MICROBE MISSION – DIVISION C EXAM – CAPTAIN'S TRYOUTS 2017 – FRANKLIN REGIONAL HIGH SCHOOL

Exam is written by Franklin Regional High School.

SCHOOL: _____
COMPETITOR NAME(S): _____
SCORE: _____/117

Test Breakdown:

- **Part A** – Principles & Calculations of Microscopy
- **Part B** – Microbial Origins, Classification, Structure, Beneficial vs. Dangerous, and Food
- **Part C** – Microbial Disease, Treatment, and Prevention
- **Part D** – Growth Curves & Graph Interpretation

This is a long test – pace yourself accordingly! Good luck.

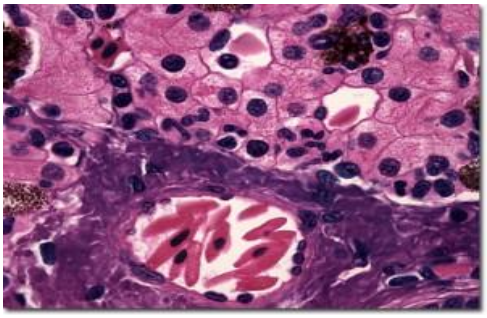
For each of the following questions, read each question carefully, and print the letter of the best answer on the line next to the question. Each correct response is worth one point, and each incorrect response is worth zero points.

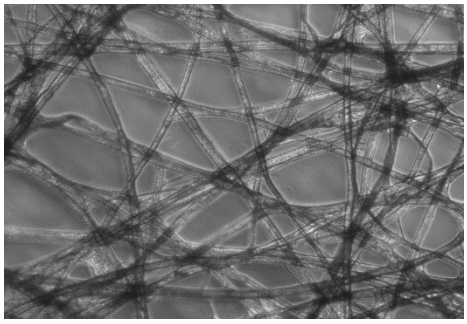
Part A: Principles & Calculations of Microscopy

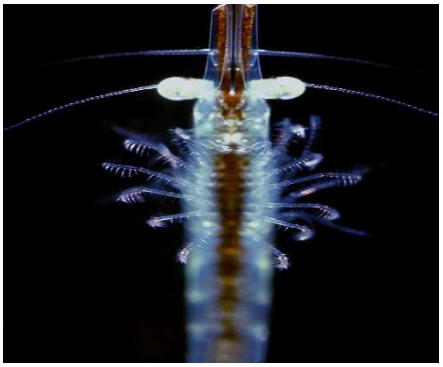
In questions 1-9, determine the type of microscope that produced the specimen indicated. 1 pt each.

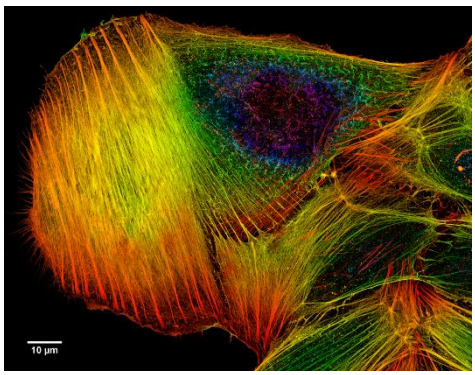
1. 

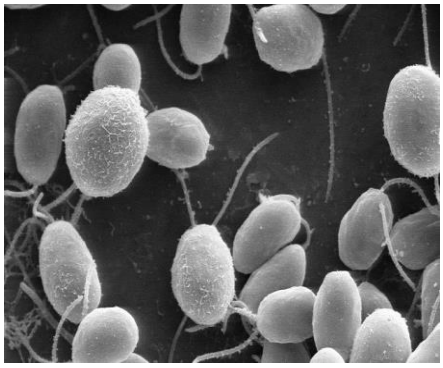
2. 

