# 7 CHAPTER

# Human Health and Diseases

## Level - 1 CORE SUBJECTIVE QUESTIONS

### MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

1. Option (B) is correct

   **Explanation:** Mast cells are significantly activated during allergic reactions, releasing histamine and other mediators that cause allergy symptoms.

2. Option (B) is correct

   **Explanation:** During an allergic reaction, when an allergen binds to IgE antibodies on the surface of mast cells and basophils, it triggers the release of histamine. Histamine is responsible for many allergy symptoms, such as itching, swelling, and redness.

3. Option (A) is correct

   **Explanation:** The female *Aedes* mosquito, particularly *Aedes aegypti* is the primary vector responsible for transmitting dengue fever to humans.

4. Option (C) is correct

   **Explanation:** The symptoms described—sustained high fever, stomach pain, constipation, headache, loss of appetite, and weakness—are characteristic of typhoid fever, which is caused by the bacterium *Salmonella typhi*.

5. Option (D) is correct

   **Explanation:** The spleen is a large, bean-shaped organ that acts as a blood filter and serves as a reservoir for erythrocytes (red blood cells). However, its size does not reduce with growth; rather, it typically remains proportionate to the individual's body size throughout life.

6. Option (A) is correct

   **Explanation:** Elephantiasis is a disease caused by parasitic infections (commonly *Wuchereria bancrofti*) transmitted by mosquitoes, leading to chronic inflammation and obstruction of lymphatic vessels. This results in severe swelling, typically in the legs and genitals.

7. Option (D) is correct

   **Explanation:** T-lymphocytes, also known as T-cells, are a type of white blood cell and are produced in the bone marrow. However, they do not remain active at all times; instead, they become activated in response to specific antigens. Additionally, T-lymphocytes mature in the thymus, not in the bone marrow. Thus, statements (iii) and (iv) are incorrect.

8. Option (D) is correct

   **Explanation:** *Haemophilus influenzae* is a bacterium primarily associated with respiratory tract infections, such as pneumonia, bronchitis, and sinusitis, as well as invasive diseases like meningitis. It is not typically linked to causing intestinal blockage.

9. Option (D) is correct

   **Explanation:** A- Chemical structure of Morphine.

   Morphine is the principal alkaloid present in opium, extracted from the latex of *Papaver somniferum*. Morphine is known to be an analgesic and a sedative.

   B- Structure of a cannabinoid molecule.

   Cannabinoids are obtained from *Cannabis sativa* and they affect the cardiovascular system.

### ASSERTION-REASON QUESTIONS (1 Mark)

1. Option (C) is correct

   **Explanation:** When cells are infected by viruses, they produce interferons, which are signaling proteins that play a crucial role in the immune response to viral infections. Interferons do not directly cause inflammation; rather, they help to initiate an antiviral response and enhance the immune response by activating nearby immune cells.

2. Option (B) is correct

   **Explanation:** Chronic consumption of alcohol can result in liver damage, eventually leading to cirrhosis, which is characterised by the scarring of the liver due to prolonged injury. Additionally, alcohol addiction can cause considerable mental and financial strain, affecting not just the individual but also their family members because of the impact of addiction on behaviour, health, and financial well-being. Both assertion and reason are true but reason does not explain the assertion.

3. Option (C) is correct

   **Explanation:** Hepatitis-B vaccine is produced from yeast. While many vaccines are derived from micro-

organisms (such as bacteria and viruses), not all types of micro-organisms are used to prepare vaccines. Some vaccines are made using inactivated or attenuated viruses, while others are sub-unit or conjugate vaccines.

4. Option (A) is correct

**Explanation:** Both *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for various infectious diseases like pneumonia, meningitis, and other respiratory infections as these bacteria can be transmitted through respiratory droplets or aerosols when an infected person coughs or sneezes, allowing healthy individuals to acquire the infection.

5. Option (A) is correct

**Explanation:** There has been an increasing prevalence of allergies and asthma among children in metropolitan cities, which can be attributed to various environmental factors, including pollution, allergens, and lifestyle changes.

6. Option (A) is correct

**Explanation:** Cocaine affects the brain by blocking the reuptake of dopamine, a neurotransmitter associated with pleasure and reward. By preventing dopamine from being transported back into the neurons, cocaine increases the concentration of dopamine in the synaptic cleft, leading to enhanced signaling and the resultant euphoric effects.

## VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. (A) As the adaptive immune response gears up, there is a reciprocal relationship between virus levels in the blood and helper T lymphocytes levels. As the level of helper T levels rises, the virus levels decline.
   (B) Several years later, if untreated, HIV patient will lose the adaptive immune response, including the ability to make antibodies, as gradually the HIV enters the helper T lymphocytes leading to a progressive decrease in the number of helper T lymphocytes.
2. (i)
   - Readymade or preformed antibodies or antitoxins against the snake venom.
   - A quick immune response is required in this case.

