

Station 1: General Principles of Microbiology

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

1. Select the true statement regarding the process of Osmosis:
 - A. Osmosis is the process by which solutes diffuse across a permeable membrane from an area of high solute concentration to an area of low solute concentration.
 - B. Osmosis is the process by which water diffuses across a permeable membrane from an area of low solute concentration to high concentration.
 - C. Osmosis is the process by which solutes diffuse across a semi-permeable membrane from an area of high solute concentration to an area of low solute concentration.
 - D. Osmosis is the process by which water diffuses across a semi-permeable membrane from an area of low solute concentration to high concentration.
2. All the following are characteristics of life except:
 - A. Reproduction
 - B. Metabolism
 - C. Growth
 - D. Contain DNA or RNA
 - E. Responsiveness
3. Features of Gram-positive bacteria include all the following except:
 - A. Have a thick cell wall
 - B. Retain crystal violet dye
 - C. Stain red when visualized under a light microscope
 - D. Are common pathogens
 - E. Capable of exponential growth
4. Compared with eukaryotes, prokaryotes lack all of the following except:
 - A. Nuclear DNA
 - B. Mitochondria
 - C. Ribosomes
 - D. Chloroplasts
5. Specialized structures which enable prokaryotic organisms to move:
 - A. Pili
 - B. Flagella
 - C. Endospores
 - D. Cilia
 - E. Proton pumps

Station 2: Differentiate Types of Microbes

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

6. Archaea are similar to Bacteria in all the following ways except:
- A. Lack organelles
 - B. Have 70s ribosomes
 - C. Cause human disease
 - D. Have circular DNA
 - E. Lack a nucleus
7. These uni-cellular marine protozoans contain carotene and chlorophylls, cause red tides in warm months and produce neurotoxins that bio-accumulate in shellfish. The protozoan described here:
- A. Amoebozoa
 - B. Dinoflagellates
 - C. Vibrio species
 - D. Trypanosomes
 - E. Alveolytes
8. What is the primary purpose of bacterial endospores?
- A. Allow bacterium to make hundreds of seeds to spread in the wind
 - B. Help bacterium differentiate into faster growing forms of bacteria.
 - C. Allow bacteria to survive in the absence of oxygen.
 - D. Allow bacteria to survive extended periods of dryness and heat
9. Fimbriae:
- A. Attach bacteria to surfaces
 - B. Cause bacteria to move through media or fluid
 - C. Are sensors for change in chemical concentration
 - D. Allow for the uptake of nutrients and fluid.
10. Some bacterial cells are called pleiomorphic. This means:
- A. They are shaped like bent rods.
 - B. They have a bent corkscrew shape.
 - C. They do not have one shape.
 - D. They are not either cocci nor bacilli.
 - E. Have characteristics of both Gram+ and Gram- cells

Station 3: Organism Shape, Function and Structure

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

11. A blood culture is obtained from a patient with a severe infection causing sepsis syndrome (ie fever, shock, organ failure). Inspection of the bacteria from the blood shows them to have the shape of a rod. In the lab report, this shape will be technically referred to as a:
- A. Coccus
 - B. Spirochete
 - C. Bacillus
 - D. Pleiomorph
 - E. Vibrio
12. The 70s ribosome is the site for protein translation in which of the following organisms:
- A. Algae
 - B. Fungi
 - C. Bacteria
 - D. Viruses
 - E. Helminth
13. What is a bacterial plasmid?
- A. A self-replicating double-strand of DNA
 - B. A self-replicating double-strand of RNA
 - C. A self-replicating single-strand of DNA
 - D. A self-replicating single-strand of RNA
14. Microbes are often grown in Petri dishes on a substance known as agar which chemically is known as polysaccharide agarose. This substance is produced by which class of organism listed below?
- A. Fungi
 - B. Plants
 - C. Bacteria
 - D. Algae
 - E. Protozoa
 - F. Archae
15. An infected fluid collection is drained from the forearm of a male who developed this condition after minor trauma. A stain of the fluid from this collection shows Gram-positive bacteria cells. Gram positive cells::
- A. Have both outer and inner permeable membranes
 - B. Have thick outer cell walls
 - C. Have lipopolysaccharide in the plasma membrane
 - D. Contain organelles that are capable of promoting resistance to antibiotics.
 - E. Are covered with biofilm

