**UNIT 3 ATAR HUMAN BIOLOGY**

**Task 5 – How biotechnology is being used to treat endocrine**

**and nervous dysfunction**

**NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ WEIGHTING: 7.5 %**

**DUE DATE: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ MARK: \_\_\_\_\_\_ %**

* **Part 1**: one week to research topic and complete notes. These are to be handed in **prior** to the in-class validation.
* **Part 2:** one hour for in-class validation comprised of extended response exam style questions.

## Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**The use of biotechnology to treat endocrine and nervous dysfunction.**

New advances in medical technologies are enabling the development of new treatments for conditions caused by endocrine and nervous dysfunction. Although the knowledge of the use of stem cells has been around for a long time failed trials and lack of funding have meant that new treatments are yet to reach the markets and are still in the research phase. However, as knowledge of how the conditions develop and what causes the conditions to develop advance more precise treatments can be trialled.

**Part 1: Research (one week) *(10% weighting)***

You are going to carry out research on the following conditions and their new treatments that are heading for the market using biotechnology.

**Make research notes on the following:**

1. The causes and symptoms of Parkinson’s disease and Alzheimer’s disease.
2. The causes and symptoms of Hypothyroidism and Type I Diabetes.
3. The process of Gene therapy and Stem cell Replacement therapy.
4. The potential use of gene therapy to treat Alzheimer’s disease with reference to the genes ApoE4 and ApoE2.
5. A comparison of the use of gene therapy and Levodopa to treat Parkinson’s disease.
6. The reasons why stem cell replacement therapy is not being looked at as seriously as gene therapy as treatments for Alzheimer’s and Parkinson’s disease.
7. How progenitor cells (stem cells) are being used to treat Type I Diabetes and why the use of technologies such as “Cell in the box”/capsules/tubular chambers are needed to help the treatment be successful.
8. How recombinant DNA technology is being used to manufacture thyroxine for the treatment of Hypothyroidism.

**Part 2: In-class assessment (one hour) *(90% weighting)***

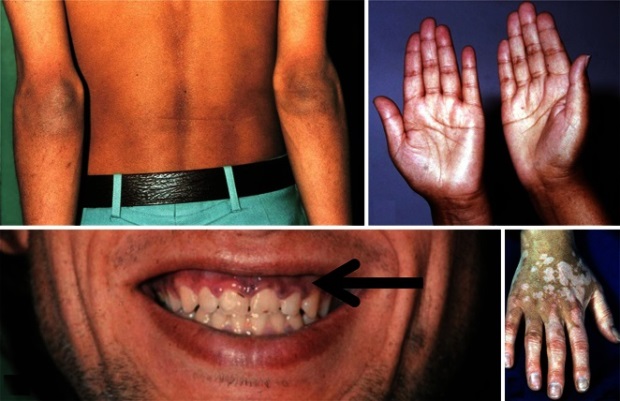
* You will be given specific examination style questions based on the topic you have researched.
* Notes will **not** be allowed for this task.

**Questions:**

1. Describe two symptoms a person would show if they had Parkinson’s and explain why they would occur.

*(3 marks)*

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The below images are of people with Addison’s disease.

1. Addison’s disease (Primary) is brought about by the dysfunction of the adrenal glands; the adrenal cortex does not produce enough cortisol as the persons own immune system has attacked the cells in the cortex causing damage.
2. Explain which treatment, gene therapy or stem cell replacement therapy, would be the most effective to treat a person with Addison’s disease. *(3 marks)*

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1. Addison’s disease is currently treated with hormone replacement therapy involving synthetic cortisol. Describe, in detail, the process by which synthetic cortisol would be made. *( 6 marks)*

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1. Explain why a capsule is required to maximise the success of treatment using progenitor cells (kind of stem cells therapy) for Type I diabetes.  *(3 marks)*

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1. Outline the general procedures that would occur for an Alzheimer’s patient to be treated using gene therapy

*(5 marks)*

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5. Describe the problems associated with administering dosages of Levodopa to patients suffering from Parkinson’s disease. (3 marks)

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**Read the article on Nanobots before answering Question 6 below.**

Nanobots are currently being investigated to determine their effectiveness at replacing the destroyed Beta Cells in the Islets of Langerhans. In studies, researchers have found that the Nanobots need to be able to do two things in order to effectively replace these cells; firstly, they must be able to carry and release insulin.

6. a) Predict what the second necessary feature of these Nanobots is and explain why it is crucial that the Nanobots have this feature if they are to be used as a long-term treatment for Type 1 Diabetes.  *(3 marks)*

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b) Nanobots could also be used to treat Hashimoto’s, an autoimmune disease in which the cells of the thyroid are destroyed.

* 1. Suggest two symptoms a person suffering from Hashimoto’s would experience if they were not medicated. *(2 marks)*

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* 1. Explain how Nanobot technology could be used to treat Hashimoto’s disease.

*(3 marks)*

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Read the following article

1. The following text has been adapted from a 2018 article on Nanowerk.com

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**Nanotechnology based drug delivery systems for nanomedicine**

*September 18th, 2018*

Development of an effective approach for delivering a new drug is as important as inventing a new drug. Even if a developed new drug has excellent therapeutic properties, it shows its potential activity in the body only when it is exactly targeted to specific molecules.

Various nanotechnological approaches for effective drug delivery have been developed and some of them have already been successfully commercialised. Most prominent nano-drug delivery systems that are in market place are cancer/tumour related.

Bioavailability – the problem with conventional drug delivery

The bioavailability of a drug within the body depends on several factors like the size of the drug molecules and solubility. Conventional dosage forms therefore face challenges in reaching the target site at appropriate dose. For example, conventional dosage forms of some of the highly water-soluble drugs cause fluctuations in drug concentration in the body due to high disintegration properties and also result in faster clearance of the drug from the blood stream.

Other drugs are fat soluble and when taken in conventional dosage forms may cause bioavailability problems. Similarly, patients suffering from chronic diseases like diabetes need to take painful insulin injections on a regular basis. Cancer patients regularly have to undergo powerful chemotherapy, which involves quite severe side effects as the anticancer drugs target cancer cells and normal cells equally. Hence, proper platforms to deliver the drugs at targeted sites without losing their effectiveness, while limiting the associated side effects, are highly required.

Many novel technologies for developing effective drug delivery systems have been developed; among these nanotechnology  platforms for achieving targeted drug delivery are gaining prominence these days. Research in this field includes the development of drug nanoparticles, polymeric and inorganic biodegradable nanocarriers for drug delivery, and surface engineering of carrier molecules.

These nanocarriers help in making fat based drugs soluble, protecting fragile drugs from enzymatic degradation, pH conditions, etc., and targeting specific sites with triggered release of drug contents.

Nanobots

Nanobots or nanomotors are advanced sub-micron sized, self-driven, biodegradable nanodevices made of bio-nano components, which carry cargo to the target sites. Basically tiny molecular sized robots that can move through the body’s blood stream and tissues. These robots can carry tiny microchips as well as drugs, hormones, even radioactive material. And, as with robots, they can be programme.