

## 10.1: Infectious diseases

1. **D**  
*Mycobacterium bovis* is a species of bacteria that causes tuberculosis, particularly in cattle, but can also infect humans, leading to a form of tuberculosis.
2. **D**  
Injections of antigens from *Bordetella pertussis* bacteria stimulate the immune system to produce a lasting immune response, providing active immunity and reducing the chance of future infections.
3. **A**  
Gram-positive bacteria have a thick peptidoglycan layer without an outer membrane, making them more vulnerable to penicillin, which targets the synthesis of this layer. Gram-negative bacteria are less susceptible due to their protective outer membrane.
4. **A**  
The percentage decrease is calculated by the formula:  
$$\left( \frac{5.3 - 3.2}{5.3} \right) \times 100 = 39.6\%$$
  
Thus, the correct answer is 39.6%.
5. **D**  
TB can be transmitted from animals (statement 4) and by ingestion (statement 5). HIV / AIDS worsens TB infections (statement 3), and multi-drug resistance (statement 6) occurs due to improper treatment.
6. **B**  
The image shows a scanning electron micrograph, as it provides a 3D view of lung squamous epithelium and red blood cells, which is consistent with option B.
7. **C**  
Two mutations are needed for teixobactin resistance (1 correct), mutations do not affect lipids (2 incorrect), and conserved lipids prevent resistance evolution (3 correct).
8. **D**  
Infectious diseases are caused by pathogens such as bacteria, viruses, fungi, or protists, making option D the correct definition.
9. **D**  
*Plasmodium vivax*, the causative agent of malaria, is a protist. It infects humans and is transmitted by Anopheles mosquitoes.
10. **D**  
HIV, TB, Malaria, and Cholera are four significant infectious diseases with different transmission routes:
  - HIV is primarily spread through sexual contact, sharing of needles, and mother-to-child transmission during childbirth or breastfeeding.
  - TB is an airborne disease, transmitted through respiratory droplets when an infected person coughs or sneezes.
  - Malaria is spread through the bite of infected female Anopheles mosquitoes, which inject the parasite into the bloodstream.
  - Cholera is usually transmitted through contaminated food or water, particularly in areas with poor sanitation.Based on these transmission routes, it's clear that an air filter would only prevent the spread of TB, which is airborne, and would not protect against HIV, Malaria, or Cholera, which are transmitted through other routes.
11. **D**  
Tuberculosis (TB) is hard to eliminate due to the pathogen's ability to remain inactive in the host (2) and the evolution of drug-resistant strains (3). Limited access to clean water (1) does not directly affect TB transmission or treatment.
12. **D**  
The correct answer is D) 2 and 3 only.  
The statement "The pathogen is not accessible to the immune system" does not directly explain why antibiotic treatment for TB takes a long time. It is more related to the difficulty of the immune system in targeting TB effectively.

TB bacteria reproduce slowly, which can make it challenging to target and eliminate all the bacteria in a reasonable amount of time.

TB bacteria are not very sensitive to antibiotics, and this is a significant factor in why TB treatment is prolonged.

