diabetes as an example, explain how environment affects phenotype.

.....  
.....  
.....  
.....  
.....  
.....[3]

- (c)** Insulin binds to receptors on the membrane of the muscle cells allow entry of glucose into the muscle cells leading to a lowering of blood glucose concentration. Suggest how a change in the amino acid sequence of the receptor found in the plasma membrane of the muscle cell could make the cell resistant to insulin.

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

**(d)** Describe how phospholipids are arranged in a plasma membrane.

.....

.....

.....

.....

.....

.....[3]

**(e)** Phospholipids are a type of lipid. Lipids, in general, are made up of glycerol and fatty acids monomers covalently bonded together. Name the covalent bond and describe the breakage of this bond.

.....

.....

.....

.....[2]

Experiments have indicated that pancreatic stem cells (PSCs) can serve as sources of insulin secreting cells.

**(f)** State the source of PSCs and explain the PSCs' normal functions.

.....

.....

.....

.....[2]

**(g)** Suggest an advantage of using the patient's own PSCs to regenerate tissue or organs.

.....

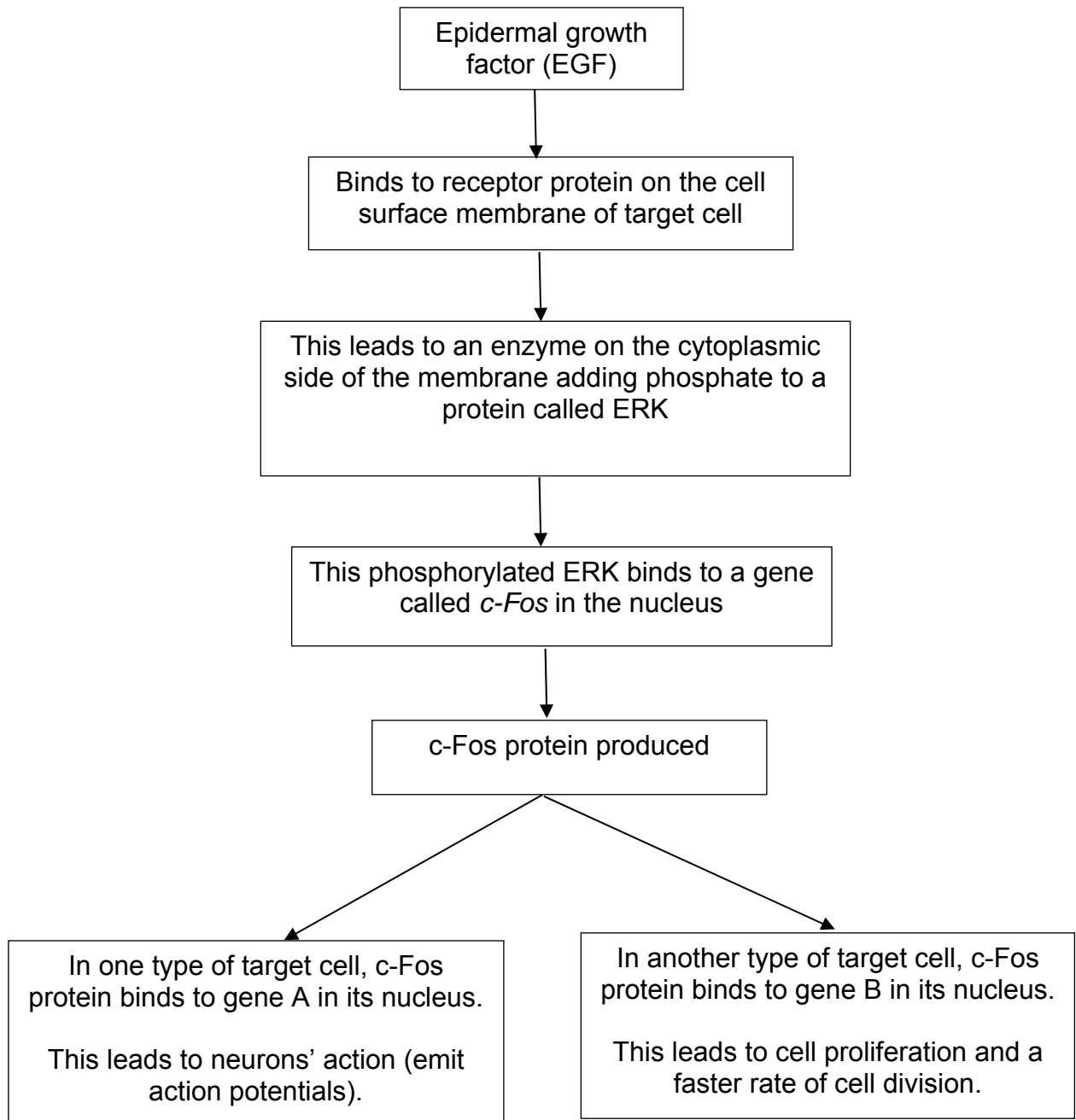
.....[1]

**[Q1 Total: 16]**

**QUESTION 2**

Epidermal growth factor (EGF) is released by cells, and is picked up either by the cell itself or by neighboring cells. It regulates the production of a number of proteins in target cells. Protein produced and its effect depends on the type of target cell.

