**IQRA NATIONAL UNIVERSITY**

**DEPARTMENT OF ALLIED HEALTH SCIENCES**

**Final-Term Examination 2020**

**Course Title: , Medical microbiology DT 4th Instructor: Muhammad sohail**

**Time: 6 hours Total Marks: 50**

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Ans No.1

**Parasites:**

A parasite is an organism that lives on or in a host organism and gets its food from or at the expense of its host. There are three main classes of parasites that can cause disease in humans: protozoa, helminths, and ectoparasites.

**Endoparasites:**

 Endoparasites are relatively common in mice. However, only two parasites regularly encountered in the [digestive tract](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/digestive-tract), the [protozoan](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/protozoa) parasites [Spiro nucleus muris](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/spironucleus-muris) and [Giardia muris](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/giardia-muris), are considered pathogenic, even though they are not associated with clinical signs in immunocompetent hosts. Diagnosis is based on demonstrating characteristic [trophozoites](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/trophozoites) in wet mounts of fresh intestinal contents or feces.

**Ectoparasites:**

 Although the term ectoparasites can broadly include blood-sucking arthropods such as mosquitoes (because they are dependent on a blood meal from a human host for their survival), this term is generally used more narrowly to refer to organisms such as ticks, fleas, lice, and mites that attach or burrow into the skin and remain there for relatively long periods of time (e.g., weeks to months). Arthropods are important in causing diseases in their own right, but are even more important as vectors, or transmitters, of many different pathogens that in turn cause tremendous morbidity and mortality from the diseases they cause.

 Internal parasites of the Sumatran rhinoceros include roundworms, flatworms, and protozoa of the genera typical of large ungulates with Fasciolidae, Paramphistomidae, Strongyloidae, Oxyuridae, Cryptosporidium, Entamoeba, Balantidium, Ophryoscolecidae, and Spirodinium spp. identified in captive animals (see Table 100.1).Routine screening of animals at the Sumatran Rhino Sanctuary in Lampung Province, Indonesia was conducted using direct smears, magnesium sulfate, and acid techniques, which proved ideal for identifying fluke eggs because sugar flotations collected too much debris. Acid sedimentation techniques were superior to use of the McMaster chamber for quantification of egg counts.

**Ans No.2**

**Protozoa:**

 **Protozoa** (also **protozoan**, plural **protozoans**) is an informal term for single-celled [eukaryotes](https://en.wikipedia.org/wiki/Eukaryotes), either free-living or [parasitic](https://en.wikipedia.org/wiki/Parasitism), which feed on organic matter such as other [microorganisms](https://en.wikipedia.org/wiki/Microorganism) or organic tissues and debris. Historically, the protozoa were regarded as "one-celled animals", because they often possess [animal](https://en.wikipedia.org/wiki/Animal)-like behaviors, such as [motility](https://en.wikipedia.org/wiki/Motility) and [predation](https://en.wikipedia.org/wiki/Predation), and lack a [cell wall](https://en.wikipedia.org/wiki/Cell_wall), as found in plants and many [algae](https://en.wikipedia.org/wiki/Algae). Although the traditional practice of grouping protozoa with animals is no longer considered valid, the term continues to be used in a loose way to identify single-celled organisms that can move independently and feed by [heterotrophy](https://en.wikipedia.org/wiki/Heterotroph).

Characteristic:

1. Size

Protozoa, as traditionally defined, range in size from as little as 1 [micrometre](https://en.wikipedia.org/wiki/Micrometers%22%20%5Co%20%22Micrometers) to several [millimetres](https://en.wikipedia.org/wiki/Millimetre%22%20%5Co%20%22Millimetre), or more.[[24]](https://en.wikipedia.org/wiki/Protozoa#cite_note-24) Among the largest are the deep-sea–dwelling [xenophyophores](https://en.wikipedia.org/wiki/Xenophyophores), single-celled foraminifera whose shells can reach 20 cm in diameter.

1. Habitat

Free-living protozoans are common and often abundant in fresh, brackish and salt water, as well as other moist environments, such as soils and mosses. Some species thrive in extreme environments such as hot springs[[36]](https://en.wikipedia.org/wiki/Protozoa#cite_note-36) and hypersaline lakes and lagoons.[[37]](https://en.wikipedia.org/wiki/Protozoa#cite_note-37) All protozoa require a moist habitat; however, some can survive for long periods of time in dry environments, by forming [resting cysts](https://en.wikipedia.org/wiki/Microbial_cyst) which enable them to remain dormant until conditions improve.

