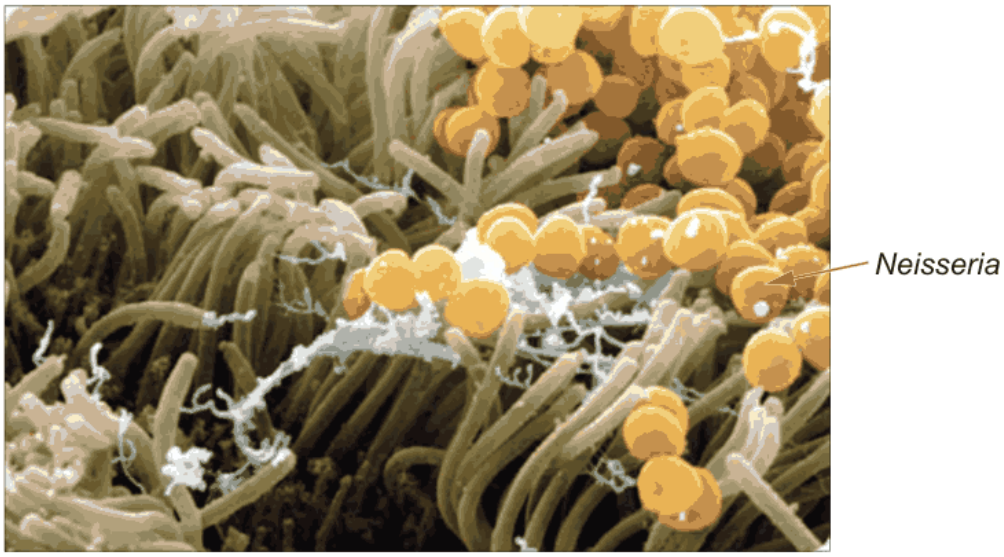
Immune Response (Option A3): Eduqas A Level Biology Exam Questions by Topic

19 questions · 42 marks · about 50 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 3 · June 2017 · Q7(a) · 1 mark

7. *Neisseria meningitidis* is an airborne pathogenic bacterium that can cause one type of meningitis.

The photomicrograph below of an airway's lining shows an example of the body's natural barriers to infection by pathogenic bacteria.

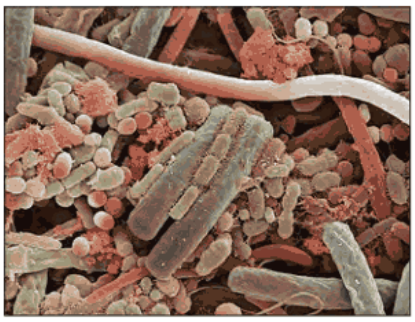


(a) With reference to the photograph, describe this first line of defence. [1]

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8. *(a)* Although micro-organisms can cause disease in humans, scientists believe that up to 10^{16} symbiotic microbial cells live in or on the human body. Up to 90% of all diseases can be traced back in some way to the composition of this microbiome. Figure 8.1 shows bacteria on the surface of a human tongue.

Figure 8.1



An average adult has 10^{13} cells in the body. Suggest why it is often said that we are more microbe than human in terms of our genomes and describe how the micro-organisms living inside our bodies and on the skin surface help protect us from infectious disease.

[3]