13. **C**  
The recognition of malaria's pathogen, a protist, and its mode of transmission via mosquito bites is a basic concept in the study of infectious diseases. Identifying the correct pathogen type and transmission method is fundamental to understanding disease etiology.
14. **D**  
Cholera is transmitted through contaminated water and food, not by animal vectors. The other statements are correct regarding the bacterial cause, risk factors like HIV/AIDS, and vaccination as a control method. Hence, D is the correct answer.
15. **B**  
Infectious diseases are defined by their transmissibility from one host to another. The presence of symptoms alone does not define an infectious disease, but rather the ability of a pathogen to be transferred between hosts, causing those symptoms. This includes a broad range of pathogens, such as bacteria, viruses, fungi, and parasites.
16. **A**  
Cholera is a waterborne disease caused by the bacteria *Vibrio cholerae*, which is most commonly spread through contaminated water or food. In situations where sanitation is poor, such as after a natural disaster like a hurricane that disrupts water supply and sewage systems, the risk of cholera outbreaks increases significantly. This is because the lack of clean water and proper sewage disposal facilitates the spread of the bacteria. The other diseases listed (HIV, malaria, and TB) do not spread as quickly through poor sanitation conditions as cholera does.
17. **D**  
Preventing cholera and tuberculosis spread in overcrowded conditions involves covering food to avoid contamination by flies, providing chlorinated drinking water to kill waterborne pathogens, and treating severe cases with antibiotics to reduce the spread of these bacterial diseases.
18. **D**  
TB antigens are proteins that would be broken down by digestive enzymes in the stomach and small intestine, rendering them ineffective at eliciting an immune response if taken orally.
19. **D**  
To develop resistance to antibiotics, bacteria require mechanisms to transport the antibiotic out of the cell, which involves specific proteins in the cell membrane.
20. **A**  
Statement 1 is correct as increased global travel increases the spread of the infection. Statement 2 is correct as well since the TB bacteria has evolved resistance to certain antibiotics due to mutations. Statement 3 is incorrect as the tuberculosis bacterium does not show great antigenic variability. Statement 4 is correct as overcrowding also increases the spread of the disease. Hence, option A is the correct answer.
21. **C**  
Option C is the correct answer as the high fatality rate of Cholera results in reduced transmission as when people die it cannot be passed.
22. **D**  
Option D is the correct answer as boiling water does not reduce the spread of TB since it is airborne. Antibiotics and vaccines both reduce the spread by targeting the bacteria and providing immunity respectively.
23. **C**  
Option C is the correct answer as HIV followed by TB is a perfect example of comorbidity as HIV first weakens the immune system and when the person is infected with TB the immune system cannot initiate a proper response which results in a severe infection that leads to death.
24. **D**  
Option D is the correct answer as leukemia is cancer and myasthenia gravis is an autoimmune condition and none of these are infectious diseases. Only TB is an infectious disease caused by a bacterium and it causes the white blood cell count to increase.
25. **C**  
Option C is the correct answer as malaria is transmitted via vectors meaning that it can be transmitted from one animal to another. Since the parasite that causes it is a eukaryote it shows multiple resistance and most of the victims are children.

26. **A**  
Option A is the correct answer as this disease can be cholera which is transmitted through contaminated food and water which is why it is suggested to eat hot food and drink cool and boiled water and also wash hands using boiled water.
27. **A**  
Option A is the correct answer as resistance of mosquitos to insecticides and the Plasmodium parasite to quinine can cause an outbreak to occur. Additionally, an influx of people due to migration can cause an outbreak as they can be carriers of the parasite.
28. **C**  
Option C is the correct answer as malaria is spread through the mosquito vector.
29. **D**  
Option D is the correct answer as leukemia patients have a high white blood cells count paired with increased bone marrow activity. Similarly a patient with measles has an increased white blood cell count.
30. **B**  
Option B is the correct answer as Mycobacterium causes tuberculosis that is spread via airborne droplets. Plasmodium causes malaria and is spread via an insect vector. Vibrio causes cholera and is spread via water.
31. **B**  
Option B is the correct answer as malaria is caused by the Plasmodium parasite which is a eukaryote. Cholera and measles are caused by a bacterium while smallpox is caused by a virus.
32. **D**  
Option D is the correct answer as disease 1 is lung cancer due to coughing up of blood and pain during breathing. Disease 2 is emphysema since it involves shortness of breath and difficulty in breathing out due to loss of elastic fibers in the alveoli.
33. **B**  
Option B is the correct answer as malaria and measles are unaffected by antibiotics. Cholera is not treatable using antibiotics as it resides in the small intestine where antibiotics cannot act. Hence, TB is reduced by all these methods.
34. **D**  
Option D is the correct answer as HIV virus has no cell membrane or ribosomes. It does have genes which are also found in the Plasmodium parasite and the TB bacteria.
35. **D**  
Option D is the correct answer as poor vaccine coverage means that more people suffer from the virus and since measles is airborne living in overcrowded accommodation also causes the virus the spread. Contamination of water sources does not promote the spread of measles since it is not a waterborne pathogen.
36. **A**  
Option A is the correct answer as the sewage in the drinking water would lead to cholera and the pools of water would encourage the breeding of mosquitoes causing the spread of malaria and due to crowded conditions if someone has tuberculosis it can spread very rapidly.
37. **B**  
Option B is the correct answer as tuberculosis is caused by a bacterium and spread by coughs and sneezes.
38. **A**  
Option A is the correct answer as humid climate promotes the spread of malaria. Option B is incorrect as being nearer to the equator does not affect the spread of malaria. Options C and D are incorrect as malaria is transmitted by mosquitos so being crowded does not matter and malaria has no correlation with sewage.
39. **C**  
Option A is incorrect as HIV is spread via pathogen. Option B is incorrect as lung cancer is genetic and is non-infectious. Option D is incorrect as TB is infectious. Hence, option C is the correct answer as sickle cell anemia is genetic and non-infectious.
40. **D**  
Option D is the correct answer as vibrio causes cholera and does not spread via droplet infection while Myobacterium that causes TB and Morbillivirus that causes measles can both spread via this method.
41. **A**  
Option A is the correct answer as cholera is caused by a bacterium and spread through the use of contaminated water. Measles is caused by the Morbillivirus and spread via coughs and sneezes.