1. Feeding

All protozoans are [heterotrophic](https://en.wikipedia.org/wiki/Heterotroph), deriving nutrients from other organisms, either by ingesting them whole or consuming their organic remains and waste-products. Some protozoans take in food by [phagocytosis](https://en.wikipedia.org/wiki/Phagocytosis), engulfing organic particles with [pseudopodia](https://en.wikipedia.org/wiki/Pseudopodia) (as [amoebae](https://en.wikipedia.org/wiki/Amoeba) do), or taking in food through a specialized mouth-like aperture called a [cytostome](https://en.wikipedia.org/wiki/Cytostome). Others take in food by [osmotrophy](https://en.wikipedia.org/wiki/Osmotrophy%22%20%5Co%20%22Osmotrophy), absorbing dissolved nutrients through their [cell membranes](https://en.wikipedia.org/wiki/Cell_membrane).

1. Motility

Organisms traditionally classified as protozoa are abundant in [aqueous](https://en.wikipedia.org/wiki/Aqueous) environments and [soil](https://en.wikipedia.org/wiki/Soil), occupying a range of [trophic levels](https://en.wikipedia.org/wiki/Trophic_level).

1. Pellicle

Unlike plants, fungi and most types of algae, protozoans do not typically have a rigid [cell wall](https://en.wikipedia.org/wiki/Cell_wall), but are usually enveloped by elastic structures of membranes that permit movement of the cell. In some protozoans, such as the ciliates and [euglenozoans](https://en.wikipedia.org/wiki/Euglenozoa), the cell is supported by a composite membranous envelope called the "pellicle".

1. Life Cycle

Some protozoa have two-phase life cycles, alternating between proliferative stages (e.g., [trophozoites](https://en.wikipedia.org/wiki/Trophozoite)) and dormant [cysts](https://en.wikipedia.org/wiki/Microbial_cyst). As cysts, protozoa can survive harsh conditions, such as exposure to extreme temperatures or harmful chemicals, or long periods without access to nutrients, water, or oxygen for periods of time. Being a cyst enables parasitic species to survive outside of a host, and allows their transmission from one host to another.

**Morphology:**

 Protozoans are single-celled eukaryotes. They are small organisms, ranging from a few microns in length up to about 1 mm. Therefore, the study of protozoans requires patience and skill as a microscope. Specialized staining and optical techniques are often required to visualize their internal structures.

The basic body organization of protozoans consists of an external [plasma membrane](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarP.htm#plasma%20membrane) which encloses the [cytoplasm](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarC.htm#cytoplasm) and [nucleus](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarN.htm#nucleus). There may be one or more nuclei, and in some taxa the nuclei are of two types: larger [macronuclei](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarM.htm#macronucleus) and smaller [micronuclei](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarM.htm#micronucleus). Organelles present within the cytoplasm that are visible by light microscopy are few. [Vacuoles](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarV.htm#vacuole) containing food material in various states of digestion may be present, and [mitochondria](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarM.htm#mitochondrion) are occasionally large enough to be seen.

Three types of locomotory organelles may be present. One or more long [flagella](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarF.htm#flagellum) may be present. [Cilia](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarC.htm#cilium), shorter and more numerous than flagella are present in some taxa. Flagella and cilia aid in swimming. [Pseudopodia](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarP.htm#pseudopodium), temporary extensions of the cytoplasm which elongate the plasma membrane, permit enable crawling.

Most protozoans pass through at least two distinct morphological forms during their life cycle. Much of the terminology for these forms is specific to particular taxa. Some terms are fairly general. Feeding stages are termed [trophozoites](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarT.htm#trophozoite), and these may reproduce [asexually](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarA.htm#asexual). Transmission stages enclosed within a membrane to resist conditions in the external environment are called [cysts](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarC.htm#cyst). Stages which are about to reproduce [sexually](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarS.htm#sexual) and form [gametes](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarG.htm#gamete) are called [gametocytes](http://www2.biology.ualberta.ca/parasites/ParPub/text/text/glossarG.htm#gametocyte).