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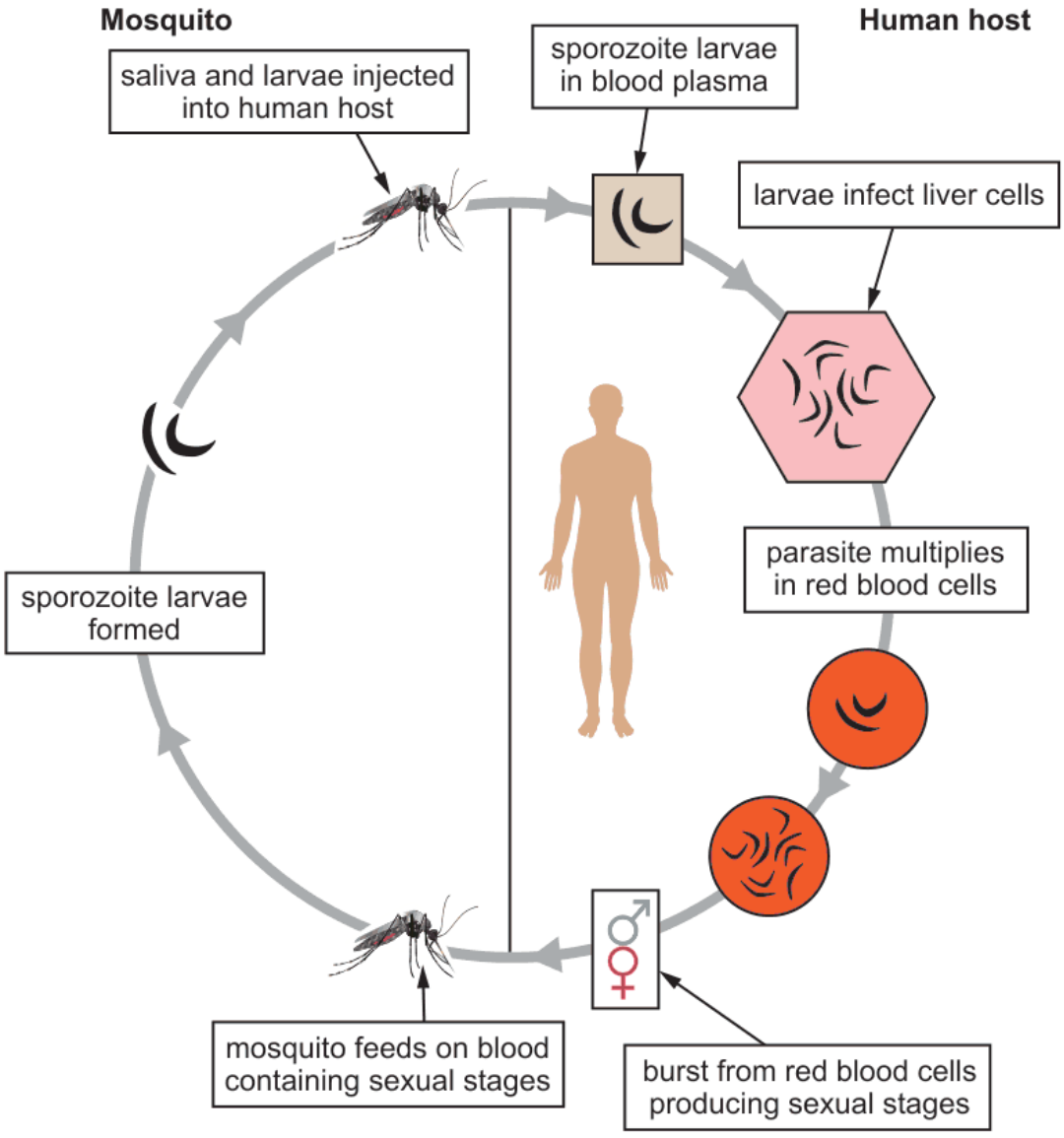
Question 3 · information from earlier in the question

7. (a) Malaria is a disease caused by a protoctistan parasite belonging to the genus *Plasmodium*. The disease is caused mainly by two species of *Plasmodium* (*P. vivax* and *P. falciparum*) of which there are many antigenic types.

The life cycle of malaria consists of multiple stages within two host organisms; humans and the *Anopheles* mosquito. Some of these stages are free-swimming (for example, sporozoites) while other stages happen within human liver cells and red blood cells.

Image 7.1 shows the generalised life cycle of the malaria parasite.

Image 7.1



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

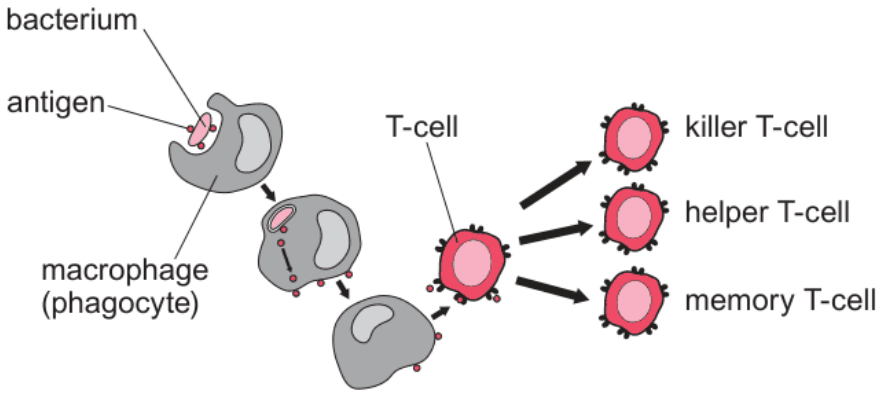
Question 3 · A level Component 3 · June 2024 · Q7(a)(ii) · 2 marks

(ii) Explain why multiplying within liver cells and red blood cells helps the parasite to evade the host's immune system. [2]

Question 4 · A level Component 3 · June 2019 · Q8(b)(i) · 3 marks

(b) Figure 8.2 shows part of the T-cell immune response when the body is infected with a pathogenic bacterium, such as *Vibrio cholerae*.