42. **D**  
Option A is incorrect as the mass of cells are not infectious. Option B is incorrect as inflammation is not infectious as well. Option C is incorrect as disruption in oxygen transport is once again not infectious. Hence, option D is the correct answer as the disruption of lung tissues by prokaryotic organisms is an example of infectious disease as these prokaryotic organisms can be spread.
43. **A**  
Option A is the correct answer as TB is spread through the air and via a bacterium and there are no rashes in the symptoms.
44. **D**  
Option D is the correct answer as global warming has made conditions favorable for certain species such as the Anopheles resulting in the risk of contracting malaria increasing.
45. **A**  
Option A is the correct answer as the alveoli bursting, loss of elastic fibers and reduction of the surface area for gaseous exchange are all symptoms of emphysema as well.
46. **D**  
Option D is the correct answer as both TB and measles are infectious diseases and are airborne. Measles is caused by a virus not a bacterium.
47. **A**  
Option A is the correct answer as all of the measures listed require economic contribution in order to be successful.
48. **A**  
Option A is the correct answer as cholera is spread via a bacterium and the use of contaminated water.
49. **C**  
Option C is the correct answer as cholera is caused by Vibrio, measles by Morbillivirus, Smallpox by Variola and tuberculosis by Mycobacterium.
50. **D**  
Option D is the correct answer as the migration of people because of wars is a social factor that causes the spread of malaria.
51. **D**  
Option D is the correct answer as measles is spread via the Morbillivirus and through coughs and sneezes.
52. **C**  
Option C is the correct answer as measles and TB are spread via airborne droplets.
53. **A**  
Option A is the correct answer as cholera is caused by Vibrio, HIV can be passed via the placenta to the child or through breast milk. The eradication program for malaria was unsuccessful as the genetic code constantly shifts meaning there is no effective vaccine and measles is caused by Morbillivirus.
54. **D**  
Option D is the correct answer as measles is caused by a Morbillivirus and viruses do not have a cytoplasm or the ability to produce ATP. Other than that all the 3 pathogens possess surface antigens.
55. **A**  
Option A is the correct answer as cholera is waterborne. Measles is caused by a virus which is airborne and HIV/AIDS is also caused by a virus but it is not airborne. TB is not waterborne and isn't caused by a virus.
56. **A**  
Option A is the correct answer as Vibrio cholerae is a prokaryote meaning that it does not have membrane bound organelles such as a mitochondria or 80S ribosomes but it does contain circular DNA.
57. **A**  
Option A is the correct answer as cholera and measles both have vaccines available and are caused by Vibrio cholerae and Morbillivirus respectively. Smallpox was eradicated but it is caused by a virus.
58. **C**  
Option C is the correct answer as infectious diseases are those that can transfer from one person to another directly or indirectly. This means that cancer and genetic diseases do not come under this term. HIV, malaria, measles and TB all come under this category.
59. **B**  
Option B is the correct answer as there is no vaccination for Malaria and antibiotics do not affect it since Plasmodium is a eukaryote meaning that it does not have a cell wall that antibiotics target.
60. **A**  
Option A is the correct answer as Plasmodium is a parasite which is eukaryotic in nature which means that it has Golgi body, ribosomes and mitochondria.