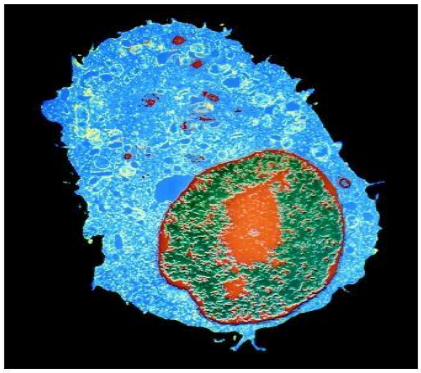
3. 

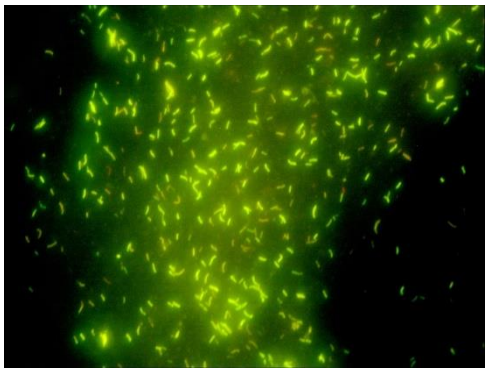
4. 

5. 

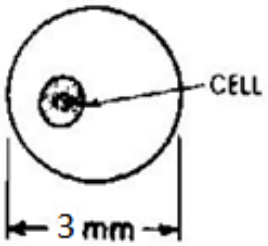
6. 

7. 

8. 

9. 

10. (2 pts – 1 pt /advantage) List 2 advantages of two-photon excitation microscopy over standard fluorescent/confocal microscopy.



In questions 11-13, refer to the microscope specimen at the right, and the info below. Fraction/decimal answers are acceptable. 1 pt each.
Ocular Lens – 10x, Scanning Power – 4x, Low Power – 10x, High Power – 40x

11._____ (1 pt) What is the approximate size of the cell, in μm?

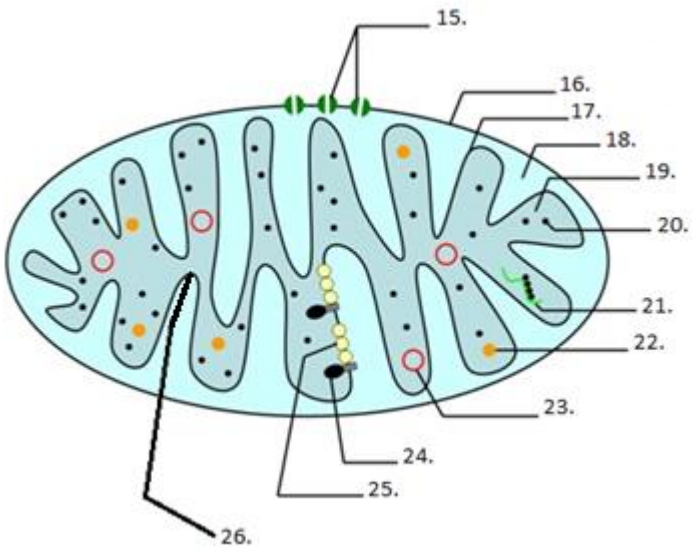
12._____ (1 pt) The image shown is at the low power objective. What would be the diameter, in mm, of the high power objective's field of view?

13._____ (1 pt) How many such cells could fit across the scanning power objective's field of view?

14._____ (3 pts) *Circle one option in parts a-f. ½ point each.* When changing objectives from scanning to low to high powers,
a. the size of the field of view increases/decreases.
b. the field of view gets lighter/darker.
c. the size of the image increases/decreases.
d. the resolution increases/decreases.
e. the working distance increases/decreases.
f. the depth of focus increases/decreases.

Part B: Microbial Origins, Classification, Structure, Beneficial vs. Dangerous, and Food

15. – 26._____ (12 pts - 1 pt each) Label the diagram shown at the right. *Be specific!*



27. - 30._____ Differentiate between stalkless and stalked particles, in terms of location and function. (1 pt for location of each, 1 pt for function of each, 4pts total)

31._____ (1 pt) Which specific transporter protein enables the import of ADP and export of ATP between the inner mitochondrial membrane?

32._____ (1 pt) Mitochondria originated from which bacterial phylum?