**Classification of Protozoa:**

 All protozoal species are assigned to the kingdom **Protista** in the Whittaker classification. The protozoa are then placed into various groups primarily on the basis of how they move. The groups are called phyla (singular, phylum) by some microbiologists, and classes by others. Members of the four major groups are illustrated in figure



Reproduction in Protozoa:

Protozoa reproduce by both asexual and sexual means, though sexual reproduction is less common and occurs in certain groups. Most protozoa reproduce asexually by cell division producing two equal or sometimes unequal cells. The cell division in certain protozoa is longitudinal, while in others transverse. In some protozoa multiple fission or schizogamy is known to occur.

**Q3. Write down names of organelles and its functions present in paramecium and euglena**

Cell organelle is a specialized entity present inside a particular type of cell that performs a specific function. There are various cell organelles, out if which, some are common in most types of cells like cell membranes, nucleus, and cytoplasm. However, some organelles are specific to one particular type of cell-like plastids and cell walls in plant cells. cell organelles are listed below

1. Cell Membrane.
2. Cell Wall.
3. Centriole.
4. Cilia and Flagella
5. Chloroplast
6. Cytoplasm
7. Cytoskeleton
8. Endoplasmic Reticulum
9. Endosomes.
10. Golgi Apparatus
11. Intermediate filaments
12. Lysozyme.
13. Microfilaments
14. Microtubules
15. Microvilli
16. Mitochondria
17. Nuclease
18. Peroxisomes
19. Plasmodesmata
20. Plastids
21. Ribosomes.
22. Storage granules
23. Vacuole
24. Vesicles

**Paramecium:**

 Paramecium is a unicellular organism with a shape resembling the sole of a shoe. It ranges from 50 to 300um in size which varies from species to species. It is mostly found in a freshwater environment.

 It is a single-celled [eukaryote](https://www.microscopemaster.com/eukaryotes.html) belonging to kingdom Protista and is a well-known genus of ciliate [protozoa](https://www.microscopemaster.com/protozoa.html).

As well, it belongs to the phylum Ciliophoran. Its whole body is covered with small hair-like filaments called the cilia which helps in locomotion. There is also a deep oral groove containing not so clear oral cilia. The main function of this cilia is to help both in locomotion as well as dragging the food to its oral cavity.

The posterior end of the body is pointed, thick and cone-like while the anterior part is broad and blunt. The widest part of the body is below the middle. The body of a paramecium is asymmetrical. It has a well-defined ventral or oral surface and has a convex aboral or dorsal body surface.

Euglena:

 genus of more than 1,000 species of single-celled [flagellated](https://www.britannica.com/science/flagellum) (i.e., having a whiplike appendage) microorganisms that feature both [plant](https://www.britannica.com/plant/plant) and [animal](https://www.britannica.com/animal/animal) characteristics. Found worldwide, Euglena live in fresh and brackish [water](https://www.britannica.com/science/water-bloom) rich in organic matter and can also be found in moist [soils](https://www.britannica.com/science/soil). As photosynthetic [protists](https://www.britannica.com/science/protist), Euglena have a [taxonomy](https://www.britannica.com/science/taxonomy) that is somewhat [contentious](https://www.merriam-webster.com/dictionary/contentious), and the genus is often placed either in the phylum Euglenozoa or the [algal](https://www.britannica.com/science/algae) phylum Euglenophyta. Euglena are characterized by an elongated cell (15–500 micrometres [1 micrometre = 10−6 metre], or 0.0006–0.02 inch) with one [nucleus](https://www.britannica.com/science/nucleus-biology), numerous [chlorophyll](https://www.britannica.com/science/chlorophyll)-containing [chloroplasts](https://www.britannica.com/science/chloroplast) (cell [organelles](https://www.britannica.com/science/organelle) that are the site of photosynthesis), a contractile [vacuole](https://www.britannica.com/science/vacuole) (organelle that regulates the cytoplasm), an [eyespot](https://www.britannica.com/science/eyespot-biology), and one or two flagella. Certain species (e.g., E. rubra) appear red in sunlight because they contain a large amount of [carotenoid](https://www.britannica.com/science/carotenoid) pigments. Unlike plant cells, Euglena lack a rigid [cellulose](https://www.britannica.com/science/cellulose) wall and have a flexible pellicle (envelope) that allows them to change shape. Though they are photosynthetic, most species can also feed [heterotrophically](https://www.britannica.com/science/heterotroph) (on other organisms) and absorb food directly through the cell surface via [phagocytosis](https://www.britannica.com/science/phagocytosis) (in which the [cell membrane](https://www.britannica.com/science/cell-membrane) entraps food particles in a vacuole for digestion). Food is often stored as a specialized complex [carbohydrate](https://www.britannica.com/science/carbohydrate) known as paramylon, which enables the organisms to survive in low-light conditions. Euglena reproduce asexually by means of longitudinal [cell division](https://www.britannica.com/science/cell-division), in which they divide down their length, and several species produce dormant cysts that can withstand drying.