61. **D**  
Option D is the correct answer as HIV/AIDS weakens the human immune response resulting in the karial pathogen having a higher occurrence rate in affected individuals.
62. **A**  
Option A is the correct answer as the infectious agent for cholera is a bacterium and it is spread when a person drinks the water containing the pathogen.
63. **C**  
Option C is the correct answer as cancer is a non-infectious disease that results from mutations and sickle cells anemia is caused by a genetic disorder and is passed down from the parents to the children. If the disease spreads through a vector it is infectious.
64. **D**  
Option D is the correct answer as mosquitos act as a vector in the transmission of malaria.
65. **C**  
Option C is the correct answer as smallpox is caused by the Variola virus and spreads through direct contact. Morbillivirus results in measles.
66. **D**  
Option D is the correct answer as tuberculosis vaccine is no ingested since the antigens would be broken down by proteases in the stomach and without them an immune response is not possible.
67. **C**  
Option C is the correct answer as Mycobacterium tuberculosis and Morbillivirus that causes measles both spread by droplet infection. Vibrio cholerae is a waterborne pathogen.
68. **A**  
Option A is the correct answer as it is possible that resistance of mosquitos to certain insecticides results in them acquiring the pathogen from diseased individuals and starting the cycle again. Similarly it could be possible that the parasite itself acquires resistance and is taken up by mosquitos. Mass migration could also contribute as there could be infected individuals that pass the pathogen on to mosquitos.
69. **B**  
Option B is the correct answer as HIV and measles are caused by a virus and malaria is caused by a parasite. TB is caused by a bacterium making 1.6 million deaths from bacterial diseases in 2002.
70. **D**  
Option D is the correct answer as TB is caused by Mycobacterium tuberculosis and can be spread via airborne droplets.
71. **D**  
Option D is the correct answer as measles is caused by the pathogen Morbillivirus, is airborne and one of its symptoms include rashes.
72. **B**  
Option B is the correct answer as HIV and measles are caused by a virus and malaria is caused by a parasite. TB is caused by a bacterium making 3.4 million deaths from viral diseases in 2002.
73. **B**  
Option B is the correct answer as the malarial parsite spreads via mosquito bites.
74. **C**  
Option C is the correct answer as since the virus is airborne global air travel has resulted in increased transmission. Poverty forcing people into overcrowding also contributes as the virus spreads form person to person. The virus does not show great antigenic variability and since it is a virus it is unaffected by antibiotics.
75. **C**  
It is difficult to control the spread of malaria as the pathogen is a eukaryote that shows great antigenic variability and the vector for the disease is capable of developing resistance to insecticides resulting in wider spread. Global air travel does not contribute to spread if proper screening takes place and civil unrest and poverty do not contribute to spread.
76. **B**  
Option B is the correct answer as poor education regarding contraceptives and safe sex practices result in spread of HIV/AIDS.
77. **A**  
Option A is the correct answer as TB is spread via airborne droplet and the pathogen is a bacterium. Measles is causes by a virus and is airborne. HIV/AIDS is caused by a virus and spreads as a result of bodily fluid being exchanged.

