1.17 Communicable Diseases and Pathogens: 1-hour Pack

Total Marks

AQA 8464 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Plants have physical, mechanical and chemical defence responses that help protect them against pathogens and herbivores.

(a) Give one example of a physical plant defence and one example of a mechanical plant defence. **(2)**

(b) Explain how a waxy cuticle acts as a physical barrier to help prevent pathogens infecting a leaf. **(2)**

(c) Some plants produce chemicals that are poisonous to insects that try to feed on their leaves. Suggest how this reduces the plant's risk of catching a communicable disease. **(2)**

(Total for Question 1 is 6 marks)

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2 Compare the transmission and prevention of malaria and measles. In your answer, evaluate which of the two diseases would be more difficult for a country with limited money for healthcare to control, using the methods available for reducing the transmission of each disease.

(Total for Question 2 is 6 marks)

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3 A glasshouse contains 500 tomato plants. On day 0, 8 plants were found to be infected with a bacterial plant disease. Assuming no control measures were introduced, the number of infected plants doubled every 3 days.

(a) Calculate the number of infected plants there would have been by day 12, if this pattern of doubling had continued. Show your working. **(3)**

(b) On day 12, growers introduced control measures (removing infected plants and increasing ventilation), and the rate of new infections fell to a constant 5 newly infected plants per day for the following 10 days. Calculate the total number of plants that had become infected in the glasshouse by day 22 (including those infected before day 12). **(2)**

(c) The disease is spread by water splash between neighbouring plants during overhead irrigation. Suggest two changes to the glasshouse's irrigation or growing practices that could reduce further transmission of this disease. **(2)**

(Total for Question 3 is 7 marks)

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4 Measles is a communicable disease caused by a virus. In the UK, most children are offered the MMR vaccine, which protects against measles.

(a) State the type of pathogen that causes measles. **(1)**

(b) Give two symptoms of measles. **(2)**

(c) Measles is spread by inhalation of droplets released into the air from the coughs and sneezes of an infected person. Explain why measles can spread quickly through a primary school. **(2)**

(d) Explain how vaccinating most of the children in a school against measles can also help to protect the small number of children who have not been vaccinated. **(3)**

(Total for Question 4 is 8 marks)

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5 HIV (human immunodeficiency virus) initially causes a flu-like illness. If untreated, HIV can severely damage the body's ability to fight off other infections and diseases, a condition known as AIDS.

(a) Give two ways that HIV can be transmitted between people. **(2)**

(b) Suggest two ways that the transmission of HIV between people could be reduced. **(2)**

(c) HIV can only be transmitted by direct contact with body fluids, whereas measles is transmitted by droplet infection through the air. Suggest why this difference affects how easily each disease can spread through a population. **(3)**

(Total for Question 5 is 7 marks)

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6 A food hygiene inspector used aseptic technique to swab a chopping board that had been used to prepare raw chicken. The swab was used to inoculate a sterile agar plate, which was then incubated at 25°C.

(a) Give two aseptic technique steps the inspector should use when inoculating the agar plate, to prevent unwanted microorganisms from contaminating it. **(2)**

(b) The population of bacteria on the plate doubled every 20 minutes. If there were 4 bacteria present on the plate at the start of incubation (time = 0), calculate the number of bacteria present after 2 hours of incubation. Show your working. **(3)**

(c) Suggest one reason why the value calculated in part (b) may be an overestimate of the number of bacteria that would actually be found on a real chopping board after 2 hours. **(1)**

(d) Suggest why school laboratories usually incubate plates like this at about 25°C rather than at 37°C (body temperature). **(2)**

(e) Predict, with a reason, how the number of colonies on a plate from the same swab, but incubated at 4°C (a fridge), would compare with the plate incubated at 25°C. **(2)**

(Total for Question 6 is 10 marks)

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7 Malaria is a disease caused by a protist, Plasmodium, and is transmitted between people by a vector: the female Anopheles mosquito.

(a) Name the type of pathogen that causes malaria. **(1)**

(b) Name the vector that spreads malaria between humans. **(1)**

(c) Explain how the malaria parasite is transmitted from an infected person to an uninfected person by the mosquito vector. **(3)**

(d) A region recorded 24500 cases of malaria in one year. After insecticide-treated bed nets were distributed to 80% of households, the number of cases fell to 6125 in the following year. Calculate the percentage decrease in the number of malaria cases. **(3)**

(e) Suggest two methods, other than bed nets, that could be used to reduce the spread of malaria in this region. **(2)**

(Total for Question 7 is 10 marks)

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Mark scheme · 1.17 Communicable Diseases and Pathogens: 1-hour Pack

Question 1

(a) physical: a waxy cuticle on the leaf surface, or a cellulose cell wall, or layers of dead cells (bark) around a stem, oe **B1**

(a) mechanical: thorns or spines, or hairs, or leaves that droop or curl when touched, or mimicry, oe **B1**

(a) Answer: Physical, e.g. a waxy cuticle on the leaf (or cellulose cell walls). Mechanical, e.g. thorns and spines (or leaves that droop/curl when touched).

