

## 10. Infectious diseases

1. State the term used to describe an organism that causes disease.

- Pathogen

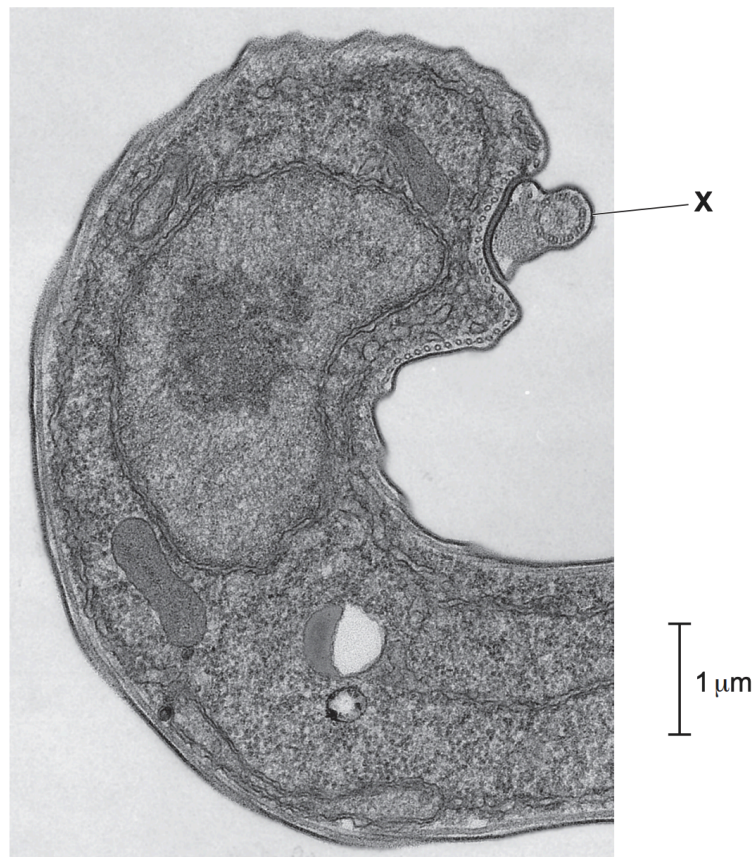
2. Name the species that cause malaria.

- *Plasmodium falciparum*
- *Plasmodium malariae*
- *Plasmodium ovale*
- *Plasmodium vivax*

3.

*Trypanosoma brucei* is a unicellular organism that causes the infectious disease known as sleeping sickness. Insects known as tsetse flies pass on the organism from infected people to uninfected people when male and female tsetse flies feed on human blood.

(a) Fig. 4.1 is a transmission electron micrograph of the form of *T. brucei* found in human blood.



Outline the similarities and differences between the modes of transmission of malaria and sleeping sickness.

Similarities	Differences
- vector is an insect / fly OR both are vector-borne / carried by a vector / involve a vector	- malaria vector is a mosquito / Anopheles ; tsetse fly not a mosquito

