

Bacteria as Pathogens

Question Paper

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|-------------------|----------------------------|
| Level | A Level |
| Subject | Biology |
| Exam Board | Edexcel |
| Topic | Microbiology and Pathogens |
| Sub Topic | Bacteria as Pathogens |
| Booklet | Question Paper |

Time Allowed: 58 minutes

Score: /48

Percentage: /100

Grade Boundaries:

| A* | A | B | C | D | E | U |
|------|--------|-----|-------|-------|-----|------|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

- 1 Tuberculosis (TB) kills approximately three million people every year. Droplets containing the organisms that cause TB are released into the air when a person suffering from TB coughs. Transmission of TB occurs if these droplets are inhaled into the alveoli of the lungs.

In the lungs, the organisms are taken up by macrophages and carried to lymph nodes.

- (a) (i) State **one** characteristic symptom of TB other than coughing. (1)

- (ii) Place a cross ☒ in the box next to the name of the organism that causes TB. (1)

- A *Macrobacterium tuberculosis*
- B *Microbacterium tuberculosis*
- C *Monobacterium tuberculosis*
- D *Mycobacterium tuberculosis*

- (iii) Describe how the organisms that cause TB are taken up by macrophages. (3)

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- (iv) Ingesting food containing these organisms is unlikely to lead to the development of TB. Give an explanation for this. (2)

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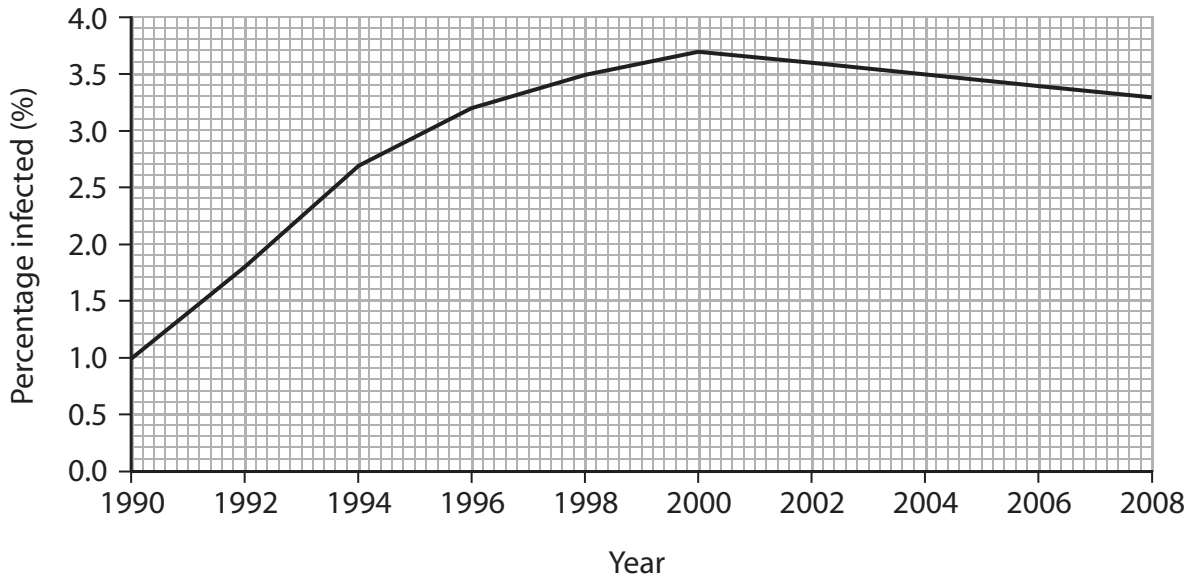
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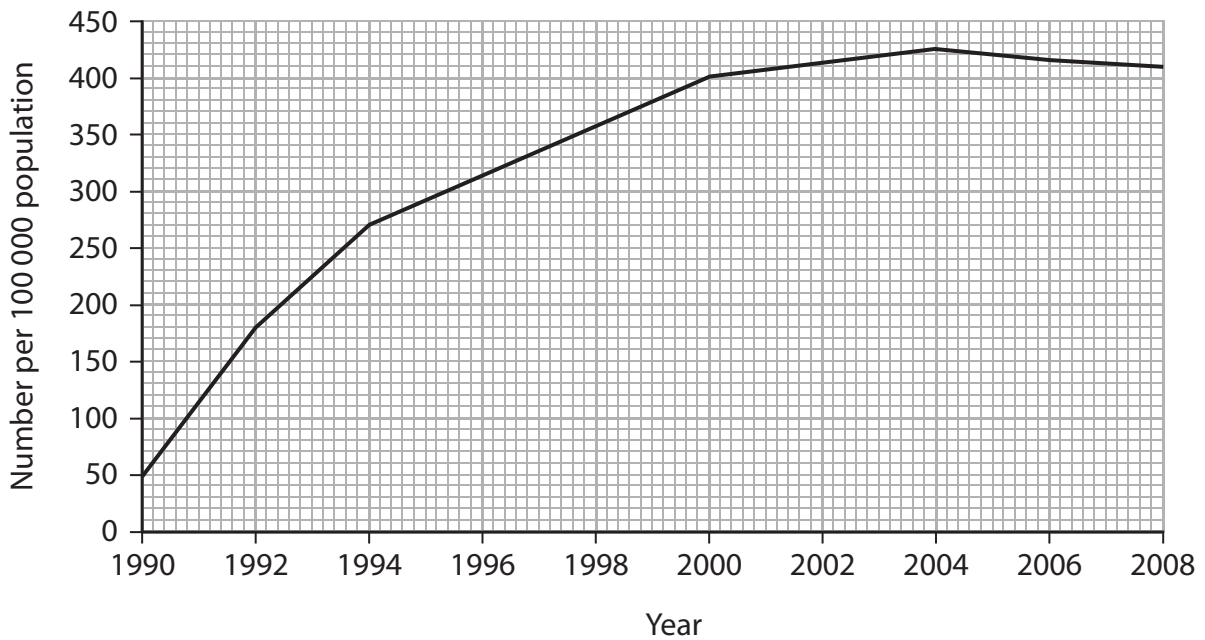
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*(b) The graphs below show data related to TB and HIV infections in the population of central Africa from 1990 to 2008.

