CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE (NURSING)

NURS 223: MEDICAL MICROBIOLOGY

STREAMS: Bsc Nursing Y2S1 **TIME: 2 HOURS**

DAY/DATE: THURSDAY 25/03/2021 **11.30 A.M. – 1.30 P.M.**

INSTRUCTIONS:

- ***Do not write anything on the question paper.***
- ***Mobile phones and any other reference materials are NOT allowed in the examination room.***
- ***The paper has THREE sections. Answer ALL questions.***
- ***Answers for SECTION A should be on first page of the answer booklet.***
- ***Number ALL your answers and indicate the order of appearance in the space provided in the cover page of the examination answer booklet***

SECTION A (50 marks)

1. In the Gram stain procedure, bacteria are exposed to 95% alcohol or to acetone/alcohol mixture. The purpose of this step is :
    a. To adhere the cells to the slide
    b. To retain the purple dye within all the bacteria
    c. To disrupt the outer cell membrane so the purple dye can leave the bacteria
    d. To form a complex with the iodine solution
2. Which one of the following is the most accurate description of the structural differences between gram-positive and gram-negative bacteria?
    a. Gram-positive bacteria have an outer lipid-rich membrane whereas gram-negative bacteria do not

   b. Gram-positive bacteria have a thick peptidoglycan layer whereas gram-negative bacteria have a thin layer
   c. Gram-positive bacteria form a sex pilus that mediates conjugation whereas gram-negative bacteria do not
   d. Gram-positive bacteria have capsules whereas gram-negative bacteria do not

3. *Corynebacterium diphtheria* causes the disease diphtheria by producing diphtheria toxin. The gene encoding the toxin is integrated into bacterial genome during lysogenic conversion. The toxin gene was acquired by the process called:
   a. Transduction
   b. Conjugation
   c. Frameshift
   d. Transformation
4. A 65-year-old woman with a prosthetic hip comes to you complaining of fever and pain in that joint. You are concerned about an infection by *Staphylococcus epidermidis*. Using your knowledge of normal flora, the most likely source of the organism is the:
   a. Vagina
   b. Dental plague
   c. Mouth
   d. Skin
5. Vertical transmission is the transmission of organisms from mother to the fetus or newborn child. Which of the following bacteria is most likely to cause vertically transmitted infection?
   a. Chylamydia trachomatis
   b. Clostridium tetani
   c. Haemophilus influenza
   d. Streptococcus pneumonia
6. The identification of *Salmonella* and *Shingella* in stool cultures using Eosin-Methylene Blue (EMB) media is dependent on which one of the following properties?
   a. *Salmonella* and *Shingella* produce a blue colony in the presence of methylene blue

b. *Salmonella* and *Shingella* produce a colorless colony because they do not ferment lactose
c. *Salmonella* and *Shingella* produce a yellow colony because they ferment glucose
d. *Salmonella* and *Shingella* produce a green colony in the presence of eosin

7. Which one of the following sets consists of bacteria, both of which are anaerobes?
   a. *Actinomyces israeli* and *Serratia mercescens*
   b. *Campylobacter jejuni* and *Vibrio cholera*
   c. *Clostridium perfringens* and *Bacteriodes fragilis*
   d. *Mycoplasma pneumoniae* and *Corynebacterium diptheriae*
8. Which of the following laboratory tests is the most appropriate to distinguish *Streptococcus pyogenes* from other β-hemolytic streptococci?
   a. Ability to grow in 6.5% NaCl
   b. Hydrolyis of esculin in the presence of bile
   c. Inhibition by optochin
   d. Inhibition by bacitracin
9. A 20-year-old sexually active woman reports dysuria and other symptoms of urinary tract infection. Gram stain of the urine reveals gram-positive cocci. Which of the following set of bacteria are most likely to cause this infection?
   a. *Staphylococcus aureus* and *Streptococcus pyogenes*
   b. *Staphylococcus saprophyticus* and *Enterococcus faecalis*
   c. *Streptococcus agalactiae* and *Staphylococcus epidermidis*
   d. *Streptococcus pneumoniae* and *Streptococcus pyogenes*
10. Your patient is a 20-year-old man with a urethral exudate. Gram stain of the pus reveals gram-negative diplococci with neutrophils. Which of the following is the best antibiotic to treat the infection?
    a. Ceftriaxone
    b. Gentamicin
    c. Pencillin G
    d. Vancomycin
11. You have been handed over a patient with second degree burns on her back who has been in the ward for the last 20 days. She is on daily cleaning with 0.9% normal saline and

dressing with silver sulphadiazine. You notice that the dressing was changed the previous day and currently the white dressing has greenish coloration. The wound is most probably secondary colonized by

a. *Staphylococcus aureus*
b. *Pseudomonas aureginosa*
c. *Escherichia coli*
d. *Streptococcus pyogenes*

