

## BIO3124 Midterm 1 – Section A

### MULTIPLE CHOICE

1. When light is absorbed by an object and emitted at a longer wavelength, it is referred to as:
  - a. fluorescence
  - b. refraction
  - c. reflection
  - d. magnification
  - e. radiation
2. The concept that human and animal diseases are caused by microorganisms is called the
  - a. germ theory
  - b. cell theory
  - c. causative theory
  - d. disease theory
3. Which of the following can safely be ingested to fight bacterial infections?
  - a. disinfectants
  - b. chlorine
  - c. antiseptics
  - d. antibiotics
  - e. phenol
4. The major difference between bacterial and human cell membranes is,
  - a. peripheral proteins in bacteria are not involved in signal transduction
  - b. bacteria do have cholesterol like structures called hopanoids instead of cholesterol
  - c. integral proteins are covalently attached to lipid bilayer in human cells but not in bacteria
  - d. lipid rafts composed of cholesterol is common in bacteria but not human cells
5. The  $F_1$  portion of *Escherichia coli* ATP synthase contains
  - a. a ring of 12 *c* subunits
  - b. the *a* proton channel
  - c. the  $\gamma$  drive shaft
  - d.  $\alpha\beta$ -subunits
  - e. none of the above
6. A divisome protein that anchors the FtsZ ring onto membrane
  - a. MinCD
  - b. ZipA
  - c. AmiC
  - d. FtsI
  - e. FtsK

7. If an object and its surroundings absorb or reflect radiation equally then the object will be:
- radiated
  - undetectable
  - reflected
  - fluoresced
  - refracted
8. Three 100 ul samples from  $10^{-6}$  dilution of *S. typhi* culture were plated on three agar plates by spread plate technique. After an overnight incubation at  $37^{\circ}\text{C}$  a total of 37, 40 and 43 colonies were counted in the plates. What was the total cell number in 5 ml of the original culture?
- $2.5 \times 10^7$
  - $2.0 \times 10^8$
  - $3.0 \times 10^{10}$
  - $2.0 \times 10^9$
9. In bacterial electron transport system the electrons and protons are first transferred from the NADH complex to,
- Cytochrome bo
  - A Quinol molecule
  - Cytochrome C oxidase
  - A Quinone molecule
  - none of above
10. The term facultative anaerobe refers to an organism that
- prefers to grow without oxygen
  - requires less oxygen than what is present in air
  - is killed by oxygen
  - doesn't use oxygen but tolerates it
  - uses oxygen when present or grows without oxygen when oxygen is absent
11. The time required to kill 90% of the microorganisms in a sample at a specific temperature is
- thermal death point
  - thermal death time
  - decimal reduction time
  - Z value
12. 90% of bacterial cells in 10 ml suspension that had  $10^8$  CFU/ml were killed by heating. How many cells would remain in the suspension?
- $9 \times 10^6$
  - $10^7$
  - $10^8$
  - $10^5$

13. As lens strength increases, the light cone \_\_\_\_\_ and the lens must be \_\_\_\_\_ the object.
- widens; touch
  - narrows; nearer to
  - widens; farther from
  - widens; nearer to
  - narrows; farther from
14. Braun's lipoprotein is a 55 carbon lipid carrier that translocates the cell wall subunits following synthesis from cytoplasm to the periplasmic space.
- True
  - False
15. Which is the counterstain in the Gram stain procedure?
- safranin
  - malachite green
  - Gram's iodine
  - crystal violet
  - methylene blue
16. Macronutrients are most abundantly used by microorganisms for building up their cells. They include,
- C, H, N, P, S, Ni, Mn, K, Fe and Ca
  - C, H, O, P, S, K, Fe, Si, Mg and Ca
  - C, H, O, N, P, S, Mg, Fe, K and Ca
  - C, O, H, N, P, S, Mn, Cl, Mg, Fe, Cr
17. Which of the following was the first to show experimental evidence to disprove spontaneous generation?
- John Needham
  - Loius Pasteur
  - Theodore Schwann
  - Francesco Redi
18. An organism absorbs light, uses water as its electron donor and carbon dioxide as its carbon source. Which type of metabolism does this organism possess?
- Chemolithotrophic autotroph
  - Photoorganotrophic heterotroph
  - Not enough information to determine which type
  - Chemoorganotrophic heterotroph
  - Photolithotrophic autotroph