   (ii) Passive immunity.
3. (A) Heroin/smack/diacetylmorphine/opioid
   (B) Cardiovascular system
   (C) Cocaine/coca alkaloid/coke/crack
   (D) Stimulates central nervous system/ produces a sense of euphoria and increased energy/ hallucination.
4. Vaccine is a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen.
   It is based on the property of memory of immune system. The antibodies produced in the body in response to these antigens would neutralise the pathogenic agents and body will show amnestic or quick response.
5. It is on the basis of patient's weight , history of prior use.
6. (i) Bacterial infections are becoming resistant to antibacterial medications and allow resistant bacteria (hard to kill-bad bugs) to increase in numbers faster than susceptible bacteria (easy to kill bugs) and can transfer through food chains to humans.
   (ii) Antibiotic may wipe out some but not all of the bacteria. The surviving bacteria shall multiply/ become more resistant to first-line of treatment/ increasing risk of complications and increased cost associated with prolonged illness.
7. Malignant tumour grows very rapidly, and starves the normal cells by competing for vital nutrients, invades and damages surrounding normal tissue. It shows metastasis and spread to other body parts or tissues.
8. - *Wuchereria bancrofti* / *Wuchereria malayi*.
   - Through the bite by the female mosquito vectors.
   - Chronic inflammation of lower limbs and genital organs resulting in gross deformities.
9. Common cold–nose / respiratory passage
   Pneumonia–(alveoli of) lungs / (air sacs of) lungs
   Causative agents–*Streptococcus pneumoniae* / *Haemophilus influenzae* (pneumonia)
   Rhino virus (common cold)
10. Female *Anopheles* mosquito takes up gametocytes with blood meal. Fertilisation and development take place in the mosquito's gut. Mature infective stage (sporozoites) escape from the gut and migrate to mosquito salivary gland, Female *Anopheles* bites the humans transmitting the *Plasmodium* to its second host to complete its life cycle.
11. Two types of acquired immune responses present in our body are:
    (i) Humoral immune response, antibody mediated.
    (ii) Cell mediated immune response, rejects the graft (in organ transplant) by identifying as non-self / T-Cells interact with antigens.
    - Primary immune response, of low intensity / slow response.
    - Secondary immune response, of high intensity / faster response.
12. - *Wuchereria bancrofti* and *Wuchereria malayi*
    - **Chronic manifestations of filariasis:**
      (1) Inflammation of the organs in which they live for many years
      (2) inflammation of lymphatic vessels of the lower limbs
      (3) deformities in genital organs.
13. (i) Due to decrease in the number of helper T – lymphocytes or weakened immunity.
    (ii) Bacterium- Mycobacterium;
    Parasite- Toxoplasma
    (iii) Enzyme Linked Immuno-sorbent Assay (ELISA) / Polymerase Chain Reaction (PCR).

**14.** (i) Smoking is a leading cause of chronic obstructive pulmonary disease, emphysema, and chronic bronchitis. It also increases the risk of lung infections and pneumonia.

(ii) Smoking damages blood vessels, leading to high blood pressure, heart attacks, strokes and other heart related complications.

(iii) Smoking can cause cancers of lungs, throat, mouth, pancreas, bladder and other organs.

(iv) Smoking weakens the immune system, making the body more susceptible at infections and slowing down the healing process.

**15.** Sneezing, watery eyes, running nose, difficulty in breathing. (any two)

Body produces IgE antibodies which gives exaggerated response to the antigens and release chemicals like histamine and serotonin from mast cells.

**16.** (i) *Cannabis sativa*

(ii) Flower tops or inflorescences, leaves and resin

(iii) Influences cardiovascular system

**17.** Provide site for interaction of lymphocytes with the antigen, lymphocytes proliferate to become effector cells.

**18.** Pneumonia

- *Streptococcus pneumoniae / Haemophilus influenzae*
- Symptoms – fever, chills, cough, headache, in severe cases lips and fingers nails may turn grey to bluish in colour. (Any two)

**19.** NACO – National AIDS Control Organisation

- Transmission of HIV –
  (1) Sexual contact with infected person.
  (2) By transfusion of contaminated blood and blood fluids.
  (3) By sharing infected needles as in the case of intravenous drug abusers.
  (4) From infected mother to her child through placenta (any three).

**20.** *Papaver somniferum*

Opioids and extracted from Fruit / latex of poppy plant / inflorescence.

It acts as depressant / slows down body functions by binding to the opioid receptors present in the central nervous system and gastrointestinal tract.

## SHORT ANSWER TYPE QUESTIONS (3 Marks)

**1.** A – Fever / chills / cough / headache / greyish blue lips and nails / severe problem in respiration.

B – *Salmonella typhi*,

C – Nasal congestion / discharge / sore throat / cough / hoarseness /tiredness.

D – *Microsporum /Trichophyton / Epidermophyton*

E – Internal bleeding / fever / muscular pain / anaemia / blockage of intestinal passage.

F – Amoebiasis / Amoebic dysentery.

**2.** A – Lymph nodes

B – Thymus

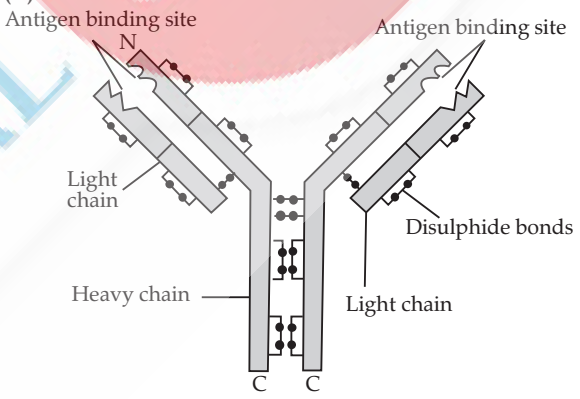
**Role of Lymph nodes:** Acts as secondary lymphoid organ/provide site for interaction of lymphocytes with antigens which then proliferate to become cells. It serve to trap the microbes or other antigens which happen to get into lymph or tissue fluid. It activates the lymphocytes and cause immune response.