Station 4: Organelle Function and Principles of microscopy

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

16. Match the term on the left with the description on the right. There is only one correct answer for each term:

- | | |
|--------------------------|---------------------------------------------------------------|
| 1. Ribosome | A. Contains enzymes to neutralize hydrogen peroxide |
| 2. Cytoskeleton | B. Functions as the transport system within a eukaryotic cell |
| 3. Centriole | C. Site of protein synthesis |
| 4. Nucleus | D. Site of most DNA in eukaryotes |
| 5. Mitochondria | E. Allows contraction of the cell |
| 6. Chloroplast | F. Its internal membranes are site for ATP production |
| 7. Endoplasmic Reticulum | G. Contains microtubules in a "9+0" arrangement |
| 8. Golgi Body | H. Light-harvesting organelle |
| 9. Peroxisome | I. Packages large molecules for export from the cell. |

17. Microscopic resolution is best described as:

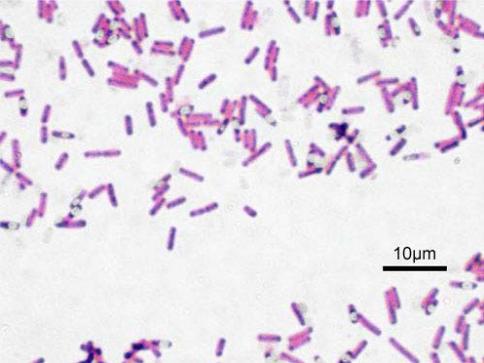
- A. The ability to view something that is small
- B. The ability to magnify a specimen.
- C. The ability to discriminate between two adjacent objects
- D. The difference between two waves of electromagnetic radiation.

18. A Sodium-potassium pump is an example of :

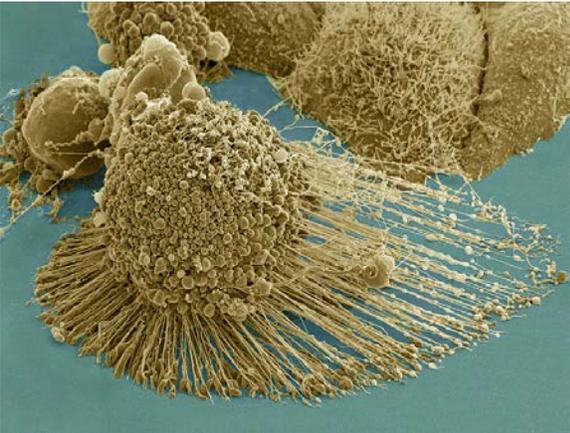
- A. Active Transport
- B. Passive Transport
- C. Endocytosis
- D. Osmosis