12. Which of the following viruses that causes human disease has an animal reservoir?
    a. Yellow fever virus
    b. Cytomegalovirus
    c. Smallpox virus
    d. Hepatitis C virus
13. Viruses can cause changes in individual cells that are visible in the light microscope after suitable staining. Which one of the following is most characteristic of the changes seen in rabies virus infected cells?
    a. Inclusion bodies in the cytoplasm of macrophages
    b. Inclusion bodies in the cytoplasm of neurons
    c. Multinucleated giants cells composed of neurons
    d. Multinucleated giants cells composed of macrophages
14. Regarding Varicella-Zoster virus (VZV), which one of the following is most accurate?
    a. The principle site of latency of VZV is the nucleus of motor neurons
    b. Domestic animals such as pigs and chickens, are the main reservoir of VZV
    c. High dose acyclovir can eliminate the latent state caused by VZV
    d. When zoster occurs in an immunocompromised patient, acyclovir should be given to prevent disseminated infection
15. Your patient is a 22-year-old woman with several episodes of bloody diarrhea. She is HIV antibody positive with CD4 count of 50. Stool cultures for Shigella, Salmonella and Campylobacter are negative. An assay for *Clostridium difficile* toxin was negative. Colonoscopy revealed many ulcerated lesions. Biopsy revealed cells with ‘owl’s eye’ inclusions in the nucleus. Which one of the following is the most likely cause of this disease?

a. Epstein Barr virus
b. Human herpes virus-8
c. Cytomegalovirus
d. Herpes simplex virus type 1

16. Regarding human papilloma virus (HPV), which one of the following is most accurate?
    a. There is no vaccine available against HPV
    b. Acyclovir is effective in preventing lesions caused by HPV
    c. The early proteins of HPV play a more important role in malignant transformation than the late proteins
    d. Antigen-antibody complexes play an important role in the pathogenesis of the warts caused by HPV
17. Regarding parvovirus B19, which of the following is most accurate?
    a. A vaccine is available that contains killed virus as the immunogen
    b. Patients infected by parvovirus B19 can be diagnosed in the laboratory using the cold agglutinin test
    c. Parvovirus B19 causes severe anemia because it preferentially infects erythrocyte precursors such as erythroblasts
    d. Parvovirus B19 commonly infects neutrophils , resulting in an immunodeficiency that predisposes to pyogenic bacterial infections
18. Regarding influenza virus and the disease influenza, which one of the following statements is most accurate?
    a. Both the killed and the live attenuated vaccines induce life-long immunity
    b. Influenza A virus causes more severe disease and more widespread epidemics than does influenza B virus
    c. The genome of influenza A virus has eight segments but the genome of influenza B virus is in one piece
    d. Chronic carriers are an important source of human infection
19. Regarding the rabies virus and the rabies disease, which of the following statements is most accurate?
    a. Finding intranclear inclusion bodies within macrophages is presumptive evidence of rabies virus infection

b. Lamivudine is used to treat rabies because it inhibits the RNA-dependent DNA polymerase in the virion
c. The incubation period of the disease is usually 2 to 4 days
d. After the animal bite, rabies virus enters the bloodstream, replicates in internal organs such the liver , then reaches the central nervous system during secondary viremia

20. Regarding the rotavirus, which of the following is most accurate?
    a. Rotavirus is a major cause of nosocomial diarrhea in intensive care units
    b. The vaccine against rotavirus contains live, attenuated virus as the immunogen
    c. Rotavirus has a nonsegmented, single-stranded RNA genome and there is no polymerase in the virion
    d. Diarrhea caused by rotavirus is due to viral protein that increases the release of IgA from many submucosal B lymphocytes
21. An outbreak of jaundice occurs in several young children who attend the same day care centre. If the outbreak was viral, which one of the following is the most likely cause?
    a. Hepatitis A virus
    b. Hepatitis B virus
    c. Hepatitis C virus
    d. Hepatitis D virus
22. Your patient is a 35-year-old man who complains that the whites of his eyes have turned yellow. After taking a history and conducting physical examination, you order serological tests to determine whether he has viral hepatitis. On the basis of the results, you tell him that he has a mild form of hepatitis that does not cause long-range damage to the liver. Your conclusion is based on a positive result on which of the following tests?
    a. Antibody to hepatitis C virus
    b. Hepatitis B surface antigen
    c. Hepatitis delta antigen
    d. IgM antibody test to hepatitis A virus
23. Yellow fever still exists in many tropical areas of the world. Which one of the following is the best reason yellow fever still exists?
    a. Sewage disposal is inadequate in many areas

b. Both monkeys and humans are reservoirs for yellow fever virus
c. The virus has mutated so the existing vaccine is no longer effective
d. The people in developing world cannot afford to take amatadine when they enter endemic areas.