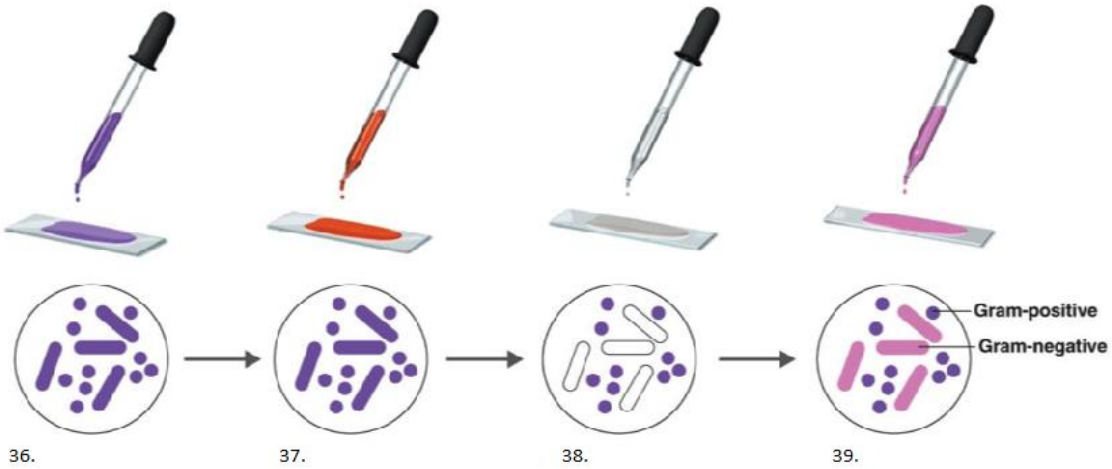
33._____ (1 pt) Chloroplasts originated from which bacterial phylum?

34._____ (1 pt) Which of the following models proposes that ancient methanogenic-like archaea invaded bacteria, forming the primitive nucleus?

a. archaea-eukaryogenesis model
b. syntrophic model
c. exomembrane hypothesis
d. methanogenic-endosymbiosis model

35._____ (4 pts – ½ point each) List 8 types of microbes.

36. - 39._____ (4 pts – 1 pt for each correct step) List the four steps in the Gram-staining procedure. Be specific!



40._____ (1 pt) Who developed the Gram stain?

41._____ (1 pt) Which type of microbe may have strange shapes, such as flat and square-shaped cells?

42._____ (1 pt) Viruses are typically measured in which metric unit?

43._____ (3 pts; ½ pt each) What are the 3 basic capsid shapes of a virus? Give an example of each.

44._____ (1 pt) Which microbe may originate from ZIP metal ion transporters?

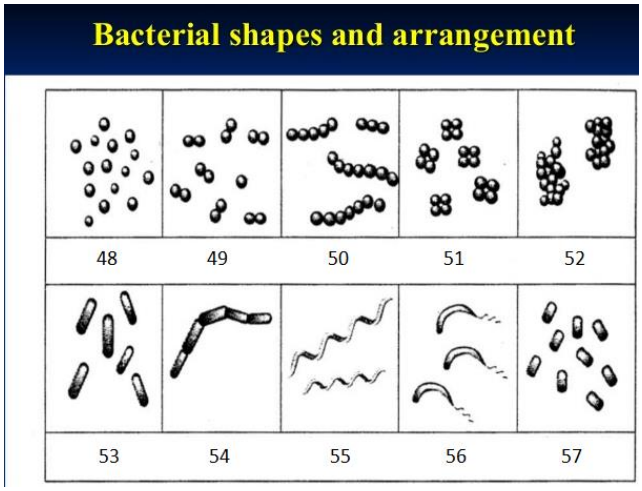
45._____ (2 pts – 1 pt for definition, 1 pt for valid example) What is a satellite virus? Give an example.

46._____ (4 pts total) Name the three layers (1 pt each) of a helminth egg. Name 2 places (0.5 pt each) a helminth egg may be found.