<ul style="list-style-type: none"> <li>- vector / carrier / insect feeds on human blood OR both diseases transmitted through blood</li> </ul>	<ul style="list-style-type: none"> <li>- for malaria only female mosquitoes, feed on blood / transmit disease / are vectors ; information given for sleeping sickness is that male and female tsetse flies feed on blood</li> </ul>
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4. Explain why people with HIV/AIDS are more likely to develop TB
  - TB is an opportunistic disease / infection of people with HIV/AIDS
  - HIV-infected people develop a weakened immune system
  - there is a decrease in number of T-helper cells so less effective primary immune response
  - fewer helper T-cells so less cytokine secreted
  - less phagocytosis of the pathogens
  - fewer B-lymphocytes stimulated to divide by mitosis and form plasma cells
  - fewer antibodies secreted so fewer pathogens destroyed
  - increased risk of latent TB becoming active in people living with HIV/AIDS
5. State ways in which the impact of antibiotic resistance can be reduced.
  - prescribe / take antibiotics, only when (absolutely) necessary: e.g. do not use for viral infections/ as preventative medicine
  - make sure correct antibiotic prescribed // make sure people take the correct dose // complete course of antibiotics
  - develop new antibiotics / antibacterials
  - use other antibacterials
  - (named) measures to prevent infection, eg. break transmission cycle to reduce the need for antibiotic use: e.g. vaccines/ good hygiene in hospitals/ quarantine people who have multi-drug resistant bacterial infections
  - report cases / patterns of antibiotic resistance
  - reduce / control antibiotics in agriculture / animals used for food
  - education for healthcare professionals / public to reduce impact of antibiotic resistance
6. Name the species that cause tuberculosis /TB
  - *Mycobacterium tuberculosis*
  - *Mycobacterium bovis*
7. Name the species of bacterium causing the transmission of TB from dairy cows to humans.
  - *Mycobacterium bovis*

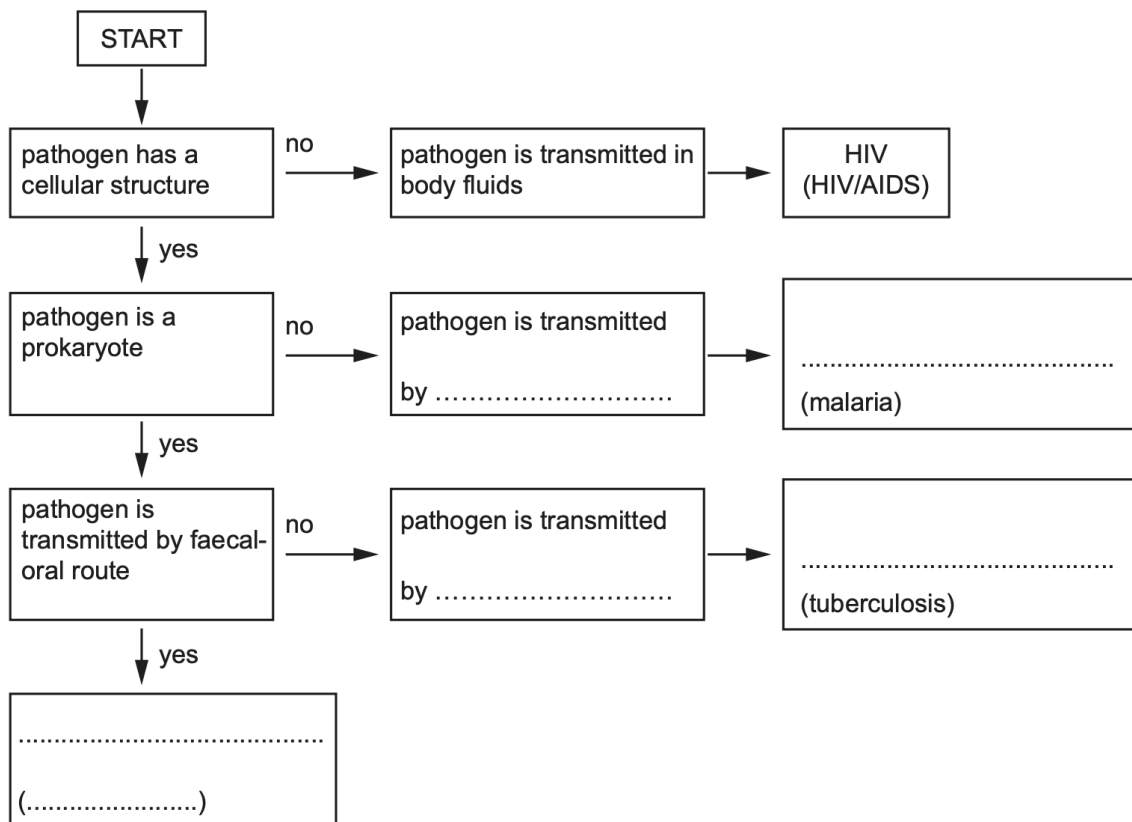
8. In some areas, cattle cannot be regularly tested or treated for TB. In these areas, milk and dairy products from infected dairy cattle may enter the human food chain. Outline a control measure that can be taken to protect people that consume milk and dairy products from these infected cattle.
  - pasteurising / drinking pasteurised milk
  