**Role of Thymus:** It acts as Primary lymphoid organ / provide micro environment for the development and maturation of T- lymphocytes. It provide site where immature lymphocytes differentiate into antigen sensitive lymphocytes.

**3. (i)**

| | Humorial immune response | Cell-mediated immune response |
|---|---|---|
| (1) | Mediated by B-lymphocytes. | Mediated by T-lymocytes. |
| (2) | Antibodies are produced by B-lymphoctyes in the blood. | T-cells do not secrete antibodies but help B-cells to produce them. |
| (3) | This is not resonsible for graft rejection. | This is respoinsible for the graft rejection. |

**(ii)**




(any correct four labels)

**4. (i)**

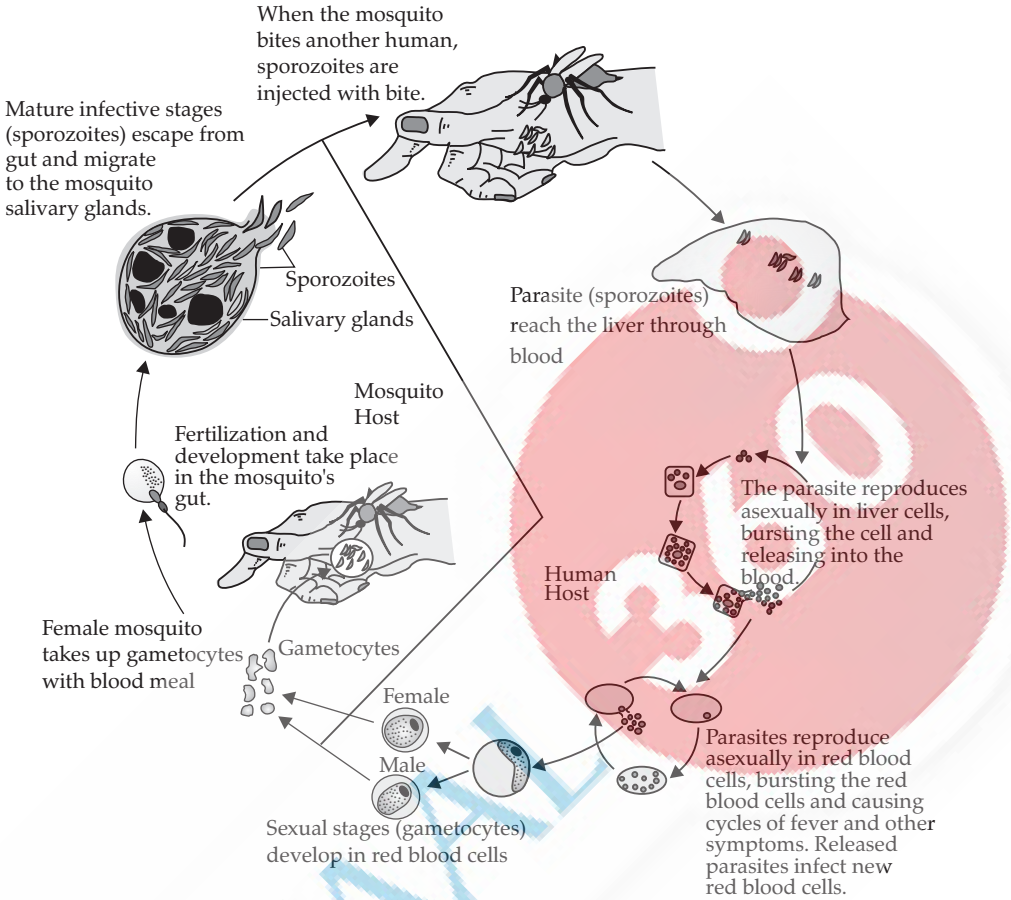
| S.No. | Malignant tumour | Benign tumour |
|---|---|---|
| 1. | Cells grow very rapidly and invade and damage the surrounding normal tissue. | Comparatively slow growth and remain confined to their original location and do not spread to other parts of the body. |
| 2. | Show metastasis. | Do not show metastasis. |

**(ii)** Metastasis

Cells from these tumours slough off and reach distant sites through blood, wherever they get lodged in the body they start a new tumour there.

5. **(i)** Opioids / Morphine
   **(ii)** Diacetylmorphine / Smack
   **(iii)** *Papaver somniferum* / Poppy plant
   **(iv)** Slows down body function, act as depressant
6. Sporozoites (infectious form of *Plasmodium*) enter in the blood of human through female Anopheles mosquito's bite. Sporozoites multiply asexually (asexual phase) in liver, Red Blood Cells (RBCs), and form gametocytes in RBCs of human host which are taken by female *Anopheles* mosquito with blood meal. Fertilisation and further development take place in the mosquito's gut leading to formation of sporozoites (sexual phase), that are stored in its salivary glands hence needs both a mosquitos and a human host for its continuity.