24. Regarding the main mechanism by which oncogenic retroviruses cause malignant transformation, which one of the following is most accurate?
    a. They cause point mutations in cellular regulatory genes
    b. They carry the genes for proteins that act as cellular growth factors
    c. They encode recombinase that causes translocation of certain chromosomes
    d. They encode a DNA polymerase that increases the rate of cellular DNA synthesis
25. Regarding the structure and replication of human immunodeficiency virus (HIV), which of the following is most accurate?
    a. Viral mRNA is the template for the synthesis of the genome RNA
    b. During entry of HIV into the cell, the viral p24 protein interacts with the CD4 protein on the cell surface
    c. HIV contains an integrase within the virion that integrates copies of the viral genome into the progeny virions
    d. HIV has an enzyme in the virion that synthesizes double-stranded DNA using single-stranded genome as the RNA-template
26. You are in the clinical lab looking at a gram stain when the laboratory technician comes up and says: "I think your patient has *Staphylococcus epidermidis* bacterimea". Which of the following sets of results did the technician find with the organism recovered from the blood culture?
    a. Gram-positive cocci in chains, catalase-positive, coagulase-positive
    b. Gram-positive cocci in chains, catalase-negative, coagulase-negative
    c. Gram-positive cocci in clusters, catalase-positive, coagulase-negative
    d. Gram-positive cocci in clusters, catalase-negative, coagulase-positive
27. Your patient in the pediatric intensive care unit is a 2-week old girl with a high fever and the signs of meningitis. Gram stain of the spinal fluid reveal gram-positive rods. Colonies on blood agar show a narrow zone of β-hemolysis. Which of the following is the most probable cause of her neonatal meningitis

a. *Listeria monocytogenes*
b. *Haemophilus ducreyi*
c. *Neisseria meningitidis*
d. *Streptococcus pneumoniae*

28. Your patient is a 30-year-old *boda-boda* operator who was admitted with a compound fracture of his leg following motorcycle accident. He now has a high fever and a rapidly spreading cellulitis with crepitus in the area of the fracture. Large gram positive rods are seen on the exudates. What is the most probable offending micro-organism?
    a. Clostridium botulinum
    b. Clostridium perfringens
    c. Clostridium defficile
    d. Clostridium tetani
29. Regarding the members of the family Enterobacteriaceae, which one of the following is the most accurate?
    a. All the members of the family are anaerobic
    b. All the members of the family ferment lactose
    c. All the members of the family have endotoxin
    d. All the members of the family produce enterotoxin
30. Your patient is a 20-year-old college lady with pain on urination and cloudy urine but no fever or flank pain. You think she probably has infection of the urinary bladder (cystitis). A Gram stain of the urine reveals gram-negative rods. Culture of urine on EMB agar shows colorless colonies and urease test was positive. Swarming motility was noted on blood agar plate. Which one of the following bacteria is the most likely cause of the infection?
    a. *Proteus mirabilis*
    b. *Escherichia coli*
    c. *Serratia mercescens*
    d. *Providencia melanonigenica*
31. Your patient is a six-year-old boy who is complaining that his ear hurts. The mother says it began yesterday and he has a fever of 39.3°C. On physical examination, you see perforated ear drum that is exuding a small amount of pus. Using a swab you obtain a

sample of the pus and do a Gram stain and culture. The Gram stain reveals small coccobacillary rods. There is no growth on a blood agar plate, but chocolate agar plate supplemented with X and V factors grow small grey colonies. Which of the following bacteria is the most likely cause of his otitis media?

a. *Bordetella pertussis*
b. *Haemophilus influenzae*
c. *Klebsiella peumoniae*
d. *Legionella pneumophila*

32. You patient is a ten-year-old boy who was bitten on the hand when he tried to break a fight between two cats yesterday. He now has a red, tender, swollen lesion at the bite site that has spread rapidly across his hand. Which of the following bacteria is the most likely cause of his cellulitis?

a. *Brucella melitensis*
b. *Francisella tularensis*
c. *Pasteurella multocida*
d. *Yersinia pestis*

33. *Mycoplasma pneumoniae* is an important cause of atypical pneumonia. Regarding this organism, which of the following is the most accurate?

a. Amoxicillin is the drug choice for pneumonia caused by this organism
b. Antibody in patient's serum will agglutinate human red blood cells at 4°C but not at 37°C
c. Gram staining of the sputum reveals small gram-negative rods
d. It is an obligate intracellular parasite that can only grow within human cells in the clinical laboratory

34. Benzathine penicillin G is used to treat primary and secondary syphilis rather than procaine penicillin G. which one of the following is the best reason for this choice?