47._____ (4 pts total) Determine whether each of the following is prokaryotic, eukaryotic, or neither. (1/2 point each)

a. CD230 (Cluster of Differentiation 230)
b. *Hepatovirus A*
c. *Vibrio genus*
d. *Psychrophiles*
e. *Phytophthora infestans*
f. *Alexandrium genus*
g. The causative agent of "beaver fever"
h. *Trichinella spiralis*

48. – 57._____ (10 pts – 1 pt each) Label the bacterial shapes in the diagram shown at the right. *Be specific!*



In questions 58-65, match the role of the microbe with the type of microbe. Use the key below to choose your answer. Answer choices may be used more than once, only once, or not at all.

A – virus, B – bacteria, C – fungus, D – archaea, E - protists

Role of Microbe

58. (1 pt) Production of Marmite food spread

59. (1 pt) Being used in other nations to treat/cure dangerous bacterial infections

60. (1 pt) Used to synthesize insulin

61. (1 pt) Used in flavoring cheese

62. (1 pt) Involved in the production of cobalamin

63. (1 pt) Contaminates beer and wine, turning alcohol into acetic acid

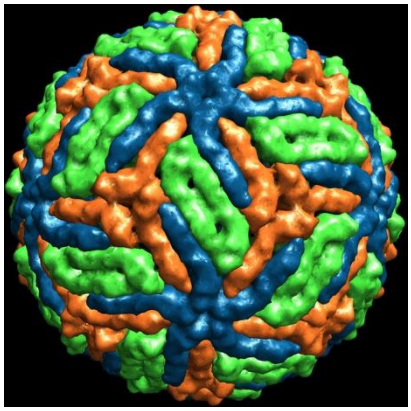
64. (1 pt) Involved in the production of carrageenan

65. (1 pt) Important providers of nitrogen fertilizer in the cultivation of rice and beans

Part D: Microbial Disease, Treatment, and Prevention

66._____ (1 pt) The key molecular event involved in the pathogenesis of prion diseases is the conversion of _____ to _____.
   e. PrP^{Sc}, PrP^{C}
   f. PrP^{C}, PrP^{Sc}
   g. Protein X, Protein Y
   h. β-sheet structures, α-helix structures

67._____ (1 pt) Which of the following is **not** a transmissible spongiform encephalopathy?
   a. BSE
   b. scrapie
   c. kuru
   d. infectious mononucleosis



68._____ (1 pt) The microbe (computer model) shown at the right would most likely cause which disease?
   a. West Nile Fever
   b. Yellow Fever
   c. Influenza
   d. Hepatitis A

69._____ (1 pt) Which of the following diseases may be prevented by improving access to clean water and reducing the number of freshwater snails?
   a. Pinworm
   b. Schistosomiasis
   c. Giardiasis
   d. Cryptosporidiosis

70._____ (1 pt) Chlamydia is caused by which of the following?
   a. *C. burnetii*
   b. *C. difficile*
   c. *C. trachomatis*
   d. *C. tetani*

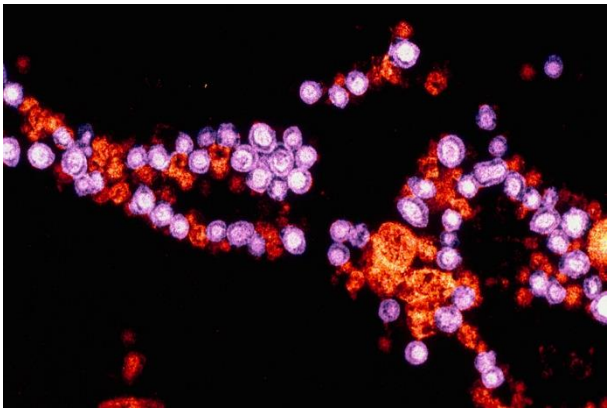
71._____ (1 pt) Which of the following medications would **not** be used to treat malaria?
a. Pyrimethamine
b. Nitazoxanide
c. Artemisinin
d. Quinine

72._____ (1 pt) *S. mutans* uses anaerobic respiration to cause which of the following diseases by changing local environmental conditions?
a. Peptic ulcer disease
b. MRSA infection
c. Strep throat
d. Dental caries