78. **A**  
Option A is the correct answer as cholera is caused by a bacterium and is food borne or water borne. Option B is incorrect as malaria is caused by a eukaryotic parasite. Option C is incorrect as measles is caused by a virus and it is airborne. Option D is incorrect as TB is caused by a bacterium.
79. **C**  
Option C is the correct answer as the given statements are all true for the Malaria.
80. **C**  
Option C is the correct answer as Morbillivirus causes measles, Mycobacterium causes TB, Plasmodium causes malaria, Variola causes smallpox and Vibrio causes cholera.
81. **C**  
Option C is the correct answer as sickle cell anemia is a genetic disorder meaning that it has no correlation with the immune system.
82. **B**  
Option B is the correct answer as HIV is a retrovirus whose reverse transcriptase can be blocked using drugs so that the incorrect nucleotides are incorporated into the genetic material produced.
83. **B**  
Option C is the correct answer as insecticide resistance results in more mosquitos surviving that can pass on the malarial parasite to hosts.
84. **B**  
Option B is the correct answer as Morbillivirus and Mycobacterium are airborne pathogens.
85. **C**  
Option C is the correct answer as the insecticides kill the mosquitos that do have resistance to it while the polystyrene balls causes the larva to suffocate.
86. **A**  
Option A is the correct answer as cholera is caused by a bacterium which is a prokaryote meaning that it will contain all of the mentioned features.
87. **B**  
Option B is the correct answer as unpasteurized milk can contain the Mycobacterium and since TB is an airborne disease living in overcrowded conditions contribute to its spread.
88. **D**  
Option D is the correct answer as Cholera is caused by a bacterium that contains 70S ribosomes, cell wall and circular DNA.
89. **A**  
Option A is the correct answer as Cholera is caused by a bacterium that contains a cell wall but since it is a prokaryote it does not contain rough endoplasmic reticulum or Golgi body.
90. **B**  
Option B is the correct answer as cholera is an infectious disease causes by Vibrio Cholerae and is water borne
91. **D**  
Option D is the correct answer as the data shows the number of deaths but does tell the population size of the demographic meaning that it is possible that people survive even after contracting this pathogen.
92. **A**  
Option A is the correct answer as TB bacteria can reside in unpasteurized milk. Providing new housing prevents overcrowding and reduces the spread of the disease as it is airborne. Sewage has no correlation with TB as it is airborne not waterborne. Identifying people who were in contact with infected individuals allows for them to receive treatment as well.
93. **B**  
Option A is incorrect as bronchitis does not cause degradation of lung tissue. Option C is incorrect as lung cancer is not infectious. Option D is incorrect as measles cannot be treated using antibiotics. Hence, option B is the correct answer as lung cancer causes lung tissue degradation. HIV/AIDS is infectious and caused by a virus. Cholera is infectious and can be treated using antibiotics and TB is infectious and can be treated using antibiotics but causes lung tissue degradation.
94. **A**  
Option A is the correct answer as malaria is infectious, insect borne and caused by a species of Plasmodium.
95. **C**  
Option C is the correct answer as from the table it can be seen that the thickness of the cell wall increases as the bacteria acquire resistance. This suggests that the thickness of the cell wall acts as a barrier towards the drugs.

96. **C**  
Option C is the correct answer as patients with HIV cannot be cured and it is possible that they are carriers meaning that they never experience the symptoms. Infected people can live for many years after the infection provided that they receive the appropriate treatment.
97. **D**  
Option D is the correct answer as tuberculosis vaccine is not ingested since the antigens would be broken down by proteases in the stomach and without them an immune response is not possible.
98. **D**  
Option D is the correct answer as the mass migration of people may include individuals who have the Plasmodium parasite in their bodies. Their migration results in the parasite being introduced into the mosquitoes and then spreads.
99. **B**  
Option B is the correct answer as Malaria is spread via a vector and caused by a protozoan. TB is caused by a bacteria and spreads via food and droplets. HIV is spread via contact and a virus is the agent.
100. **B**  
Option B is the correct answer as the pathogen is present in the lumen of the gut where the antibodies cannot reach and the bacteria can remain dormant for extended periods.
101. **C**  
Option C is the correct answer as in malaria the number of red blood cells decreases since the parasite matures in them and the cells burst when the parasite has matured.
102. **A**  
Option A is the correct answer as in refugee camps the water is likely to be contaminated with sewage that contains the Vibrio bacteria that causes Cholera.
103. **D**  
Option D is the correct answer as due to global trade and tourism the bacterium has spread to the far reaches of the world and since the bacteria targets cells of small intestine it cannot be acted upon by antibodies.
104. **D**  
Option D is the correct answer as inhibiting the enzyme HDP causes the parasite to reproduce slowly since it is unable to convert the free haem groups into non-toxic compounds and hence those free haem groups act as toxins for it.
105. **C**  
Option C is the correct answer as 1 can be either lung cancer or emphysema. 2 can be smallpox or measles or HIV/AIDS. 3 can be cholera or TB. 4 can be either of the 3 mentioned for 2. Using this information option C is the best choice.
106. **D**  
Option D is the correct answer as refrigeration does not have any effect on the cholera bacteria. Overcrowding results in unsanitary conditions that promote the spread and having no hand washing facilities results in the bacteria spreading through contact.