a. Patients allergic to procaine penicillin G are not allergic to benzathine penicillin G
b. Benzathine procaine penicillin G has minimal inhibitory concentration than procaine penicillin G
c. Benzathine penicillin G penetrates the central nervous system to a greater degree than procaine penicillin G

d. Benzathine penicillin G is a depot preparation that provides a long-lasting, high level of the drug that kills the slow-growing *Treponema pallidum*

35. Your patient is a 20-year-old male university student with a urethral discharge. Gram stain of the discharge reveals many neutrophils but no bacteria. You suspect the infection may be caused by Chlamydia trachomatis. Which one of the following is the laboratory result that best supports your clinical diagnosis?
    a. Gram stain of the pus reveals many small gram-positive rods
    b. The organism produces β-hemolytic colonies on blood agar plate when incubated aerobically
    c. The organism produces α-hemolytic colonies on blood agar plate when incubated anaerobically
    d. Fluorescent antibody staining of cytoplasmic inclusions in epithelial cells in the exudate
36. Several fungi are associated with disease in immunocompromised patients. Which one of the following is LEAST frequently associated?
    a. *Cryptococcus neoformans*
    b. *Aspergillus fumigatus*
    c. *Malassezia furfur*
    d. *Mucor* species
37. Aspergillosis is recognized in tissue by the presence of
    a. Budding cells
    b. Septate hyphae
    c. Metachromatic granules
    d. Pseudohyphae
38. Each of the following statements concerning fungi is correct EXCEPT
    a. Yeasts are fungi that reproduce by budding
    b. Molds are fungi that have elongated filaments called hyphae
    c. Thermally dimorphic fungi exist as yeasts at 37°C and as molds at 25°C
    d. Both yeasts and molds have a cell wall made of peptidoglycan

39. You have made a clinical diagnosis of meningitis in a 50-year-old immunocompromised woman. A latex agglutination test on spinal fluid for capsular polysaccharide antigen is positive. Of the following organisms, which one is the MOST likely cause?
    a. *Histoplasma capsulatum*
    b. *Cryptococcus neoformans*
    c. *Aspergillus fumigatus*
    d. *Candida albicans*
40. Your patient is a woman with a vaginal discharge. You suspect on clinical grounds that it may be due to Candida albicans. Which one of the following statements is LEAST appropriate?
    a. A gram stain of the discharge should reveal budding yeast
    b. Culture of the discharge on Sabouraud's agar should produce a white mycelium with aerial conidia
    c. The clinical lab can use germ tube formation to identify the isolate as C. albicans
    d. Antibiotics predispose to Candida vaginitis by killing the normal flora lactobacilli that keep vaginal pH low
41. Each of the following statements concerning mucormycosis is correct EXCEPT
    a. The fungi that cause mucormycosis are transmitted by airborne asexual spores
    b. Tissue sections from a patient with mucormycosis show budding yeast
    c. Hyphae typically invade blood vessels and cause necrosis of tissues
    d. Ketoacidosis in diabetic patients is a predisposing factor to mucormysis

For questions 42 to 50 select the ONE lettered option that is MOST closely associated with the numbered items. Each lettered option may be selected once, more than once or not at all.

i. Histoplasma capsulatum
ii. Candida albicans
iii. Aspergillus fumigates
iv. Coxsackie virus
v. Sporothrix schenkii
vi. Coccidiodes immitis

vii. Rhizopus nigricans
viii. Blastomyces dermatitidis
ix. Adenovirus
x. Rhinovirus
xi. Epstein-Barr virus
xii. Parainfluenza virus
xiii. Cryptococcus neoformans

42. Causes myocarditis and pleurodynia
43. A budding yeast that is member of the normal flora of the vagina
44. A yeast acquired by inhalation that causes meningitis primarily in immunocompromised patients
45. A dimorphic organism that is transmitted by trauma to the skin
46. A mold that invades blood vessels primarily in patients with diabetic ketoacidosis
47. Causes tumors in laboratory rodents
48. A mold that causes pneumonia in immunocompromised patients
49. Causes croup in young children
50. Causes infectious mononucleosis

SECTION B (30 marks)

1. Describe five (5) virulent factors of *Staphylococcus aureus* (5 marks)
2. With examples, state three (3) mechanisms by which bacteria my evolve to drug-resistant strains (3 marks)
3. Describe four (4) properties of *Clostridium tetani* that are useful in its laboratory identification (4 marks)
4. Describe five (5) properties of *Myocobacterium tuberculosis* that are useful in its pathogenesis (5 marks)
5. Illustrate how you would differentiate between the various gram-negative bacteria of the gastrointestinal tract using sugar fermentation, triple sugar iron (TSI) and urease agar tests (7 marks)
6. Using the human immunodeficiency virus (HIV) replicative cycle, indicate the sites of action of important antiviral drugs (6 marks)

SECTION C (20marks)

1. Bacteria may be classified using different approaches. Describe a detailed classification of bacteria using morphology and Gram staining properties (20 marks)

…….