19. **The first person to visualize individual microbes was:**

- a. Louis Pasteur
- b. Robert Hooke
- c. **Antoni van Leeuwenhoek**
- d. Lady Montagu
- e. Edward Jenner

20. **Most of the human pathogenic bacteria are heterotrophs, and acquire their nitrogen through,**

- a. Reduction of nitrate
- b. **Break down of their host proteins and nucleic acids**
- c. Oxidation of ammonia to hydroxylamine
- d. fixation of atmospheric N<sub>2</sub>

### SHORT ANSWER

21. **Describe an experimental design to show the protective importance of the bacterial cell wall against osmotic lysis. (5 points, 1 point each)**

1. Removal of cell wall by either B-lactam treatment or by lysozyme treatment for their test set
2. Should include equivalent amount of untreated cells for negative control
3. Should expose the treated and untreated cells to hypotonic solution for same duration of time
4. Use hemocytometer to count the number of intact cells in both treated and untreated sets
5. Should expect lower number of cells in treated set compared to untreated control

22. **Why is oxygen so dangerous for cells and how do cells deal with these problems? (5 points, 1 point each)**

1. In aerobic respiration the active electrons are transferred onto molecular oxygen.
2. Reactive oxygen species such as superoxide radicals, hydrogen peroxide, and hydroxyl radicals are formed.
3. They interact with and cause damage to DNA, RNA, proteins, and lipids.
4. Organisms must either avoid oxygen or have ways to detoxify its active species.
5. Some organisms produce enzymes, such as superoxide dismutase, catalase, and peroxidase, to neutralize the toxic oxygen species.

23. **What was the major complaint about Lazzaro Spallanzani's experiment to disprove spontaneous generation, and how did Louis Pasteur's swan-neck flasks overcome this? (5 points, 1 point each)**

1. Spallanzani's flasks were plugged and sealed so as not to let organisms accidentally enter the boiled medium.
2. Opponents argued that no growth was observed simply due to the lack of oxygen.
3. Pasteur's swan-neck flasks did not allow organisms to enter the flask
4. but did allow oxygen to enter.
5. Growth was still not observed.

## **BIO3124 Midterm 1 – Section B**

### **MULTIPLE CHOICE**

**Higher-power lenses require more light and thus an open:**

- a. ocular
- b. condenser
- c. objective
- d. lens
- e. diaphragm

**What type of gas do cyanobacteria produce for planet Earth?**

- a. carbon dioxide
- b. oxygen
- c. hydrogen
- d. nitrogen
- e. water vapor

**The type of antimicrobial drug that would be least toxic to humans is a drug that:**

- a. inhibits nucleic acid synthesis
- b. disrupts the cytoplasmic membrane
- c. inhibits metabolic pathways
- d. inhibits protein synthesis
- e. inhibits cell wall synthesis

**In the three-domain model, the bacterial ancestor of mitochondria derives from ancient:**

- a. archaea
- b. proteobacteria
- c. fungi
- d. protists
- e. cyanobacteria

**Which of the following obtain energy from the oxidation of inorganic or organic chemicals?**

- a. Phototroph
- b. Lithotroph
- c. Heterotroph
- d. Chemotroph

**Which is the primary stain in the Gram staining?**

- a. crystal violet
- b. methylene blue
- c. malachite green
- d. safranin
- e. Gram's Iodine

**The teichoic acids found on the surface of the Gram positive bacteria is a polymer of glycerol that is connected to each other by a phospho-diether bonds.**

- a. **False**
- b. True

**A bacterial culture medium contains 10 g NaCl, 0.5 g  $\text{KH}_2\text{PO}_4$ , 2.7 g  $\text{Na}_2\text{KPO}_4$ , 10 g glucose, 0.005 g phenol red, 10 g yeast extract and water up to 1000 ml. What class of culture media does this formulation belong to?**

- a. **none is correct**
- b. this is a defined synthetic medium
- c. this is a minimal medium with glucose as its carbon source
- d. this is a selective medium for *E.coli*

**Which of the following was the first to show experimental evidence to disprove spontaneous generation?**

- a. Theodore Schwann
- b. Louis Pasteur
- c. **Francesco Redi**
- d. John Needham

**Which pair of traits can the same organism have?**

- a. obligate anaerobe; catalase producer
- b. **thermophile; facultative anaerobe**
- c. Gram-positive; Gram-negative
- d. obligate aerobe; obligate anaerobe
- e. microaerophile; grows in 21% oxygen

