Free Response Questions – Application Syllabus

Instructions to students:

- **Revise** the relevant section/s of your lecture notes, tutorials, tests and exams after looking at each question.
- **Memorize** these relevant section/s before writing your answers. If you forget any point while writing, revise again and re-write the entire answer. Do not cheat by just looking at the notes and adding on the points to your answer – you are merely cheating your own learning!
- The marks allocated for each question is a rough gauge of how many points there should be in your answer – they are not the absolute number of points. Thus, if you have more points than the marks allocated, write everything down. **Highlight / underline all the key words and phrases in your answers.** This set of answers can serve as your revision notes in future, if it is well done.
- Pace your learning. Attempt **10 questions a day, everyday** and you will finish revising and memorizing the Biology syllabus before the end of Term 3!

Isolating, Cloning and Sequencing DNA

1. Describe the natural function of restriction enzymes and its role in formation of recombinant DNA molecule. [8]
2. [N2014/P3/Q5] Describe and explain the properties of plasmids that allow them to be used as DNA cloning vectors. [7]
3. [N2009/P3/Q4] Distinguish between a genomic DNA and cDNA library. [6]
4. [N2014/P3/Q5] Eukaryotic genes cannot be expressed directly in the bacterial plasmid because of differences between prokaryotes and eukaryotes, including the presence of introns.
   Outline these problems and explain how they are overcome in order to allow expression of eukaryotic genes in plasmids within E.coli cells. [7]
5. [N2013/P3/Q5] Therapeutic genes can be introduced into stem cells. Discuss why the genes used are more likely to be obtained from a cDNA library, than a genomic DNA library. [7]
6. [N2014/P3/Q5] A eukaryotic gene is isolated with blunt ends. Outline the procedures for cloning this gene in a bacterial plasmid. [6]
7. [N2009/P3/Q4] Outline the large-scale production of a **named** important protein by genetic engineering. [8]
8. Describe the polymerase chain reaction (PCR) and explain the advantages and limitations of this procedure. [8]
9. [N2011/3/Q5] Explain how gel electrophoresis is able to separate fragments of DNA [6]
   Explain how gel electrophoresis is used to analyse nucleic acids and proteins and to distinguish between two alleles of a gene. [8]
10. Outline the process of nucleic acid hybridisation and explain how it can be used to detect and analyse restriction fragment length polymorphism (RFLP). [8]
    [N2011/3/Q5] Explain what is meant by restriction fragment length polymorphism (RFLP) and how it can be detected. [6]
11. Describe how restriction fragment length polymorphism analysis can be carried out. [15]
12. Explain how RFLP analysis facilitated the process of
    (i) genomic mapping, [6]
    (ii) diseases detection, [4]
    (iii) DNA fingerprinting [4]

[N2011/3/Q5] Explain how RFLP analysis has helped the process of detecting a named genetic disease. [8]

13. [N2008/P3/Q4] Discuss the aims/ goals of the human genome project. [6]
14. [N2008/P3/Q4] Discuss the benefits of the human genome project. [8]
15. [N2008/P3/Q4] Discuss the ethical concerns that have arisen about the human genome project. [6]

Applications of Molecular and Cell Biology

1. Explain the unique features of stem cells and the normal functions of stem cells in a living organism. [8]
2. [N2013/P3/Q5] Describe features of zygotic stem cells and embryonic stem cells that distinguish them from each other. [5]
3. [N2013/P3/Q5] Describe the features of blood stem cells and explain their normal functions. [8]
4. [N2007/P3/Q4] With reference to genetic diseases
    a. Describe SCID (severe combined immunodeficiency) and cystic fibrosis. [8]
    b. Explain gene therapy treatment, using both viral and non-viral delivery systems. [6]
5. Describe a type of genetic disease that can be treated with gene therapy. [7]
   [N2015/P3/Q5] Describe the cause and symptoms of the genetic disease cystic fibrosis/ SCID. [7]
6. [N2015/P3/Q5] Explain how a disease such as cystic fibrosis can be treated by gene therapy, using **non-viral** delivery systems. [5]
   Explain how a disease such as SCID can be treated by gene therapy, using **viral** delivery systems. [5]
7. [N2007/P3/Q4] Discuss the factors that keep gene therapy from becoming an effective treatment for genetic diseases. [6]
8. Discuss the social and ethical considerations for the use of gene therapy. [5]
   [N2015/P3/Q5] Describe **four** problems that may be associated with using a **viral vector** to introduce an allele into the cells of a person with a genetic disease. For **each** problem, explain the related ethical issues that should be considered. [8]
9. Discuss the process by which plants are cloned. [6]
   [N2012/P3/Q5] Describe how plant tissue culture is used to clone plant cells. Explain the scientific reasons for each step in the process. [8]
10. [N2010/P3/Q4] Discuss the role that cloning in plants could play in such crop improvements. Include, in your discussion, any advantages or disadvantages of such cloning. [8]
11. [N2012/P3/Q5] Discuss the social implications of genetically modified crop plants. [6]
12. [N2010/P3/Q4] Explain the significance of genetic engineering in improving the quality and yield of crop plants and animals in solving the demand for food in the world. [12 (6m – quality; 6m – yield)]
13. Discuss the ethical and social implications of genetically modified organisms. [6]
14. [N2012/P3/Q5] Comment on the statement 'Genetically modified crop plants and animals should be treated as new species'. [6]