Figure 8.2



(i) Explain the role of the macrophage in the T-cell response. [3]

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Question 5 · A level Component 3 · June 2019 · Q8(b)(ii) · 3 marks

(ii) Describe the roles of each of the T-cell types shown in figure 8.2 as part of the immune response. [3]

Question 6 · A level Component 3 · June 2022 · Q7(b)(ii) · 3 marks

(ii) Vaccination against flu results in an active cell-mediated immune response.

Describe how **cell-mediated immunity** to the flu virus develops following vaccination. [3]

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Question 7 · A level Component 3 · Autumn 2020 · Q8(c)(i) · 2 marks

(c) The puff adder is a venomous snake that lives in parts of Africa.

Victims of puff adder bites may be given an injection of anti-venom containing antibodies specific to a toxin found in the puff adder's venom.

Anti-venom is produced by injecting very small volumes of the toxin (the antigen) into a mammal such as a sheep. The sheep produces specific antibodies that are purified from blood taken from the sheep.

(i) The sheep's immune system produces specific B lymphocytes in response to the antigen. The B lymphocytes then increase their numbers rapidly. Explain how the formation of B lymphocytes leads to the production of antibodies, which can be used as anti-venom. [2]

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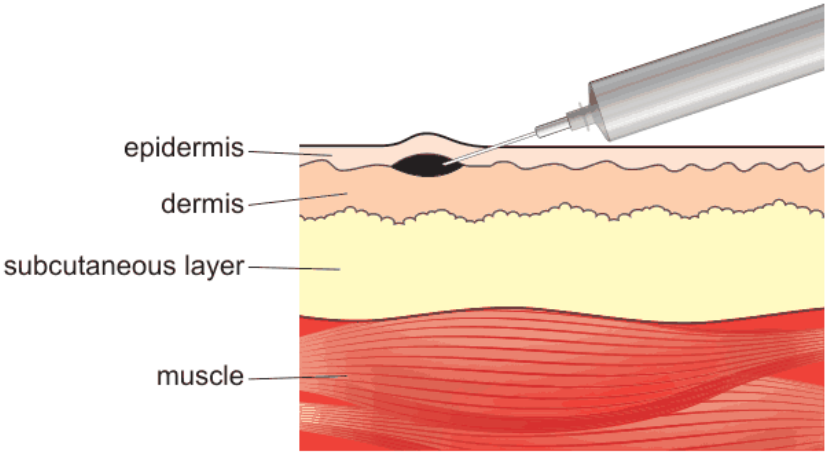
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Question 8 · information from earlier in the question

(c) The most widely used vaccine against TB is the BCG vaccine. The vaccine is prepared with a live, attenuated form of *Mycobacterium bovis*. *M. bovis* is closely related to *M. tuberculosis*. The vaccine is administered by an injection below the epidermis of the skin (intradermal injection) as shown in **Image 7.3**.

Image 7.3



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 8 · A level Component 3 · June 2023 · Q7(c)(ii) · 3 marks

(ii) Describe how injecting the vaccine would result in antibody production. [3]

Question 9 · A level Component 3 · June 2019 · Q8(c)(i) · 2 marks

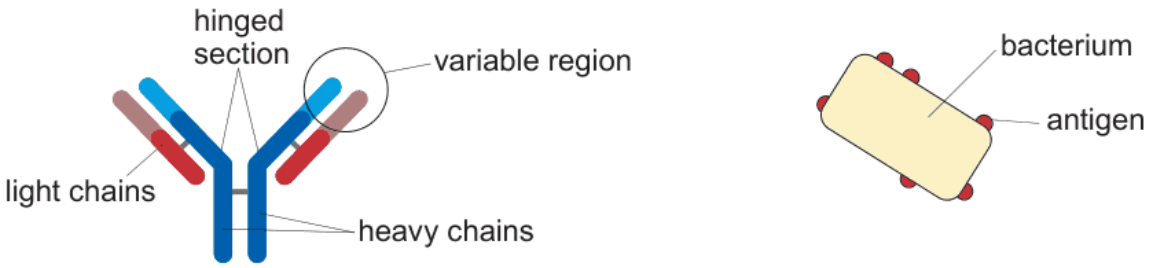
(c) B-cells are activated in a similar way but synthesise antibodies that are specific protein molecules that can bind to foreign antigens. These antibodies can be of different types, as shown in figure 8.3.