## 10.2: Antibiotics

1. **C**  
The antibiotic weakens the bacterial cell wall, causing it to burst due to osmotic lysis as water enters the cell. Cellulose is not present in bacterial cell walls, and the permeability of the cell wall is not affected.
2. **B**  
Increasing antibiotic concentration reduces the non-resistant bacterial population (statement 1). The proportion of resistant bacteria rises with higher antibiotic concentrations (statement 2). Statement 3 is incorrect, as resistant bacteria do not always increase in number, but their proportion does, especially at higher antibiotic levels.
3. **B**  
Penicillin inhibits the formation of cross-links between peptidoglycan molecules in bacterial cell walls, preventing the cell from maintaining its structural integrity during growth, ultimately leading to cell lysis.
4. **B**  
Molecule Y functions as an antibiotic since no bacterial growth occurs in its presence, but it cannot be released from intact cells of organism X. There is no evidence to suggest that molecule Y would affect protein synthesis from nuclear DNA in human cells.

5. **C**  
Using a specific antibiotic after testing for the pathogen ensures targeted treatment, reducing the risk of antibiotic resistance. This prevents overuse or misuse of antibiotics, which can increase resistance in the pathogen.
6. **C**  
Using specific antibiotics (1) and developing new ones (3) can reduce resistance. Antibiotics should not be used for viral infections (2), as this misuse increases resistance.
7. **B**  
Bacteria types 2, 3, and 4 show decreasing inhibition zones (<13.0 mm) over time, indicating growing resistance to the antibiotic. Types 1 and 5 maintain larger zones, showing no significant resistance.
8. **D**  
This process is leading to antibiotic resistance in bacterial populations involves recognizing the role of random mutation, genetic variation, reproductive success, and allele frequency changes. This sequence reflects the fundamental principles of evolutionary biology and antibiotic resistance mechanisms
9. **D**  
Penicillin is an antibiotic that targets bacterial cell wall synthesis by inhibiting the enzyme needed for the production of peptidoglycan, which is a component of bacterial cell walls. Viruses do not have cell walls and do not synthesize peptidoglycan; therefore, they are unaffected by penicillin.
10. **B**  
Antibiotic resistance in bacteria often arises due to a mutation which can occur randomly, not necessarily due to the presence of the antibiotic itself. When such a mutation confers resistance to an antibiotic like penicillin, those bacteria with the mutation can survive and reproduce, passing the resistant allele to their offspring. Over time, especially under the selective pressure of the antibiotic, the number of bacteria carrying the resistance allele increases in the population. Statement 4 is incorrect because the mutation for resistance is not always caused by the presence of penicillin; it can occur spontaneously due to error in DNA replication or other factors.
11. **A**  
Analyzing zones of inhibition in an antibiotic susceptibility test involves measuring the effectiveness of antibiotics against bacteria. The size of the zone of inhibition indicates the antibiotic's effectiveness, with larger zones indicating more effective antibiotics.
12. **A**  
Option A is the correct answer as all of the 3 methods reduce the rate of antibiotic resistance by using different antibiotics, or antibiotics with different modes of action or finishing prescribed course of antibiotics.
13. **A**  
Option A is the correct answer as penicillin kills bacteria by halting the formation of the peptidoglycan cross links and this causes water to enter the bacteria causing them to burst.
14. **D**  
Option D is the correct answer as it can also be that the mutation caused base addition or deletion other than swapping. If the antibiotic is hydrophobic then it should be able to cross the membrane since the inside of the membrane is hydrophobic. The mutation resulted in the alteration of the tertiary structure of the P allowing the bacteria to acquire resistance.
15. **A**  
Option A is the best description as multiple drug resistance in bacteria means that the bacteria have multiple genes coding for resistance against several different antibiotics.
16. **D**  
Option D is the correct answer as mutations in bacterial DNA may grant resistance to bacteria and patients not completing antibiotic courses results in bacteria acquiring immunity against the antibiotic. Using vaccines does not contribute to development of resistance since the antigens are used not antibiotics.
17. **A**  
Option A is the correct answer as the initial mechanism in antibiotic resistance development is always the occurrence of a mutation.
18. **A**  
Option A is the correct answer as all the 3 statements are correct since use of any antibiotic may result in the pathogen acquiring resistance against it since mutations are spontaneous and random.
19. **A**  
Option A is the correct answer as not completing a course means that bacteria that the antibiotics targets are still alive and they may acquire resistance. Keeping antibiotics from previous prescriptions also allows development of resistance. Using antibiotics in farming allows unintended bacteria to acquire resistance.