9. Explain the most likely mode of transmission of TB from an infected person to an animal.
  - infected person coughs / breathes out / talks / sneezes and uninfected animal inhales / inspires / breathes in
  - aerosol / droplet transmission // transmitted by aerosol
  
10. In most people, the response of the immune system to the infection of lung tissue by *M. tuberculosis* can prevent the spread of the bacterium to other organs of the body. The bacterium is contained in the lungs in a dormant state. This is known as latent TB. Outline the treatment that is used to kill *M. tuberculosis* in latent TB infections.
  - antibiotics / antibacterials
  - detail: e.g. combination treatment / combination of antibiotics
  - take antibiotic for 4 – 12 months
  - shorter time using combination than single antibiotic
  
11. Name the species of prokaryote that causes cholera.
  - *Vibrio cholerae*
  
12. Outline two control methods, other than ART (antiretroviral therapy), that can be used to reduce the transmission of HIV.
  - practising safe sex / use contraceptives
  - screening blood before transfusions / not taking blood from high risk individuals
  - avoid sharing needles / syringes / drug injecting equipment OR use new / sterile needles / syringes / drug injecting equipment
  - avoid breast feeding / use baby milk products instead of breast milk
  
13. Discuss the factors that contribute to the success of a vaccination programme.
  - access to whole population / all people at risk
  - reaching enough of the population to give herd immunity
  - vaccinating children early enough in their lives/ before the time when they are most at risk
  - ref. to education about importance / benefits / advantages of vaccination
  - countering anti-vaccination campaigns / misinformation about vaccines

- long duration of protection given by vaccine / artificial immunity
- little / no mutation of pathogen (to evade vaccine) // little / no antigenic shift // few / no strains develop
- ability to change vaccine in response to changing strains of pathogen
- no side effects
- plentiful / good supply of vaccine
- sufficient numbers of people trained to deliver vaccine // idea that administering vaccine is simple process
- low cost of production / transport / storage / delivery to population
- provide incentives for people to get vaccinated / idea that disease is a current threat to population
- long shelf life of vaccine
- stable vaccine, eg. in high temperatures // vaccine can be freeze-dried
- no boosters required

14.

3 (a) A class of students was studying the features of some human pathogens. One of the students constructed a flow chart to identify four different human pathogens. The student used information about the structure and mode of transmission of each of these pathogens.

Fig. 3.1 shows the partially completed flow chart.



- (insect) vector / Anopheles mosquito
- Plasmodium falciparum / ovale / malariae / vivax

- *Vibrio cholerae* and cholera
- *Mycobacterium tuberculosis* / *bovis*
- airborne droplets / droplet infection / aerosol (infection) NOT air droplets

15. State and explain how health authorities can reduce the transmission of HIV.

- supply, condoms / femidoms / dental dams: barrier to transmission during sexual intercourse ;
- needle exchange schemes / other suitable support for intravenous drug users: decreases risk of sharing contaminated equipment
- use new needles / new syringes / sterilised equipment for medical procedures: decreases risk of transmission from contaminated blood ;
- provide testing for HIV, in high risk groups / to individuals at high risk: for early diagnosis so newly infected people so can start drug treatment immediately ;
- test pregnant women for HIV / provide powdered milk to women who are HIV positive: prevent women who are HIV positive passing HIV in breast milk ;
- prevent people who are HIV positive being blood donors / screen donated blood / heat-treat donated blood OR prevent people receiving blood infected with HIV during blood transfusions / operations
- carry out contact tracing: locate people who are undiagnosed / may be HIV positive / should be offered test
- supply (named) drugs to people living with HIV / who are HIV positive / pregnant women with HIV: prevents HIV, spreading throughout the body / infecting more T-lymphocytes / A to reduce viral load
- provide education / information about HIV treatments / HIV transmission: to raise awareness of ways to reduce infection

16. Suggest why treating people who have developed HIV/AIDS with ART may help to reduce the number of overall deaths from infectious diseases, such as cholera, TB and malaria.

