1.3 Infection and Response: 1-hour Pack

AQA 8461 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The human body has several non-specific defence systems that act as barriers to prevent pathogens entering the body.

(a) Describe how the skin acts as a defence against pathogens. **(2)**

(b) Describe how the nose acts as a defence against pathogens. **(2)**

(c) Describe how the trachea and bronchi act as a defence against pathogens. **(2)**

(Total for Question 1 is 6 marks)

2 A public health poster compares two methods to prevent flu spread: method 1 is vaccination; method 2 is frequent handwashing. The poster states: vaccination reduces infection by 70% in a large trial; handwashing reduces infection by 30% in observational studies.

(a) Give three reasons why a large trial result is stronger evidence than observational studies. **(3)**

(Total for Question 2 is 3 marks)

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3 Give two different types of pathogen and an example of a disease caused by each.

(a) Name one type of pathogen and an example disease it causes. **(1)**

(b) Name a different type of pathogen and an example disease it causes. **(1)**

(Total for Question 3 is 2 marks)

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4 Explain how harmless bacteria that live on human skin can help prevent pathogenic infections.

(a) Explain the protective role of normal skin flora. **(2)**

(Total for Question 4 is 2 marks)

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5 If each infected person infects an average of 1.8 other people, how many new cases are expected next generation from 50 currently infected people? Give your answer as an integer.

(a) Calculate the expected new cases. **(1)**

(Total for Question 5 is 1 mark)

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6 A vaccination programme against Disease X was introduced in a country. The number of new cases reported was 8400 in Year 1 (before the programme) and 1260 in Year 3 (after the programme).

(a) Calculate the percentage decrease in the number of new cases between Year 1 and Year 3. **(3)**

(b) Suggest one reason, other than vaccination, why the number of cases might have decreased. **(1)**

(Total for Question 6 is 4 marks)

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7 Salmonella and gonorrhoea are both bacterial diseases with very different methods of transmission and prevention.

(a) State how a person could become infected with Salmonella bacteria. **(1)**

(b) Describe two symptoms of salmonella food poisoning. **(2)**

(c) In the UK, poultry are routinely vaccinated against Salmonella. Explain how this reduces cases of salmonella food poisoning in humans. **(2)**

(d) Gonorrhoea is a sexually transmitted bacterial infection. Many strains are now resistant to the antibiotic penicillin. Suggest two ways the spread of gonorrhoea can be reduced. **(2)**

(Total for Question 7 is 7 marks)

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8 A gardener in Cheshire notices a mosaic pattern of yellow and dark green patches on the leaves of her tomato plants and suspects Tobacco Mosaic Virus (TMV).

(a) State one symptom of TMV infection in plants, other than the mosaic pattern on the leaves. **(1)**

(b) Explain how TMV infection could reduce the yield of the gardener's tomato plants. **(2)**

(c) Describe how the gardener could confirm that the plants have TMV rather than a mineral deficiency. **(2)**

(Total for Question 8 is 5 marks)

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9 Explain how vaccination protects both the vaccinated individual and the wider community during an outbreak.

(Total for Question 9 is 6 marks)

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10 Describe the roles of antibodies and memory cells in the adaptive immune response after infection or vaccination.

(a) Describe the role of antibodies. **(1)**

(b) Describe the role of memory cells. **(1)**

(c) Explain how antibodies and memory cells together give effective protection on re-infection. **(1)**

(Total for Question 10 is 3 marks)

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11 MRSA is a strain of bacteria that is resistant to many antibiotics, including methicillin. Explain how the population of antibiotic-resistant bacteria such as MRSA can increase over time.

(Total for Question 11 is 5 marks)

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12 A public health team records the weekly incidence of a viral infection in a town of 12 000 people. Incidence per week per 1000 people was:
Week 1: 6.0
Week 5: 1.5
Between week 1 and week 5 a vaccination campaign reached 60% of the population. Calculate the percentage decrease in incidence per 1000 people from week 1 to week 5 and discuss one reason why the decrease might not be entirely due to vaccination.

(a) Calculate the percentage decrease in incidence per 1000 people between week 1 and week 5. Show working. **(2)**

(b) Give one plausible reason why the incidence fell that is not vaccination and explain briefly. **(1)**

(Total for Question 12 is 3 marks)

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Mark scheme · 1.3 Infection and Response: 1-hour Pack

Question 1

(a) acts as a physical barrier to pathogens **B1**

(a) produces sebum, an oily antimicrobial secretion, which inhibits the growth of pathogens on the skin's surface **B1**

(a) Answer: It is a physical barrier and secretes antimicrobial sebum that inhibits pathogen growth.

(b) hairs trap large particles/pathogens **B1**

(b) mucus traps pathogens/particles **B1**

(b) Answer: Hairs and mucus in the nose trap pathogens and dust particles.

(c) lined with mucus, which traps pathogens **B1**

(c) lined with cilia, which waft/sweep the mucus (and trapped pathogens) up to the throat to be swallowed **B1**

(c) Answer: Mucus traps pathogens and cilia sweep the mucus up to the throat to be swallowed.

Question 2

(a) trials are usually controlled and can reduce bias by using control groups or randomisation, oe **B1**

(a) large trials have more participants so results are more reliable and less likely due to chance, oe **B1**

(a) observational studies can have confounding variables that are not controlled so cause and effect is less certain, oe **B1**

(a) Answer: Controlled trials reduce bias (e.g. randomisation or control groups), large trials are more reliable with less chance variation, and observational studies may have confounding variables so cause and effect is less certain.

Question 3

(a) one correct type of pathogen with a matching disease, e.g. bacterium - tuberculosis; virus - influenza; fungus - athlete foot; protozoan - malaria, oe **B1**

(a) Answer: Any one correct pair, for example: bacterium - tuberculosis.