**Which one of the following proteins is involved in sensor-receptor adaptation in bacterial chemotaxis**

- a. CheA
- b. CheZ
- c. CheW
- d. **CheB**
- e. CheY

**The use of antibodies linked to fluorophores is known as:**

- a. atomic force microscopy
- b. fluorescence
- c. X-ray diffraction
- d. **immunofluorescence**

**Which one of the following statements is correct for LPS,**

- a. its variable O-antigen comprises the basis for differences in immunogenicity
- b. All answers are correct
- c. is part of gram negative outer membrane with a non variable O-antigen
- d. is present in *Staphylococcus aureus* cells that determines its antigenicity
- e. is composed of lipid A, a core polypeptide and O-antigen

**Three 200 ul samples from  $10^{-6}$  dilution of *E.coli* culture were plated on three agar plates by spread plate technique. After an overnight incubation at  $37^{\circ}\text{C}$  a total of 35, 40 and 45 colonies were counted in the plates. What was the average cell number per milliliter (i.e. CFU/ml) in the original culture?**

- a.  $2.0 \times 10^8$
- b.  $3.0 \times 10^{10}$
- c.  $2.5 \times 10^7$
- d.  $5.0 \times 10^9$

**Magnification without resolution is known as \_\_\_\_\_ magnification.**

- a. maximum
- b. zero
- c. total
- d. empty
- e. complete

**Human pathogens are:**

- a. thermophiles
- b. extreme thermophiles
- c. mesophiles
- d. psychrophiles
- e. halophiles

**Enzymes transferring electrons at the start of the ETS are referred to as \_\_\_\_\_, whereas enzymes transferring electrons to the terminal electron acceptor are designated \_\_\_\_\_.**

- a. oxidases; dehydrogenases
- b. sulfatases; nitrogenases
- c. dehydrogenases; oxidases
- d. none is right

**The  $F_0$  portion of *Escherichia coli* ATP synthase that rotates while translocating protons is:**

- a. an  $\alpha\beta$ -subunit
- b. the *a* proton channel
- c. a ring of 12 *c* subunits
- d. the  $\gamma$  drive shaft
- e. none is right

**Which does not apply to autoclaving**

- a. use of hot steam increases the heat transfer capacity
- b. use of high pressure enables achieving temperatures above boiling point of water
- c. should not be used for sterilizing culture media containing heat labile component
- d. kills bacteria and inactivates viruses by disrupting membranes and denaturing proteins but cannot kill endospores

**Which of the following is not correct according to the doctrine of spontaneous generation,**

- a. eggs are not required for fruit fly to exist
- b. organic matter carry a vital capacity that can be destroyed by heat
- c. every form of life originates from decaying matter from other living organisms
- d. inanimate matter has evolved gradually to form life since the beginning of the earth
- e. air is required for the decaying matter to be transformed into life

**SHORT ANSWER**

**21. Explain how the Z-ring is formed at the equatorial plane of the E.coli cells during cell division. (5 points, 1 mark each)**

- 1. MinCD proteins, inhibitor of FtsZ multimerization, continuously oscillate between the two poles of the cell.
- 2. While oscillating MinCD spend more time at the poles
- 3. This causes a reducing gradient of MinCD toward the centre of cell to form.
- 4. centre of the cell is where the lowest concentration of MinCD is, would mean the least inhibitory effect on FtsZ multimerization
- 5. This allows the FtsZ protein to oligomerize at the exact equatorial plane of the cell

**22. How would you use Robert Koch's postulates to prove that a specific organism causes a new disease in mice? (5 points, 1.25 marks each)**

- 1. The suspected organism is found in all diseased mice, but absent from healthy mice.
- 2. The suspected organism is isolated from the diseased mice and grown in pure culture.
- 3. When the suspected organism is introduced into a healthy mouse, the same disease occurs.
- 4. The same strain of microbe is obtained from the newly diseased mouse.

**23. Describe three mechanisms organisms use to reduce osmotic stress. (5 points)**

- 1. **Compatible solutes** can be made or imported to increase intracellular osmolarity when cells are in hypertonic environments. (2 marks)
- 2. **Pressure sensitive channels** can allow solutes to escape when cells are in hypotonic environments. (2 marks)
- 3. Water can cross the cell membrane either by **diffusion** or more quickly using aquaporins. (1 mark)