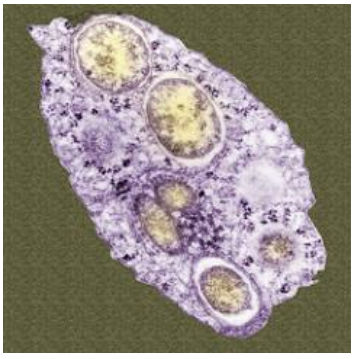
73._____ (1 pt) Which of the following was the first fungicide used in controlling Dutch Elm Disease?
a. Carbendazim phosphate
b. Carbendazim hydrochloride
c. Thiabendazole hypophosphite
d. Propiconazole

74._____ (1 pt) Which of the following is *closest* to the optimum temperature for toxin development in *C. botulinum*?
a. 25°C
b. 35°C
c. 45°C
d. 55°C

75._____ (1 pt) In which of the following diseases are *tumor necrosis factor alpha*, *interleukin-6*, and *interleukin-8* generally released following treatment?
a. Tuberculosis
b. Syphilis
c. Anthrax
d. 55°C



76._____ (1 pt) Which of the following is a typical symptom of the disease caused by the microbe (microscopic image) shown at the right?
a. Meningitis
b. Tender lymphadenopathy
c. High fever (104.0 °F)
d. Diarrhea



77._____ (1 pt) Microbiologists are currently trying to utilize the genus shown at the right to prevent spread which of the following diseases?
a. AIDS
b. Hepatitis

c. Ebola Hemorrhagic Fever
d. Dengue Fever

78._____ (1 pt) The results of RV 144, or the Thai trial, published in September 2009, related to prevention of which disease?
a. Malaria
b. Legionnaire's Disease
c. HIV/AIDS
d. Histoplasmosis

79._____ (1 pt) Which of the following diseases can be microscopically diagnosed by the presence of Guarneri bodies?
a. Small pox
b. Chicken pox
c. Rabies
d. Paralytic Shellfish Poisoning

80._____ (1 pt) *Rhipicephalus sanguineus* is a vector for which of the following diseases?
a. Potato Blight
b. Pertussis
c. Estuary Associated Syndrome
d. Rocky Mountain Spotted Fever

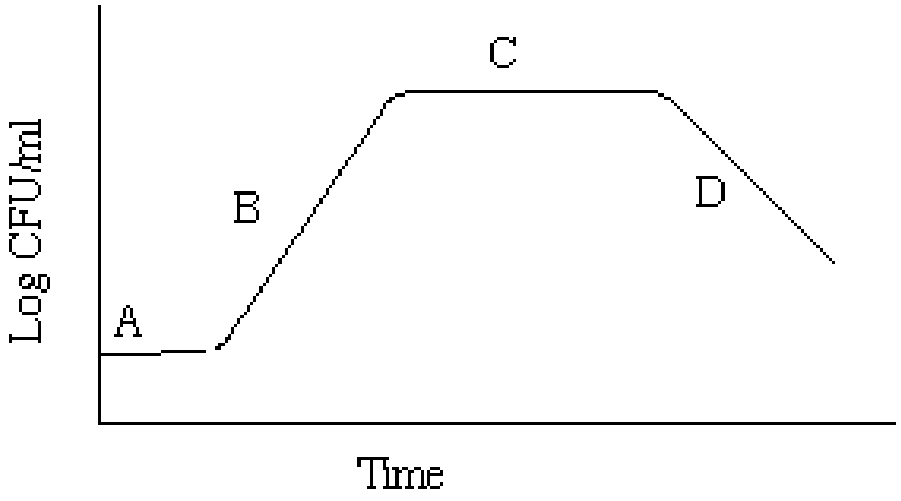
81._____ (1 pt) To decontaminate a building from anthrax spores, which of the following can be used?
a. X-ray radiation
b. Chlorine dioxide gas
c. Lasers
d. Industrial building cleaners

82._____ (1 pt) The patient shown at the right has most likely been infected by which of the following microbes?
a. Epstein-Barr virus
b. Methicillin-resistant *Staphylococcus aureus*
c. *Trichophyton rubrum*
d. *Streptococcus agalactiae*