Figure 8.3



IgM is made up of five antibody molecules bonded together. A more detailed diagram of IgG is shown in figure 8.4 along with a bacterial cell, showing antigens on the surface.

Figure 8.4



(i) The hinged sections of the IgG molecule give it some structural flexibility. Suggest an advantage of this. [2]

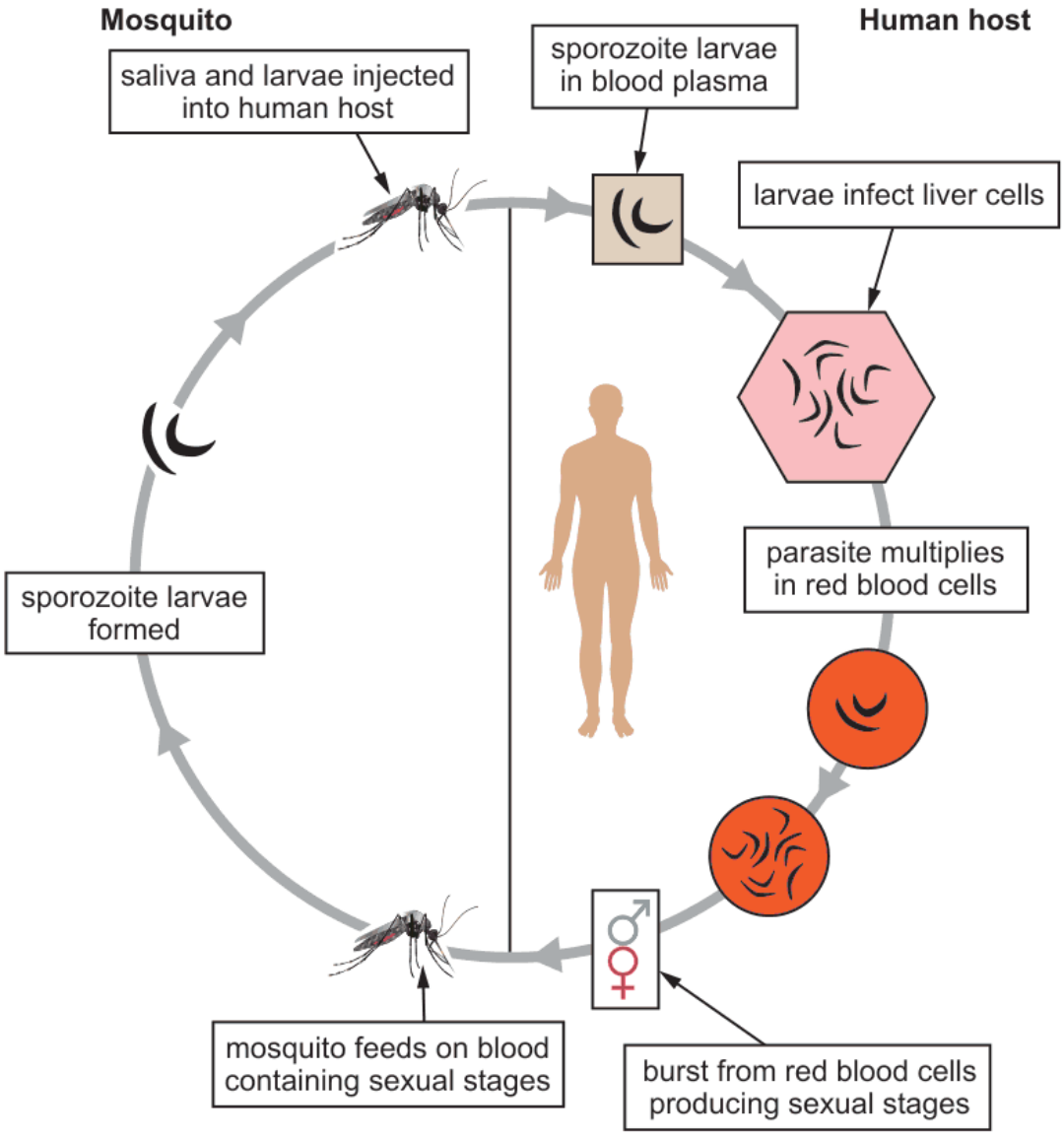
Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

7. (a) Malaria is a disease caused by a protoctistan parasite belonging to the genus *Plasmodium*. The disease is caused mainly by two species of *Plasmodium* (*P. vivax* and *P. falciparum*) of which there are many antigenic types.

