Biology and Life Sciences

**Question 1**

*Part a*

SARS was appeared to be the first severe pandemic that emerged in the 21st century. Some of the personal physical barriers such as isolation of patient were done and they managed according to the infection control strict procedures. Infection control practices were enhanced such as frequent washing of hands, awareness regarding not touching nose, mouth an eyes with unclean hands, people start using face masks in public places. People start wearing disposable gloves before touching any infected bodily fluids.

As SARS is spread by close person to person contact. This virus is usually spread by a respiratory droplet that is produced when the person with this disease sneeze or cough. Use of the face mask in the public places played a very important role in the spread of this disease. This virus is also spread when the person touches an infected surface and then touches his mouth eyes and nose. Hand washing strategy played a very important role in the prevention of this disease. Secondly health care professionals and other used gloves which also prevent the spread of this disease.

Spanish flu epidemic occurs in 1918-1919. At that time no vaccine present can protect against this infection. Secondly, there were no antibiotics that can be used to treat the secondary infections associated with the Spanish flu.

The Spanish flu virus is caused by the H1N1 virus whereas SARS is caused by a coronavirus. Currently, there is no vaccine available to treat SARS infection

*Part b*

The flu shot is an inactive vaccine and is made by using a dead virus, the vaccine protects against whereas the nasal spray flu vaccine is made up of live but weakened virus.

*Part c*

Life expectancy in America has been declined from 78.7 to 78.6. The reason for this decline can be due to increased suicide rate, drug overdose and chronic liver diseases.

*Part d*

Cell replacement therapy is defined as transplantation of human cells to repair or replace damaged cells.

*Part d: 1*

Two types of cell therapy such as neuroprotection and cellular replacement are used to treat the neurodegenerative disorder. Different types of cells such as mesenchymal stem cells, hematopoietic stem cells, skeletal muscle stem cells, dendritic cells, lymphocytes, and pancreatic islet cells are used in cell replacement therapy. In cell replacement cell is grafted into a damaged neuronal subtype whereas in neuroprotection support is given to the residual neuron.

*Part d: 2*

No, these methods are not commonly used now as exact neurodegeneration mechanism is highly complicated to treat the neurodegenerative disorder.

**Question 2**

Scaffold: It is a framework that holds tissue and cells together. The scaffold should be biocompatible and have nontoxic properties.

It should be a three-dimensional structure with interconnected porous networks that helps in the growth of cell and transport of metabolic waste and nutrient.The scaffold should be biodegradable and have appropriate degradation rate so that it can mimic the growth of cell and tissue in vivo and invitro.

**Question 3**

Transgenic bacteria are bacteria that are genetically altered to produce a necessary and specific gene. These types of alteration involve the insertion of required genes in the DNA. A specific gene is selected by using the restriction enzymes they are extracted from. Then this gene is inserted into a bacteria. As these bacteria are single-celled organism the gene is only inserted once and because bacteria multiply very fast.

The process that is involved with mycobacterium spegmatis is gene cloning. It is a process of isolating and then making many copies of a gene. It is useful for many purposes such as to isolate and then make many copies of a normal gene in the process of gene therapy. It involves four steps:

**Isolation**: In this step, a restriction enzyme is used to break the DNA at a specific sequence of the base. This process is done to isolate the gene. The restriction enzymes are isolated from bacteria and cut DNA at a specific sequence.

**Ligation:** In this step DNA ligase combine plasmid DNA with isolated genes.

**Transformation:** In this process, the recombinant DNA is inserted in a living cell that is mostly a bacterial cell.

**Selection:** In this step, it is made sure that the growing transformational bacteria have recombinant DNA. This is a very important step as a transformation step is not always successful.

Biotechnology has a wide range of application in medicine and agriculture. It is used in gene therapy to treat a genetic disorder. It is used in transforming bacteria so that it can be used to make human proteins. Insulin which was the first human protein was prepared by this technology. This also helps in creating transgenic crops.

**Question 4**

Gene therapy is a process of introduction of normal genes in the cells to replace the defective and missing to treat a genetic disorder.

The Human Genome Project was started around 1986. The main purpose of this project was to locate and sequence all genes that are found in the DNA of humans. The main objective was to know about the disease hereditary and to discover those genes that can be helpful in gene therapy. As currently there is no cure for the cystic fibrosis. Gene therapy can be found effective. In this process, the faulty CFTR gene is replaced with a working one. The treatment uses a lentivirus to deliver a healthy copy of a CFTR gene.

Yes, this treatment is a logical one as it helps in increasing both quality of life as well as life expectancy.

In 1993 the earliest clinical trials in CF patients were conducted. These trials used viral and non-viral gene transfer agents. These agents were introduced in both the nasal and bronchial airway epithelium. Mostly Engineered adenoviruses were used in these trials. But some of these have been associated with significant inflammatory responses and toxicity that was unacceptable.