- can decrease viral load / reduce number of HIV
- helps to increase / maintain number of T-lymphocytes / T-helper cells
- maintains / improves strength of immune system / immune response
- increases chance of recovery from infectious / opportunistic disease
- decreases risk of having / helps prevent other opportunistic diseases

1. Explain what is meant by an infectious disease.

- caused by pathogens
- is transmissible

2. Explain how vaccination programmes can help to control the spread of infectious diseases, such as polio.

- vaccination programme aims to vaccinate, whole populations / large numbers
- vaccine allows (most) children / people to have an immune response (against antigens of the disease organism)
- develop, long-term immunity / artificial active immunity / memory cells against, polio / disease
- idea that vaccinated individuals cannot, transmit virus / transmit polio / infect others
- herd immunity / described
- AVP: ref. to vaccination programme aims to break the transmission cycle

3. Explain why penicillin is not effective against viruses

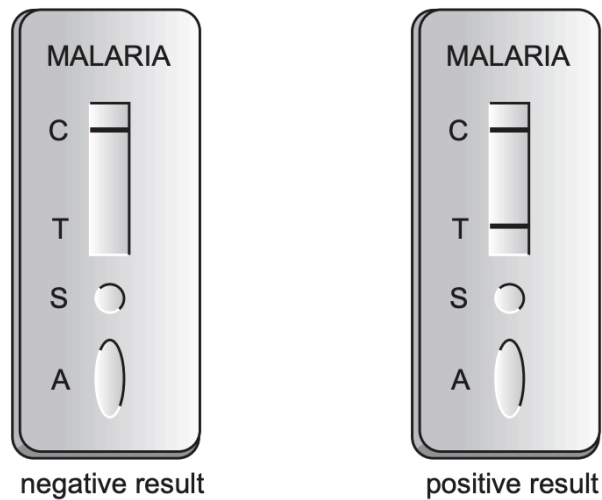
- penicillin only acts on bacteria / prokaryotes
- virus does not have, cell walls / murein / peptidoglycan
- virus does not have transpeptidases / the enzyme that is, inhibited / acted on, by penicillin
- virus does not grow / penicillin (only) acts on growing cells
- virus does not have cellular structure / virus is acellular ;

4. Explain how malaria is transmitted.

- vector = female Anopheles (mosquito).
- mosquito / (female) Anopheles, takes blood from infected person.
- mosquito inserts saliva / anticoagulant with pathogen / Plasmodium / parasite into (blood of) uninfected person.

5.

Fig. 5.2 shows two diagnostic test strips for malaria.



**Fig. 5.2**

- A sample of blood from a person suspected of having malaria is put into the well labelled **S**.
- A buffer solution is put into the well labelled **A**.
- The buffer solution moves the blood towards the results window.
- A line at position **C** indicates that the test is working correctly.
- A line at position **T** indicates a positive result for malaria.

State three advantages of using test strips for malaria, such as those shown.