**OR**




7. The ways of achieving good health are:
   (1) Balanced diet.
   (2) Personal hygiene.
   (3) Regular exercise / yoga.
   (4) Vaccination.
   (5) Proper disposal of waste.
   (6) Control of vectors.
   (7) Maintenance of hygienic food and water.

   **(Any six)**
8. - Penicillin
   - Alexander Fleming while working on *Staphylococci bacteria*, once observed a mould growing in one of his unwashed culture petri dish around which *Staphylococci* could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould *Penicillium notatum*.
   - Alexander Fleming, Ernest Chain, Howard Florey were awarded the Nobel prize for this discovery.
9. Sexual Stage (gametocytes) develop in RBC, gametocytes are taken by female Anopheles mosquito with blood meal, fertilisation and development take place in the mosquito's gut, mature infective stages (sporozoites) escape from gut, migrate to mosquito's salivary glands, when the mosquito bites another human sporozoites are injected with bite.
10. The principle of vaccination is based on the property of "memory" of the immune system.
    A preparation of antigenic proteins or pathogen or inactivated / weakened pathogen are introduced into the body.
    The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection.
    Memory T cell and B cell that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.
11. **(i)** Central nervous system, Gastrointestinal tract.
    **(ii)** Diacetyl morphine
    **(iii)** *Papaver somniferum*
12. **(i)** Contact inhibition—The property of normal cells by virtue of which contact with other cells inhibits their uncontrolled growth.

Normal cells do not grow any further till 'in contact with other cells', whereas cancerous cells lost this property and continue to divide to form tumor.

**(ii)** Destroys tumour
Activates the immune system of patients.

**13. (i)** Enzyme-Linked Immunosorbent Assay [ELISA]
It is based on the principle of antigen-antibody interaction. HIV infection can be detected by the presence of antigen or by detecting the antibody synthesised against the pathogen.
Polymerase chain reaction (PCR)
Early detection and amplification of genetic material of pathogen/virus.

(ii) RNA

**14.** (i) *Entamoeba histolytica*.

(ii) Through contaminated water or contaminated food.

(iii) Consuming clean drinking water, consuming non-contaminated food (vegetables, fruits), taking care of personal hygiene, periodic cleaning and disinfecting of water reservoirs (pools, tanks).

## LONG ANSWER TYPE QUESTIONS (5 Marks)

**1. (i)** Contact Inhibition is present in normal cells but not in cancer cells.
When normal cells come in contact with other cells it inhibits their uncontrolled growth.

**(ii)** Cellular oncogenes/Proto-oncogenes. When activated under certain conditions could lead to oncogenic transformation of the cells.

**(iii)** (1) **Biopsy and histopathology:** A piece of suspected tissue cut into thin sections is stained, and examined under microscope by pathologist for increased cell counts.

(2) **Magnetic Resonance Imaging (MRI):** Detects cancer of internal organs. Uses strong magnetic fields and non–ionising radiations to detect pathological and physiological changes in living tissue.

**2.** (i) Life cycle of the *Plasmodium* from the period it enters the human body till a female *Anopheles* mosquito bites an infected person.
*Plasmodium* enters the human body as sporozoites (through the bite of infected Anopheles mosquito)
The *Plasmodium* reproduces asexually in the liver cells initially;
And then on releasing it in blood to attack the Red Blood cells (RBCs).
Parasite (*Plasmodium*) reproduces asexually in Red Blood cells (RBCs).
Resulting in rupture/ bursting of the RBCs.
Several sexual stages (gametocytes) develop in RBCs.
Female *Anopheles* mosquito takes up gametocytes with blood meal.

**(ii)** (1) Fertilisation of male and female gametocytes.
(2) Production of sporozoites.
(3) Migration of sporozoites into salivary glands of mosquito. (Any two)

**3.** (i)

| | Malignant Cancer | Benign Cancer |
|---|---|---|
| 1. | Mass proliferating cells called neoplastic of tumour cells grows rapidly. | Tumour cells grows slowly. |
| 2. | It spreads to other parts of the body or causes metastasis. | It is confined to their original location, or causes no metastasis. |
| 3. | Invading and damaging the normal tissues. | Causes little damage in the tissues. |

(ii)
- Biopsy and/histopathological studies, a piece of suspected tissue or blood or bone marrow cut into thin section is stained and examined by pathologist.
- Radiography, use of X-rays.
- CT/Computed tomography, to generate 3-dimensional image of the internal organs by using X-rays.
- MRI, uses strong magnetic field and non ionising radiations to accurately detect pathological and physiological changes in the living tissue.
- Antibodies against specific antigens, are used for detection of certain cancer.
- Technique of Molecular Biology, applied to detect genes in an individual with inherited susceptibility to certain cancer.

**4.**
- Caused by Chikungunya virus / alphavirus
- Spread in human by bite of female *Aedes* mosquitoes.
- Symptoms include fever, joint pain, muscle pain, headache, nausea, fatigue and rashes. (Any four)
- The spread of Chickengunya can be prevented by:
  (1) Reducing open water filled spaces.
  (2) Using insecticides to kill mosquitoes larva.
  (3) Full cover clothing.
  (4) Introducing Gambusia fish in stagnant water that feed on mosquito larva.

**5.** (i) The vaccine contains the antigen, which stimulates or activates immune cells to produce antibodies (by B lymphocytes) which generates primary response or humoural immune response.