Fig. 2 shows how EGF regulates 3 genes.



**Fig. 2**

(a) Name the **two** transcription factors in Fig. 2.

.....  
 .....[1]

(b) Dysregulation of checkpoints of cell division allows gene mutations, e.g. *c-Fos* gene, to occur spontaneously and accumulation of gene mutations can result in uncontrolled cell division and cancer.

(i) During which part of the cell cycle are gene mutations most likely to occur?

.....[1]

(ii) Suggest an explanation for your answer in (b)(i).

.....  
 .....[1]

(c) Gene B has been associated with a significant number of human cancers. Scientists used polymerase chain reaction (PCR) to make multiple copies of gene B extracted from a patient's cancer tissue sample.

The reaction mixture includes the sample of DNA to be copied plus the following ingredients:

- DNA primers
- buffer solution
- heat-stable DNA polymerase (Taq polymerase)
- deoxyribonucleoside triphosphates (deoxyATP, deoxyTTP, deoxyCTP and deoxyGTP)

(i) Suggest why a buffer needs to be present in the reaction mixture.

.....  
 .....[1]

(ii) The deoxyribonucleoside triphosphates that are added to the reaction mixture are the monomers used for making the new DNA strands.

Suggest **one further** reason for adding the deoxyribonucleoside triphosphates to the reaction mixture.

.....  
 .....[1]

- (iii) In the first stage of PCR, the mixture is heated to a temperature of around 90°C to denature the DNA. Suggest why high temperatures are needed to separate the two DNA strands.

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

- (iv) At the end of several cycles of PCR, many copies of the DNA sample in the reaction mixture will have been made. The DNA samples are then separated out to produce a DNA banding pattern.

State the technique used to separate out the DNA samples **and** describe how this technique works.

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....[4]

- (d) Methotrexate is a drug used in the treatment of cancer. It is a competitive inhibitor and affects the enzyme folate reductase.

Explain why this drug does not affect other enzymes.

.....  
 .....[1]

**[Q2 Total : 12]**

**QUESTION 3**

- (a) An example of an aquatic salamander, the olm, *Proteus anguinus*, is shown in the photograph below. This species is an amphibian endemic to the caves of Slovenia and Croatia.

Olms have a number of special adaptations: external gills as adults, undeveloped eyes, lack of skin pigmentation and a slow metabolic rate.



Magnification  $\times 0.1$

- (i) Explain what is meant by the phrase 'endemic to the caves of Slovenia and Croatia'.

.....  
.....[1]



Suggest how natural selection could have led to the evolution of the olm.

.....[5]

- (b)** A transgenic animal is one that carries a foreign gene that has been deliberately inserted into its genome. The foreign gene is constructed using recombinant DNA methodology. In addition to the gene itself, the DNA usually includes other sequences to enable it to be expressed correctly by the cells of the host.

Atlantic salmon (foreground) which normally grows in Spring and Summer was genetically modified to produce the Aquadvantage<sup>®</sup> salmon (background).



### Fig.3.1

Credits : <http://foreverconscious.com/wp-content/uploads/2014/04/gmo-salmon-compare.png>

- (i) Explain why the genetically engineered Aquadvantage<sup>®</sup> salmon (GM salmon) is considered a transgenic animal.

.....[2]

- (ii) Describe the **effect** of the genetic modifications carried out on the GM salmon.

.....  
 .....[1]

- (iii) Explain the significance of the transgenic GM salmon in solving the demand for food in the world.

.....  
 .....[1]

- (iv) State one ethical and one environmental implications of GM salmon.

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

**[Q3 Total : 12]**

## 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.

- 4**    **(a)**    Explain what is meant by primary, secondary, tertiary and quaternary structure of haemoglobin. [10]
- (b)**    Haemoglobin is a globular protein. Using a named example of fibrous protein, give **three** differences between fibrous and globular proteins. [3]
- (c)**    Explain how the allele for haemophilia may be passed from a man to his grandchildren.

You may use genetic diagrams to support your answer. [7]

**[Q4 Total: 20]**

**OR**

- 5**    **(a)**    Describe the structure of a chloroplast. [6]
- (b)**    Describe how, in photosynthesis, light energy is converted into chemical energy, in the form of ATP. [8]
- (c)**    Outline the steps of the Calvin cycle. [6]

**[Q5 Total: 20]**

- **END OF PAPER** -