19. Label below each photograph with the type of microscope used to attain the image:

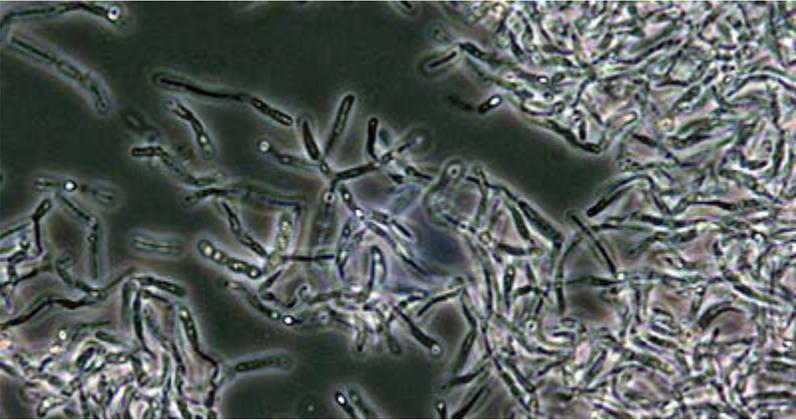
A. _____



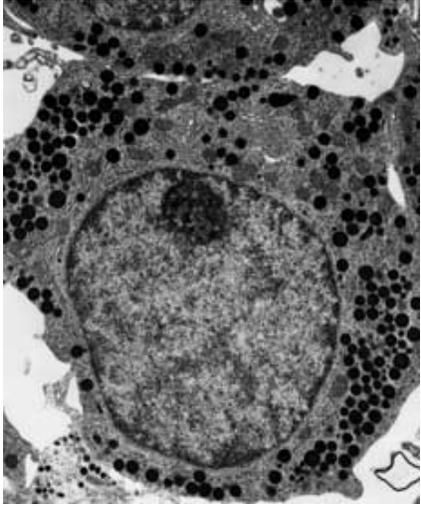
B. _____



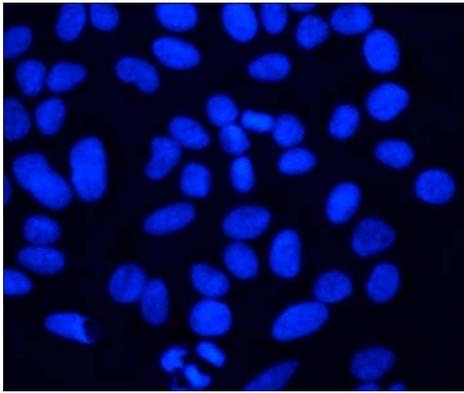
C. _____



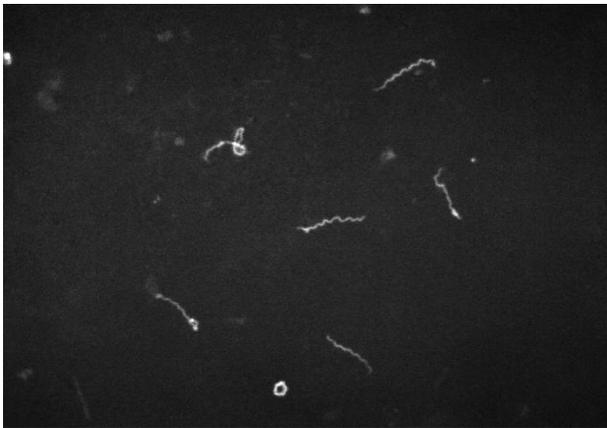
D. _____



E. _____



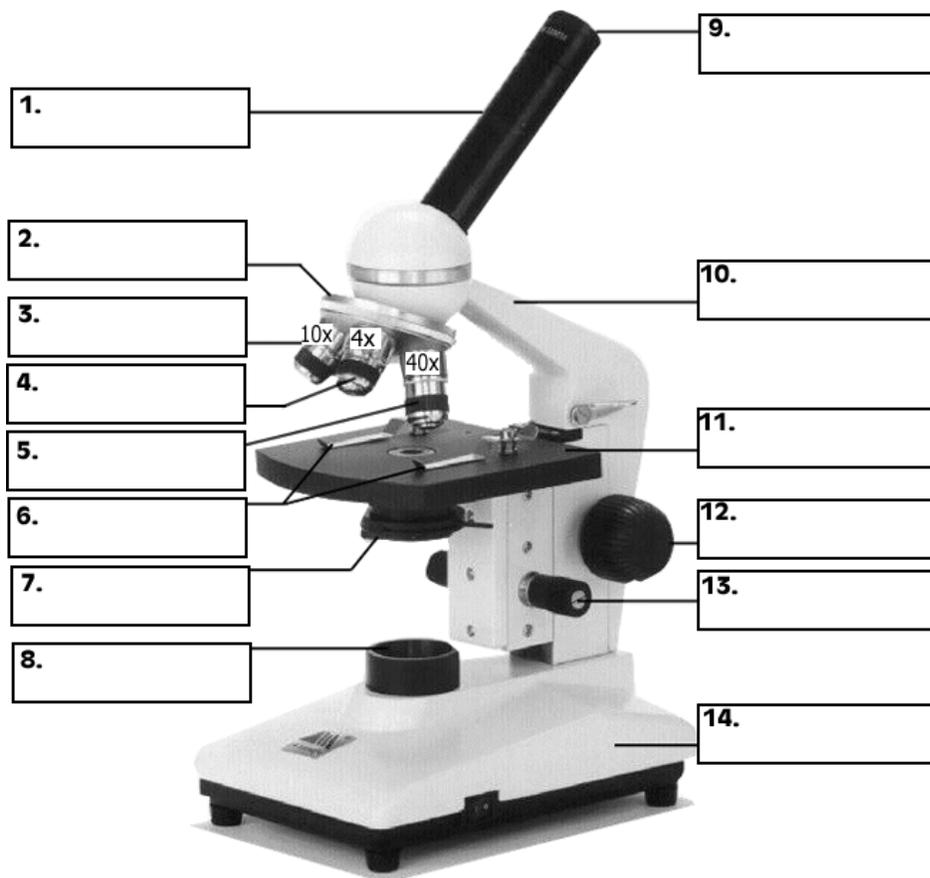
F. _____



Station 5: Principles of Microscopy

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

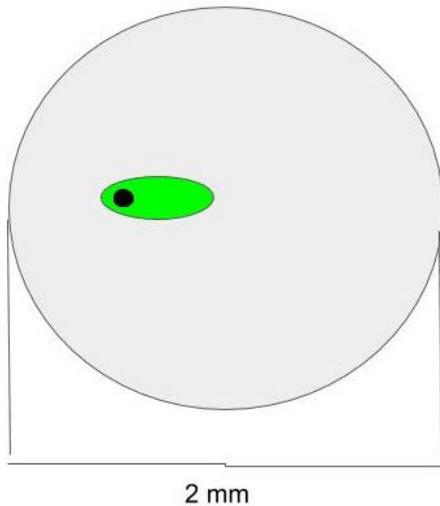
20. Label the parts of the light microscope:



21. The Field of View in microscopy is defined as:

- A. The horizontal diameter of the visible field
- B. The vertical diameter of the visible field
- C. The total area viewable
- D. The circumference of the viewable field

For the following questions (22-24), images will be viewed with a light microscope that has an ocular lens of 10x and objectives with the following powers: scanning= 4x, low = 10 x, high = 40x.



22. For the image above, what is the approximate size of the cell in micrometers (μM)?
- A. 20 μM
 - B. 50 μM
 - C. 500 μM
 - D. 200 μM
 - E. 250 μM
23. 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?
- A. 0.2 mM
 - B. 0.5 mM
 - C. 0.8 mM
 - D. 8.0 mM
24. A new cell type is examined under low power and 10 cells fit like a beaded chain (cocci) across the diameter of the field of view. How many cells could fit across the scanning objective lens?