20. **B**  
Option B is the correct answer as from the information we can deduce that the cell walls have a different composition and cannot be made from peptidoglycan as penicillin acts on it. It cannot be made from cellulose as well since there is no evidence pointing to that fact.
21. **D**  
Option A is incorrect as antibiotics are not resistant bacteria are. Option B is incorrect as bacteria P is not resistant to both antibiotics since they have clear areas around them. Option C is incorrect as bacteria R have a mutation that makes them resistant to antibiotic X not Y. Hence, option D is the correct answer as N is a control that allows us to identify that bacteria R is not affected by antibiotic X.
22. **D**  
Option A is incorrect as not all mutations result in resistance to antibiotics. Option B is incorrect as antibiotics do not increase the rate of mutation. Option C is incorrect as mutations are spontaneous events and can occur even in the absence of antibiotics. Hence, option D is the correct answer as the proportion of antibiotic resistant bacteria in a population increases with an increase in the use of antibiotics as the bacteria are continuously exposed to the antibiotic.
23. **D**  
Option D is the correct answer as RNA polymerase, 70S ribosomes and DNA synthesis are all present in eukaryotic cells such as human cells as well. Only bacterial cells contain peptidoglycan so they will be affected by ampicillin only.
24. **B**  
Option B is the correct answer as from the table it is clear that when the total antibiotic use (X) increases there is an increase in the percentage of cases with penicillin resistant bacteria (Y).
25. **D**  
Option D is the correct answer as teixobactin binds to lipids and not proteins and since lipids are not coded for by DNA it is unlikely that the bacteria can evolve resistance to it.
26. **A**  
Option A is the correct answer as cholera and TB are caused by bacterium which antibiotics are effective against while measles is caused by a virus which antibiotics are not effective against.
27. **D**  
Option D is the correct answer as the antibiotic might prevent the translation of proteins by binding to 70S ribosomes that bacteria also have. Options B and C are incorrect as the linear DNA is still synthesized and circular DNA is not translated. Option A is incorrect as mitochondria do not have cell walls.
28. **C**  
Option A is incorrect as using high concentration also increase the probability of the bacteria acquiring resistance. Option B is incorrect as giving preventative antibiotics might result in bacteria acquiring resistance to a wide spectrum of antibiotics. Option D is incorrect as treating low level infections using antibiotics might cause them to acquire resistance making them difficult to deal with. Hence, option C is the correct answer as regularly changing the antibiotic makes sure that the bacteria are not in contact with one particular antibiotic for an extended period of time.
29. **D**  
Option D is the correct answer as the formula for percentage increase is  $[(\text{final}-\text{initial})/\text{initial}] \times 100$ . This gives 650 as the percentage increase.
30. **B**  
Option B is the correct answer as the antibiotic is taken in regular intervals to make sure that the concentration is maintained at a level that is lethal to the bacteria but not high enough to have side effects on the body.
31. **C**  
Option C is the correct answer as penicillin acts as a competitive inhibitor in the cell wall synthesis.
32. **D**  
Option D is the correct answer as viruses reproduce inside the cells of humans where antibiotics cannot reach.
33. **B**  
Option A is incorrect as tetracycline does not bind to bacterial cell walls. Option C is incorrect as tetracycline inhibits translation not transcription. Option D is incorrect as tetracycline is not produced by ribosomes. Hence, option B is the correct answer as tetracycline must not be allowed to pass the cell wall.
34. **D**  
Option D is the correct answer as HIV/AIDS and measles are caused by viruses which are not affected by antibiotics.

