1.18 Human Defences, Vaccination and Drug Development: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Painkillers and antibiotics are both medicines used to treat illness, but they work in very different ways.

(a) State what painkillers do to relieve the symptoms of an illness. **(2)**

(b) Dr Aleksander Nowak, a GP in Cardiff, sees a patient with symptoms of a common cold. Explain why he would not prescribe antibiotics for this patient. **(2)**

(Total for Question 1 is 4 marks)

2 The trachea (windpipe) and bronchi are lined with goblet cells, which produce mucus, and with cells that have cilia on their surface. Explain how the ciliary escalator helps to prevent lung infections.

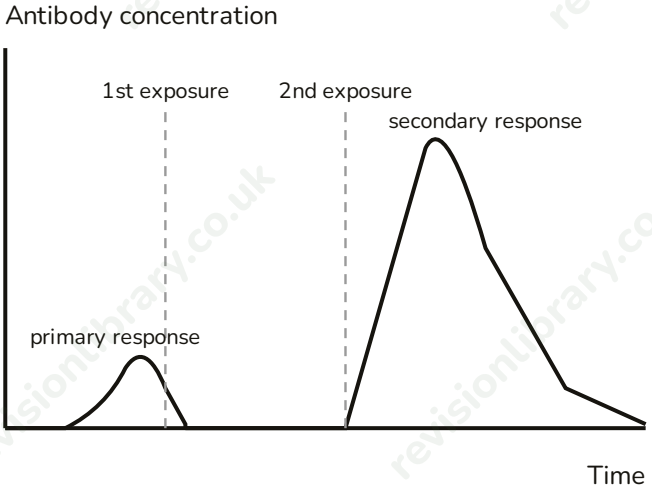
(Total for Question 2 is 4 marks)

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3 Phagocytosis is the process by which a phagocyte destroys a pathogen. Describe the main stages of phagocytosis.

(Total for Question 3 is 4 marks)

4 When a person is vaccinated, they are given a small, safe dose of a dead, inactivated or harmless part of a pathogen, which contains specific antigens. Explain, using ideas about the primary and secondary immune response, how vaccination can give a person long-term protection against a serious disease.



(Total for Question 4 is 6 marks)

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5 Antibiotics, such as penicillin, are medicines that treat bacterial infections.

(a) Explain why antibiotics cannot be used to treat a viral infection such as the common cold. **(2)**

(b) Evaluate the risk to public health caused by doctors overprescribing antibiotics. **(2)**

(Total for Question 5 is 4 marks)

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6 A student is investigating bacterial growth. A culture starts with 400 bacterial cells. Under ideal conditions, the population doubles every 20 minutes. Calculate the number of bacterial cells present after 100 minutes, assuming growth continues at this rate with no antibiotic present.

(Total for Question 6 is 3 marks)

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Mark scheme · 1.18 Human Defences, Vaccination and Drug Development: 30-minute Pack

Question 1

(a) painkillers relieve symptoms such as pain (oe) **B1**

(a) they do this without killing the pathogen / without treating the underlying cause of the illness (oe) **B1**

(a) Answer: Painkillers relieve symptoms such as pain, but do not kill the pathogen causing the illness.

(b) a cold is caused by a virus, and antibiotics are not effective against/do not kill viruses (oe) **B1**

(b) viruses reproduce inside the body's own cells, making them very difficult to target with a drug without also damaging the patient's own cells (oe); allow: prescribing antibiotics unnecessarily also contributes to antibiotic resistance **B1**

(b) Answer: A cold is caused by a virus, and antibiotics only work against bacteria; viruses reproduce inside the body's own cells, making them very difficult to target without harming the patient's own cells.

Question 2

mucus (produced by goblet cells lining the trachea/bronchi) traps pathogens and other particles breathed in with air (oe) **B1**

cilia are hair-like structures on the surface of the cells lining the airways (oe) **B1**

cilia beat together in a coordinated, wave-like motion (oe) **B1**

this moves the mucus (containing trapped pathogens) up and away from the lungs towards the throat, where it is swallowed or coughed out, so fewer pathogens reach/infect the lungs (oe) **B1**

Answer: Mucus traps inhaled pathogens; the coordinated beating of cilia sweeps the mucus up and out of the airways towards the throat, so fewer pathogens reach the lungs.

Question 3

the phagocyte recognises the pathogen as foreign (e.g. by antigens on its surface) and moves towards it (oe) **B1**

the phagocyte engulfs/surrounds the pathogen (oe) **B1**

the pathogen becomes enclosed within a vesicle inside the phagocyte (oe) **B1**

enzymes are released into the vesicle, which digest/destroy the pathogen (oe) **B1**

Answer: The phagocyte recognises and moves towards the pathogen, engulfs it into a vesicle, then releases enzymes that digest and destroy it.

Question 4

the antigens in the vaccine trigger a primary immune response (oe) **B1**

lymphocytes produce antibodies specific to that antigen, but this response is relatively slow and produces a low concentration of antibodies (oe) **B1**

memory lymphocytes (memory cells) are produced and remain in the blood for a long time after vaccination (oe) **B1**

if the person later encounters the same/live pathogen, the memory cells recognise the antigen rapidly (oe) **B1**

this triggers a faster secondary immune response, producing antibodies more quickly and in much greater quantity than the primary response (oe) **B1**

the pathogen is destroyed before the person shows symptoms of the disease, so they are immune (oe) **B1**

Answer: Vaccination triggers a primary response, producing antibodies and memory cells; on later exposure to the real pathogen, memory cells trigger a much faster, larger secondary response that destroys the pathogen before symptoms develop, giving long-term immunity.

Question 5

(a) antibiotics kill bacteria (or stop bacteria growing/reproducing) by a mechanism that specifically targets structures/processes found in bacterial cells (e.g. the bacterial cell wall) (oe) **B1**

(a) viruses do not have this bacterial target and reproduce inside the body's own cells, so antibiotics have no effect on them (oe) **B1**

(a) Answer: Antibiotics work by targeting structures/processes found only in bacterial cells (such as the cell wall); viruses lack these targets and reproduce inside human cells, so antibiotics cannot affect them.

(b) overuse of antibiotics increases the rate at which bacteria develop and spread antibiotic resistance, through natural selection: resistant bacteria survive and reproduce, passing on the resistance gene (oe) **B1**

(b) this can lead to infections that are difficult or impossible to treat with existing antibiotics, which is a serious risk to public health (oe); allow reference to the need to develop new antibiotics **B1**

(b) Answer: Overprescribing antibiotics speeds up the evolution of antibiotic-resistant bacteria (by natural selection), which can create infections that existing antibiotics can no longer treat - a serious public health risk.

Question 6

number of doublings = 100 / 20 (= 5) **M1**

number of cells = 400 x 2^5 (= 400 x 32) **M1**

12800 (cells) cao **A1**

Answer: 12800 cells

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