



ANSWER BOOK

Infectious disease: transmission and control

Pathogens, disease and immunity · Unit B11

AQA not examined as a topic · OCR A 4.1.1 · Edexcel A 6.6, 6.11, 6.13
Edexcel B 2.2 iv, 3.2 iv, 6.4 ii, 6.5 i, 6.6 i · CAIE 10.1

15 questions · 52 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

- A1** **B1** HIV is transmitted through direct contact with infected body fluids. **B1** tuberculosis is transmitted by droplets, breathed out in a cough or sneeze and inhaled by another person. [2]
IDT-Q15

SECTION B · Standard, 3 to 5 marks

- B1** **B1** biological: the BCG vaccine gives partial protection, strongest against the severe childhood forms, and is worth using even though it is imperfect. **B1** biological: active cases are treated with a combination of antibiotics for six months or more, because the bacterium grows slowly and shelters inside macrophages, and a treated patient stops coughing viable bacteria within weeks; pasteurising milk is biological too, heating it enough to denature the proteins of *M. bovis* and close that route. **B1** the resistant cases arise because a patient who feels well at two months and stops has spared the least susceptible bacteria, mutants present by chance from the start, which then reproduce; supervised courses, with a health worker watching each dose swallowed, are the answer. **B1** social: better ventilation and less crowded housing cut the droplet dose, contact tracing finds the undiagnosed cases still seeding the chain, and testing herds and slaughtering infected animals closes the *M. bovis* route at its source. **B1** economic: supervision, drugs, housing and pasteurisation all cost money, and the populations that need them most can afford them least, so a judgement is needed on where limited funds do most good, with the argument that money spent returns as the productivity of adults who can work and children who can learn. [5]
IDT-Q1
- B2** **B1** the parasite cannot pass directly from person to person: it needs a vector, the female *Anopheles* mosquito, female because only females take blood meals. **B1** biting an infected person, she takes up the parasite's sexual stages with the blood. **B1** these complete their development in her gut, and one to two weeks later the infective stages pass into the next person in her saliva as she feeds again. **B1** in that person the parasite multiplies first in the liver and then in the red blood cells, whose synchronised bursting gives the waves of fever. [4]
IDT-Q2
- B3** **B1** the drugs hold replication so low that the immune system stays intact and AIDS never develops, and a person with an undetectable viral load does not transmit the virus sexually. **B1** the virus archives its genome inside the T-helper cells themselves, so it is never cleared and returns if the drugs are stopped. **B1** its surface antigens mutate faster within a single patient than those of influenza do worldwide, so antibodies and memory cells raised against one version do not recognise the next. **B1** it also infects the T-helper cells that any vaccinated response would have to depend on, so the response a vaccine provokes is attacking the cells that coordinate it. [4]
IDT-Q3