35. **D**  
Option D is the correct answer as bacterial cells have 70S ribosomes while humans have 80S ribosomes which are different in structure.
36. **B**  
Option A is incorrect as 1 and 5 have diameters still above 13 mm. Option C is incorrect as the antibiotic cannot be used to treat type 3 since it shows resistance due to less diameter. Option D is incorrect as type 5 can become resistance as mutations that lead to that are spontaneous. Hence, option B is the correct answer as only types 2, 3 and 4 have diameters less than 13 mm meaning that they are resistant to the antibiotic.
37. **D**  
Statements 1 and 3 are incorrect as being synthetic does not mean that bacteria cannot acquire resistance and bacteria can acquire resistance by preventing the entry of cathelicidins through the cell wall. Statements 2 and 4 are correct as tetracycline dependence can be reduced by using cathelicidins and it can also be used against multidrug resistance bacteria.
38. **C**  
Option C is the correct answer as mutations are random and spontaneous and they allow some of the bacteria to survive and these bacteria reproduce and eventually replace the non-resistant bacteria that are killed by the antibiotics.
39. **A**  
Option A is the correct answer as dividing  $3.2/5.3$  and multiplying by 100 gives 60.37 as the answer. Subtracting this from 100 gives 39.6 as the answer.
40. **B**  
Option B is the correct answer as penicillin acts as an inhibitor for the enzyme transpeptidase and its action causes the cell walls to weaken as there are no cross links. It can only act when the cell wall is being made as after that inhibiting the enzyme will have no effect since the cross links have already been formed.
41. **C**  
Option C is the correct answer as using these antibiotics in humans will cause pathogenic bacteria to acquire resistance and pose a larger threat.
42. **C**  
Option C is the correct answer as since the cross links do not form the cell wall is weakened and cannot resist the pressure and as a result the bacteria bursts due to osmotic lysis. Statements 2 and 3 are incorrect as bacterial cell walls do not contain cellulose and the cell wall is always fully permeable.
43. **A**  
The people who do not have antibodies to blood group A can safely receive it. From the table we can see that groups A and AB can receive blood safely making option A the correct answer.
44. **B**  
Option B is the correct answer as bacterial cells have 70S ribosomes while humans have 80S ribosomes which are different in structure.

### 10.3: Multiple topics

1. **D**  
The percentage increase in multidrug-resistant infections from 0.2% to 1.5% is calculated as:  

$$\left( \frac{1.5 - 0.2}{0.2} \right) \times 100 = 650\%$$
Hence, the increase is 650%.
2. **B**  
The graph shows that resistance to three antibiotics—ciprofloxacin, azithromycin, and tetracycline—peaked in 2015, after which a slight decline is observed for ciprofloxacin and azithromycin in 2016.
3. **D**  
Option D is the correct answer as for cholera there is a vaccination program available and for measles as well. Measles spreads between humans via contact. The Plasmodium parasite has no vaccinations due to the great antigenic variability and the spread of the disease is influenced by the climate which effects the mosquito population that acts as a vector for the pathogen.
4. **D**  
Option D is the correct answer as a rise in global temperatures favors mosquito populations and increasing irrigation lands means that water is available for the mosquitoes to lay their eggs. Increasing the use of

antibiotics may provide the pathogen with resistance but will not increase the distribution. A fall in annual rainfall will decrease the spread of malaria as there will be less stationary water bodies for mosquitos to lay eggs.

5. **A**

Option A is the correct answer as cholera pathogens are not destroyed in the small intestines and the plasmodium parasite's antigens change during its life cycle making the development of a vaccine difficult. Smallpox was able to be eradicated as its antigens remained stable. Vaccines work against bacteria as well.

6. **D**

Option D is the correct answer as 4 to 3 to 1 to 2 is the correct sequence for developing resistance to the antibiotic.

7. **B**

Option B is the correct answer as a single vaccine is most important for the eradication of measles without the requirement of boosters.

8. **D**

Option D is the correct answer as antibiotics do not stimulate the production of antibodies.