Graph 1 – The percentage of the population infected by TB



Graph 2 – The number of cases of HIV infection per 100 000 population



2 Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

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(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis*, are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

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(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

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(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

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(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

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3 Bacteria and viruses can cause human diseases.

(a) Distinguish between the structure of bacteria and viruses

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(b) Infection with a bacterium can result in the development of active immunity to that bacterium. This results in the production of antibodies by plasma cells.

(i) Describe how infection with a bacterium results in the production of plasma cells.

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(ii) Explain how antibodies help a person to recover from an infection.

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(iii) A person who has had an organ transplant has to take immunosuppressive drugs. This prevents the immune system from destroying the organ transplant. Some of these drugs work by inhibiting the production of cytokines.

Suggest what effect these drugs could have on a person infected with a bacterium or a virus.

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(Total for Question 3 = 13 marks)

4 Bovine respiratory diseases (BRD) are a major problem in cattle, causing serious economic losses. The causes of BRD are multiple and complex. The most severe cases of BRD involve infections by both viruses and bacteria.

(a) The table below shows some features found in bacteria and viruses. For each feature, place **one** cross ☒ in the appropriate box, in each row, to show whether it is found in bacteria only, in viruses only or in both bacteria and viruses.

(3)

| Feature | Bacteria only | Viruses only | Both bacteria and viruses |
|-----------------------|---------------|--------------|---------------------------|
| Glycogen granules | ☒ | ☒ | ☒ |
| Nucleic acids | ☒ | ☒ | ☒ |
| Protein coat (capsid) | ☒ | ☒ | ☒ |

(b) Mild cases of BRD can usually be treated using antibiotics. The treatment of severe cases of BRD will involve the use of antibiotics and other medications.

(i) Suggest why medications, other than antibiotics, are needed to treat the most severe cases of BRD.

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- (ii) The table below shows the effectiveness of various antibiotics on three species of bacteria that can contribute towards severe cases of BRD.

| Antibiotic | Effectiveness of various antibiotics on three BRD bacterial pathogens (%) | | |
|-----------------|---|------------------------------|--------------------------|
| | <i>Mannheimia haemolytica</i> | <i>Pasteurella multocida</i> | <i>Histophilus somni</i> |
| Danofloxacin | 71 | 88 | 84 |
| Enrofloxacin | 83 | 93 | 95 |
| Florfenicol | 85 | 90 | 95 |
| Oxytetracycline | 56 | 70 | 55 |
| Spectinomycin | 72 | 76 | 67 |
| Tilmicosin | 61 | 64 | 93 |

A group of cattle has BRD but the bacteria pathogen has not been identified. Suggest which antibiotics would be the most suitable to use to treat these cattle.

Give reasons for your answer.

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(iii) Suggest why it might be advisable to change the antibiotic being used, in the treatment of these cattle, once the pathogen has been identified.

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(Total for Question 4 = 11 marks)