

NATIONAL UNIVERSITY OF LESOTHO

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF PHARMACY

COURSE: PHA 3304 – CLINICAL MICROBIOLOGY

FINAL EXAMINATION

JANUARY 2024

MARKS: 100

TIME: 3 HOURS

INSTRUCTIONS:

The paper has FOUR (4) sections, section A to D.

- Answer ALL questions

SECTION A – MULTIPLE CHOICE QUESTIONS (MCQs)

[20 MARKS]

1. What is the structure that is found in Gram-negative but not in Gram-positive bacteria?
 - A. Capsule
 - B. Cell wall
 - C. Endospore
 - D. Outer membrane

2. Since prokaryotes do not possess mitochondria, oxidative phosphorylation and electron transport in these cells take place in association with which structure?
 - A. Polysaccharide gel layer
 - B. Lipopolysaccharide layer
 - C. Peptidoglycan layer
 - D. Lipoprotein bilayer

3. Which test is routinely used to differentiate Staphylococci from streptococci?
 - A. Catalase test
 - B. Test with hydrogen peroxide
 - C. Polymerase chain reaction
 - D. Growth in 6.5% sodium chloride

4. Which test can be used to identify *Treponema pallidum* from a syphilitic lesion (either primary or secondary stage)?
 - A. Gram stain
 - B. Immunofluorescent stain of smear made from the active lesion
 - C. Special culture using hemoglobin and yeast extract
 - D. Rapid plasma regain (RPR) assay

5. If a culture is inoculated to a density of 5×10^2 cells/mL at time 0 and has both a generation time and lag time of 10 minutes, how many cells/mL will there be at 40 minutes?
 - A. 1.5×10^3
 - B. 2×10^3
 - C. 4×10^3
 - D. 6×10^3

6. In the screen for bacterial meningitis (most commonly a latex particle agglutination test), what chemical component are we searching for in the cerebrospinal fluid?
 - A. Cellular proteins
 - B. Endotoxin
 - C. Immunoglobulins
 - D. Polysaccharide

7. Which of the following bacterial structures or products is notoriously anti-phagocytic?
 - A. Teichoic acid of *Streptococcus pyogenes*
 - B. Bound coagulase of *Staphylococcus aureus*

- C. Pili of gonococci
 - D. Peptidoglycan of rough strains of pneumococci
8. What fungus causes Tinea capitis or ringworm infection of the scalp?
- A. *Aspergillus fumigatus*
 - B. *Microsporum canis*
 - C. *Epidermophyton floccosum*
 - D. *Candida albicans*
9. How do the oncogenes of the human papilloma viruses act?
- A. They act as tumor suppressor genes
 - B. They code for early viral proteins, leading to malignant transformation
 - C. They function identically to cellular oncogenes
 - D. We do not know how they act because they are present in every cell of every individual and yet only some become cancerous
10. A baby has the greatest chance of acquiring which among the following viruses *in utero*?
- A. Cytomegalovirus
 - B. Hepatitis B virus
 - C. Herpes simplex virus
 - D. Rubella virus
11. What is the most dominant method of spread for measles?
- A. Animal bite
 - B. Fecal-oral
 - C. Respiratory droplet spread
 - D. Fomite spread
12. How are human papilloma virus type 4 warts spread?
- A. Fomite spread
 - B. Fecal-oral
 - C. Sexual contact
 - D. Animal bit
13. Which of the following mechanisms is most likely to be involved in multiple drug resistance transfer from one cell to another?
- A. Conjugation with one parent with a free plasmid carrying drug resistance
 - B. Conjugation with one parent with chromosomal drug resistance
 - C. Specialized transduction of a chromosomal gene for drug resistance
 - D. Transformation of chromosomal genes
14. Which among the following bacteria have humans as the only known reservoir?
- A. *Shigella* species
 - B. *Bacillus anthracis*
 - C. *Listeria monocytogenes*
 - D. *Salmonella* species except *S.typhi*

15. Which among the following diseases, mosquitoes are **not** vectors for the disease?
- A. Malaria
 - B. Mosquito-borne encephalitis
 - C. Yellow fever
 - D. African trypanosomiasis
16. Which one among the following parasites is **not** transmitted by cysts?
- A. *Entamoeba histolytica*
 - B. *Giardia lamblia*
 - C. *Trichomonas vaginalis*
 - D. *Enterobius vermicularis*
17. Which one among the following parasites is **not** transmitted by eggs?
- A. *Enterobium vermicularis*
 - B. *Giardia lamblia*
 - C. *Strongyloides stercoralis*
 - D. *Ascaris lumbricoides*
18. Which one among the following bacteria are coagulase positive?
- A. *Staphylococcus epidermidis*
 - B. *Staphylococcus saprophyticus*
 - C. *Staphylococcus aureus*
 - D. *Streptococcus pyogenes*
19. Which one of the following is characteristic of species that turns sheep blood agar green?
- A. Beta hemolytic
 - B. Alpha hemolytic
 - C. Gamma hemolytic
 - D. Non-hemolytic
20. Which one of the following is the most common causative agent of meningitis in newborns?
- A. *Chlamydia*
 - B. *Neisseria gonorrhoea*
 - C. *Neisseria meningitidis*
 - D. Group B Streptococci