(ii) Memory cells generate, amnestic response/ secondary response.

(iii) P = Yes
Q = Catching an infection/getting infected.
R = No
S = Yes
T = No

**6.** (i) Diacetylmorphine, as it is highly addictive, and being a depressant it slows down body functions.

(ii) (1) *Cannabis sativa*, affects the cardiovascular system of the body.

(2) *Erythroxylum* coca/coca plant, interferes with the transport of neurotransmitter dopamine/ produces sense of euphoria / increased energy.

(3) *Papaver somniferum*, acts as depressant/slows down body function/ reduces pain/sedative.

**7. (i)** Cancer cells appears to have lost the property of contact inhibition. As a result they continue to form mass of cells (tumour).

**(ii)** When proto-oncogenes are activated under certain conditions it could lead to oncogenic transformation of the cells.

**(iii)**
- X-rays/UV rays/Nicotine/Caffeine/Tobacco smoke/Oncogenic viruses.
- Damage DNA which causes neoplastic transformation.

## Level - 2 ADVANCED COMPETENCY FOCUSED QUESTIONS

### MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

**1.** Option (A) is correct

**Explanation:** Ringworm is a fungal infection characterised by dry, scaly lesions on various parts of the body.

**2.** Option (B) is correct

**Explanation:** *Haemophilus influenzae* is primarily associated with respiratory tract infections, which often present with symptoms such as cough, chest pain, and fever.

**3.** Option (C) is correct

**Explanation:** When a vaccine containing a small part of the virus is administered, it stimulates the immune system to produce its own antibodies against that virus. This process is considered "artificially acquired" because the immunity is gained through vaccination rather than through natural infection. It is also "active" because the immune system is actively engaging in producing antibodies in response to the vaccine.

**4.** Option (B) is correct

**Explanation:** Antibiotics are drugs specifically designed to act against bacteria, not viruses or protozoa. They typically interfere with bacterial metabolic processes, such as cell wall synthesis (e.g., Penicillin), protein synthesis (e.g., Tetracycline), and DNA replication or enzyme function.

**5.** Option (B) is correct

**Explanation:** Lyme disease is caused by the bacterium *Borrelia burgdorferi*. It is transmitted through the bite of an infected blacklegged tick. Common symptoms include high fever,skin rash (often "bull's-eye" shaped), and swollen joints and muscle pain.

**6.** Option (C) is correct

**Explanation:** The BCG vaccine (Bacillus Calmette–Guérin) is recommended at birth in India to protect infants and young children from severe forms of tuberculosis, especially TB meningitis and miliary TB.

**7.** Option (C) is correct

**Explanation:** Vibrio cholerae causes cholera, a severe diarrheal disease. It is transmitted through the fecal-oral route, typically via contaminated food or water.

**8.** Option (B) is correct

**Explanation:** Antigenic shift is a process in which two different strains of the influenza virus infect the same host cell and exchange genetic material. This leads to the formation of a completely new subtype of the virus. The new strain may have drastically altered surface proteins (antigens), against which the population has little to no immunity. This is often responsible for pandemics, such as the 2009 $H_1N_1$ (swine flu) outbreak.

**9.** Option (B) is correct

**Explanation:** Vitamin A plays a key role in maintaining healthy epithelial tissues (like skin and mucous membranes), which are the first line of defence against pathogens. It also supports the functioning of the immune system, particularly T-lymphocytes and antibody production. Deficiency in vitamin A weakens the immune system, making individuals — especially children — more vulnerable to infections, including measles, respiratory infections, and diarrhea.

**10.** Option (B) is correct

**Explanation:** Hepatitis A is caused by the Hepatitis A virus (HAV) and is transmitted through the fecal-oral route. Poor sanitation and open defecation can lead to contamination of drinking water and food. The construction of community toilets improves sanitation, reducing environmental contamination and thereby lowering transmission rates. The drop in hepatitis A cases confirms the role of fecal-oral transmission.

### ASSERTION-REASON QUESTIONS (1 Mark)

**1.** Option (C) is correct

**Explanation:** Assertion is true. Overuse or misuse of antibiotics creates selective pressure, allowing resistant bacteria (those with mutations) to survive and multiply. This leads to antibiotic resistance.

Reason is false. Antibiotics do not kill resistant bacteria. Resistant bacteria survive the antibiotic treatment and proliferate, making the infection harder to treat.

**2.** Option (A) is correct

**Explanation:** Assertion is true. Vaccination is a method of developing immunity by preparing the immune system to recognise and fight specific infectious agents. Reason is alsotrue. Vaccines typically contain weakened (attenuated) or inactivated pathogens or their antigens. These do not cause disease, but they stimulate the immune system to produce antibodies and memory cells. This provides immunity in case of future exposure.

**3.** Option (A) is correct

**Explanation:** Assertion is true. Patients with AIDS (Acquired Immuno-Deficiency Syndrome) are more vulnerable to infections, even from normally harmless organisms (opportunistic infections), because their immune systems are severely weakened.

Reason is also true. HIV (Human Immunodeficiency

Virus) specifically targets and destroys $CD4^+$ T-helper cells, which play a central role in activating other immune responses. The loss of T-helper cells compromises the immune system's ability to defend the body.

4. Option (D) is correct

**Explanation:** Assertion is false. Cancer is not a communicable disease. It cannot spread from one person to another through casual contact, air, or bodily fluids like infectious diseases.