**Q4. What is antibiotic resistance? Explain the mechanism of bacterial resistance. Its causes and solutions to the problem.**

**Antibiotic Resistance:**

 **Antimicrobial resistance** (**AMR** or **AR**) is the ability of a microbe to resist the effects of medication that once could successfully treat the microbe. The term **antibiotic resistance** (**AR** or **ABR**) is a subset of AMR, as it applies only to [bacteria](https://en.wikipedia.org/wiki/Bacteria) becoming resistant to [antibiotics](https://en.wikipedia.org/wiki/Antibiotic).[https://en.wikipedia.org/wiki/Antimicrobial\_resistance - cite\_note-WHO2014-3](https://en.wikipedia.org/wiki/Antimicrobial_resistance%20-%20cite_note-WHO2014-3) Resistant microbes are more difficult to treat, requiring alternative medications or higher doses of antimicrobials. These approaches may be more expensive, [more toxic](https://en.wikipedia.org/wiki/Adverse_effect) or both. Microbes resistant to multiple antimicrobials are called [multidrug resistant](https://en.wikipedia.org/wiki/Multiple_drug_resistance) (MDR). Those considered extensively drug resistant (XDR) or totally drug-resistant (TDR) are sometimes called "superbugs".

**Mechanism of bacterial resistance:**

 The three fundamental mechanisms of antimicrobial resistance are (1) enzymatic degradation of antibacterial drugs, (2) alteration of bacterial proteins that are antimicrobial targets, and (3) changes in membrane permeability to antibiotics. Antibiotic resistance can be either plasmid mediated or maintained on the bacterial chromosome. The most important mechanism of resistance to the penicillin’s and cephalosporins is antibiotic hydrolysis mediated by the bacterial enzyme β-lactamase. The expression of chromosomal β-lactamase can either be induced or stably derepressed by exposure to β-lactam drugs. Methods to overcome resistance to β-lactam antibiotics include the development of new antibiotics that are stable to β-lactamase attack and the coadministration of β-lactamase inhibitors with β-lactam drugs. Resistance to methicillin, which is stable to gram-positive β-lactamase, occurs through the alteration of an antibiotic target protein, penicillin-binding protein 2. Production of antibiotic modifying enzymes and synthesis of antibiotic-insensitive bacterial targets are the primary resistance mechanisms for the other classes of antibiotics, including trimethoprim, the sulfonamides, the aminoglycosides, chloramphenicol, and the quinolone drugs. Reduced antibiotic penetration is also a resistance mechanism for several classes of antibiotics, including the β-lactam drugs, the aminoglycosides, chloramphenicol, and the quinolones.

**Causes of bacterial resistance:**

* Over-prescription of antibiotics
* Patients not finishing the entire antibiotic course
* Overuse of antibiotics in livestock and fish farming
* Poor infection control in health care settings
* Poor hygiene and sanitation
* Absence of new antibiotics being discovered

**Solution to the bacterial resistance**

The recent increase in bacterial resistance has been, and continues to be, unmatched by drug discovery and development. The judicious use of antibacterial must be observed so as to contain bacterial resistance and maintain the utility of agents currently on the market. Appropriate antibacterial use involves antibacterial avoidance when not indicated. When indicated, appropriate antibacterial use dictates that the optimal drug, dose and duration be utilized. Professional society guidelines facilitate drug selection as well as outline diagnostic criteria and important considerations for patient stratification. Pharmacodynamics is also key for drug selection and often guides determination of not only the optimal drug but also the optimal dose and duration. Importantly, bacterial eradication is essential, as it will reduce clinical failure, recurrence, or relapse and prevent the selection of resistance. Additional strategies to influence antibacterial prescribing and use such as formal continuing medical education, printed educational materials, better diagnostic tests, and vaccination contribute to the efforts to minimize bacterial resistance and are also addressed.