- results are accurate (rely on monoclonal antibodies)
- results are obtained quickly / diagnosis is quick
- low cost / cheap
- does not need highly trained medical professional / easy to read / easy to use
- does not need specialised equipment
- easily, transported / distributed (in bulk)
- can ensure appropriate treatment is given immediately malaria is confirmed ;
- reduces unnecessary use of antimalarial drugs (just in case) ;
- (a small area for S so) only a small sample of blood needed ;

6. Discuss the factors that determine the global distribution of malaria.

habitat of Anopheles mosquito

- in areas where, Anopheles (mosquito) / vector, occurs
- Anopheles mosquitoes only live in humid conditions ;
- warm temperatures for, development / growth, of, parasite / Plasmodium (in vector / mosquito) ;
- warm temperature for, development / growth, of mosquito larvae ;
- mosquitoes require bodies of, still water for breeding
- mosquitoes require places where there is sufficient rainfall ;

- low altitude ;

#### resistance

- insecticide / repellent, resistance of mosquitoes ;
- drug resistance of parasite ;

#### prevention

- in countries / areas, where, prevention / control measures, are not implemented by, governments / health authorities ;
- further detail e.g. any example of a, prevention / control measure that is not used or not implemented fully ;

#### immunity

- immunity to malaria in human population (limits distribution) ;

#### people

- migration of infected people from areas (with high rates of malaria) ;
- high rates of HIV infection ;

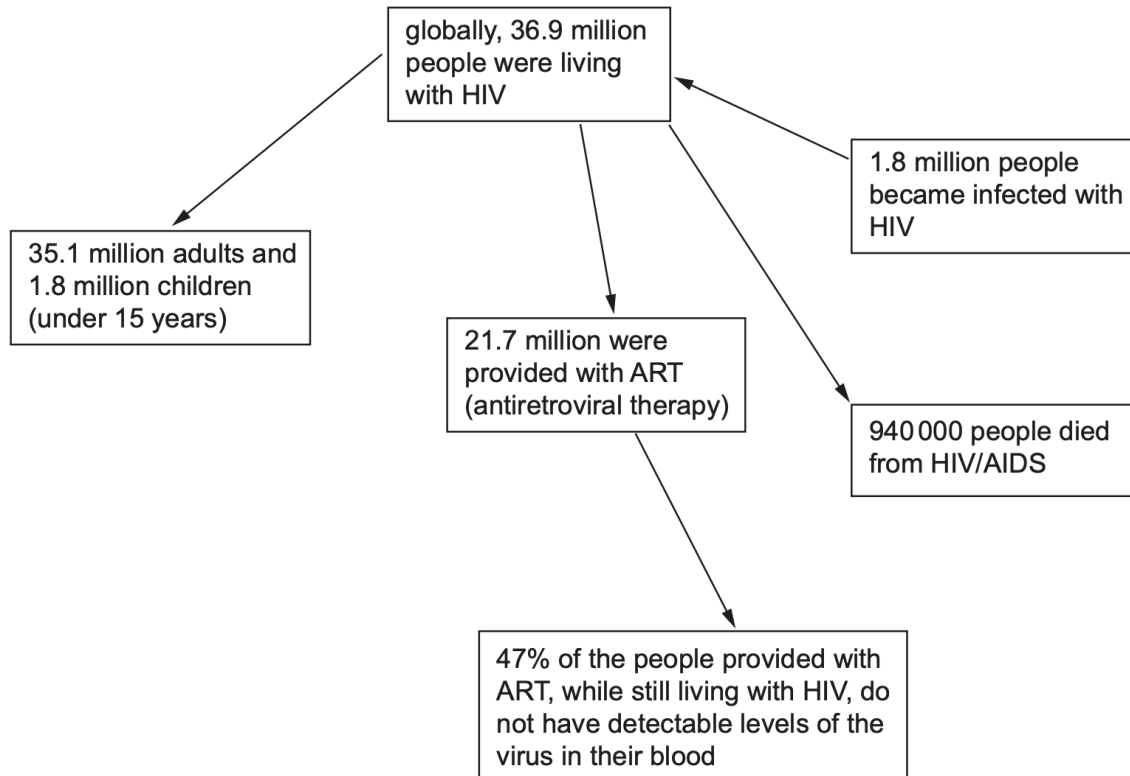
7. State the disadvantage of prescribing antibiotics as a preventive measure against TB.