The life cycle of malaria consists of multiple stages within two host organisms; humans and the *Anopheles* mosquito. Some of these stages are free-swimming (for example, sporozoites) while other stages happen within human liver cells and red blood cells.

Image 7.1 shows the generalised life cycle of the malaria parasite.

Image 7.1



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 10 · A level Component 3 · June 2024 · Q7(a)(iii) · 3 marks

(iii) The sexual stage involving meiosis helps to increase **genetic variation** within parasite populations.
Explain why this means that a person may develop symptoms of malaria following re-infection. [3]

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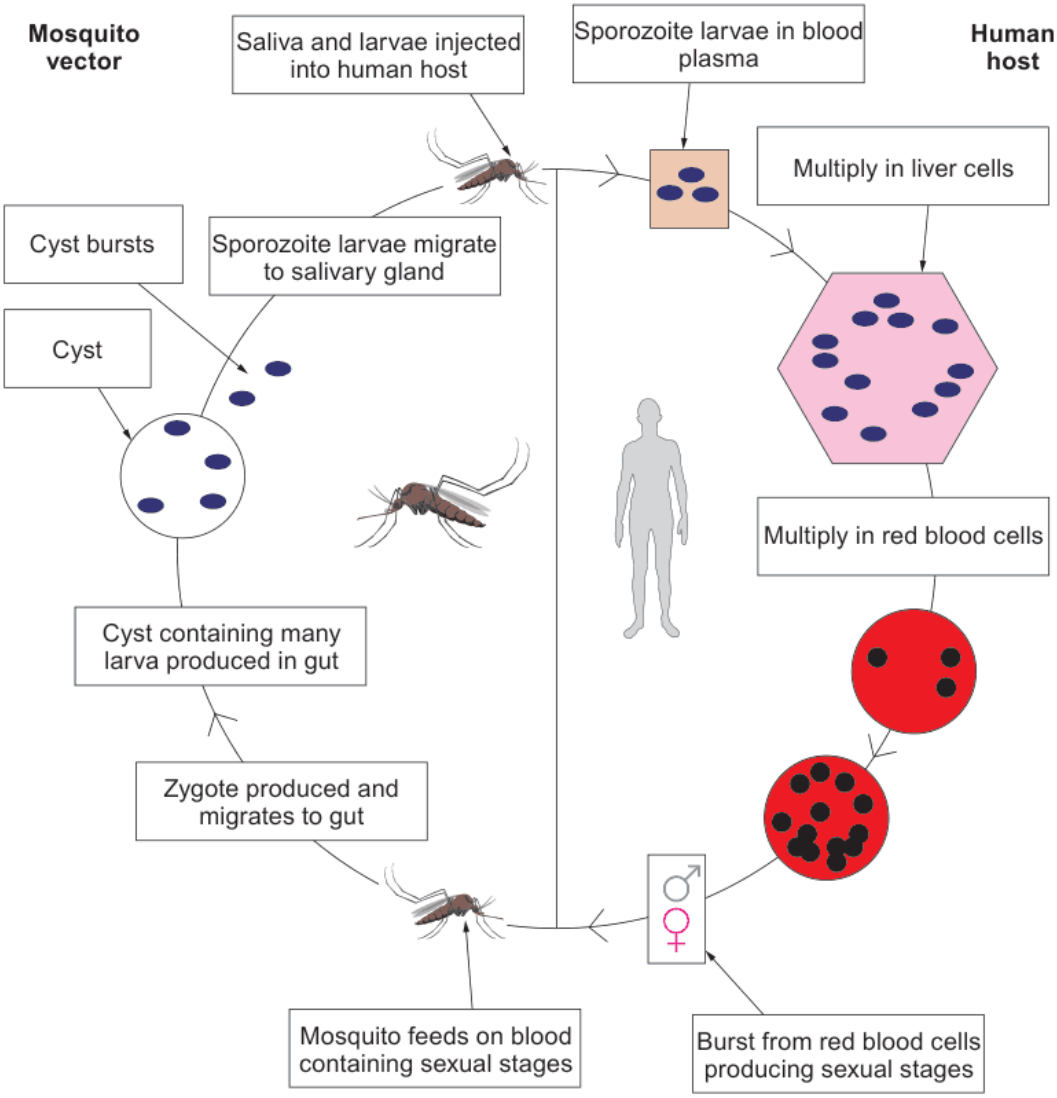
8. Malaria is a disease caused by the parasitic protoctist, *Plasmodium* and carried by a vector, the *Anopheles* mosquito.