- A. 25 cells
 - B. 50 cells
 - C. 100 cells
 - D. 250 cells

Station 6: Industrial Microbiology, Cell growth

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

25. The process of fermentation of glucose into _____ by bacteria is used in the industrial production of cheddar cheese.

- A. Propionic acid
- B. Lactic acid
- C. Ethanol
- D. Acetone
- E. Isopropyl Alcohol

26. The process by which a liquid is flash heated to reduce the rate of spoilage of food was discovered by:

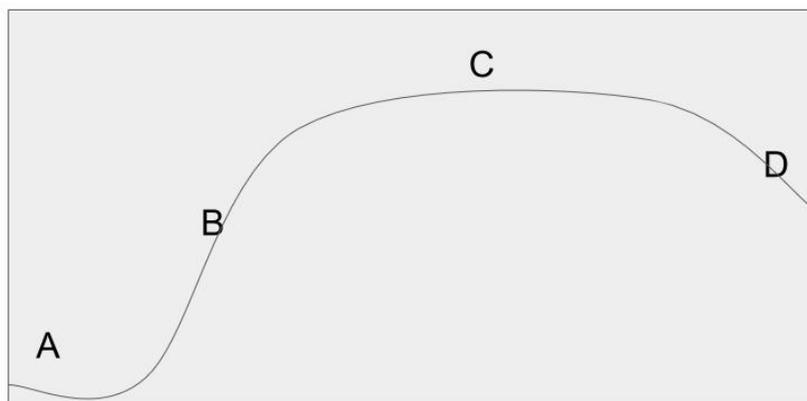
- A. Joseph Lister
- B. Robert Koch
- C. Louis Pasteur
- D. Anton von Leeuwenhook

27. _____ is the process of using physical or chemical agents (ie ultra-violet light, heat, alcohol or bleach) to primarily to destroy or inhibit pathogens.

- A. Degerming
- B. Asepsis
- C. Disinfection
- D. Sterilization
- E. Pasteurization

28. Below is a representative semi-log plot for the number of *E. coli* bacteria (y-axis) in a vessel of liquid media over time (x-axis). Match the Phases of Growth shown schematically below:

1. Phase at which DNA and protein synthesis are maximized.
2. Cells are actively synthesizing enzymes and metabolites.
3. The number of new cells produced is exceeded by the number of dying cells.
4. Phase at which number of surviving and dying cells are equal.