Reason is true. Some viruses (oncoviruses) can cause cancer, such as:

Human papillomavirus (HPV) → Cervical cancer

Hepatitis B and C viruses → Liver cancer

Epstein-Barr virus (EBV) → Certain lymphomas

These viruses can be transmitted, but cancer itself does not spread between individuals.

5. Option (A) is correct

**Explanation:** Assertion is true. Antihistamines are commonly used to relieve allergy symptoms such as sneezing, itching, and swelling.

Reason is also true. Allergies are caused when the immune system overreacts to harmless substances (allergens), triggering mast cells to release histamines, which cause inflammation and other allergic symptoms. Since antihistamines block histamine receptors, they counteract the effects of excess histamine, relieving allergy symptoms.

## VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. Passive acquired immunity is provided to the person.

Rabies progresses quickly and can be fatal. The injection contains pre-formed antibodies to neutralise the virus immediately, as the body doesn't have enough time to develop its own immune response.

2. Prophylaxis helps prevent infection in high-risk areas by inhibiting the growth of *Plasmodium* before symptoms appear.

**Causative organism:** *Plasmodium* spp. (e.g., *Plasmodium falciparum*)

3. Disease: Ascariasis

**Preventive measure:** Use clean drinking water, proper sanitation, and washing hands before eating.

4. These diseases spread through the fecal-oral route. Proper hygiene and sanitation prevent the ingestion of contaminated food or water, thereby reducing disease transmission.

5. Chemotherapy damages not only cancer cells but also rapidly dividing healthy cells, including those in the immune system.

**Precaution:** Avoid exposure to crowded places or infected individuals to reduce the risk of infections.

## SHORT ANSWER TYPE QUESTIONS (3 Marks)

1. The malarial parasite *Plasmodium* (e.g., *P. vivax, P. falciparum*) is transmitted to humans through the bite of an infected female *Anopheles* mosquito. The life cycle in the human host involves two main stages:

(i) **Liver Stage (Pre-Erythrocytic Phase):** When the mosquito bites a human, it injects sporozoites into the bloodstream. These sporozoites travel to the liver and infect liver cells. Inside liver cells, they multiply and develop into merozoites. The liver cells burst, releasing merozoites into the bloodstream.

(ii) **Blood Stage (Erythrocytic Phase):** Merozoites infect red blood cells (RBCs). Inside RBCs, they grow and multiply, forming more merozoites. Infected RBCs burst, releasing toxins and merozoites, causing cyclic fever and chills. Some merozoites develop into gametocytes, the sexual forms of the parasite.

(iii) **Transmission Back to Mosquito:** When another female *Anopheles* mosquito bites the infected person, it ingests the gametocytes. Sexual reproduction occurs in the mosquito's gut, completing the parasite's life cycle.

Controlling the mosquito population is crucial for the following reasons:

(i) Mosquitoes are the sole vectors that transmit Plasmodium from one person to another.

(ii) Breaking the vector–host transmission cycle helps in preventing new infections.

**Vector control measures like:**

(i) Eliminating stagnant water (breeding sites)

(ii) Using insecticide-treated nets (ITNs)

(iii) Indoor residual spraying (IRS)

(iv) Biological controls (e.g., larvivorous fish) can significantly reduce malaria incidence in a community.

2. When a patient stops taking antibiotics midway during TB treatment, it creates a dangerous situation where:

(i) **Survival of Resistant Bacteria:** TB is caused by Mycobacterium tuberculosis, which requires a long course of antibiotics (typically 6–9 months). Stopping treatment early kills only the sensitive bacteria, while partially resistant bacteria survive. These surviving bacteria multiply, creating a population of drug-resistant TB (DR-TB) strains.

(ii) **Development of MDR-TB and XDR-TB:** MDR-TB (Multi-Drug Resistant TB) resists first-line drugs like isoniazid and rifampicin.In worse cases, XDR-TB (Extensively Drug Resistant TB) may develop, which resists second-line drugs too.

**Public Health Consequences:**

(i) **Harder to Treat:** Requires longer, more expensive, and more toxic treatments.

(ii) **Higher Transmission Risk:** Drug-resistant TB can spread to others, making community control difficult.

(iii) **Increased Mortality:** Higher death rates due to treatment failure.

(iv) **Healthcare Burden:** Increases cost and complexity of TB management in public health systems.

3. The person is showing active acquired natural immunity. During the first infection with the measles virus, the immune system produces antibodies and memory cells specific to the virus. If exposed again, the immune memory triggers a rapid and effective response, preventing reinfection.

   A measles vaccine contains a weakened (attenuated) or inactivated form of the virus. It does not cause the disease, but it stimulates the immune system to produce antibodies, and Memory B and T cells. This provides long-term immunity, similar to natural infection, without the risk of serious illness.

4. The biological reason behind this increase are:

   (i) Urban environments often have high levels of air pollution, including particulate matter, smoke, pollen, and industrial chemicals.

   (ii) These pollutants act as allergens or irritants that trigger the immune system in sensitive individuals.

   (iii) In allergies and asthma, the immune system overreacts to these harmless substances, leading to histamine release from mast cells, and inflammation of airways (in asthma). Symptoms include sneezing, wheezing, coughing, breathlessness

   **Preventive Measures:**

   (i) **Reduce Exposure to Allergens and Pollutants:** Use air purifiers indoors, wear masks in polluted or high-pollen areas, and keep windows closed during high-pollen seasons.