SECTION B – TRUE OR FALSE

[20 MARKS]

State whether the following are TRUE or FALSE

1. Fever and cough are first-line defense mechanisms against infection.
2. *Salmonella typhi* is spread by oral/fecal route.
3. *Moraxella catarrhalis* is a rod-shaped Gram-positive organism which is one of the most common causes of upper respiratory tract infections.
4. Rickettsia species are non-Gram-staining bacteria.
5. *Staphylococcus aureus* is commonly found in the nose.
6. Vancomycin is a drug of choice for treatment of methicillin-resistant *Staphylococcus aureus* (MRSA).
7. Group A streptococcus are the most common causes of pharyngitis, scarlet fever and impetigo.
8. Mycobacterium species are acid fast rods with waxy cell wall and are facultative anaerobes.
9. Minimum inhibitory concentration (MIC) measures the antibiotic killing effect (bactericidal activity).
10. Minimum bactericidal concentration (MBC) measures antibiotic inhibition of bacterial multiplication.
11. Human immunodeficiency virus target receptors on the host cell are CD4 and CXCR4.
12. Oseltamivir prevents the release stage of viral infection in influenza?
13. *Plasmodium falciparum* is characterized as a gastrointestinal cestode.
14. *Giardia lamblia* ventral sucking disk attaches to lining of duodenal wall causing a foul-smelling diarrhea.
15. *Enterobium vermicularis* is a protozoal disease treated with mebendazole.
16. *Enterobium vermicularis* is not transmitted by eggs of helminthes.
17. *Candida albicans* only causes systemic fungal infections.
18. Pigeon breeders are susceptible to infection by *Cryptococcus neoformans*.
19. Pneumonia in AIDS patients is commonly caused by a fungal infection with *Pneumocystis jirovecii*.
20. Treatment of *P.jirovecii* infection includes trimethoprim/sulfamethoxazole for mild disease and dapsone for moderate/severe disease.

SECTION C – MATCHING**[10 MARKS]**

1. Match the following parasites in the first column with the description in the second column. (5)

Parasite	Description
1. <i>Giardia lamblia</i>	A. Invasive amebae causing dysentery, which is noted for causing extraintestinal abscesses
2. <i>Cryptosporidium parvum</i>	B. Chronic infections associated with bladder carcinoma
3. <i>Pediculus humanus</i>	C. Untreatable or at least poorly treatable causative agent of chronic diarrhea in AIDS patients, which is diagnosed by finding acid fast cysts in the stool
4. <i>Schistosoma haematobium</i>	D. Carrier of epidemic typhus and Trench fever
5. <i>Entamoeba histolytica</i>	E. Fatty diarrhea associated with malabsorption syndrome

2. Match the following viral features with the agent. (5)

Feature	Causative agent
1. Teratogenic	A. Influenza A
2. Oncogenic virus	B. Hepatitis B
3. Highest transmissibility rate by needle stick	C. Human papilloma virus
4. Genetic shift important to epidemiology	D. Human immunodeficiency virus
5. Unique proteins of the pathogen are coded for by pol gene	E. Rubella

SECTION D – SHORT/LONG ANSWER QUESTIONS

[50 MARKS]

1. The human microbiome is one of the greatest determinants of human health. [10]
 - a. Discuss the characteristics of the normal flora, giving two (2) examples of specific organisms in different body sites. (6)
 - b. Discuss the first-line host defense mechanisms against infection in the genitourinary tract. (4)

2. Compare and contrast the following types of culture media used in the clinical microbiology laboratory: [8]
 - a. Blood agar and MacConkey agar (4)
 - b. Chocolate agar and Mannitol salt agar (4)

3. A 21-year-old student was seen by his family physician with complaints of pharyngitis. Examination of the pharynx revealed patchy erythema and exudates on the tonsillar pillars. Throat smear showed Gram-positive cocci in chains and Gram-negative diplococci. He admitted to having been sexually active. [10]
 - a. What may be causes of infection? Give the rationale based on results of Gram stain and clinical presentation. (4)
 - b. What is the simplest test that can be done to differentiate between Staphylococcus and Streptococcus infection? (2)
 - c. Characterize Neisseria species in terms of their shape, virulence factors, glucose metabolism. Give examples of two (2) Neisseria species. (4)

4. Discuss distinguishing features, one disease caused and one drug used in the treatment of infection by the following microorganisms. [12]
 - a. *Clostridium difficile* (4)
 - b. *Pneumocystis jirovecii* (4)
 - c. *Entamoeba histolytica* (4)

5. The best prospects for treatment and cure of microbial diseases are always those unique factors of a pathogen's life cycle that can be altered without affecting the survival of the host's own cells. In HIV, one such therapeutic target would be the products of the pol gene, which codes for the reverse transcriptase unique to the retroviral life cycle. It also codes for protease and integrase. [10]
 - a. If it were possible to ablate expression of the HIV pol gene, how would the virus's life cycle be directly altered? (6)
 - b. What makes HIV different from herpes simplex (4)

END