(b) a second correct type and matching disease different from part a, oe **B1**

(b) Answer: Any different correct pair, for example: virus - influenza.

Question 4

(a) normal bacteria occupy niches and resources so reduce space and nutrients for pathogens **M1**

(a) some produce harmful substances or change pH to inhibit pathogen growth, oe **A1**

(a) Answer: Normal skin bacteria occupy space and resources preventing pathogen colonisation, and some release substances or alter pH that inhibit pathogen growth.

Question 5

(a) 90 new cases (50 x 1.8 = 90) cao **B1**

(a) Answer: 90

Question 6

(a) decrease = 8400 - 1260 = 7140 **M1**

(a) (7140 / 8400) x 100 **M1**

(a) 85% cao **A1**

(a) Answer: 85% decrease

(b) e.g. improved sanitation/hygiene, improved treatment or isolation of infected individuals, public health campaigns raising awareness **B1**

(b) Answer: For example, improved sanitation/hygiene or better isolation/treatment of infected individuals.

Question 7

(a) eating food contaminated with the bacteria (oe) **B1**

(a) Answer: By eating food contaminated with Salmonella bacteria.

(b) fever **B1**

(b) abdominal cramps / vomiting / diarrhoea (any one) **B1**

(b) Answer: Any two of: fever; stomach cramps; vomiting; diarrhoea.

(c) vaccination reduces the number of poultry/eggs infected with (or carrying) the bacteria **B1**

(c) this reduces the chance of the bacteria being passed on to humans through contaminated poultry meat or eggs **B1**

(c) Answer: Fewer poultry carry the bacteria, so fewer contaminated eggs/meat reach humans, reducing human infection rates.

(d) using a barrier method of contraception, e.g. a condom **B1**

(d) treating both/all sexual partners with an appropriate antibiotic **B1**

(d) Answer: Using barrier contraception (e.g. condoms) and ensuring all sexual partners are treated with an effective antibiotic.

Question 8

(a) stunted growth (allow reduced yield) **B1**

(a) Answer: Stunted growth of the plant.

(b) the mosaic pattern reduces the area of leaf that is green/contains chlorophyll **B1**

(b) this reduces the rate of photosynthesis, so less glucose is available for growth, resulting in smaller plants/less fruit **B1**

(b) Answer: Damaged, discoloured leaf tissue photosynthesises less, so less glucose is made for growth, reducing plant size and fruit yield.

(c) use a testing kit containing monoclonal antibodies that bind specifically to TMV antigens/proteins (oe) **B1**

(c) or take a sample and compare the symptoms/pathogen with a reference database or send to a laboratory for analysis **B1**

(c) Answer: Use a monoclonal-antibody-based detection kit specific to TMV, or compare symptoms/sample against a reference database in a laboratory.

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Question 9

Level 3 Detailed explanation. The answer links how vaccination stimulates an immune response producing memory cells and antibodies, how this provides faster protection on exposure reducing infection or severity, and explains herd immunity where high vaccination levels reduce overall pathogen transmission protecting unvaccinated or vulnerable people; includes clear causal links and an example or consequence. **5-6**

Level 2 Some explanation. The answer states that vaccination stimulates immunity and reduces transmission in the population but the link between individual immunity and herd protection may be incomplete or only one example given. **3-4**

Level 1 Simple statements. The answer mentions vaccination helps people not get sick or that it reduces spread, with little or no explanation of how or no mention of population-level effects. **1-2**

Indicative content:

- Vaccination introduces antigens so the immune system produces antibodies and memory cells without causing full disease.
- Memory cells allow a faster, stronger immune response when the real pathogen is encountered, often preventing infection or reducing severity.
- Fewer infected individuals mean the pathogen has fewer hosts to infect, so transmission in the community falls.
- High vaccination coverage leads to herd immunity, protecting those who cannot be vaccinated (very young, immunocompromised).
- An example: if most people are vaccinated against measles, outbreaks are small and vulnerable people are less likely to be exposed.

Question 10

(a) antibodies bind to specific antigens, neutralise pathogens or mark them for destruction by other immune cells, oe **B1**

(a) Answer: Antibodies bind specific antigens to neutralise pathogens or mark them for destruction.

(b) memory cells remain after first exposure and allow a faster, larger immune response on re-exposure to the same pathogen, oe **B1**

(b) Answer: Memory cells remain and cause a faster, larger immune response on re-exposure to the same pathogen.

(c) combined explanation: memory cells trigger rapid production of specific antibodies on re-exposure, preventing disease development, oe **M1**

(c) Answer: Memory cells trigger rapid production of specific antibodies on re-exposure, preventing disease development.

Question 11

mutations occur naturally/randomly in bacterial DNA **B1**

some mutations may result in bacteria being resistant to an antibiotic **B1**

when the antibiotic is used, non-resistant bacteria are killed, but resistant bacteria survive (selection pressure) **B1**

surviving resistant bacteria reproduce, passing on the resistance allele/gene to their offspring **B1**

over many generations, the proportion of resistant bacteria in the population increases (natural selection); overuse or incomplete courses of antibiotics increase the rate at which this happens **B1**

Answer: Indicative content - award any 5 of the marking points listed, max 5 marks.

Question 12

(a) shows correct method: percentage decrease = (6.0 - 1.5)/6.0 x 100 or equivalent **M1**

(a) 75% decrease cao **A1**

(a) Answer: 75% decrease

(b) one plausible alternative with brief explanation, e.g. seasonal change reduced transmission; increased social distancing or school closures reduced contacts; natural depletion of susceptibles, oe **B1**

(b) Answer: Seasonal factors or increased social distancing could have reduced transmission, so the fall may not be solely due to vaccination.

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