Malaria is endemic in many tropical countries. A large proportion of the 1 million people who die from malaria each year are children under five years of age and 90% of cases occur in sub-Saharan Africa.

There are many stages in the life cycle. A larval form of the parasite is passed into human blood plasma when a mosquito feeds on blood. The parasite reproduces rapidly in the liver and erythrocytes (red blood cells) of a human host.

A summary of the life cycle of *Plasmodium falciparum* is shown in **image 8.1**.

Image 8.1



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

In 2015, 'Mosquirix' (trade name) was the first vaccine licensed for use against malaria.

A clinical trial of the vaccine involved 1000 healthy infants under 3 months old and 1000 healthy children aged 3 months to 5 years across Africa. The trial included a control group.
Infants and children in the trial were injected with an antigen, a protein called CSP, found on the plasma membrane of the sporozoite stage of the life cycle.

Scientists measured the immune response to the antigen by recording the concentration of anti-CSP antibody in the blood of individuals in each age group.

A summary of the results of the trial is shown in **table 8.2**.

Table 8.2

Age Group	Mean anti-CSP antibody concentration / a.u.
< 3 months (infants)	333
3 months – 5 years (children)	465

The concentration of anti-CSP antibody was lower in infants than in children. Despite this, the infant group did **not** show a higher frequency of cases of malaria.

Most infants in the trial were breast fed. Infants produced even lower concentrations of the anti-CSP antibody if their mother lived in an area which had a higher incidence of malaria cases.

(iv) Use your knowledge of immunity to suggest an explanation for:

Question 11 · A level Component 3 · Autumn 2020 · Q8(b)(iv)II · 2 marks

II. the infants' lower susceptibility to malaria. [2]

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Question 12 · A level Component 3 · June 2025 · Q7(d)(ii) · 2 marks

(ii) Scarlet fever caused by *S. pyogenes* is very uncommon in children under 6 months old who are breastfed.

State the type of immunity present in these children and suggest how this occurs. [2]

Question 13 · A level Component 3 · June 2024 · Q7(b)(v) · 2 marks

(v) Explain how vaccination can give long-term protection against disease. [2]

Question 14 · A level Component 3 · June 2022 · Q7(b)(i) · 1 mark

(b) Random changes in viral antigens, known as antigen shift, may originate in animals and then transfer to humans who may live in close proximity to them. The 2007 flu outbreak originated from imported poultry.

Several forms of haemagglutinin (H) and neuraminidase (N) exist. Combinations of different forms of the two proteins produce different strains of the flu virus. The 2007 flu strain was H7N1.

A new flu vaccine is produced each year. It contains the H and N protein combination found to be most prominent during that year.

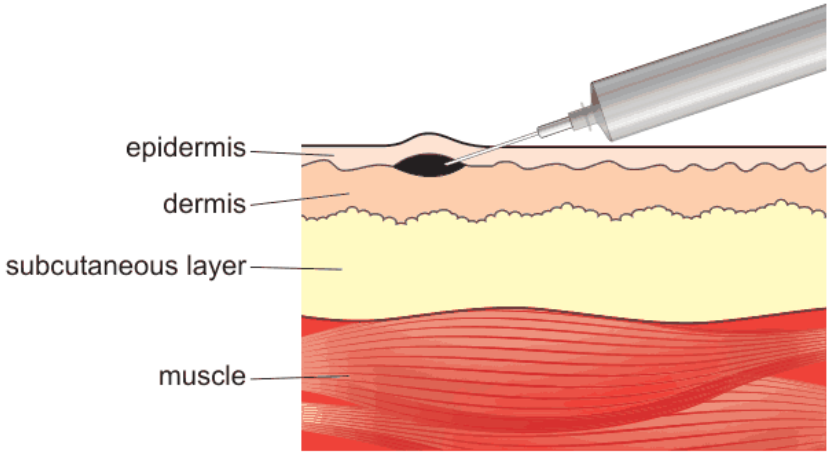
(i) Explain why a flu vaccine should contain only the H and N proteins and no viral RNA. [1]

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Question 15 · information from earlier in the question

(c) The most widely used vaccine against TB is the BCG vaccine. The vaccine is prepared with a live, attenuated form of *Mycobacterium bovis*. *M. bovis* is closely related to *M. tuberculosis*. The vaccine is administered by an injection below the epidermis of the skin (intradermal injection) as shown in **Image 7.3**.

Image 7.3



Question 15 · A level Component 3 · June 2023 · Q7(c)(iii) · 2 marks

(iii) There may be concerns regarding the use of a live vaccine. Suggest what these concerns may be and give a suitable alternative to a live vaccine. [2]

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Question 16 · information from earlier in the question

(c) The puff adder is a venomous snake that lives in parts of Africa.