83. – 92. _____ (10 pts) Name the disease caused by the microbe in the picture to the right. Describe the symptoms, host defenses against this microbe in humans, diagnosis (apart from the clinical appearance), and treatment. Which microbe is responsible for 50% of cases of this disease? (**+1 pt** for correct disease identification, **+2 pts** for 4 symptoms or more, **+2 pts** for 2 host defenses or

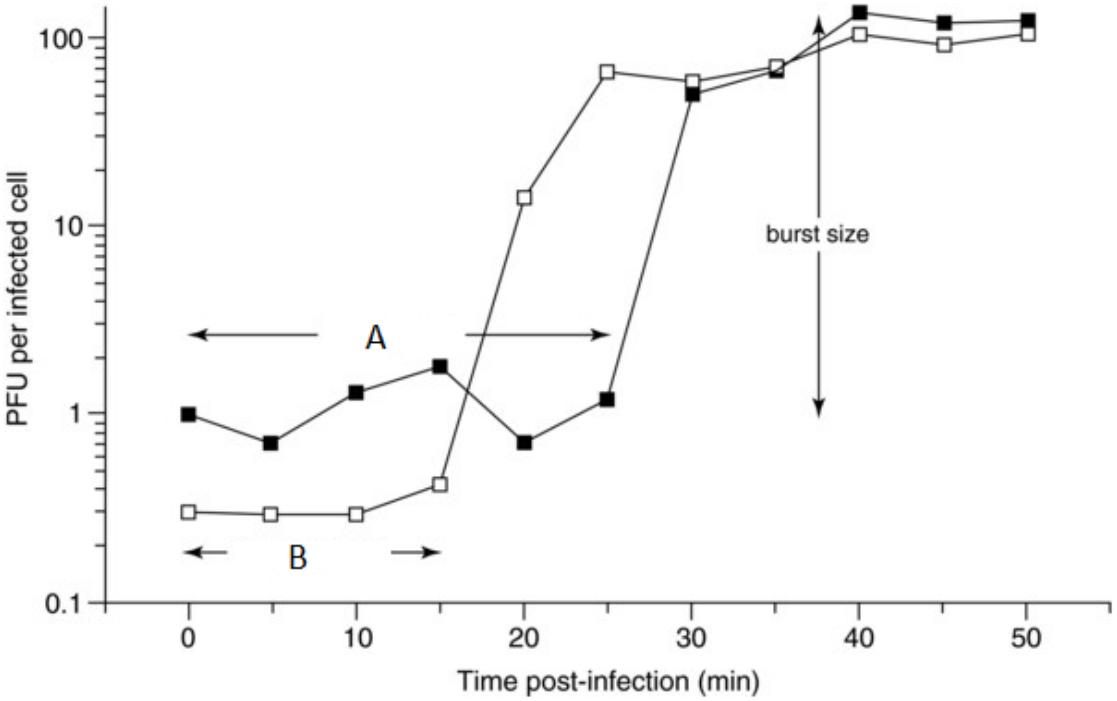
more, **+2 pts** for 2 diagnostic techniques or more apart from the clinical appearance, **+2 pts** for at least 2 categories of treatment are given, **+1** for correct identification of microbe responsible for 50% cases, must be specific)

Part D – Growth Curves & Graph Interpretation



Use the above graph to answer the following questions.

93. (1 pt) Label stage *A* of the graph.
94. (1 pt) Label stage *B* of the graph.
95. (1 pt) Label stage *C* of the graph.
96. (1 pt) Label stage *D* of the graph.
97. (1 pt) In which stage of the above graph are starvation proteins produced by the culture? (Give a letter)
98. (1 pt) In which stage of the above graph does synthesis of RNA, enzymes, and other molecules occur? (Give a letter)



Use the above graph to answer the following questions.

99. (1 pt) What is the name for this type of graph?
100. (1 pt) What is the name of the period indicated by *A*?
101. (1 pt) What is the name of the period indicated by *B*?
102. (1 pt) What does burst size mean?