   (ii) **Adopt a Healthy Lifestyle and Hygiene Practices:** Avoid smoking and secondhand smoke, maintain clean indoor environments (dust-free, mould-free), and use hypoallergenic bedding and cleaning products.

5. Even if symptoms disappear early, not all bacteria are killed immediately. The stronger or slightly resistant bacteria may survive if the medication is stopped too soon. Completing the full course ensures complete eradication of the infection and prevents a relapse.

   Stopping antibiotics early can lead to the survival and multiplication of resistant bacteria. These bacteria become harder to kill with standard antibiotics, leading to drug-resistant infections. The consequences include longer illness duration, more expensive and toxic second-line treatments, and higher risk of spreading resistant bacteria to others (public health threat).

## CASE BASED QUESTIONS (4 Mark)

1. **(i)** The rupture of RBCs associated with the release of toxic substance haemozoin is responsible for the chills and fever/recurring every 3 - 4 days.

   (ii) The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood.

   Parasite further reproduces asexually in red blood cells. Released parasite infects new red blood cells. Sexual stages (gametocytes) develop in red blood cells.

   **Student to attempt either subpart C or D.**

   (iii) The infection is caused by the bite of the female *Anopheles* mosquito which introduces the sporozoites in the human body.

   **OR**

   (iv) Fertilisation and development of sporozoits take place in the mosquito's gut.

2. **(i)** Option (A) is correct

   **Explanation:** Patient X exhibited heightened alertness and hallucinations, which are typical effects of cocaine, a stimulant that increases energy and can lead to psychological effects such as hallucinations. Patient Y appeared drowsy with a slower heart rate, indicating the use of morphine, an opioid that depresses the central nervous system, leading to sedation and drowsiness.

   **(ii)** Option (A) is correct

   **Explanation:** Cocaine, which patient X consumed, is classified as a coka alkaloid because it is derived from the coca plant. It falls under the stimulant category. Morphine, consumed by patient Y, is classified as an opioid, which is a class of drugs derived from opium poppy that are primarily used for pain relief and can cause sedation.

   **(iii)** Option (B) is correct

   **Explanation:** The statement that drug misuse leads to an increase in the number of healthy individuals is incorrect, as substance abuse generally has detrimental effects on health.

   **(iv)** Option (B) is correct

   **Explanation:** Cocaine is a powerful stimulant that increases alertness, energy levels, and heart rate. It activates the central nervous system, leading to increased sympathetic activity (e.g., elevated heart rate and blood pressure) and often causing feelings of euphoria.

3. **(i)** Allergy, the exaggerated response of the immune system to certain antigens present in the environment.

   **(ii)** By analysing the production of IgE type of antibodies or by injecting very small doses of possible allergens and study the reaction.

   **(iii)** (a) Mast cells
   - Histamine, serotonin

   Drugs are – Anti-histamine, Adrenalin, steroids.
   (any two drugs)

   **OR**

   (b) Yes,
   (1) Lowering of immunity due to modern lifestyle.
   (2) More sensitivity to allergens.
   (3) Protected environment provided in early life.

**4.** (i) Macrophages,
Virus replication (RNA genome)

(ii) Enzyme-linked immuno-sorbent assay (ELISA)/ Polymerase Chain Reaction (PCR)
Treatment available – Antiviral drugs that are only partially effective as they only prolong the life of the patient.

**(iii)** (a) (1) Making blood HIV safe in blood banks
(2) Use of only disposable needles and syringes in hospitals
(3) Free distribution of condoms
(4) Controlling drug abuse
(5) Advocating safe sex,
(6) Regular check-ups for HIV susceptible population. (Any two)

**OR**

**(b)** This is because of drastic reduction of helper T-lymphocytes that are responsible to fight infections. Person become immune-deficient and is unable to protect oneself from other bacterial or viral or fungal or parasitic infection.

**5. (i)** Sporozoites.

**(ii)** Undergoes asexual reproduction.

**(iii)** The number increase asexually, parasites ultimately change into gametocytes and undergoes gametogenesis.

**(iv)** (a) Fertilisation and development takes place in host 'X', ultimately forming the infective stage sporozoites.

**OR**

(b) • Bursting of RBCs
• Malaria
• Haemozoin

**6.** (i) Incubation period

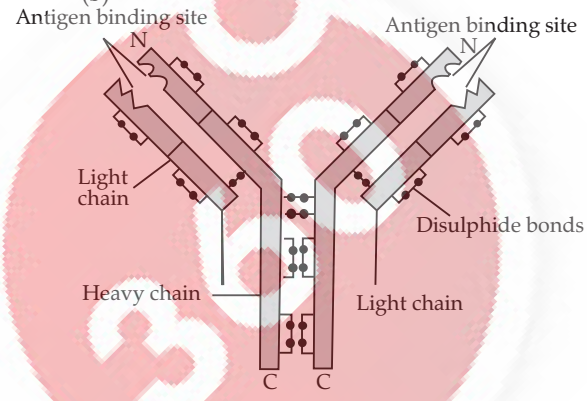
(1) Infected person may not take precautions during this period as there are no symptoms of the disease.