Victims of puff adder bites may be given an injection of anti-venom containing antibodies specific to a toxin found in the puff adder's venom.

Anti-venom is produced by injecting very small volumes of the toxin (the antigen) into a mammal such as a sheep. The sheep produces specific antibodies that are purified from blood taken from the sheep.

(i) The sheep's immune system produces specific B lymphocytes in response to the antigen. The B lymphocytes then increase their numbers rapidly. Explain how the formation of B lymphocytes leads to the production of antibodies, which can be used as anti-venom. [2]

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Question 16 · A level Component 3 · Autumn 2020 · Q8(c)(ii) · 1 mark

(ii) Suggest why anti-venom is administered to a person bitten by a puff adder even though they would produce their own antibodies to the toxin in the venom. [1]

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Question 17 · A level Component 3 · Autumn 2020 · Q8(b)(ii) · 1 mark

(ii) State **one** reason why a vaccine for malaria has proved difficult to produce. [1]

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Question 18 · A level Component 3 · June 2018 · Q8(c) · 5 marks

(c) Urgent research is being carried out to provide protection against Zika to pregnant women, as quickly as possible as well as providing a long-term prevention strategy.

Two research projects currently in progress are:

1. The use of an injection containing anti-Zika antibodies for use in pregnant women. This has had some success in animal trials with mice.
2. The development of a vaccine to confer immunity against the virus.

Evaluate the relative advantages and disadvantages of these strategies in the prevention of Zika cases. State which one would be more effective in the long term and explain your reasoning. [5]

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Question 19 · A level Component 3 · Autumn 2021 · Q7(d)(ii) · 1 mark

(ii) UK government policy cannot impose compulsory vaccination as it is the right of the individual to choose. Health care workers travelling to areas affected by cholera are offered cholera vaccination prior to travel. Suggest **one** reason for making a case for compulsory vaccination of health workers. [1]

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Mark schemes

Question 1 · A level Component 3 · June 2017 · Q7(a) · 1 mark

7	(a)	**Both for one mark.** • Mucus traps (bacteria) **and** Cilia moves it NOT microvilli	1			1

Question 2 · A level Component 3 · June 2019 · Q8(a) · 3 marks

8	*(a)*			**Cells:** There are {more than 1 000 times/ many more} microbial cells {on /in} our bodies than human cells. (1) **Genomes:** There are {many different/ variety} bacterial {genomes/ species} within the human body. (1) **Protection:** They prevent {harmful microbes/ pathogens} colonising the human body and causing disease/ outcompete pathogenic bacteria. (1)	2	1	3

Question 3 · A level Component 3 · June 2024 · Q7(a)(ii) · 2 marks

(ii)		(Parasite) antigens not on surface of host cells (1) {Avoid detection by / hidden from} {host immune system / macrophages / lymphocytes} / do not trigger an immune response (1)	1	1		2

Question 4 · A level Component 3 · June 2019 · Q8(b)(i) · 3 marks

	(b)	(i)		Any **three** (×1) from: {engulfs the foreign microbe/ ref to phagocytosis} (1) antigenic presentation. (1) The T-cell recognises the foreign antigen (1) T cells are then activated / undergo clonal expansion (1)	3		3	

Question 5 · A level Component 3 · June 2019 · Q8(b)(ii) · 3 marks

(ii)	Killer T cells – {cause lysis of/ destroy} {target cells/ named cells}. NOT kill (1) Helper T cells – co-operate with B cells to initiate antibody response/ secretes cytokines/ B cell activation (1) Memory T cells – remain {dormant/ in circulation} until host is exposed to antigen again/ initiate secondary immune response/owtte (1) Reject reference to antibodies except in relation to B cell activation.	3	3

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Question 6 · A level Component 3 · June 2022 · Q7(b)(ii) · 3 marks

	(ii)		**Any three (×1) from** A. antigen presentation or description of (1) B. T cell activation (1) C. clonal expansion (1) D. Release of cytokines (1) E. Cytokines stimulate {phagocytic cells/named phagocyte/monocyte/macrophages} (to engulf virus/antigens) (1) F. T memory cells are formed (1) (Reject antibody production or reference to B cells unless in the context of being stimulated by cytokines. Ignore reference to cytotoxic/killer T cells)	2	1	3

Question 7 · A level Component 3 · Autumn 2020 · Q8(c)(i) · 2 marks

(c)	(i)	B lymphocytes/cells differentiate/develop into plasma cells (1) (ignore ref to memory cells) Plasma cells produce antibodies {specific/ complementary} to {puff adder toxin/ the antigen} (1)	1	1	2