**Q.5 Explain the mechanism of bacterial pathogenicity. Write down at least two bacterial diseases in detail.**

**Introduction:**

A **pathogen** is a microorganism that is able to cause disease in a plant, animal or insect. **Pathogenicity** is the ability to produce disease in a host organism. Microbes express their pathogenicity by means of their **virulence**, a term which refers to the degree of pathogenicity of the microbe. Hence, the **determinants of virulence** of a pathogen are any of its genetic or biochemical or structural features that enable it to produce disease in a host.

The relationship between a host and a pathogen is dynamic, since each modifies the activities and functions of the other. The outcome of such a relationship depends on the virulence of the pathogen and the relative degree of resistance or susceptibility of the host, due mainly to the effectiveness of the host defense mechanisms.

**Mechanisms of Bacterial Pathogenicity**

Two broad qualities of pathogenic bacteria underlie the means by which they cause disease:

**1. Invasiveness** is the ability to invade tissues. It encompasses mechanisms for **colonization** (adherence and initial multiplication), **production of extracellular substances which facilitate invasion** (**invasions**) and **ability to bypass or overcome host defense mechanisms**.

**2.** **Toxigenesis** is the ability to produce toxins. Bacteria may produce two types of toxins called **exotoxins** and **endotoxins**. **Exotoxins** are released from bacterial cells and may act at tissue sites removed from the site of bacterial growth. **Endotoxins** are cell-associated substance.  (In a classic sense, the term **endotoxin** refers to the lipopolysaccharide component of the outer membrane of Gram-negative bacteria).  However, endotoxins may be released from growing bacterial cells and cells that are lysed as a result of effective host defense (e.g. lysozyme) or the activities of certain antibiotics (e.g. penicillins and cephalosporins). Hence, bacterial toxins, both soluble and cell-associated, may be transported by blood and lymph and cause cytotoxic effects at tissue sites remote from the original point of invasion or growth. Some bacterial toxins may also act at the site of colonization and play a role in invasion

**Bacterial Disease:**

 **Bacterial disease**, any of a variety of illnesses caused by [bacteria](https://www.britannica.com/science/bacteria). Until the mid-20th century, bacterial [pneumonia](https://www.britannica.com/science/pneumonia) was probably the leading cause of death among the elderly. Improved sanitation, [vaccines](https://www.britannica.com/science/vaccine), and [antibiotics](https://www.britannica.com/science/antibiotic) have all decreased the mortality rates from bacterial infections, though [antibiotic-resistant](https://www.britannica.com/science/antibiotic-resistance) strains have caused a resurgence in some illnesses. In the early 21st century, [tuberculosis](https://www.britannica.com/science/tuberculosis), which is caused by Mycobacterium tuberculosis—several strains of which had developed resistance to one or more drugs widely used to treat the infection—was among the deadliest [infectious diseases](https://www.britannica.com/science/infectious-disease) worldwide.

The Plague of Athens

 In 430 B.C.E., the Plague of Athens killed one-quarter of the Athenian troops that were fighting in the great Peloponnesian War and weakened Athens’ dominance and power. The plague impacted people living in overcrowded Athens as well as troops aboard ships that had to return to Athens. The source of the plague may have been identified recently when researchers from the University of Athens were able to use DNA from teeth recovered from a mass grave. The scientists identified nucleotide sequences from a pathogenic bacterium, Salmonella enterica serovar typhi, which causes typhoid fever. This disease is commonly seen in overcrowded areas and has caused epidemics throughout recorded history.

Bubonic Plagues

 From 541 to 750 C.E.., an outbreak of what was likely a bubonic plague (the Plague of Justinian), eliminated one-quarter to one-half of the human population in the eastern Mediterranean region. The population in Europe dropped by 50 percent during this outbreak. The bubonic plague would strike Europe more than once.

One of the most devastating pandemics was the Black Death (1346 to 1361) that is believed to have been another outbreak of bubonic plague caused by the bacterium *Yersinia pestis*. It is thought to have originated initially in China and spread along the Silk Road, a network of land and sea trade routes, to the Mediterranean region and Europe, carried by rat fleas living on black rats that were always present on ships. The Black Death reduced the world’s population from an estimated 450 million to about 350 to 375 million. Bubonic plague struck London hard again in the mid-1600s. In modern times, approximately 1,000 to 3,000 cases of plague arise globally each year. Although contracting bubonic plague before antibiotics meant almost certain death, the bacterium responds to several types of modern antibiotics; mortality rates from plague are now very low.

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