

UNIVERSITY OF ESWATINI
FACULTY OF SCIENCE AND ENGINEERING
DEPARTMENT OF BIOLOGICAL SCIENCES
MAIN EXAMINATION PAPER 2020/2021

COURSE CODE: BIO461

TITLE OF PAPER: BIOTECHNOLOGY

TIME ALLOWED: **THREE (3) HOURS**

INSTRUCTIONS: NUMBERS IN BRACKETS DENOTE THE NUMBER OF MARKS

THIS PAPER COMPRISES OF **THREE SECTIONS**. SECTION A COMPRISES OF 25 QUESTIONS. SECTION B COMPRISES OF 6 QUESTIONS. ANSWER ALL QUESTIONS IN SECTIONS A AND B.

SECTION C HAS TWO QUESTIONS. ANSWER ONLY **ONE** QUESTION FROM SECTION C.

CLEARLY INDICATE THE SECTION AND QUESTION NUMBER ON YOUR ANSWER PAPER.

NO ADDITIONAL MATERIAL (E.G. NOTES, CALCULATORS ETC) MAY BE TAKEN INTO THE EXAMINATION.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

Section A

Total marks available: 25

There are twenty-five (25) questions in this section. Answer **ALL** the questions in this section

- AQ1:** The 'Central Dogma' involves: [1]
a) translation of DNA to mRNA
b) production of proteins directly from DNA
c) unwinding of DNA using DNA ligase
d) transcription of proteins to mRNA
e) translation of proteins from mRNA
- AQ2:** Cells used as cell lines are most commonly from: [1]
a) fish embryos
b) human tumours
c) rabbit kidneys
d) monkey ovaries
e) mouse pancreas
- AQ3:** Intellectual property rights are: [1]
a) outlined in the universal declaration of human rights article 21
b) to enable a more equal society
c) designed to protect the inventor and have very little to do with society
d) all of the above
e) none of the above
- AQ4:** DNA can be safely stored in [1]
a) a freezer at -20°C
b) expression vectors
c) methyltransferase
d) cloning vectors
e) polyethylene glycol
- AQ5:** Palindromic sequences are used by which of the following to cut DNA? [1]
a) Control vectors
b) Restriction endonucleases
c) Expression vectors
d) Ligases
e) None of the above
- AQ6:** The 'ori' can be found in: [1]
a) cDNA
b) DNA ligase
c) Expression vectors
d) Endoplasmic reticulum
e) Cell wall
- AQ7:** Multiple protein expression forms are [1]
a) caused by post-translational modifications
b) found on mRNA of transformed cells
c) a result of mutations on the intron of DNA
d) selective markers for cloning vectors
e) found in all prokaryotic cells

AQ8: A cosmid is:

[1]

- a) a type of hybrid plasmid containing beta-phage DNA sequences
- b) a type of expression vector than can accommodate 250kb of DNA
- c) a type of cloning vector that can accommodate 250kb of DNA
- d) a type of plasmid that contains one or more cohesive sites
- a) contain an F-factor origin of replication

AQ9: Horseradish peroxidase is:

- b) inhibited with sulphuric acid
- c) used in labelling antibodies
- d) used in labelling DNA probes
- e) all of the above
- f) none of the above

AQ10: In batch bioreactors processes:

[1]

- a) medium and inoculum are added at the beginning and reactor sealed until the end of the process
- b) medium and inoculum is continuously added to the reactor
- c) medium and nutrients are continuously added to the reactor
- d) all of the above
- e) none of the above

AQ11: Secondary antibodies can be:

[1]

- a) used in direct ELISA assays
- b) bound to an antigen during *insitu* hybridization
- c) labelled with a fluorophore and used for *insitu* hybridization
- d) used to highlight different chromosomes
- e) none of the above

AQ12: Explants are:

[1]

- a) discarded plants from failed genetic engineering
- b) genetically modified plants containing animal genes
- c) small pieces of plant tissue cultured in a nutrient medium under sterile conditions
- d) all of the above
- e) none of the above

AQ13: Biotechnology patent officers often sit in which government ministry?