Question 8 · A level Component 3 · June 2023 · Q7(c)(ii) · 3 marks

(ii)	**Any three (×1) from** • Macrophages engulf the bacterial cells by phagocytosis/ Antigen presentation by macrophages (1) • Activation of T helper cells/ ref to cytokines (1) • B cells are activated/ clonal selection (1) • clonal expansion/ or description of (1) • some then differentiate into plasma cells (1)	3	3

Question 9 · A level Component 3 · June 2019 · Q8(c)(i) · 2 marks

(c)	(i)	Any **two** (×1) from It allows the antibody to {bend/flex/distort/change shape} in order (for both arms) to bind to different antigens (1) because antigens are different distances apart on the target cell (1) antigens on different cells / cause clumping/ agglutination of bacterial cells(1)	2	2

Question 10 · A level Component 3 · June 2024 · Q7(a)(iii) · 3 marks

(iii)	Antigenic variation / antigen (shape / structure) would be different (1) Memory cells do not recognise antigen / antibodies not complementary (1) No secondary response / primary response occurs / slower immune response/ ref to making new antibodies (1)	1	2		3

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Question 11 · A level Component 3 · Autumn 2020 · Q8(b)(iv)II · 2 marks

II	Passive immunity (1) Infants receive antibodies (to malaria antigens) from their {mother/breast milk /colostrum/transplacental} (1) Mothers exposed to higher incidence of {malaria/malaria antigens} may produce {more antibodies/different antibodies} to different plasmodium antigens (and pass them to infants) (1)	2	2

Question 12 · A level Component 3 · June 2025 · Q7(d)(ii) · 2 marks

(ii)	Natural passive (immunity) (1) (From) antibodies { in breastmilk / crossing the placenta} (1)	2	2	

Question 13 · A level Component 3 · June 2024 · Q7(b)(v) · 2 marks

(v)	**Any two (x1) from** • Memory cells (1) • {More rapid / greater} (secondary) response / rapid clonal expansion / owtte} {on re-infection / secondary exposure to antigen} (1) • Retained long after initial immune response / low level of antibodies always present (1)	2		2

Question 14 · A level Component 3 · June 2022 · Q7(b)(i) · 1 mark

(b)	(i)		(Does not have the nucleic acid/RNA and therefore) cannot replicate inside (human) cells/ ORA/ prevent production of viral RNA in cells	1	1

Question 15 · A level Component 3 · June 2023 · Q7(c)(iii) · 2 marks

	(iii)	Could cause {pathogenic response/ disease}/ owtte (1) Not: side effects unqualified Antigen / RNA/ {dead/ inactive/ related} pathogen (1)		2	2		

Question 16 · A level Component 3 · Autumn 2020 · Q8(c)(ii) · 1 mark

(ii)	An immune response/production of victim's own antibodies would be too slow/insufficient quantity to prevent symptoms becoming fatal/prevent tissue damage/ latent period would be too long OR (converse) Need additional antibodies for the response to be fast enough to prevent fatality/tissue damage (1)	1	1

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Question 17 · A level Component 3 · Autumn 2020 · Q8(b)(ii) · 1 mark

(ii)	Mutations within the parasite/plasmodium (DNA) change antigen (shape)/ high antigenic variation Too many different types of antigen (for each stage in the life cycle) (1) (Mark is either for changes in the antigen OR number of different types of antigens)	1	1

Question 18 · A level Component 3 · June 2018 · Q8(c) · 5 marks

(c)	Strategy **2** more effective in long term (1)			
	Any four (x1) from:		1	
	Number **1**	1		
	• Advantage: Antibodies would act quickly/ confers immediate protection (1)			
	• Placental transfer will protect the baby (1)		1	5
	• Disadvantage: no memory cells would be produced/ no long term immunity (1)	1		
	Number **2**			
	• Advantage: the production of memory cells (1)	1		
	• Reference to herd immunity (1)			
	• Disadvantage: would take longer to act (1)			

Question 19 · A level Component 3 · Autumn 2021 · Q7(d)(ii) · 1 mark

(ii)	**Any one (x1) from** (Duty of care) to protect others from infection/could carry infection back to UK (1) government has a duty to protect whole population (not just individuals) (1) (if health workers contract cholera) reduce resources/number of medical staff available to treat cholera sufferers in affected country (1) Health workers more likely to come into contact with disease/vulnerable people/people at risk of disease (1)	1	1

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