(2) Number of microorganisms is high and can be transmitted via droplet infection.

(ii) (a) Incubation period is the time period between infection and appearance of its symptoms.
AIDS can be easily transmitted during this period.
T-lymphocytes are attacked by the pathogen of this disease.

**OR**

(b)




(iii) During period of illness.

## LONG ANSWER TYPE QUESTIONS (5 Marks)

**1.** The reasons behind the rise in dengue and chikungunya during monsoon are:

(i) **Water Accumulation:** During the monsoon, stagnant water collects in open containers, drains, and construction sites. This provides ideal breeding grounds for Aedes mosquitoes, the primary vectors of dengue and chikungunya.

(ii) **Increased Humidity and Temperature:** Warm and humid conditions accelerate mosquito breeding and virus replication inside mosquitoes.

(iii) **Poor Waste Management and Drainage:** Blocked drains and garbage accumulation create unsanitary conditions, enhancing mosquito proliferation.

The community-level steps to control the spread are:

(i) **Eliminate Mosquito Breeding Sites:** Conduct regular drives to remove stagnant water from rooftops, tires, coolers, and containers. Cover water storage tanks and ensure proper drainage systems.

(ii) **Promote Use of Mosquito Protection:** Distribute and encourage the use of mosquito nets, repellents, and window screens. Organise awareness campaigns about peak mosquito activity times (daytime for Aedes).

(iii) **Conduct Fogging and Larvicidal Measures:** Regular fogging in high-risk areas to kill adult mosquitoes. Use biological or chemical larvicides to control mosquito larvae in water bodies.

**2.** Chemotherapy causes infections and fatigue because:

(i) **Targets Rapidly Dividing Cells:** Chemotherapy is designed to destroy cancer cells, which divide rapidly. However, it also affects healthy rapidly dividing cells, such as Bone marrow cells (which produce blood cells), Hair follicle cells, and cells lining the digestive tract.

(ii) **Reduced White Blood Cells (WBCs):** Damage to the bone marrow reduces WBC count, weakening the immune system. This makes the patient more vulnerable to infections from bacteria, viruses, and fungi.

(iii) **Low Red Blood Cells and Nutrient Absorption:** Fewer red blood cells (anaemia) leads to fatigue and weakness. Chemotherapy also damages the gut lining, affecting appetite and nutrient absorption.

**Chemotherapy patients can be supported by:**

(i) **Nutritional Support:** Provide a balanced, high-protein, and nutrient-rich diet. Include iron-rich foods to reduce anemia-related fatigue. Offer

small, frequent meals to cope with nausea or appetite loss.

(ii) **Infection Control:** Maintain strict hygiene and avoid contact with sick individuals. Use masks and sanitized environments. Administer growth factors (e.g., G-CSF) to boost WBC production if needed.

(iii) **Emotional and Physical Support:** Provide psychological counselling to manage anxiety and depression. Encourage gentle physical activity if tolerated to improve energy levels.

3. **In Humans:**

**Overuse:** Taking antibiotics for viral infections like colds or flu (where they are ineffective) exposes bacteria unnecessarily, allowing them to develop resistance.

**Misuse:** Stopping the antibiotic course midway or using leftover antibiotics kills only the weaker bacteria, while resistant ones survive and multiply.

In Livestock: Antibiotics are often used as growth promoters or to prevent disease in healthy animals in crowded farms. This constant exposure leads to the development of resistant bacteria, which can spread to humans via food products (meat, milk), soil and water contamination.

**Strategies to Address Antibiotic Resistance:**

(i) **Individual-Level Strategies:**

(1) **Use Antibiotics Responsibly:** Take antibiotics only when prescribed by a certified medical professional. Complete the full course even if symptoms disappear early.

(2) **Avoid Self-Medication:** Never use leftover antibiotics or someone else's prescription. Don't pressure doctors to prescribe antibiotics unnecessarily.

(ii) **Government-Level Strategies:**

(1) **Regulate Antibiotic Sales and Use:** Enforce strict prescription-only policies for antibiotics in pharmacies. Monitor and restrict antibiotic use in agriculture and animal husbandry.

(2) **Public Awareness and Education:** Launch campaigns to inform the public about the dangers of antibiotic resistance. Train healthcare providers on rational prescription practices.

4. Floods often lead to contamination of drinking water with sewage and waste, which carries disease causing micro-organisms. This creates ideal conditions for the spread of waterborne diseases like Cholera (*Vibrio cholerae*), Typhoid (*Salmonella typhi*), Hepatitis A (Hepatitis A virus). These diseases spread through the fecal-oral route, i.e., by consuming contaminated food and water or through poor hygiene.

The precautionary steps to prevent outbreaks are:

(i) **Ensure Access to Safe Drinking Water:** Use boiled, chlorinated, or filtered water for drinking and cooking. Distribute water purification tablets in affected areas.

(ii) **Promote Hygiene and Sanitation:** Encourage handwashing with soap, especially before meals and after using the toilet. Avoid open defecation and use temporary toilets or latrines where needed.

(iii) **Proper Food Handling:** Eat freshly cooked food. Avoid raw vegetables and street food during the outbreak period.

(iv) **Vaccination and Medical Support:** Provide vaccines where possible (e.g., Hepatitis A, Typhoid).Set up medical camps for early diagnosis and treatment to prevent disease spread.