(b) the waxy cuticle covers the leaf surface, making it difficult for pathogens to penetrate/enter the plant tissue, oe **B1**

(b) it also reduces the amount of moisture left on the leaf surface, creating drier conditions that are less favourable for fungal spores to germinate, oe **B1**

(b) Answer: The waxy cuticle covers the leaf, forming a barrier that pathogens find difficult to penetrate. It also reduces moisture on the leaf surface, making conditions less favourable for fungal spores to germinate.

(c) the poisonous chemicals deter or kill insects that would otherwise feed on the plant, oe **B1**

(c) fewer insects feeding on the plant means fewer wounds/points of entry in its surface, and fewer opportunities for insects acting as vectors to introduce pathogens, reducing the risk of infection, oe **B1**

(c) Answer: The poisonous chemicals deter or kill insects that would feed on the plant. With fewer insects feeding, there are fewer wounds for pathogens to enter through and fewer chances for insect vectors to introduce pathogens.

Question 2

Level 3 A detailed, logically structured comparison of the transmission and prevention of malaria and measles, leading to a clear, scientifically justified evaluation of which disease would be more difficult to control with limited healthcare funding. Correct scientific terminology is used throughout. **5-6**

Level 2 A description of how both malaria and measles are transmitted and prevented, with a simple comparison made between them and some attempt to judge which would be harder to control, though the reasoning may be incomplete or one-sided. **3-4**

Level 1 Basic, isolated statements are made about how malaria and/or measles are spread or prevented, with little or no comparison between the two diseases and no justified evaluation. **1-2**

Level 0 No relevant content. **0**

Indicative content:

- Malaria is spread by a vector (the female Anopheles mosquito), which carries the Plasmodium protist between people when it feeds on blood.
- Measles is spread directly between people by droplet infection, through the air, from the coughs and sneezes of an infected person.
- Malaria prevention relies mainly on vector control: insecticide-treated bed nets, spraying insecticide, draining or covering standing water where mosquitoes breed, and antimalarial drugs.
- Measles prevention relies mainly on vaccination (the MMR vaccine) of the population, alongside isolating infected individuals to limit droplet spread.
- Vector control methods can be expensive to maintain, since nets need replacing, insecticide needs reapplying, and standing water can reappear, and mosquitoes can evolve resistance to insecticides over time.
- A vaccination programme can give long-lasting, population-wide protection from a single course of doses, which may become cheaper per person protected once the programme is established.
- However, vaccination programmes also have ongoing costs and challenges, such as cold-chain storage of vaccines and reaching people in remote areas.
- Malaria transmission depends on the local mosquito population, so control may need to continue indefinitely wherever suitable breeding sites and mosquitoes remain.
- A well-run measles vaccination programme can eventually reduce cases to a very low level (herd immunity), reducing the need for ongoing case-by-case control measures.
- A justified conclusion should be reached: for example, that malaria may be more difficult to control with limited funding because vector control needs continuous, repeated investment, whereas an established vaccination programme protects the population with lower ongoing cost per case prevented; or the reverse view, provided it is supported by scientifically accurate comparison and reasoning.
- Credit any scientifically accurate evaluation that is clearly supported by a comparison of the transmission and prevention methods of both diseases.

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Question 3

(a) number of doublings = 12 / 3 = 4, oe **M1**

(a) method: 8 x 2^4 (or sequential doubling: 8, 16, 32, 64, 128), oe **M1**

(a) 128 (infected plants) cao **A1**

(a) Answer: 128 infected plants

(b) new infections from day 12 to day 22 = 5 x 10 = 50 (using their (a) as the day-12 total, ft), oe **M1**

(b) 178 (128 + 50) cao (ft from (a)) **A1**

(b) Answer: 178 plants had become infected in total by day 22.

(c) use drip irrigation (watering the soil/roots directly) instead of overhead sprinklers, to avoid water splashing between plants, oe **B1**

(c) increase the spacing between plants, to reduce plant-to-plant contact and the distance water can splash between them, oe **B1**

(c) Answer: Any two of: use drip irrigation instead of overhead sprinklers, to avoid water splash between plants; increase the spacing between plants, to reduce contact and splash distance; water earlier in the day so leaves dry faster.

Question 4

(a) virus cao **B1**

(a) Answer: Virus.

(b) a red skin rash, oe **B1**

(b) a fever (high temperature), oe (accept: sore, red eyes) **B1**

(b) Answer: A red skin rash and a fever (high temperature).

(c) children in a primary school classroom are in close contact with each other for long periods of time, oe **B1**

(c) so droplets from an infected child's coughs/sneezes are easily inhaled by many other children nearby, oe **B1**

(c) Answer: Children in a primary school are in close contact for long periods, so droplets from an infected child's coughs and sneezes are easily breathed in by many other children.

(d) vaccinating most of the population means fewer people can become infected with (and pass on) the measles virus, oe **B1**

(d) this reduces the overall number of measles cases circulating within the school/population, oe **B1**

(d) so unvaccinated children are much less likely to come into contact with an infected person, reducing their chance of catching measles, oe **B1**

(d) Answer: Vaccinating most children means fewer people can become infected and pass the virus on, so there are fewer cases circulating overall. This makes it much less likely that an unvaccinated child will come into contact with an infected person.