- increases risk of antibiotic resistance developing; an antibiotic resistant bacterial strain may develop
- mutation(s) occur in bacteria which, make antibiotics ineffective / prevent antibiotic action - A mutation occurs which may make bacteria resistant

8.

(d) Fig. 6.1 is a summary of some of the statistics published by UNAIDS (Joint United Nations Programme on HIV and AIDS) about HIV and HIV/AIDS for the year 2017.

The figures shown in Fig. 6.1 for 2017 are estimated.



One other statistic published by UNAIDS indicated that, in 2017, only 75% of the estimated 36.9 million people living with HIV knew that they had been infected with the virus.

With reference to the information in Fig. 6.1, discuss the importance of this statistic.

9.2 million do not know that they are, living / infected with HIV

- risk to themselves: not accessing, ART / treatment; only people who know will access ART/ if tested, can access ART
- high(er) viral, loads / levels (compared to many on ART)
- greater risk of, developing / dying from, HIV/AIDS / HIV-related diseases
- greater risk of transmitting, virus / HIV (includes placental transmission)
- detail of prevention that may not be practised
  - are sharing contaminated needles
  - are donating blood
  - are breastfeeding
  - are not, practising safe sex / using condoms / AW
- (may develop opportunistic infection so) greater risk of spreading infectious diseases
- problems with increase in infection within a population
  - increased cost of care / medication

- increased pressure on medical staff
- reduction in size of labour force
- ref. to testing for HIV ; R testing for HIV/AIDS
  - indicates more, education / advertising, needed to encourage testing
  - indicates more testing required / focusing on at risk groups
- AVP
  - e.g. if people do not know status, no contact tracing can occur
  - authorities provide free condoms to try and reduce overall transmission

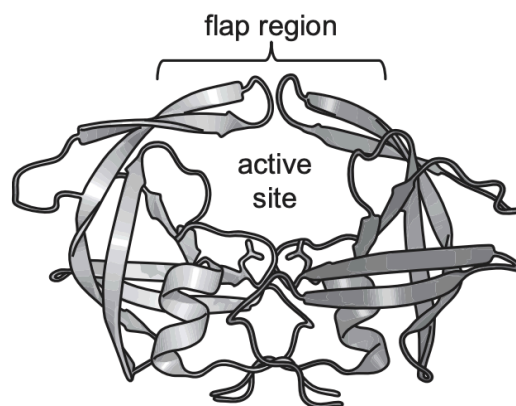
9. Suggest why antibiotics may be prescribed for a person with HIV/AIDS.  
to treat / to cure / may have / prone to / to prevent / infectious diseases /  
infections caused by bacterial pathogens  
e.g. bacterial / opportunistic / secondary disease(s) / infection(s)

10.

Some polypeptides are translated as part of one long polyprotein chain. After translation, enzymes cut the polyprotein into separate functioning proteins.

HIV protease cuts a polyprotein that has been produced within the host cells of actively replicating HIV. The separate proteins are required in the replication of the virus.

Fig. 3.1 shows how the two polypeptide chains of HIV protease form an enzyme with an active site enclosed by flaps, forming the flap region.



**Fig. 3.1**

(i) The flap region of HIV protease is flexible.

Indinavir is one of the therapeutic drugs used in HIV anti-retroviral therapy (ART). It is similar to the polyprotein substrate of HIV protease. Suggest and explain how indinavir acts as a therapeutic drug.

- acts as competitive inhibitor ;
- binds to active site instead of substrate to prevent entry / binding of substrate; competes with substrate to prevent ESC formation

- will be permanent / non-reversible ; causes / induces, flap region to open to bind to active site ;

11. State the type of organism that causes malaria and name one organism that causes malaria in humans.

- Type of organism: protoctist
- Name of organism: Plasmodium falciparum / Plasmodium malariae / Plasmodium ovale / Plasmodium vivax