29. Which phase shown above is the phase (A-D) at which antibiotics are most effective against bacterial pathogens? _____.

30. The starting population of the culture is known to be 100 organisms at the end of Stage A. The doubling time of the bacteria is 30 minutes under the current conditions. After 3 hours how many total bacteria are present in the culture media?

- A. 600
- B. 6,000
- C. 6,400
- D. 12,800
- E. Some other number

Station 7: Genetics, Division, Cell growth

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

31. Matching: Name the Microbe that causes the Disease in the left column (Note: in some cases the Genus alone will be given, thus it is important to give the best answer):

- | | |
|-------------------------|-----------------------|
| A. Syphilis | 1. Naegleria |
| B. Dental Caries | 2. H. pylori |
| C. Lyme Disease | 3. Candida albicans |
| D. Peptic Ulcer disease | 4. Ophiostoma ulmi |
| E. Amebic encephalitis | 5. Treponema Pallidum |
| F. Thrush | 6. Borrelia sp. |
| G. Dutch Elm Disease | 7. Strep. mutans |

32. Haploid nuclei_____.

- A. Contain one set of chromosomes
- B. Contain 2 sets of chromosomes
- C. Contain half a set of chromosomes
- D. Are found in the cytosol of eukaryotic cells.
- E. Contain both X and Y chromosomes.

33. Which of the following sequences represents the correct order of the events in division:

- A. Prophase, anaphase, metaphase, prophase.
- B. Prophase, metaphase, anaphase, telophase
- C. Prophase, metaphase, telophase, anaphase
- D. Prophase, anaphase, telophase, telophase.
- E. Prophase, telophase, metaphase, anaphase
- F. Prophase, telophase, anaphase, metaphase.

34. In mitosis, the phase at which sister chromatids line up on an equatorial plane in the center of the cell and are attached to the spindle fibers by their centromeres.

- A. Telophase
- B. Metaphase
- C. Prophase
- D. Anaphase

35. Identify the phase of mitosis that the cell shown below is in at the time the photo was taken:



- A. Telophase
- B. Metaphase
- C. Prophase
- D. Anaphase

Station 8: Human Pathogens

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

36. Human pathogens grow primarily in the temperature range of the human body (about 37C⁰). Organisms that thrive in this temperature range are classified as:

- A. Thermophiles
- B. Hyperthermophiles
- C. Mesophililes
- D. Psycrophiles
- E. Neutrophiles
- F. Barophiles

37. Clostridia are Gram+ rod-shaped organisms that cause important diseases such as botulism and tetanus. These organisms cannot survive in the presence of oxygen. Which of the following terms describes an organism which cannot live in the presence of O₂?

- A. Facultative anaerobe
- B. Obligate anaerobe
- C. Facultative aerobe
- D. Obligate aerobe

38. Transmissible Spongiform Encephalopathies result in progressive neurodegenerative changes in the nervous system of humans and animals. The structure of the misfolded prion protein (PrP) is:

- A. Alpha sheets
- B. Alpha helices
- C. Beta sheets
- D. Beta helices.

39. The most selective antibiotics are those that interfere with:

- A. Bacterial cell walls
- B. Bacterial DNA
- C. Bacterial RNA
- D. Bacterial plasma membranes
- E. Bacterial pili

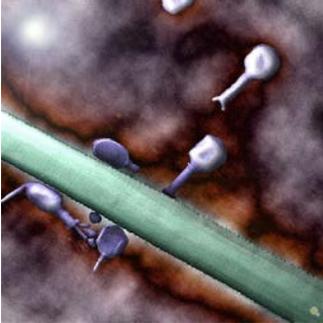
40. Compared to a non-enveloped virus, an enveloped virus has a:

- A. Capsid
- B. Cell membrane
- C. Plasma membrane
- D. Glycocalyx

Station 9: Human Pathogens, Therapy

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

41. The T4 bacteriophage is known to infect the bacterium, *E. coli* through the process of lytic replication. Steps in this process include all the following except:



- A. Attachment
- B. Entry
- C. Synthesis
- D. Integration
- E. Assembly

42. A patient presents to the ER with the complaint of fever and tightness of the jaw muscles 3 days after a fall injury resulted in a jagged cut to the right wrist. He has not had any booster vaccinations since childhood. A Gram stain of fluid oozing from the wound shows Gram-positive rods with a lollipop shape indicating the presence of endospores (see figure). The strategy of vaccination is effective in this case as antibodies are generated against:



- A. Cell wall
- B. Ribosomes
- C. Endotoxin
- D. Endospores
- E. Plasma membrane proteins

43. A patient presents to the hospital two days after an abrasion to the right thigh from an accident on his motorcycle with fever, redness and tenderness of the thigh and a large infected fluid collection in the left kidney. Cultures from both the kidney and blood show MRSA. Which antibiotic would be most appropriate for this patient?:

- A. Vancomycin
- B. Cephazolin
- C. Penicillin
- D. Gentamycin
- E. Vancomycin
- F. Fluconazole

44. A 27 year old female who is an avid soccer player presents after a weekend tournament to her physician with scaly, red, raised, itchy lesions with peeling skin between the toes. A KOH prep shows branched hyphae that are typical of dermatophytes. The term dermatophyte refers to:



- A. Pathogenicity
- B. Where the organism grows
- C. Method of spread
- D. Origin of the cell
- E. Unique metabolism of organism

45. A fungus that can infect both healthy and immunocompromised patients is called_____.

- A. An opportunistic pathogen
- B. A true pathogen
- C. A commensal organism
- D. A symbiotic organism
- E. Dimorphic organism

Station 10: Human Pathogens, Therapy

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

46. A patient develops the clinical signs and symptoms of “ringworm.” A KOH prep of the skin at the leading edge of the lesion shows branched hyphae. Treatment for this condition will should consist of topical agents that target:



- A. Sequestration of iron
- B. Inhibition of ATP formation
- C. Blockage of ribosomal function
- D. Inhibition of ergosterol synthesis

47. A patient developed a “swimmer’s itch” while travelling in Africa and subsequently develops fever, nausea and abdominal pain. Within a year blood in the stool is seen. A low magnification view of a stool sample demonstrates the following egg with its characteristic spike. This agent causes what is commonly known as:



- A. Elephantiasis
- B. Pinworm
- C. Snail fever
- D. Roundworm
- E. Liver fluke

48. A 72 year old woman is started on immunosuppressive drugs for her arthritis. Within 2 weeks she develops a painful, blistering rash across the right thorax. After recovery, the causative agent for this condition may continue to reside in:



- A. Nerve root cells
- B. Lymphoid cells
- C. Keratinocytes
- D. Peripheral blood
- E. Liver

49. Viruses known to cause the common cold include all the following except.

- A. Rhinovirus
- B. Variola
- C. Adenovirus
- D. Coronavirus

50. Matching: match the medical diagnosis on the left to the characteristic clinical finding on the right:

- | | |
|------------|-------------------------------------------------------------|
| 1. AIDS | A. vectors: dogs, cats, raccons |
| 2. Polio | B. parotitis (salivary gland swelling) |
| 3. Dengue | C. Koplik's spots (raised white lesion on mucous membranes) |
| 4. Rabies | D. Severe birth defects in fetus |
| 5. Mumps | E. low CD4+ T cells (ie lymphocytes) |
| 6. Rubella | F. hemorrhagic fever/breakbone fever |
| 7. Measles | G. life-long paralysis |

If needed:

Station 11 (Extra Questions) : Human Pathogens, Therapy

Multiple Choice = 5 points, Matching = 1 point each, fill in the blank = 1 point each

51. Effective measures of harnessing the immune system to improve the prevention of the common cold have not been developed due to:

- A. These viruses infect the nasal passages which are not easily accessed by the immune system
- B. There are too many different proteins on the different surfaces of viruses
- C. Vaccines against the cold are toxic to humans
- D. These viruses occur naturally in the nasal passages, so are not recognized as being foreign to the immune system.

52. Many antiviral drugs act by inhibition of a viral DNA polymerase enzyme. Select the virus for which this class of drugs would be effective.

- A Cytomegalovirus
- B Influenza
- C Measles
- D Mumps
- E Rabies

53. You are informed of an outbreak of diarrhea and vomiting amongst the 200 guests at a wedding reception. About two thirds of the guests became ill between 2 and 3 days after the reception. You obtain a list of guests and the menu for the buffet meal. Select the most appropriate epidemiological investigation.

- A. A case-control study
- B. A correlational study
- C. A cross-sectional study
- D. A randomized controlled trial
- E. A retrospective cohort study