Question 5

(a) sexual contact (unprotected sex) with an infected person, oe **B1**

(a) exchange of bodily fluids, e.g. sharing needles contaminated with infected blood, or from mother to baby during pregnancy/birth/breastfeeding, oe **B1**

(a) Answer: Any two of: unprotected sexual contact; sharing infected needles; exchange of bodily fluids; from mother to baby during pregnancy, birth or breastfeeding.

(b) using a condom during sexual intercourse, oe **B1**

(b) not sharing needles (e.g. needle exchange programmes for drug users), or screening donated blood/organs for HIV before use, oe **B1**

(b) Answer: Any two of: using condoms; not sharing needles; screening donated blood before use; taking antiretroviral drugs, which reduce the amount of virus in the blood.

(c) HIV transmission generally requires close, direct contact or specific behaviours (e.g. unprotected sex, sharing needles) between people, oe **B1**

(c) measles can be transmitted through the air by droplets, so it can spread between people who only have brief or indirect contact (e.g. being in the same room), oe **B1**

(c) this means measles can generally spread more quickly through a population than HIV, which relies on more specific/less frequent routes of transmission, oe **B1**

(c) Answer: HIV needs close, direct contact or specific behaviours to spread, whereas measles can pass through the air between people with only brief contact. This means measles can generally spread through a population more quickly than HIV.

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Question 6

(a) flame (sterilise) the inoculating loop before and after use, oe **B1**

(a) only briefly lift the lid of the sterile agar plate, holding it at an angle, when inoculating it, to limit exposure to airborne microorganisms, oe (accept: work near a lit Bunsen burner; sterilise the agar/petri dish before use; tape the lid down with a few short pieces of tape rather than sealing it completely) **B1**

(a) Answer: Any two of: flame the inoculating loop before and after use; only briefly lift the lid at an angle when inoculating the plate; work close to a Bunsen burner flame; use a sterile (pre-sterilised) agar plate; secure the lid with a few short pieces of tape rather than sealing it completely.

(b) 2 hours = 120 minutes; number of divisions = 120 / 20 = 6, oe **M1**

(b) method: 4 x 2^6 (or repeated doubling shown: 4, 8, 16, 32, 64, 128, 256), oe **M1**

(b) 256 (bacteria) cao **A1**

(b) Answer: 256 bacteria

(c) a real chopping board has far less nutrients available than nutrient agar, or bacteria compete for limited space/nutrients, or toxic waste products build up, so the bacteria could not keep dividing at the same rate, oe **B1**

(c) Answer: A real chopping board has much less nutrients available than nutrient agar (and bacteria would compete for limited space and nutrients), so the population would not keep doubling at this rate.

(d) 37°C is closer to human body temperature, so incubating at this temperature is more likely to encourage the growth of pathogens that could infect humans, oe **B1**

(d) incubating at a lower temperature (25°C) makes the practical safer to carry out in a school laboratory, oe **B1**

(d) Answer: 37°C is close to human body temperature, so it favours the growth of pathogens that could infect people. Incubating at 25°C instead makes the practical safer in a school laboratory.

(e) fewer colonies (less bacterial growth) would be seen on the plate incubated at 4°C, oe **B1**

(e) because at a lower temperature, bacterial reproduction (binary fission)/enzyme-controlled reactions happen more slowly, so the bacteria divide less often in the same time, oe **B1**

(e) Answer: Fewer colonies would grow at 4°C, because bacterial reproduction (binary fission) happens more slowly at lower temperatures, so the bacteria divide less often in the same time.

Question 7

(a) a protist cao **B1**

(a) Answer: A protist (Plasmodium).

(b) the (female) Anopheles mosquito cao **B1**

(b) Answer: The female Anopheles mosquito.

(c) a mosquito bites (feeds on the blood of) a person infected with the malaria parasite, taking the parasite into its body along with the blood, oe **B1**

(c) the parasite develops/multiplies inside the mosquito, oe **B1**

(c) when the mosquito later bites an uninfected person, it injects saliva containing the parasite into that person's bloodstream, infecting them, oe **B1**

(c) Answer: A mosquito feeds on the blood of an infected person, taking in the parasite. The parasite develops inside the mosquito, and when the mosquito later bites another person, it injects saliva containing the parasite into their blood, infecting them.

(d) decrease = 24500 - 6125 = 18375, oe **M1**

(d) percentage decrease = (18375 / 24500) x 100, oe **M1**

(d) 75% cao **A1**

(d) Answer: 75% decrease

(e) spraying insecticide (e.g. indoors, on walls) to kill mosquitoes, oe **B1**

(e) draining or covering standing water where mosquitoes breed, or fitting window/door screens, or taking antimalarial drugs, oe **B1**

(e) Answer: Any two of: spraying insecticide to kill mosquitoes; draining or covering standing water where mosquitoes breed; fitting window and door screens; taking antimalarial prophylactic drugs.

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