[1]

- a) Ministry of Finance
- b) Ministry of Health
- c) Ministry of Transport
- d) Ministry of Education
- e) Ministry of Commerce

AQ14: Which of the following are examples of biopharmaceuticals

[1]

- a) HIV treatment (e.g. tenofavir-lamivudine-dolutegravir)
- b) paracetamol
- c) monoclonal antibodies
- d) All of the above
- e) None of the above

AQ15: When producing large quantities of recombinant human insulin using *E.coli*, you would: [1]

- a) Insert genomic DNA into an expression vector
- b) Insert complementary DNA into an expression vector
- c) Insert genomic DNA into a cloning vector
- d) Insert complementary DNA into an expression vector
- a) None of the above

AQ16: A gene gun is: [1]

- a) used to transform eukaryotic cells with exogenous DNA
- b) used to ballistic weapon used by the body to eliminate metastatic cancer cells
- c) a method to chemically inserting cells with exogenous RNA
- d) used by viruses to inject viral DNA into cells
- b) None of the above

AQ17: What does the term 'karyotyping' mean? [1]

- c) simultaneously driving and typing on your phone
- d) pairing and ordering all the chromosomes of an organism
- e) inserting a plasmid into a host
- f) annealing two complementary DNA sequences together
- g) cutting of a palindromic sequence of DNA

AQ18: Plantibodies are: [1]

- a) antibody implants for the long acting drug therapy
- b) monoclonal antibodies made by plants
- c) engineered plant for better texture and palatability
- d) vaccines made by plants
- e) asexual propagation of plants

AQ19: You are growing Sf9 insect cell lines in your lab. Which of the following statements are correct? [1]

- a) cells should be grown at pH 7.4 in a petri-dish dry incubator at 27°C
- b) cells should be grown at pH 6.2 in a petri-dish in a humid incubator at 27°C
- c) cells should be grown at pH 7.4 in a sealed flask in a dry incubator at 37°C
- d) cells should be grown at pH 6.2 in a petri-dish in a humid incubator at 38.5°C
- e) None of the above

AQ20: Telomeric probes are: [1]

- a) RNA probes specific to the telomeres of all human chromosomes
- b) peptide probes specific to the telomeres of all human chromosomes
- c) probes that detect aneuploidy of any chromosome
- d) all of the above
- e) none of the above

AQ21: Honey Crisp apples were genetically modified for better:

- a) nutrition
- b) hardiness
- c) harvest yield
- d) flavour
- e) growth rate

- AQ22:** Senescence occurs when [1]
a) the bioprocessor cycle ends
b) a recombinant plasmid has entered a host cell
c) antibiotic resistance has been disrupted
d) a monoclonal antibody is produced by a cell
e) none of the above
- AQ23:** 3D cell culture [1]
a) better mimics the *in vivo* environment
b) requires a hydrophobic structure to support cell growth
c) must use more than one cell line
d) is the most common form of cell culture
e) none of the above
- AQ24:** When hybridizing a probe for FISH analysis, the hybridization step requires you to: [1]
a) Freeze the slides first
b) Wash the slides in saline-sodium citrate buffer
c) Denature the proteins on the slide using heat
d) Denature the nucleic acids on the slide using an alkali
e) Dehydrate the slide using ethanol 70%
- AQ25:** *Agrobacterium tumefaciens*: [1]
a) can be used to infect plants with exogenous DNA to develop genetically modified crops
b) is a strain of bacteria that causes potato blight
c) can be used to develop monoclonal antibodies in mice
d) is a bacteriophage used to develop rotavirus vaccine
e) none of the above

Section B

Total marks available: 50

There are six (6) questions in this section. Answer **ALL** the questions in this section

- BQ1:** Describe how TRIPS flexibilities can allow low- and middle- income countries to access medicines. [10]
- BQ2:** Using a diagram, describe the operation of ONE type of bioreactor. [4]
- BQ3:** List three (3) advantages and three (3) disadvantages for multi-use of bioreactors. [6]
- BQ4:** Explain the production and use of monoclonal antibodies. Use a diagram to illustrate your explanation. [15]
- BQ5:** Briefly describe five (5) methods of host cell transfection. [10]
- BQ6:** Give a brief overview of **ONE** of the landmark cases of biotechnology and IP, and how the case was pivotal for biotechnology and patent law. [5]

Section C

Total marks available: 25

There are two (2) questions in this section. Answer only **ONE** question

CQ1: You are developing a new drug for asthma. You are currently in pre-clinical trials and have some lung tissue stored in the -70°C . Previous results from transcriptomic analysis of your frozen lung tissue have shown elevated mRNA levels from the gene AIR123. Explain how you would identify the **location** of airaxin, the protein encoded by AIR123, in your lung tissue. [25]

OR

CQ2: Explain the application of recombinant DNA technology in agriculture. [25]

END OF EXAMINATION