BSc Degree Examinations 2018-9

Department: BIOLOGY

Title of Exam: Introduction to Biomedical Sciences Part II

Time Allowed: 1.5 hours

Marking Scheme:
Total marks available for this paper: 50
The marks available for each question are indicated on the paper

Instructions:
Answer all questions in the spaces provided on the examination paper

For marker use only:

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Total as %

DO NOT WRITE ON THIS BOOKLET BEFORE THE EXAM BEGINS
DO NOT TURN OVER THIS PAGE UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR
1. The velocity of blood flow is slowest in the capillaries. How is this achieved and why is this important? (4 marks)

2. Explain why blood in the coronary sinus drains into the right atrium. (3 marks)

3. Explain why mice that are negative for the Scl gene die in utero. (3 marks)

4. Why are beta blockers such as propranolol contraindicated in individuals with asthma or Chronic Obstructive Pulmonary Disease (COPD)? (2 marks)
5. a) Rett syndrome is caused by mutations in the gene encoding which protein?  

(1 mark)

b) Draw an ECG trace that you would expect to record from a healthy girl and an ECG trace you would expect to record from a girl with Rett syndrome who also presents with long QT syndrome. Label the different ECG waves.  

(2 marks)

c) Describe how DNA methylation changes across postnatal development in neurons.  

(3 marks)

THE SPACE ABOVE THIS LINE SHOULD BE SUFFICIENT FOR YOUR ANSWER
6. a) Shade and label the diagram below to highlight the brain region where alpha waves appear upon eye closing. (1 mark)

![Brain Diagram](image1)

b) Shade the thalamus in the diagram below. State the subdivision of the thalamus that sends axons to the brain region mentioned in a) above. (2 marks)

![Brain Diagram](image2)
7. You record electrical activity between an electrode inserted in a neuron and an electrode in the conducting fluid outside.

a) The figure below shows changes in membrane potential in response to a 0.5 mA current injection before (A) and after the addition of the mitochondrial inhibitor cyanide (B). Explain the effect of cyanide. (4 marks)

![Graph A: 0.5 mA current injection before cyanide addition with voltage changes over time.]

![Graph B: 0.5 mA current injection after cyanide addition with voltage changes over time.]

b) The figure below shows a separate experiment whereby you record Na^+ currents
\( I_{Na} \) (blue lines) in response to a voltage step (purple lines) before (A) and after the addition of pronase (a protease, B). Describe the effect of pronase treatment on \( I_{Na} \) and state the molecular basis for this effect.

(4 marks)

8. Explain the consequence of a mutation resulting in a non-functional testosterone receptor on gonad and external genitalia development in XY embryos.

(4 marks)

THE SPACE ABOVE THIS LINE SHOULD BE SUFFICIENT FOR YOUR ANSWER
9. A study was performed to determine if there is a link between serum progesterone concentration and risk of spontaneous miscarriage. Describe the data in the table below and explain the role of progesterone during pregnancy.

<table>
<thead>
<tr>
<th>Serum progesterone (ng/ml)</th>
<th>Percentage of pregnancies that ended in spontaneous miscarriage</th>
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<tbody>
<tr>
<td>0–4.9</td>
<td>85.5 %</td>
</tr>
<tr>
<td>5.0–9.9</td>
<td>65.8 %</td>
</tr>
<tr>
<td>10.0–14.9</td>
<td>31.3 %</td>
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<tr>
<td>15.0–19.9</td>
<td>9.8 %</td>
</tr>
<tr>
<td>20.0–24.9</td>
<td>7.7 %</td>
</tr>
</tbody>
</table>

(3 marks)

10. A male patient is affected by an X-linked dominant disease for which the causative genetic mutation has not been identified. His female partner does not suffer from the disease. Explain which preimplantation genetic diagnosis approach(es) would be suitable to ensure that the child of the couple is not affected by the X-linked dominant disease. Consider both the biopsy approach and the genetic testing method.

(5 marks)
11. Explain why only one follicle reaches full maturity during the follicular phase of a menstrual cycle. (5 marks)

12. Is Tamoxifen an agonist or antagonist at estrogen receptors? Explain your answer. (4 marks)