- B4** **B1** cholera takes the faecal-oral route: *Vibrio cholerae* leaves an infected person in faeces and enters the next by mouth, so with no latrines sewage reaches the one water source that serves thousands of people. **B1** the disease accelerates its own spread, because the watery diarrhoea produced by the toxin, litres of it a day, is loaded with the bacterium. **B1** many infected people are carriers with mild symptoms or none who still shed the bacterium, so the visible cases are only a fraction of the sources. **B1** separating sewage from drinking water, by providing latrines and a treated supply, removes the route itself and so stops transmission regardless of how many people are already infected; oral vaccine can blunt the outbreak meanwhile. [4]
IDT-Q4
- B5** **B1** measles virus has stable surface antigens, so a single set of antibodies and memory cells remains effective for life, whereas *Plasmodium* moves through liver, blood and mosquito stages that each present different antigens. **B1** a measles vaccine only has to match one stable set of antigens, whereas a malaria vaccine effective against one *Plasmodium* stage's antigens does not protect against the antigens of a different stage. **B1** measles vaccination has decades of use behind it against a virus that has not changed its antigens in that time, whereas a malaria vaccine is recent and must contend with a parasite whose antigens differ at every life stage. **A1** this variation between stages, on top of ordinary mutation, is why protection from a malaria vaccine is only partial rather than complete, unlike the measles vaccine. [4]
IDT-Q8
- B6** **B1** *M. tuberculosis* travels in droplets coughed out by a person with active disease, whereas *M. bovis* travels in unpasteurised milk and through close contact with infected cattle. **B1** *M. tuberculosis* is controlled by measures such as ventilation, reduced crowding and supervised antibiotic treatment, which act on person-to-person spread. **B1** *M. bovis* is controlled by testing herds and slaughtering infected animals and by pasteurising milk, which act on the animal-to-person route instead. **A1** so tuberculosis needs two different sets of control measures, medical and social for one route and agricultural for the other, matched to the two separate routes by which the disease reaches people. [4]
IDT-Q9
- B7** **B1** screening donated blood for HIV antibodies (and, in fourth-generation tests, for the p24 protein) prevents transmission through transfusion. **B1** needle exchange programmes supply sterile equipment to people who inject drugs, preventing transmission through shared needles. **B1** giving antiretroviral drugs to pregnant women who are HIV positive cuts mother-to-child transmission from roughly one in four to under one in a hundred. **A1** widespread antiretroviral treatment also reduces onward sexual transmission, because a person with a sustained undetectable viral load does not transmit the virus, so treatment functions as prevention as well as therapy. [4]
IDT-Q10

- B8** **B1** cholera is caused by the bacterium *Vibrio cholerae*. **B1** malaria is caused by *Plasmodium falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. **B1** tuberculosis is caused by *Mycobacterium tuberculosis* and by *Mycobacterium bovis*, whose usual hosts are cattle. [3]
IDT-Q5
- B9** **B1** a person with untreated active TB coughs *M. tuberculosis* into shared air in droplets, which other people inhale. **B1** infection is a matter of dose and time, so hours spent in the same unventilated room night after night deliver enough bacteria to establish an infection. **B1** crowding shortens the distance a droplet has to travel and puts more people in that air, and the malnutrition that accompanies poor housing weakens the immune response that would otherwise end the infection early. [3]
IDT-Q6
- B10** **M1** untreated infections are 25 per cent of 4000 = 1000, and treated infections are 0.8 per cent of 4000 = 32. **A1** 1000 - 32 = 968 infections prevented each year. **A1** $968 \div 1000 \times 100 = 96.8$ per cent reduction. [3]
IDT-Q7
- B11** **B1** Snow had found the transmission route, water from the contaminated pump, even without knowing what pathogen it carried or how it caused disease. **B1** removing that one water source broke the route between the source of infection and new hosts, and the outbreak ended. **A1** this shows that a disease can be controlled effectively by interrupting its transmission route, without needing to identify the pathogen or have a cure for it. [3]
IDT-Q11
- B12** **B1** resistance mutations to any one drug arise by chance and are already present in a small number of parasites before the drug is used. **B1** a parasite resistant to artemisinin is still likely to be susceptible to the second drug, and vice versa, since the two act differently. **A1** using both together means a parasite has to carry resistance mutations to both drugs at once to survive treatment, which is far less likely, so resistant lines are much slower to establish than with either drug alone. [3]
IDT-Q12
- B13** **B1** a biological measure such as a drug or a vaccine only works if people can access it and are able to use it as intended. **B1** a patient who cannot afford to miss work for clinic visits may stop an antibiotic course early even though the drug itself is effective, which is an economic barrier to a biological measure succeeding. **A1** the three categories interlock rather than add: a drug or a vaccine is a biological object, but whether people use it correctly is social, and whether they can obtain or afford it at all is economic, so a programme relying on only one axis is incomplete. [3]
IDT-Q13

B14 **B1** in most people infected with *M. tuberculosis*, the bacterium survives inside [3]
IDT-Q14 macrophages, walled into granulomas by the immune response, without causing active disease. **B1** keeping the bacterium contained in this dormant state depends on continued immune surveillance, including T-helper cells co-ordinating the response. **A1** an untreated HIV infection destroys T-helper cells over years, so the immune system can no longer keep the dormant tuberculosis contained, and it can become active disease.

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